

**COLLECTION OF INTERNACIONAL  
TOPICS IN HEALTH SCIENCES**

**SEVEN**

PUBLICAÇÕES ACADÊMICAS  
2024

**V.02**



**COLLECTION OF INTERNACIONAL  
TOPICS IN HEALTH SCIENCES**

Seven Publicações  
(Organização)

**EDITOR-IN-CHIEF**

Prof<sup>o</sup> Me. Isabele de Souza Carvalho

**EXECUTIVE EDITOR**

Nathan Albano Valente

**BOOK ORGANIZER**

Seven Publications LTDA

**EDITORIAL PRODUCTION**

Seven Publications Ltda

2023 by Seven Editora

Copyright © Seven Publisher

Text Copyright © 2023 The Authors

Edition Copyright © 2023 Seven Publisher

**TEXT EDITING**

Stefanie Vitoria Garcia de Bastos

**ART EDIT**

Alan Ferreira de Moraes

**COVER IMAGES**

AdobeStok

**LIBRARIAN**

Bruna Heller

**AREA OF KNOWLEDGE**

Health Sciences

The content of the text and its data in its form, correctness and reliability are of the author's sole responsibility and does not necessarily represent the official position of Seven Academics Events and Publishing Company. The work can be downloaded and shared if credit is given to the author, but without the possibility of altering it in any way or using it for commercial purposes.

All manuscripts were previously submitted to blind peer review, members of the Editorial Board of this Publisher, and were approved for publication based on criteria of neutrality and academic impartiality.

Seven Publications is committed to ensuring editorial integrity at every stage of the publication process, preventing plagiarism, fraudulent data, or results, and preventing financial interests from compromising the ethical standards of publication. Suspected situations of scientific misconduct will be investigated with the highest academic and ethical rigor.



The contents of this book have been submitted by the author for open access publication, in accordance with the terms and conditions of the Creative Commons 4.0 Attribution License International.

## EDITORIAL BOARD

### EDITOR-IN-CHIEF

Prof<sup>o</sup> Me. Isabele de Souza Carvalho

### EDITORIAL BOARD

Pedro Henrique Ferreira Marçal - Vale do Rio Doce University  
Adriana Barni Truccolo - State University of Rio Grande do Sul  
Marcos Garcia Costa Morais - State University of Paraíba  
Mônica Maria de Almeida Brainer - Federal Institute of Goiás Ceres Campus  
Caio Vinicius Efigenio Formiga - Pontifical Catholic University of Goiás  
Egas José Armando - Eduardo Mondlane University of Mozambique  
Ariane Fernandes da Conceição - Federal University of Triângulo Mineiro  
Wanderson Santos de Farias - University for Sustainable Development  
Maria Gorete Valus - University of Campinas  
Luiz Gonzaga Lapa Junior - University of Brasilia  
Janyel Trevisol - Federal University of Santa Maria  
Irlane Maia de Oliveira - Federal University of Mato Grosso  
Paulo Roberto Duailibe Monteiro - Fluminense Federal University  
Luiz Gonzaga Lapa Junior - University of Brasilia  
Yuni Saputri M.A - Nalanda University, India  
Arnaldo Oliveira Souza Júnior – Federal University of Piauí, CEAD  
Anderson Nunes Da Silva - Federal University of Northern Tocantins  
Adriana Barretta Almeida - Federal University of Paraná  
Jorge Luís Pereira Cavalcante - Iberoamerican University Foundation  
Jorge Fernando Silva de Menezes - University of Aveiro  
Antonio da Costa Cardoso Neto - University of Flores, Buenos Aires  
Antônio Alves de Fontes-Júnior - Cruzeiro do Sul University  
Alessandre Gomes de Lima - Faculty of Medicine of the University of Porto  
Moacir Silva de Castro - Pontifical Catholic University of São Paulo  
Marcelo Silva de Carvalho- Federal University of Alfenas  
Charles Henrique Andrade de Oliveira - University of Pernambuco  
Telma Regina Stroparo - State University of Ponta Grossa  
Valéria Raquel Alcantara Barbosa - Fundação Oswaldo Cruz  
Kleber Farinazo Borges - University of Brasilia  
Rafael Braga Esteves - University of São Paulo  
Inaldo Kley do Nascimento Moraes - State University of Southwest Bahia  
Mara Lucia da Silva Ribeiro - Federal University of São Paulo

S498c

Seven Editora.

Collection of Internacional Topics in Health Sciences  
[electronic resource] / Seven Editora. – São José dos Pinhais,  
PR: Seven Editora, 2024.

Electronic data (1 PDF). 2 v.

Includes bibliography.

ISBN 978-65-85932-15-8

1. Health sciences. 2. International health. I Title.

CDU 61

**Indexes for systematic catalogue:**

1. CDU: Health sciences 61

Cataloguing at source: Bruna Heller (CRB10/2348)

**Seven Publications Ltda**  
CNPJ: 43.789.355/0001-14  
[editora@sevenevents.com.br](mailto:editora@sevenevents.com.br)  
São José dos Pinhais/PR

## **AUTHOR'S STATEMENT**

The author of this work DECLARES, for the following purposes, that:

You do not have any commercial interest that creates a conflict of interest in relation to the content published;

Declares to have actively participated in the construction of the respective manuscripts, preferably under the following conditions: "a) Study design, and/or data acquisition, and/or data analysis and interpretation; b) Preparation of the article or review to make the material intellectually relevant; c) Final approval of the manuscript for submission";

Certifies that the published text is completely free of fraudulent data and/or results and authorship defects;

Confirms the correct citation and reference of all data and interpretations of data from others Research;

Acknowledges that it has informed all sources of funding received to carry out the research; Authorizes the editing of the work, including catalog registrations, ISBN, DOI and other indexers, visual design and cover creation, internal layout, as well as its release and dissemination according to the criteria of Seven Academics Events and Publishing Company.

## **PUBLISHER'S STATEMENT**

Seven Publications DECLARES, for the purposes of rights, duties and any methodological or legal meanings, that:

This publication constitutes only a temporary transfer of copyright, constituting a right to publication and reproduction of the materials. The Publisher is not co-responsible for the creation of published manuscripts, under the terms established in the Copyright Law (Law 9610/98), in article 184 of the Penal Code and in article 927 of the Civil Code; The author(s) is solely responsible for verifying such copyright and other issues, holding the Publisher harmless from any civil, administrative, and criminal damages that may arise.

Authorizes the DISSEMINATION OF THE WORK by the author(s) in lectures, courses, events, concerts, media and television, provided that there is due recognition of the authorship and editing and without any commercial purpose, with the presentation of the due CREDITS to SEVEN PUBLICATIONS, being the author(s) and publisher(s) responsible for the omission/exclusion of this information;

All ebooks are open access, so don't sell them on your website, partner sites, e-commerce platforms, or any other virtual or physical medium. Therefore, it is exempt from copyright transfers to authors, since the format does not generate other rights beyond the didactic and advertising purposes of the work, which can be consulted at any time.

All members of the editorial board have doctors and are linked to public institutions of higher education, as recommended by CAPES to obtain the Qualis book;

Seven Academic Events does not assign, sell, or authorize the use of the names and e-mails of the authors, as well as any other data of theirs, for any purpose other than the dissemination of this work, in accordance with the Civil Rights Framework for the Internet, the General Data Protection Law and the Constitution of the Federative Republic.

## AUTHORS

Adriana Erbs Mira  
Adriana Paula Jordão Isabella  
Akel Fares Akel Neto  
Alba Regina de Abreu Lima  
Alcides Mendes da Luz Filho  
Alfredo Ribeiro Filho  
Aline dos Santos Moreira de Carvalho  
Alissa Paglioco Correia  
Aloísio Olímpio  
Amabile Giovana Marcarini  
Ana Carolina Tonini Andrighetti  
Ana Clara Haluch Maoski Kleiner  
Ana Paula de Assis Sales  
Anderson Kretschmer  
André Luis Ramos Soares  
Andressa Conceição de Maria Melo Oliveira  
Andrezza Gabrielly dos Santos Soldera  
Andriely Gomes dos Santos  
Ângela Cardoso Alvarenga  
Anna Clara Silva Torres  
Antonio de Pádua Andrade Júnior  
Bárbara Mendes de Sousa  
Beatriz de Souza Nunes e Silva  
Bruna Malacarne  
Bruna Thais da Rocha Paes  
Bruno Bessa Andrade  
Cadidja Suzzi Oliveira Leitão  
Camila Avancini da Rocha  
Camila Franzner Donath  
Carla Patrícia Hernandez Alves Ribeiro  
César  
Carlos Alberto Ocon  
Carlos Nazareno Ferreira Borges  
Carolina Braga Bracarense  
Caroline Zorzi  
Cecília Maria Resende Gonçalves de Carvalho  
Christian Douradinho  
Cicero Igno Guedes Bezerra  
Clarissa Lopes Drumond  
Claudia Cristina Soares Muniz  
Claudia Sordi  
Cristiane de Souza Araujo  
Cristina Braga  
Cristina Elizabeth Pessoa  
Cristina Nunes Capeloa  
Danilo Matos Oliveira  
Davi Nogueira Jales  
Debora Souto-Souza  
Déborah de Fatima Diniz Rocha  
Diamantino Ribeiro  
Edson Bruno Pazzinatto Espich  
Eduarda Franco Jorge  
Eduardo Zanzin Teruel  
Elane Natielly da Conceição Silva  
Elisabete Maria Zanin  
Ely Eduardo Saranz Camargo  
Emília Moura Silva  
Erick Matheus Garcia Barbosa  
Fernanda Sebastiana Mendes Pitanga  
Francisberg Dias Coêlho  
Gabriel Hiroaki Antunes  
Gabriela Alves Miranda Damaceno  
Gabriela Stocco Rodrigues  
Gabiella Magalhães Silva  
Gabrielly Segatto Brito  
Gleicer Vívian da Silva Lodoro  
Gleyce Kelly de Brito Brasileiro Santos  
Gleyson Moura dos Santos  
Guilherme dos Santos Lara  
Guilherme Melo de Oliveira  
Ian Vilas Boas Covizzi  
Isabella Kittlaus  
Isabelle Melo Martins  
Isadora Cucolo Oliveira  
Ivone Freires de Oliveira Costa Nunes  
Janaina Sousa Campos Alvarenga  
Jandui Gomes de Abreu Filho  
Jeferson Manoel Teixeira  
Jhuliano Silva Ramos de Souza  
João Carlos de Andrade Menezes  
João Pedro Santos Torres  
João Pedro Vayego Lourenço  
João Roberto de Lima Gaffrée  
José Klidenberg de Oliveira Júnior  
Josilene de Souza da Conceição Kaminski  
Julia Pina Vieira dos Santos  
Juliana de Carvalho Carmelo Paiva  
Juliana de Oliveira Musse  
Juscilene da Silva Maciel  
Karoliny Araujo Santana  
Kathiane Benedetti Corso  
Kelly da Silva  
Kenya Correa Rosa  
Laís Flávia de Castro Pinheiro Campos  
Larissa Guerra Fernandes  
Laura Beatriz Guimarães Sousa  
Leonardo Perovano Camargo  
Lidiane Souza Lima  
Liz Helena Pereira Silva  
Luana Tavares Neves  
Lucas de Oliveira Mesquita  
Lucas de Oliveira Sá  
Lucas Mendonça Silva de Ávila  
Lucca Puzana Antunes

Luciano Henrique Figueira  
Luís Gustavo Boguea Moreira Dutra  
Luis Henrique Brito Barreto Souza  
Luiz Henrique Gonçalves dos Santos  
Luiz Osvaldo Becker Geraldi  
Lynda Sthefanny Alves dos Santos  
Maísa Diane Turra Lena  
Maitê de Mello e Castro  
Marcelo Marreira  
Marcos Alexandre Casimiro de Oliveira  
Maria Adriana Simão Figueirêdo  
Maria Clara Barbosa de Almeida  
Maria Cláudia Nunes Araújo Teodoro  
Maria da Gloria Tavares Demamann  
Maria Eduarda Campêlo dos Santos  
Maria Eduarda Raielly da Silva  
Maria Gabryella Pereira da Silva Camarço  
Maria José dos Reis  
Maria Nascimento Cunha  
Mariana Gomes Vidal Sampaio  
Mariana Michalski Fagundes Cunha  
Marjori Gonçalves Lencina  
Matheus de Pádua Macedo Andrade  
Matheus Savindo Batista Sanches  
Michely Mandelli Micheleto  
Miriam Salete Wilk Wisniewski  
Monica Augusta Mombelli  
Mozart Borges de Paula  
Naiane Ronsoni Rigo  
Nailton Gomes da Silva  
Nandra Martins Soares  
Natalia Demarco Kielek  
Nattaska Nyckolly Rodrigues Maciel  
Navale Lopes de Araújo  
Neylor Rodrigo Oliveira Aragão  
Paloma Martins Mendonça  
Paula Rocha  
Paulo Cassanego Jr  
Pedro Henrique Alves Guedes  
Priscila Lini  
Rafael Machado Amorim  
Rafaela Chiuco Zeni



Rafaella da Matta Castilho  
Raphaella Barroso Guedes-Granzotti  
Raulison Vieira de Sousa  
Renata Afonso da Silva Pereira  
Renata Pereira Georjutti  
Roberta Dalponte  
Roberto César Bossi Pimenta  
Rodrigo Sousa de Carvalho  
Rolando Gutierrez Rosales  
Romário Ferreira Andrade  
Ruan Cândido Barros de Oliveira  
Ruth Hellen do Nascimento Gomes  
Ryan Cândido Barros de Oliveira  
Sabrina Kaylane da Silva Alves  
Samara da Silva São José  
Sarah Camila Valesi Machado  
Sarah Celeste Rodrigues de Sousa Val  
Sarah dos Santos Oliveira  
Sarah Nicolly Romualdo Frota  
Sebastiao Ailton da Rosa Cerqueira Adão  
Sheila Adami Vayego  
Sílvia Costa Pinto  
Solange Cavalcante Costa  
Sueli de Carvalho Vilela  
Tailma Silva Lino de Souza  
Tárik Abdalla dos Santos  
Telma Aparecida Saubier  
Teresa Dávila Cruz Matias  
Thais Freitas de Lira  
Thomaz Nassif Jorge Bassi  
Tiago da Cruz Monteiro  
Uderlei Doniseti Silveira Covizzi  
Valdete Santos de Araújo  
Vilmar Barbosa de Sousa Júnior  
Vitoria Consulin  
Vivian Maria Madeiro  
Viviane Claudino Batista  
Walter Rocha Passos Nieto  
Warley Silva de Oliveira  
Welly Minghun Chiang  
Wenberger Lanza Daniel de Figueiredo  
Zélia Marilda Rodrigues Resck



## SUMMARY

### **Integration of Neurofeedback and Virtual Reality - Innovative approaches to the clinical practice of Attention Deficit Hyperactivity Disorder**



Paula Rocha and Diamantino Ribeiro

  <https://doi.org/10.56238/sevened2024.016-001>

.....1-12

### **Factors associated with pertussis in Brazil: An epidemiological analysis (2018-2023)**



Gabriela Stocco Rodrigues, Rafaela Chiuco Zeni, Guilherme dos Santos Lara, Mariana Michalski Fagundes Cunha, Michely Mandelli Micheleto, Ana Carolina Tonini Andrighetti, Camila Franzner Donath, Adriana Erbs Mira, Amabile Giovana Marcarini, Roberta Dalponte, Caroline Zorzi and Edson Bruno Pazzinato Espich

  <https://doi.org/10.56238/sevened2024.016-002>

.....13-21

### **Labor and puerperium outcomes in women with a history of urinary tract infection during pregnancy**



Bruna Thais da Rocha Paes, Ana Paula de Assis Sales, Vivian Maria Madeiro, Tailma Silva Lino de Souza, Gabrielly Segatto Brito, Juscilene da Silva Maciel, Laís Flávia de Castro Pinheiro Campos, Andrezza Gabrielly dos Santos Soldera and Andriely Gomes dos Santos

  <https://doi.org/10.56238/sevened2024.016-003>

.....22-35

### **Leishmaniose visceral**


Carolina Braga Bracarense, Lucas de Oliveira Mesquita, Lucca Piuzana Antunes, Sarah dos Santos Oliveira, Janaina Sousa Campos Alvarenga and Ângela Cardoso Alvarenga

  <https://doi.org/10.56238/sevened2024.016-004>

.....36-47

### **Outcome of antibiotic treatment in patients with abdominal trauma at the hospital in Ceilândia**



Rolando Gutierrez Rosales, Jandui Gomes de Abreu Filho, Karoliny Araujo Santana, Nailton Gomes da Silva, Déborah de Fatima Diniz Rocha, Mozart Borges de Paula, Bruno Bessa Andrade, Kenya Correa Rosa and Matheus Savindo Batista Sanches

  <https://doi.org/10.56238/sevened2024.016-005>

.....48-55

### **Study of the art of facial expressions in the emotion of irony**



Carla Patrícia Hernandez Alves Ribeiro César, Raphaela Barroso Guedes-Granzotti, Claudia Sordi and Kelly da Silva

  <https://doi.org/10.56238/sevened2024.016-006>

.....56-70

### **Use of essential oils extracted from the Caatinga as an alternative for the treatment of infectious diseases and inflammation**


Bárbara Mendes de Sousa, Anna Clara Silva Torres, Pedro Henrique Alves Guedes, Liz Helena Pereira Silva, Thais Freitas de Lira, Teresa Dávila Cruz Matias, Cicero Igno Guedes Bezerra, Maria Adriana Simão Figueirêdo, Lucas de Oliveira Sá, Sabrina Kaylane da Silva Alves and Mariana Gomes Vidal Sampaio

  <https://doi.org/10.56238/sevened2024.016-007>

.....71-86

## **Spatial distribution of patients with pressure injuries treated at a teaching hospital**


*Juliana de Oliveira Musse, Cristina Braga, Marcelo Marreira, Maria José dos Reis, Christian Douradinho, Cristina Nunes Capeloa, João Carlos de Andrade Menezes, Carlos Alberto Ocon, Adriana Paula Jordão Isabella, Fernanda Sebastiana Mendes Pitanga, Claudia Cristina Soares Muniz, Alfredo Ribeiro Filho, Lidiane Souza Lima, Gleyce Kelly de Brito Brasileiro Santos, Neylor Rodrigo Oliveira Aragão, João Pedro Santos Torres and Aloísio Olímpio*

 <https://doi.org/10.56238/sevened2024.016-008>

.....87-101

## **Child and adolescent psychological care in a Basic Health Unit in the triple border: Characterization and analysis**


*Cristina Elizabeth Pessoa, Nandra Martins Soares and Monica Augusta Mombelli*

 <https://doi.org/10.56238/sevened2024.016-009>

.....102-116

## **Association between polymorphisms in the gene encoding the vitamin D receptor, lipid profile and anthropometric parameters in elderly Brazilians**


*Ivone Freires de Oliveira Costa Nunes, Cecília Maria Resende Gonçalves de Carvalho, Gabriella Magalhães Silva, Gleyson Moura dos Santos, Maria Eduarda Raielly da Silva, Elane Natielly da Conceição Silva, Nauale Lopes de Araújo, Lynda Sthefanny Alves dos Santos, Laura Beatriz Guimarães Sousa, Gleicer Vívian da Silva Lodoro, Ruth Hellen do Nascimento Gomes and Sarah Celeste Rodrigues de Sousa Val*

 <https://doi.org/10.56238/sevened2024.016-010>

.....117-133

## **Areas of expertise of forensic nursing in Brazil**

*Jhuliano Silva Ramos de Souza, Zélia Marilda Rodrigues Resck and Sueli de Carvalho Vilela*

 <https://doi.org/10.56238/sevened2024.016-011>

.....134-161

## **Gestational Hypertensive Syndromes: Understanding the pathological aspects and treatment of preeclampsia with the 4P rule**


*Ryan Cândido Barros de Oliveira, Ruan Cândido Barros de Oliveira, Beatriz de Souza Nunes e Silva, Solange Cavalcante Costa and Welly Minghun Chiang*

 <https://doi.org/10.56238/sevened2024.016-012>

.....162-182

## **Analysis of the prevalence and impact of burnout in university professors**


*Maria Nascimento Cunha and Sílvia Costa Pinto*

 <https://doi.org/10.56238/sevened2024.016-013>

.....183-193

## **Tragedy in Paracambi-RJ: Analysis of the impacts of floods and floods from the perspective of mental health, infectious diseases, absence of socio-environmental intervention and public health in the scenario before and after flooding**



*Jeferson Manoel Teixeira, Tiago da Cruz Monteiro, Luis Henrique Brito Barreto Souza, Wenberger Lanza Daniel de Figueiredo, Erick Matheus Garcia Barbosa and Valdete Santos de Araújo*

 <https://doi.org/10.56238/sevened2024.016-014>

.....194-217

## "What has been studied about Technostress?": A Systematic Review of Literature under scientific production from 2001 to 2022



Marjori Gonçalves Lencina, Kathiane Benedetti Corso and Paulo Cassanego Jr

  <https://doi.org/10.56238/sevened2024.016-015>

.....218-245

### Acute Coronary Syndrome: Approach and impacts



Luana Tavares Neves, Luiz Osvaldo Becker Geraldi, Alissa Paglioco Correia, Ana Clara Haluch Maoski Kleiner, Gabriela Alves Miranda Damaceno, Thomaz Nassif Jorge Bassi, Luiz Henrique Gonçalves dos Santos, Lucas Mendonça Silva de Ávila, Anderson Kretschmer, Walter Rocha Passos Nieto, Julia Pina Vieira dos Santos and Larissa Guerra Fernandes

  <https://doi.org/10.56238/sevened2024.016-016>

.....246-260

### Description of human skull with AATM and secondary comorbidities in university collection



Priscila Lini, André Luis Ramos Soares and Maria da Gloria Tavares Demamann

  <https://doi.org/10.56238/sevened2024.016-017>

.....261-267

### Root resorption in endodontically treated teeth that have been subjected to orthodontic forces



Roberto César Bossi Pimenta, Warley Silva de Oliveira, Maria Cláudia Nunes Araújo Teodoro, Renata Afonso da Silva Pereira, Juliana de Carvalho Carmelo Paiva, Luciano Henrique Figueira, Renata Pereira Georjutti, Eduardo Zanzin Teruel, Akel Fares Akel Neto and Debora Souto-Souza

  <https://doi.org/10.56238/sevened2024.016-018>

.....268-279

### "The cell phone is free!": A study of the student's propensity to Smartphone Dependence and the teacher's perception in the classroom



Rafael Machado Amorim, Kathiane Benedetti Corso, Sebastiao Ailton da Rosa Cerqueira Adão, João Roberto de Lima Gaffrée and Cristiane de Souza Araujo

  <https://doi.org/10.56238/sevened2024.016-019>

.....280-298

### Contextualizing Forensic Nursing



Jhuliano Silva Ramos de Souza, Zélia Marilda Rodrigues Resck and Sueli de Carvalho Vilela

  <https://doi.org/10.56238/sevened2024.016-020>

.....299-309

### Endodontic retreatment, fiberglass pin installation and composite resin prosthetic rehabilitation: Case report



Nattaska Nyckolly Rodrigues Maciel, Clarissa Lopes Drumond, Raulison Vieira de Sousa, José Klidenberg de Oliveira Júnior and Marcos Alexandre Casimiro de Oliveira

  <https://doi.org/10.56238/sevened2024.016-021>

.....310-339

## **Trends and impacts of e-cigarette use among medical students at a private university in São Paulo, analysis of influencing factors and long-term health implications: A systematic review**



Rodrigo Sousa de Carvalho, Danilo Matos Oliveira, Andressa Conceição de Maria Melo Oliveira, Telma Aparecida Saubier, Viviane Claudino Batista, Luís Gustavo Boguea Moreira Dutra, Guilherme Melo de Oliveira, Sarah Camila Valesi Machado, Romário Ferreira Andrade, Eduarda Franco Jorge, Samara da Silva São José and Rafaella da Matta Castilho

  <https://doi.org/10.56238/sevened2024.016-022>

.....340-349

## **Alzheimer's Disease and the Amyloid Cascade**



Isadora Cucolo Oliveira, Maitê de Mello e Castro, Vitoria Consulin, Gabriel Hiroaki Antunes, Tárík Abdalla dos Santos, João Pedro Vayego Lourenço, Ian Vilas Boas Covizzi, Sheila Adami Vayego, Alba Regina de Abreu Lima and Uderlei Doniseti Silveira Covizzi

  <https://doi.org/10.56238/sevened2024.016-023>

.....350-371

## **Cervical cancer: From diagnosis to treatment**



Maria Gabryella Pereira da Silva Camarço, Davi Nogueira Jales, Cadidja Suzzi Oliveira Leitão, Alcides Mendes da Luz Filho, Isabella Kittlaus, Emília Moura Silva, Maria Eduarda Campêlo dos Santos, Vilmar Barbosa de Sousa Júnior, Maria Clara Barbosa de Almeida, Francisberg Dias Coêlho, Antonio de Pádua Andrade Júnior, Sarah Nicolly Romualdo Frota and Matheus de Pádua Macedo Andrade

  <https://doi.org/10.56238/sevened2024.016-024>

.....372-380

## **Similarities of clinical practice guidelines in the management of lower pain: Literature review**



Josilene de Souza da Conceição Kaminski, Aline dos Santos Moreira de Carvalho and Paloma Martins Mendonça

  <https://doi.org/10.56238/sevened2024.016-025>

.....381-404

## **Cardiology: From anatomical and physiological discoveries to the beginnings of the medical specialty in the interior of Rio Grande do Sul**



Naiane Ronsoni Rigo, Natalia Demarco Kielek, Bruna Malacarne, Maísa Diane Turra Lena, Elisabete Maria Zanin and Miriam Salete Wilk Wisniewski

  <https://doi.org/10.56238/sevened2024.016-026>

.....405-415

## **Self-medication and inappropriate use of antimicrobials in municipalities of Rondônia in the legal Amazon**



Camila Avancini da Rocha and Ely Eduardo Saranz Camargo

  <https://doi.org/10.56238/sevened2024.016-027>

.....416-426

## **Obstetric violence and the multidisciplinary team**


Isabelle Melo Martins

  <https://doi.org/10.56238/sevened2024.016-028>

.....427-432


**Intersectoriality, the health of the elderly and the exercise orientation service: A documental analysis**

*Leonardo Perovano Camargo and Carlos Nazareno Ferreira Borges*

 <https://doi.org/10.56238/sevened2024.016-029>

.....433-442

## Integration of Neurofeedback and Virtual Reality - Innovative approaches to the clinical practice of Attention Deficit Hyperactivity Disorder

 <https://doi.org/10.56238/sevned2024.016-001>

Paula Rocha<sup>1</sup> and Diamantino Ribeiro<sup>2</sup>

### ABSTRACT

Attention Deficit Hyperactivity Disorder (ADHD) is a prevalent neurodevelopmental disorder characterized by symptoms of inattention, hyperactivity, and impulsivity, which can have an important impact on people's daily functioning and quality of life. Traditional treatment methods, including medication and behavioral therapy, often have limited success and present several challenges. Recent technological developments provide promising alternatives, notably through the integration of *neurofeedback* and virtual reality (VR) into clinical practice. This article explores the potential of combining these innovative tools to improve the treatment of ADHD. Neurofeedback, a technique that trains individuals to regulate brain activity, has been shown to be effective in managing ADHD symptoms. Similarly, VR provides immersive and engaging environments that can be adapted to therapeutic needs. By combining *neurofeedback* with VR, practitioners can create interactive and personalized treatment protocols aimed at improving patient engagement, adherence, and outcomes. In this paper, we discuss the mechanisms of action, current applications and empirical evidence supporting the use of *neurofeedback technologies* and VR in the treatment of ADHD.

**Keywords:** Neurology, *Neurofeedback*, Virtual reality, ADHD, Innovative treatments.

---

<sup>1</sup> Lusófona University, Porto, Portugal  
E-mail: paularocha@keepcorporate.com  
ORCID <https://orcid.org/0009-0000-4080-2161>

<sup>2</sup> Lusófona University, Porto, Portugal  
E-mail: diamantinojtribeiro@gmail.com  
ORCID <https://orcid.org/0000-0002-7168-8821>



## INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a prevalent neurodevelopmental disorder that affects both children and adults, characterized by persistent patterns of inattention, hyperactivity, and impulsivity. These symptoms can significantly impair academic, occupational, and social functioning, leading to several long-term challenges. Traditional approaches to treating ADHD include pharmacologically-based treatments, such as stimulant medications, and behavioral therapies. While these treatments can be effective, (American Psychiatric Association, 2022) (Beehuspoteea & Bhadrakalimuthu, 2023; Honkasilta & Koutsoklenis, 2022) 1) long-term and variable responses between individuals (Craig et al., 2015; Idrees et al., 2023).

In recent years, there has been a growing interest in exploring innovative technological solutions to improve ADHD treatment outcomes. Two promising technologies are *neurofeedback* and virtual reality (VR).

Neurofeedback is a form of *biofeedback* that allows individuals to gain control over their brain activity, allowing them to get real-time feedback on brain wave patterns. This technique has shown potential to improve attention and reduce hyperactivity in individuals with ADHD (Tough et al., 2024) (Patil et al., 2022; Simkin et al., 2014). On the other hand, VR provides immersive and interactive environments that can be adapted to therapeutic needs, through the creation of engaging and motivating contexts for behavioral interventions (Jingilli et al., 2023; Zhao et al., 2023).

The integration of *neurofeedback* and VR represents a new approach to ADHD treatment, as it can leverage the strengths of both technologies to create more effective therapeutic experiences. Neurofeedback can help individuals with ADHD develop better self-regulation skills, as it directly targets brain functioning, while VR can provide a supportive environment that increases engagement and facilitates the practice of these skills in realistic contexts (Corrado et al., 2024; Sergis et al., 2024). By combining these tools, practitioners may be able to develop more personalized and dynamic treatment protocols that respond to the unique needs of each patient.

This article aims to explore the potential of integrating *neurofeedback* and VR into the clinical practice of ADHD. Through a brief review of the literature and empirical evidence, the mechanisms of action, efficacy and practical considerations of these technologies are explored. The challenges and opportunities associated with their implementation are observed, with the aim of obtaining information on how they can be effectively incorporated into existing treatment structures. Ultimately, this article seeks to contribute to the ongoing development of innovative treatment strategies for ADHD by highlighting the view of *neurofeedback* and VR as complementary tools to improve clinical outcomes.



## NEUROFEEDBACK IN THE TREATMENT OF ADHD

Neurofeedback, a form of *biofeedback*<sup>3</sup> that trains individuals to regulate their brain activity, has emerged as a promising therapeutic approach to ADHD. The technique involves monitoring brain waves through electroencephalography (EEG) and presenting real-time feedback to the individual, often in the form of visual or auditory cues, to reinforce desirable brainwave patterns ( Marzbani et al., 2016; Homes et al., 2023) . The underlying premise is that individuals can learn to modulate their brain activity, which in turn can lead to improvements in cognitive and behavioral functions associated with ADHD. (Martín-Rodríguez et al., 2024)

Neurofeedback works on the principle of operant conditioning, in which individuals receive immediate feedback on the activity of their brain waves, typically focusing on increasing beta waves (associated with concentration and alertness) and decreasing theta waves (associated with inattention and sleepiness). Over successive sessions, this feedback loop helps the brain adopt more optimal activity patterns, thereby improving attention, impulse control, and overall cognitive function ( Gruzelier , 2014; Koomen et al., 2021) ( Enriquez-Geppert et al., 2017; Gruzelier , 2014; Koomen et al., 2021) .

Research on *neurofeedback* for ADHD has shown promising results. A meta-analysis by Arns et al. (2009) concluded that *neurofeedback* has a large effect on ADHD symptoms, comparable to the effect of stimulant medications. Similarly, a literature review by Lofthouse et al. (2012) reported significant improvements in attention, hyperactivity, and impulsivity in children undergoing ( Arns et al., 2009) *neurofeedback* ( Lofthouse et al., 2012) treatment. These studies suggest that *neurofeedback* may be an effective non-pharmacological intervention to manage ADHD symptoms.

Several randomized controlled trials have further validated the efficacy of *neurofeedback*. For example, a study by Gevensleben et al. (2009) demonstrated that children with ADHD who participated in *neurofeedback* sessions showed significant improvements in attention and hyperactivity, compared to a control group that received cognitive training. These improvements were maintained at a six-month follow-up, indicating the potential for long-term benefits ( Gevensleben et al., 2009) .

Despite the positive results, *neurofeedback* has its challenges and limitations. One of the main concerns is the variability of treatment protocols and the lack of standardized guidelines, which can affect the consistency and reliability of results. In addition, treatment requires a significant time

---

<sup>3</sup> Biofeedback is a mind–body technique in which individuals learn how to modify their physiology for the purpose of improving physical, mental, emotional and spiritual health. Much like physical therapy, biofeedback training requires active participation on the part of patients and often regular practice between training sessions. Frank, D. L., Khorshid, L., Kiffer, J. F., Moravec, C. S., & McKee, M. G. (2010). Biofeedback in medicine: who, when, why and how? *Mental health in family medicine*, 7(2), 85–91.





commitment, often involving 20-40 sessions, which can be a barrier for some families. On the other hand, the high cost of equipment and the need for specialized training for professionals can limit accessibility and widespread adoption ( Courteous et al., 2016) ( Arns et al., 2014) ( Faster Capital, 2024; Flanagan & Saikia , 2023)

*Neurofeedback* represents, despite the limitations described, a promising avenue for the treatment of ADHD, constituting a non-invasive and potentially long-lasting alternative to traditional therapies.

## VIRTUAL REALITY IN THE TREATMENT OF ADHD

Virtual reality (VR) technology has made remarkable progress in recent years, through the creation of immersive and interactive experiences that can be harnessed for therapeutic purposes.

In the context of ADHD, VR is envisioned as a unique platform to engage patients in controlled but realistic environments where they can practice attention, impulse control, and other cognitive skills essential to managing their symptoms. ( Corrigan et al., 2023; Sergis et al., 2024)

VR systems create simulated environments that users can interact with using specialized hardware such as headsets, motion sensors, and controllers. These environments can be designed to replicate real-world scenarios or abstract spaces that target specific cognitive functions. For individuals with ADHD, VR can facilitate tasks that require sustained attention, executive function, and self-regulation, thereby providing opportunities for therapeutic intervention in a controlled but flexible setting ( Freeman et al., 2017) ( Bashiri et al., 2017; Cunha et al., 2023) .

The application of VR in the treatment of ADHD is still in its early stages, but initial studies have shown promising results. A study by Cho et al. (2004) demonstrated that children with ADHD who participated in a VR-based mindfulness pilot project showed important improvements in attention and impulsivity compared to a control group. Similarly, a pilot study by Di Giusto et al. (2023) concluded that VR training programs designed to improve executive function led to improved performance on attention and problem-solving tasks in children with ADHD. ( Give et al., 2004) ( Of Right et al., 2023)

One of the main advantages of VR is its ability to create engaging and motivating therapeutic experiences. Traditional treatment methods can often be found tedious or monotonous by children with ADHD, leading to poor adherence and suboptimal outcomes. VR, on the other hand, can make therapeutic tasks more engaging by incorporating game-like elements and interactive challenges that maintain the user's interest and motivation ( DAVIS et al., 2015) ( Bucchiarone , 2022) .

Despite its potential, the use of VR in the treatment of ADHD is not without its challenges. One of the main concerns is the cost and accessibility of VR technology, as high-quality VR systems



can be expensive, and there may be logistical barriers to integrating them into standard clinical practice. Additionally, the immersive nature of VR can sometimes cause motion sickness or other discomfort in some users, which can limit the length and effectiveness of sessions. ( Lindner et al., 2019) ( Grassini & Laumann , 2020)

Another challenge is the need for specialized training for clinicians to effectively administer and adapt VR-based interventions. This includes not only understanding the technical aspects of VR systems, but also being able to design and implement VR scenarios that align with therapeutic goals. (A. “Skip” Rizzo & Koenig , 2017)

In terms of development, more research is needed to establish standardized protocols and to rigorously evaluate the long-term efficacy of VR interventions for ADHD ( Dosis et al., 2015) .

Nevertheless, the studies consulted allow us to infer that VR is very promising as an innovative tool for the treatment of ADHD. Their ability to provide immersive, engaging, and interactive therapeutic experiences can complement traditional interventions and potentially improve outcomes for individuals with ADHD.

## INTEGRATION OF NEUROFEEDBACK AND VIRTUAL REALITY

The integration of *neurofeedback* and virtual reality (VR) represents an innovative approach to the treatment of ADHD, combining the strengths of both methodologies to improve therapeutic outcomes.

Some researchers argue that this hybrid approach enhances the ability of *neurofeedback* to promote self-regulation of brain activity with the immersive and immersive environments of VR, providing a comprehensive and dynamic treatment modality ( Corrado et al., 2024; Corrigan et al., 2023; Sergis et al., 2024; Tough et al., 2024) .

The integration of *neurofeedback* and VR involves using VR environments to create the visual and interactive feedback needed for *neurofeedback* sessions. In this setup, EEG sensors monitor the user's brain activity in real-time, and the VR environment responds accordingly. For example, successful regulation of brainwave patterns can result in progression in a VR game or scenario, thereby enhancing desired neural activity through immediate, immersive feedback. This combination aims to increase the involvement, motivation and overall effectiveness of the (A. “Skip” Rizzo & Koenig , 2017) *neurofeedback process* ( Enriquez-Geppert et al., 2017) , as we mentioned.

Several studies have investigated the effectiveness of combining *neurofeedback* with VR for the treatment of ADHD, as demonstrated by the following examples:

- Rizzo et al. (2004) developed a VR classroom environment where children with ADHD could practice self-regulation and attention control. In this study, *neurofeedback* was



integrated into the VR classroom, giving immediate feedback on brainwave activity as children engaged in classroom tasks. Over the course of several sessions, the children showed marked improvements in their ability to stay focused and reduce impulsive behaviors. Teachers reported observable improvements in classroom behavior and academic performance. (A. A. Rizzo et al., 200 C.E.)

- Dosis et al. (2015) conducted a study in which children with ADHD underwent *neurofeedback* sessions in a VR environment designed to improve executive functions such as working memory, planning, and cognitive flexibility. VR scenarios required participants to solve complex problems while receiving *neurofeedback*. This immersive approach has led to important improvements in tasks related to executive functions, and parents have reported improvements in activities of daily living that require executive skills. ( Dosis et al., 2015)
- In an innovative approach, Lindner et al. (2019) evaluated the feasibility and effectiveness of an at-home VR neurofeedback program for children with ADHD. Families received VR headsets and EEG devices to use at home, guided by an app. Over a period of 12 weeks, the children participated in 'gamified' neurofeedback sessions. The study concluded that *VR neurofeedback* at home was not only feasible, but also resulted in a significant reduction in ADHD symptoms, as reported by parents and teachers. ( Lindner et al., 2019)
- A study by Bioulac et al. (2020) explored the use of *neurofeedback* in VR to treat children with ADHD and comorbid anxiety. The VR environment included scenarios designed to elicit and then help manage anxiety responses, while also aiming for attention control. Neurofeedback helped children learn to modulate their brain activity to reduce anxiety and improve attention. Integrated treatment resulted in significant reductions in anxiety and ADHD symptoms, highlighting the versatility of *VR neurofeedback* in addressing multiple concomitant conditions. ( Bioulac et al., 2020)

Despite the promising results, and in addition to the challenges already described, there is a need for standardized protocols and training for professionals to be able to effectively implement these technologies in practice.

In terms of future prospects, one of the ways forward is to invest in the development of more flexible and cost-effective *VR neurofeedback* solutions . This may include, as Enriquez-Geppert et al (2017) point out, the creation of portable and cost-effective devices that can be easily integrated into various clinical and home settings. ( Enriquez-Geppert et al., 2017)

Large-scale randomized controlled trials are also needed to establish efficacy and best practices for *VR neurofeedback* in the treatment of ADHD. Exploring the integration of this



technology with other therapeutic approaches, such as cognitive behavioral therapy, could further improve treatment outcomes and allow for more comprehensive care to be provided for individuals with ADHD. (A. “Skip” Rizzo & Koenig, 2017)

Overall, it can be noted that the integration of *neurofeedback* and VR represent a cutting-edge approach to the treatment of ADHD, as it is a dynamic and engaging platform for cognitive and behavioral treatments.

## FINAL THOUGHTS

The integration of *neurofeedback* and virtual reality (VR) in the treatment of ADHD is, at this point, a promising and innovative approach that brings together the strengths of both technologies.

This combined method allows you to treat the main symptoms of ADHD, such as inattention, hyperactivity, and impulsivity, while increasing engagement and motivation through immersive and interactive experiences.

The case studies presented in this exploratory study highlight the potential benefits and applications of this integrative approach, constituting in our view a basis for further research and development. These case studies demonstrate that combining *neurofeedback* with VR can lead to improvements in attention, impulse control and executive function.

One of the main advantages of integrating *neurofeedback* and VR is increased user engagement and motivation. Traditional *neurofeedback* can sometimes be perceived as monotonous, making it challenging for the therapist to maintain adherence from participants. The immersive nature of VR transforms therapeutic tasks into interactive and enjoyable experiences, thereby increasing motivation and the likelihood of sustained participation. This is particularly important for children with ADHD, who often have difficulties maintaining attention and engagement. (Lindner et al., 2019)

In addition, the flexibility and adaptability of VR environments allow for the creation of personalized therapeutic scenarios tailored to individual needs. This personalized approach can be programmed to the specific symptoms and challenges faced by each patient, increasing the overall effectiveness of the treatment.

Despite the promising potential, there are several challenges to overcome if the benefits of integrating *neurofeedback* and VR into ADHD treatment are to be fully realized. As we have shown, cost remains a major barrier, as high-quality VR systems and *neurofeedback* equipment can be expensive. Reducing the cost of these technologies and increasing accessibility will be crucial for widespread adoption. In addition, there is a need to develop standardized protocols and training for clinicians in order to ensure effective implementation and maximize therapeutic benefits.



Another consideration is the potential for side effects, such as motion sickness or eye strain, associated with VR use. It is essential to ensure that VR experiences are comfortable and safe for all users. At the same time, long-term studies are needed to assess both the sustained efficacy and possible risks of long-term exposure to VR in therapeutic settings. ( Grassini & Laumann , 2020)

Therefore, based on the literature, we believe that it is essential to deepen the investigation and improve the integration of *neurofeedback* and VR. This includes developing cost-effective solutions that are accessible to a wider range of clinical and patient settings. As Bioulac et al. (2020) state, large-scale randomised controlled trials are needed to establish the efficacy and best practices for this integrative approach.

In the same vein, investigating the combination of VR *neurofeedback* with other therapeutic modalities, such as cognitive-behavioral therapy, could provide a more comprehensive and multifaceted treatment strategy.

In addition, technological development will also play a key role in increasing the feasibility and effectiveness of *neurofeedback* in VR. As Enriquez-Geppert et al. (2017) point out, innovation in portable and affordable VR devices, as well as user-friendly software, can facilitate the integration of these technologies into everyday clinical practice and home interventions.

In summary, the integration of *neurofeedback* and VR represents a cutting-edge approach to the treatment of ADHD, constituting a dynamic and engaging platform for cognitive and behavioral treatments. While there are still challenges, the potential benefits of this innovative method can be very substantial. Ongoing research and new technologies will be essential to realize the full potential of this integrative approach, improving the quality of life for individuals with ADHD.



## REFERENCES

1. American Psychiatric Association. (2022). \*Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR) (Revised)\*. American Psychiatric Association.
2. Arns, M., de Ridder, S., Strehl, U., Breteler, M., & Coenen, A. (2009). Efficacy of Neurofeedback Treatment in ADHD: The Effects on Inattention, Impulsivity and Hyperactivity: A Meta-Analysis. \*Clinical EEG and Neuroscience, 40\*(3), 180–189. <https://doi.org/10.1177/155005940904000311>
3. Arns, M., Heinrich, H., & Strehl, U. (2014). Evaluation of neurofeedback in ADHD: The long and winding road. \*Biological Psychology, 95\*, 108–115. <https://doi.org/10.1016/j.biopsycho.2013.11.013>
4. Bashiri, A., Ghazisaeedi, M., & Shahmoradi, L. (2017). The opportunities of virtual reality in the rehabilitation of children with attention deficit hyperactivity disorder: a literature review. \*Korean Journal of Pediatrics, 60\*(11), 337. <https://doi.org/10.3345/kjp.2017.60.11.337>
5. Beehuspoteea, N., & Badrakalimuthu, V. R. (2023). Exploring the relationship between ADHD and dementia. \*Progress in Neurology and Psychiatry, 27\*(2), 5–9. <https://doi.org/10.1002/pnp.784>
6. Bioulac, S., Micoulaud-Franchi, J.-A., Maire, J., Bouvard, M. P., Rizzo, A. A., Sagaspe, P., & Philip, P. (2020). Virtual Remediation Versus Methylphenidate to Improve Distractibility in Children With ADHD: A Controlled Randomized Clinical Trial Study. \*Journal of Attention Disorders, 24\*(2), 326–335. <https://doi.org/10.1177/1087054718759751>
7. Bucchiarone, A. (2022). Gamification and virtual reality for digital twin learning and training: architecture and challenges. \*Virtual Reality & Intelligent Hardware, 4\*(6), 471–486. <https://doi.org/10.1016/j.vrih.2022.08.001>
8. Cho, B.-H., Kim, S., Shin, D. I., Lee, J. H., Min Lee, S., Young Kim, I., & Kim, S. I. (2004). Neurofeedback Training with Virtual Reality for Inattention and Impulsiveness. \*CyberPsychology & Behavior, 7\*(5), 519–526. <https://doi.org/10.1089/cpb.2004.7.519>
9. Corrado, S., Tosti, B., Mancone, S., Di Libero, T., Rodio, A., Andrade, A., & Diotaiuti, P. (2024). Improving Mental Skills in Precision Sports by Using Neurofeedback Training: A Narrative Review. \*Sports, 12\*(3), 70. <https://doi.org/10.3390/sports12030070>
10. Corrigan, N., Păsărelu, C.-R., & Voinescu, A. (2023). Immersive virtual reality for improving cognitive deficits in children with ADHD: a systematic review and meta-analysis. \*Virtual Reality, 27\*(4), 3545–3564. <https://doi.org/10.1007/s10055-023-00768-1>
11. Cortese, S., Ferrin, M., Brandeis, D., Holtmann, M., Aggensteiner, P., Daley, D., Santosh, P., Simonoff, E., Stevenson, J., Stringaris, A., Sonuga-Barke, E. J. S., Asherson, P., Banaschewski, T., Brandeis, D., Buitelaar, J., Coghill, D., Cortese, S., Daley, D., Danckaerts, M., ... Zuddas, A. (2016). Neurofeedback for Attention-Deficit/Hyperactivity Disorder: Meta-Analysis of Clinical and Neuropsychological Outcomes From Randomized Controlled Trials. \*Journal of the American Academy of Child & Adolescent Psychiatry, 55\*(6), 444–455. <https://doi.org/10.1016/j.jaac.2016.03.007>
12. Craig, S. G., Davies, G., Schibuk, L., Weiss, M. D., & Hechtman, L. (2015). Long-Term Effects of Stimulant Treatment for ADHD: What Can We Tell Our Patients? \*Current Developmental Disorders Reports, 2\*(1), 1–9. <https://doi.org/10.1007/s40474-015-0039-5>



13. Cunha, F., Campos, S., Simões-Silva, V., Brugada-Ramentol, V., Sá-Moura, B., Jalali, H., Bozorgzadeh, A., & Trigueiro, M. J. (2023). The effect of a virtual reality based intervention on processing speed and working memory in individuals with ADHD—A pilot-study. *\*Frontiers in Virtual Reality, 4\**. <https://doi.org/10.3389/frvir.2023.1108060>
14. Di Giusto, V., Purpura, G., Zorzi, C. F., Blonda, R., Brazzoli, E., Meriggi, P., Reina, T., Rezzonico, S., Sala, R., Olivieri, I., & Cavallini, A. (2023). Virtual reality rehabilitation program on executive functions of children with specific learning disorders: a pilot study. *\*Frontiers in Psychology, 14\**. <https://doi.org/10.3389/fpsyg.2023.1241860>
15. Dovis, S., Van der Oord, S., Wiers, R. W., & Prins, P. J. M. (2015). Improving Executive Functioning in Children with ADHD: Training Multiple Executive Functions within the Context of a Computer Game. A Randomized Double-Blind Placebo Controlled Trial. *\*PLOS ONE, 10\**(4), e0121651. <https://doi.org/10.1371/journal.pone.0121651>
16. Enriquez-Geppert, S., Huster, R. J., & Herrmann, C. S. (2017). EEG-Neurofeedback as a Tool to Modulate Cognition and Behavior: A Review Tutorial. *\*Frontiers in Human Neuroscience, 11\**. <https://doi.org/10.3389/fnhum.2017.00051>
17. Faster Capital. (2024, June 16). Behavioral health biotechnology Advancements in Neurofeedback Technology for Mental Health. *\*Faster Capital\**. <https://www.fastercapital.com/content/Behavioral-health-biotechnology-Advancements-in-Neurofeedback-Technology-for-Mental-Health.html>
18. Flanagan, K., & Saikia, M. J. (2023). Consumer-Grade Electroencephalogram and Functional Near-Infrared Spectroscopy Neurofeedback Technologies for Mental Health and Wellbeing. *\*Sensors, 23\**(20), 8482. <https://doi.org/10.3390/s23208482>
19. Freeman, D., Reeve, S., Robinson, A., Ehlers, A., Clark, D., Spanlang, B., & Slater, M. (2017). Virtual reality in the assessment, understanding, and treatment of mental health disorders. *\*Psychological Medicine, 47\**(14), 2393–2400. <https://doi.org/10.1017/S003329171700040X>
20. Gevensleben, H., Holl, B., Albrecht, B., Vogel, C., Schlamp, D., Kratz, O., Studer, P., Rothenberger, A., Moll, G. H., & Heinrich, H. (2009). Is neurofeedback an efficacious treatment for ADHD? A randomised controlled clinical trial. *\*Journal of Child Psychology and Psychiatry, 50\**(7), 780–789. <https://doi.org/10.1111/j.1469-7610.2008.02033.x>
21. Grassini, S., & Laumann, K. (2020). Are Modern Head-Mounted Displays Sexist? A Systematic Review on Gender Differences in HMD-Mediated Virtual Reality. *\*Frontiers in Psychology, 11\**. <https://doi.org/10.3389/fpsyg.2020.01604>
22. Gruzelier, J. H. (2014). EEG-neurofeedback for optimising performance. II: Creativity, the performing arts and ecological validity. *\*Neuroscience & Biobehavioral Reviews, 44\**, 142–158. <https://doi.org/10.1016/j.neubiorev.2013.11.004>
23. Honkasilta, J., & Koutsoklenis, A. (2022). The (Un)real Existence of ADHD—Criteria, Functions, and Forms of the Diagnostic Entity. *\*Frontiers in Sociology, 7\**. <https://doi.org/10.3389/fsoc.2022.814763>
24. Idrees, I., Bellato, A., Cortese, S., & Groom, M. J. (2023). The effects of stimulant and non-stimulant medications on the autonomic nervous system (ANS) functioning in people with



ADHD: A systematic review and meta-analysis. *\*Neuroscience & Biobehavioral Reviews*, 144\*, 104968. <https://doi.org/10.1016/j.neubiorev.2022.104968>

25. Jingili, N., Oyelere, S. S., Nyström, M. B. T., & Anyshchenko, L. (2023). A systematic review on the efficacy of virtual reality and gamification interventions for managing anxiety and depression. *\*Frontiers in Digital Health*, 5\*. <https://doi.org/10.3389/fdgth.2023.1239435>
26. Koomen, A., Keeser, D., & Sonja, V. (2021). The effects of neurofeedback on attention and sleep in individuals with and without ADHD or insomnia: a literature review. *\*Applied Neuroscience and Mental Health*, 1\*(1), 30–49. <https://doi.org/10.31739/ANAMH.2021.1.30>
27. Lindner, P., Miloff, A., Fagnäs, S., Andersen, J., Sigeman, M., Andersson, G., Furmark, T., & Carlbring, P. (2019). Therapist-led and self-led one-session virtual reality exposure therapy for public speaking anxiety with consumer hardware and software: A randomized controlled trial. *\*Journal of Anxiety Disorders*, 61\*, 45–54. <https://doi.org/10.1016/j.janxdis.2018.07.003>
28. Lofthouse, N., Arnold, L. E., Hersch, S., Hurt, E., & DeBeus, R. (2012). A Review of Neurofeedback Treatment for Pediatric ADHD. *\*Journal of Attention Disorders*, 16\*(5), 351–372. <https://doi.org/10.1177/1087054711427530>
29. Martín-Rodríguez, A., Gostian-Ropotin, L. A., Beltrán-Velasco, A. I., Belando-Pedreño, N., Simón, J. A., López-Mora, C., Navarro-Jiménez, E., Tornero-Aguilera, J. F., & Clemente-Suárez, V. J. (2024). Sporting Mind: The Interplay of Physical Activity and Psychological Health. *\*Sports*, 12\*(1), 37. <https://doi.org/10.3390/sports12010037>
30. Marzbani, H., Marateb, H., & Mansourian, M. (2016). Methodological Note: Neurofeedback: A Comprehensive Review on System Design, Methodology and Clinical Applications. *\*Basic and Clinical Neuroscience Journal*, 7\*(2). <https://doi.org/10.15412/J.BCN.03070208>
31. Patil, A. U., Madathil, D., Fan, Y.-T., Tzeng, O. J. L., Huang, C.-M., & Huang, H.-W. (2022). Neurofeedback for the Education of Children with ADHD and Specific Learning Disorders: A Review. *\*Brain Sciences*, 12\*(9), 1238. <https://doi.org/10.3390/brainsci12091238>
32. Rizzo, A. A., Schultheis, M., Kerns, K. A., & Mateer, C. (200 C.E.). Analysis of assets for virtual reality applications in neuropsychology. *\*NEUROPSYCHOLOGICAL REHABILITATION*, 14\*(1/2), 207–239. [https://verduvr.com/wp-content/uploads/2019/09/13.-Analysis\\_of\\_assets\\_for\\_virtual\\_reality\\_application.pdf](https://verduvr.com/wp-content/uploads/2019/09/13.-Analysis_of_assets_for_virtual_reality_application.pdf)
33. Rizzo, A. “Skip,” & Koenig, S. T. (2017). Is clinical virtual reality ready for primetime? *\*Neuropsychology*, 31\*(8), 877–899. <https://doi.org/10.1037/neu0000405>
34. Sergis, N., Troussas, C., Krouska, A., Tzortzi, C., Bardis, G., & Sgouropoulou, C. (2024). ADHD Dog: A Virtual Reality Intervention Incorporating Behavioral and Sociocultural Theories with Gamification for Enhanced Regulation in Individuals with Attention Deficit Hyperactivity Disorder. *\*Computers*, 13\*(2), 46. <https://doi.org/10.3390/computers13020046>
35. Simkin, D. R., Thatcher, R. W., & Lubar, J. (2014). Quantitative EEG and Neurofeedback in Children and Adolescents. *\*Child and Adolescent Psychiatric Clinics of North America*, 23\*(3), 427–464. <https://doi.org/10.1016/j.chc.2014.03.001>
36. Tosti, B., Corrado, S., Mancone, S., Di Libero, T., Rodio, A., Andrade, A., & Diotaiuti, P. (2024). Integrated use of biofeedback and neurofeedback techniques in treating pathological conditions






and improving performance: a narrative review. \*Frontiers in Neuroscience, 18\*. <https://doi.org/10.3389/fnins.2024.1358481>

37. Vatrano, M., Nemirovsky, I. E., Tonin, P., & Riganello, F. (2023). Assessing Consciousness through Neurofeedback and Neuromodulation: Possibilities and Challenges. \*Life, 13\*(8), 1675. <https://doi.org/10.3390/life13081675>
38. Zhao, X., Ren, Y., & Cheah, K. S. L. (2023). Leading Virtual Reality (VR) and Augmented Reality (AR) in Education: Bibliometric and Content Analysis From the Web of Science (2018–2022). \*SAGE Open, 13\*(3). <https://doi.org/10.1177/21582440231190821>

## Factors associated with pertussis in Brazil: An epidemiological analysis (2018-2023)

 <https://doi.org/10.56238/sevemed2024.016-002>

**Gabriela Stocco Rodrigues<sup>1</sup>, Rafaela Chiuco Zeni<sup>2</sup>, Guilherme dos Santos Lara<sup>3</sup>, Mariana Michalski Fagundes Cunha<sup>4</sup>, Michely Mandelli Micheleto<sup>5</sup>, Ana Carolina Tonini Andrighetti<sup>6</sup>, Camila Franzner Donath<sup>7</sup>, Adriana Erbs Mira<sup>8</sup>, Amabile Giovana Marcarini<sup>9</sup>, Roberta Dalponte<sup>10</sup>, Caroline Zorzi<sup>11</sup> and Edson Bruno Pazzinato Espich<sup>12</sup>**

### ABSTRACT

An upward trend was observed in the incidence of pertussis in Brazil, leading to an epidemic alert, based on epidemiological bulletins issued by government health agencies. Our objective in the present study was to identify the epidemiological profile of pertussis in Brazil. We used the incidence of notifications of the disease in the period from January 2018 to December 2023. A quantitative, retrospective, and epidemiological methodological approach was used, showing the number of hospitalizations due to pertussis. Data were

<sup>1</sup> Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul  
E-mail: gabrielastocco@outlook.com

ORCID: <https://orcid.org/0009-0005-1902-965X>

<sup>2</sup> Doctor and Master, graduated from the Pontifical Catholic University of Paraná (PUCPR)  
E-mail: rafaelaczeni@gmail.com

ORCID: <https://orcid.org/0000-0002-2157-9811>

<sup>3</sup> Physician, graduated from the Pontifical Catholic University of Paraná (PUCPR)  
E-mail: guilherme.slara@outlook.com

ORCID: <https://orcid.org/0000-0002-8210-7949>

<sup>4</sup> Undergraduate student in Medicine at Centro Universitário Campo Real  
E-mail: marianafagundescunha@gmail.com

ORCID: <https://orcid.org/0009-0001-2998-8847>

<sup>5</sup> Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul  
E-mail: michelymicheleto@hotmail.com

ORCID: <https://orcid.org/0009-0000-5483-7357>

<sup>6</sup> Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul  
E-mail: toniniana@gmail.com

ORCID: <https://orcid.org/0009-0001-8468-9348>

<sup>7</sup> Psychologist, graduated from the Pontifical Catholic University of Paraná (PUCPR)  
Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul

E-mail: camifranzner@gmail.com

ORCID: <https://orcid.org/0000-0002-8210-7949>

<sup>8</sup> Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul  
E-mail: adri.erbs.mira@gmail.com

ORCID: <https://orcid.org/0009-0003-7268-6435>

<sup>9</sup> Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul  
E-mail: amabilegiovanamar@icloud.com

ORCID: <https://orcid.org/0009-0008-0388-8523>

<sup>10</sup> Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul  
E-mail: robertadaponte@outlook.com

ORCID: <https://orcid.org/0009-0005-7400-2898>

<sup>11</sup> Undergraduate student in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul  
E-mail: caroline.zorzi13@gmail.com

ORCID: <https://orcid.org/0009-0003-4287-1998>

<sup>12</sup> Postgraduate in LL.M in Business Law from Fundação Getúlio Vargas do Rio de Janeiro (FGV-RJ)  
Graduating in Medicine at Faculdade Estácio IDOMED de Jaraguá do Sul

E-mail: edsonespich@hotmail.com

ORCID: <https://orcid.org/0009-0004-5594-4313>



collected through the SUS Department of Informatics (DATASUS), and the variables investigated were year of processing, region, sex, color/race, age group, and pertussis-related deaths. The information pointed out that the need for robust and continuous public policies for the control and prevention of pertussis is highlighted, with a special focus on the most affected populations and regions.

**Keywords:** Pertussis, Epidemiology, Observational Study.



## INTRODUCTION

Pertussis is a highly transmissible acute infectious disease and represents a significant cause of morbidity and mortality in children. It is caused by the bacteria *Bordetella pertussis* and *B. parapertussis*. The human being is the only known natural reservoir, although the existence of chronic carriers has not yet been proven. (MEDEIROS, 2017)

This disease mainly affects the respiratory system, including the trachea and bronchi. It is manifested by intense episodes of dry cough. In infants, it can lead to serious complications and even death.

Pertussis is transmitted mainly by direct contact between a sick person and an unvaccinated person, through droplets expelled during coughing, sneezing or even when speaking. In some cases, transmission can occur through objects recently contaminated with secretions from infected people. However, this form of transmission is infrequent, as the causative agent of the disease has difficulty surviving outside the human body. The incubation period of the bacteria, that is, the time between infection and the onset of symptoms, usually ranges from 5 to 10 days, but can extend from 4 to 21 days and, rarely, up to 42 days.

The characteristic symptoms of pertussis begin with a catarrhal phase and evolve into a paroxysmal phase, marked by intense coughing and the characteristic whooping cough. These symptoms are caused by the toxins produced by the bacterium *B. pertussis*. The colonization of the airways by the bacterium and the resulting cellular lesions are central aspects in the pathophysiology of the disease. (MEDEIROS, 2017).

The differential diagnosis of pertussis should be made considering other acute respiratory infections, such as tracheobronchiolitis, bronchiolitis, adenoviruses, and laryngitis. In addition, there are other diseases known as "pertussis syndrome" or coqueluchoid diseases, which can present similar symptoms (TREVIZAN; COUTINHO, 2008).

Laboratory diagnosis of pertussis involves several strategies. Nasopharyngeal culture is considered the "gold standard" due to its high specificity, although its sensitivity varies. In addition, other methods, such as the Elisa test for immunoglobulin detection, fluorescent antibody (DFA) testing, and real-time PCR, can also be used to confirm the diagnosis. It is worth mentioning that PCR can detect both live and dead bacteria, so it is important to consider clinical symptoms when indicating this test. Serology is beneficial in patients vaccinated for more than 2 years and should be collected in two stages, preferably in the catarrhal phase (MOTTA; CUNHA, 2012).

The treatment of pertussis is carried out with antibiotics, with macrolides being the first choice. Erythromycin, azithromycin, and clarithromycin are appropriate agents for initial treatment. It is important to administer them during the catarrhal phase for greater effectiveness. In addition, the



choice of antimicrobial should consider factors such as potential adverse events, drug interactions, tolerability, adherence to the prescribed regimen, and cost

Therefore, it is important to conduct research to identify the factors that contribute to the increase in the number of cases of disease and to understand the characteristics of the most affected population. In addition, it is essential to develop more effective prevention and control strategies, considering the growing concern of health authorities around the world (TREVIZAN; COUTINHO, 2008).

Therefore, the objective of the present study was to identify and characterize the epidemiological profile of confirmed pertussis cases in Brazil between 2018 and 2023.

## OBJECTIVE

This study aims to investigate and understand the factors associated with the incidence of pertussis in Brazil in the period between January 2018 and December 2023. In addition, it seeks to analyze the geographic distribution of the disease, as well as possible seasonal variations. This research will contribute to a deeper understanding of the spread of pertussis and will allow the identification of the most affected population groups. In addition, individual characteristics that may make certain groups more vulnerable to the disease will be investigated.

## METHODOLOGY

This is an observational epidemiological study of a descriptive nature. Descriptive epidemiological studies play a significant role in health sciences research, constituting the first stage in the application of the epidemiological method to understand the behavior of a health problem in a population.

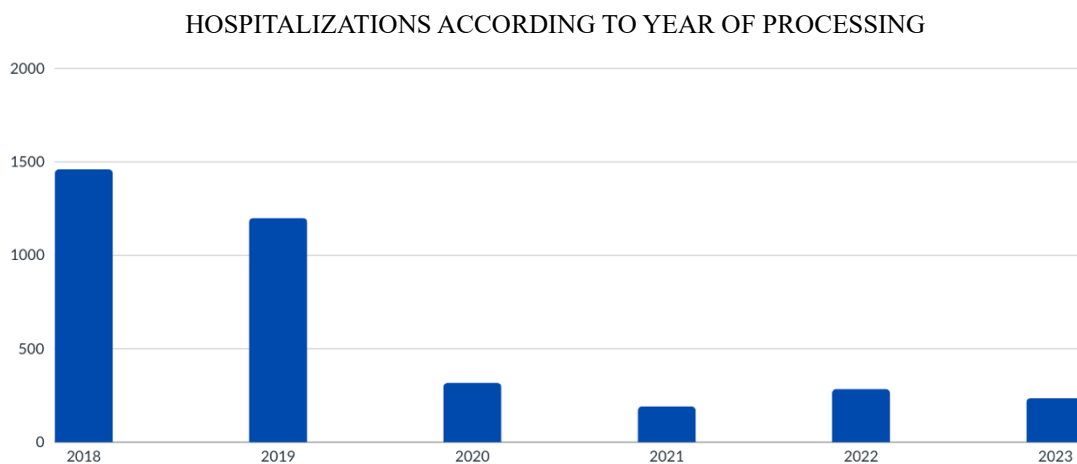
The data were obtained by consulting the SUS Notifiable Diseases Information System (SINAN) databases, referring to the period from 2018 to 2023. The following aspects were evaluated: year of processing, region, sex, color/race, age group, and pertussis-related deaths. Information was also obtained from the SCIELO and GOOGLE SCHOLAR databases, in which the keywords "pertussis", "epidemiological profile" and "observational study" were used.

The study population consisted of the number of confirmed pertussis cases diagnosed in Brazil and recorded from January 2018 to December 2023. The indicator used to project the results (tables) was the number of confirmed cases of pertussis, with A37 being the code of the International Classification of Diseases (ICD-10). To avoid incomplete information in the system, such as that of the year 2024, it was decided to use only the years prior to 2024 available in the system. From the data obtained from the DATASUS SINAN, new tables were built in Microsoft Excel, which were later analyzed by means of descriptive and analytical statistics.

Due to the information obtained through a database in the public domain, according to item III of Resolution No. 510/2016, it was not necessary to submit the study to the Research Ethics Committee (CEP).

## RESULTS

There were 3,691 cases of hospitalizations for pertussis in Brazil from January 2018 to December 2023. The average length of stay was 6.2 days. The highest number of cases was recorded in 2018, 1,460 (39.5%) of total hospitalizations. The year 2021 represented the lowest number of hospitalizations with 192 (5.2%).

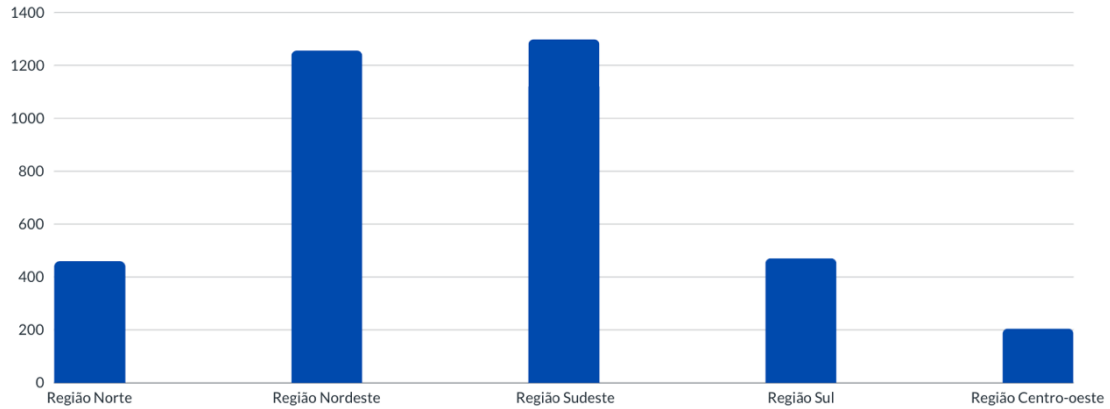


Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

The Southeast Region had the highest number of hospitalizations, 1,299. The total number of hospitalizations due to pertussis in the Southeast Region of Brazil, which is formed by the states of São Paulo, Minas Gerais, Rio de Janeiro and Espírito Santo, corresponds to 35.1% of the total number of hospitalizations reported. However, the region that presented the lowest number of cases for the same period was the Central-West Region with 205 cases, representing 5.5% of total hospitalizations.



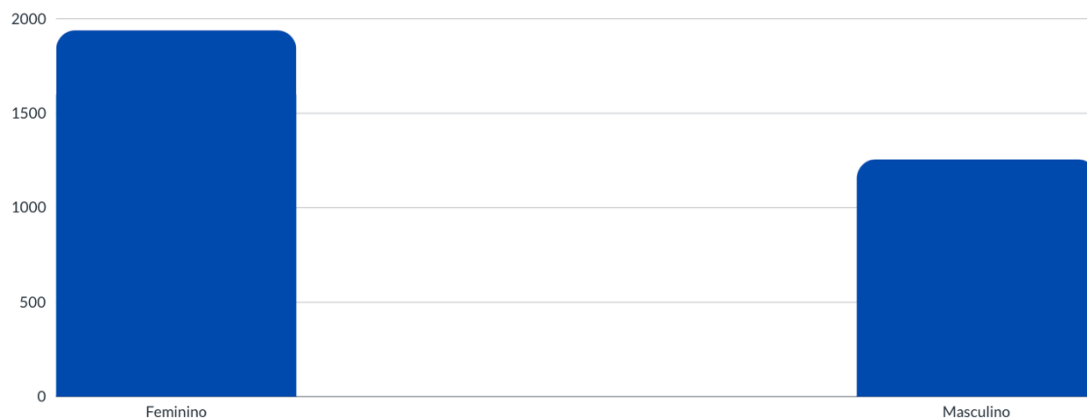
### HOSPITALIZATIONS ACCORDING TO REGION



Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

The individuals most affected by the disease were female, with 1,939 hospitalizations, representing 52.5%. Males had 1,752 hospitalizations, expressing 47.4%.

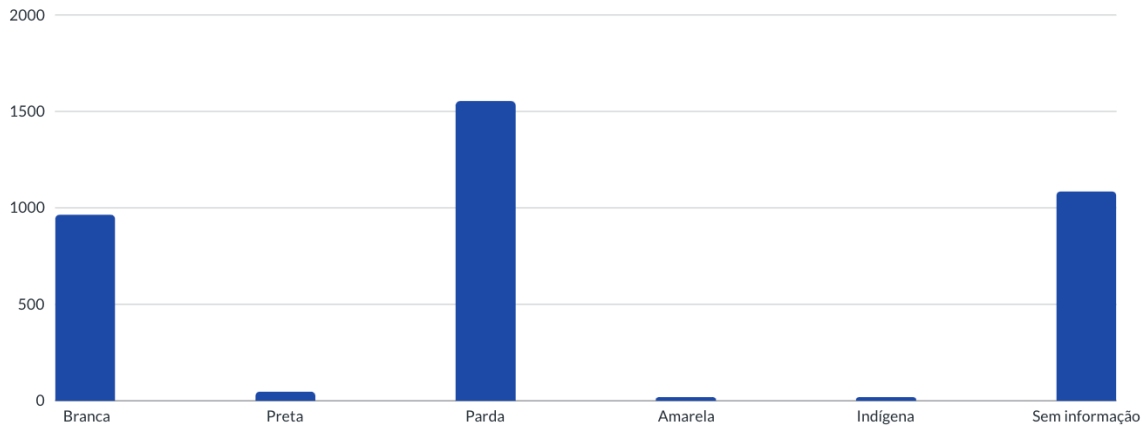
### HOSPITALIZATIONS ACCORDING TO SEX



Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

The brown color/race registered 1,554 hospitalizations, representing 42.1% of the cases. This data shows the prevalence of pertussis in brown individuals, mainly, followed by white individuals with 965 hospitalizations, making up 26.1% of total hospitalizations. However, there were 1,086 cases that did not obtain information regarding the color/race of the affected patients.

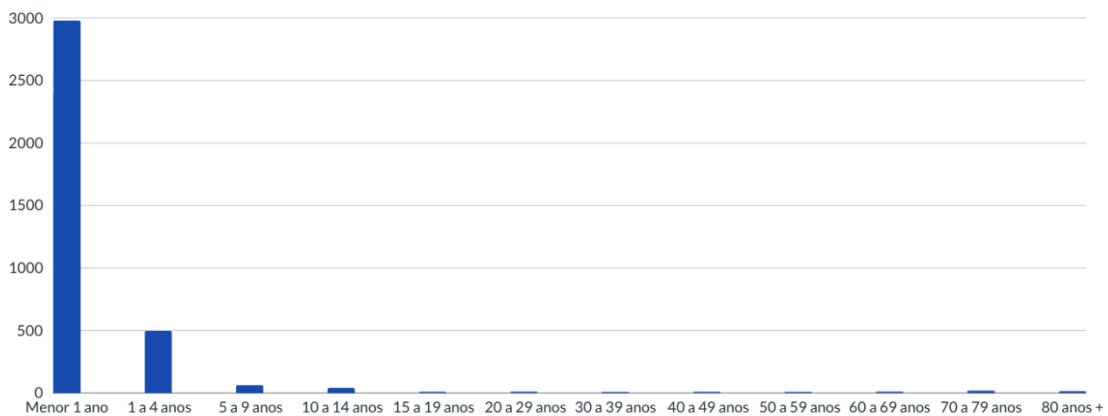
### HOSPITALIZATIONS ACCORDING TO COLOR/RACE



Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

The age group with the highest number of hospitalizations was the one under 1 year of age, with 2,981 cases, representing 80.7% of total hospitalizations and corroborating the theories seen in the literature on this topic.

### HOSPITALIZATIONS ACCORDING TO AGE GROUP

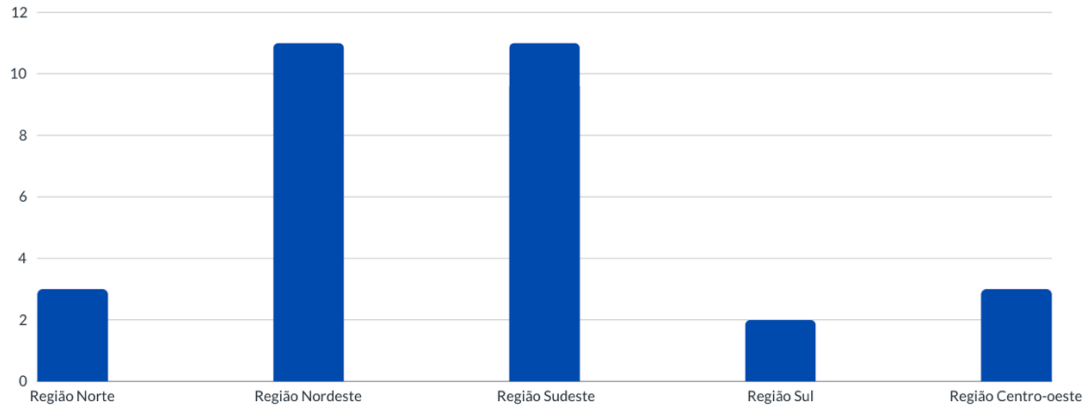


Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

Regarding the total number of deaths from pertussis, a total of 30 deaths were recorded between 2018 and 2023, which were more expressive in the Northeast Region and in the Southeast Region, with 11 cases in each.



### DEATHS ACCORDING TO REGION



Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

## CONCLUSION

Based on the results obtained, we can conclude that pertussis continues to be a public health problem in Brazil. During the period from January 2018 to December 2023, 3,691 hospitalizations for this disease were recorded. The year 2018 had the highest number of cases.

The Southeast Region concentrated the highest number of hospitalizations, representing 35.1% of the total. This suggests that the states of São Paulo, Minas Gerais, Rio de Janeiro, and Espírito Santo face a significant challenge in controlling pertussis.

Demographics are also relevant. Women were most affected, accounting for 52.5% of hospitalizations. Brown color/race was the most prevalent among the patients, with 42.1% of the cases.

The most vulnerable age group was children under 1 year old, with 80.7% of hospitalizations. This observation is in line with the existing literature on the subject, which highlights the susceptibility of infants to pertussis.


As for deaths, 30 deaths were recorded in the period. The Northeast and Southeast regions were the most affected, with 11 cases each. These results indicate the continued need for pertussis surveillance, prevention, and education to protect the health of the population.



## REFERENCES

1. Brasil. Ministério da Saúde. (2014). \*Guia de vigilância em saúde\*. Brasília: Ministério da Saúde.
2. Coqueluche. Modo de Transmissão. Disponível em: [http://nhe.fmrp.usp.br/wp-content/uploads/2018/05/cve12\\_guia\\_ve\\_atualizado\\_coqueluche.pdf](http://nhe.fmrp.usp.br/wp-content/uploads/2018/05/cve12_guia_ve_atualizado_coqueluche.pdf). Acesso em: 2 jul. 2024.
3. Medeiros, A. T. N. de, et al. (2017). Reemergência da coqueluche: perfil epidemiológico dos casos confirmados. \*Cadernos Saúde Coletiva\*, 25(4), 453–459.
4. Motta, F., & Cunha, J. (2012). Coqueluche: revisão atual de uma antiga doença. \*Boletim Científico de Pediatria\*, 1(2), 42-46.
5. Trevizan, S., & Coutinho, S. E. D. (2008). Perfil epidemiológico da coqueluche no Rio Grande do Sul, Brasil: estudo da correlação entre incidência e cobertura vacinal. \*Cadernos de Saúde Pública\*, 24(1), 93–102.

## Labor and puerperium outcomes in women with a history of urinary tract infection during pregnancy

 <https://doi.org/10.56238/sevned2024.016-003>

**Bruna Thais da Rocha Paes<sup>1</sup>, Ana Paula de Assis Sales<sup>2</sup>, Vivian Maria Madeiro<sup>3</sup>, Tailma Silva Lino de Souza<sup>4</sup>, Gabrielly Segatto Brito<sup>5</sup>, Juscilene da Silva Maciel<sup>6</sup>, Laís Flávia de Castro Pinheiro Campos<sup>7</sup>, Andrezza Gabrielly dos Santos Soldera<sup>8</sup> and Andriely Gomes dos Santos<sup>9</sup>**

### ABSTRACT

**Objective:** To summarize the studies that evaluate possible outcomes of labor and puerperium in women who had Urinary Tract Infection during pregnancy. **Methods:** Integrative literature review with a search carried out in the Virtual Health Library (VHL), National Library of Medicine National Institutes of Health (PubMed), Web of Science and CINAHL databases, with articles from 2018 to 2022 as inclusion criteria. **Results:** Seven articles were selected for this review, and all studies brought preterm labor as one of the main outcomes, followed by 71.4% that point to low birth weight, 42.9% emphasize neonatal death, 28.6% point to abortion and premature rupture of membranes, 14.3% associate neonatal asphyxia and preeclampsia as one of the main findings. In addition, 42.9% of the articles outlined the sociodemographic profile of these women, relating maternal age, multiparity, ethnicity, and socioeconomic conditions. **Conclusion:** Prematurity, low birth weight, and neonatal death were the main outcomes found in this review. It is suggested that further studies investigate whether there is a relationship between neonatal asphyxia and preeclampsia as complications of UTI in pregnancy.

**Keywords:** Pregnancy Complications, Pregnant Women, Urinary Infections, Nursing.

<sup>1</sup> Nurse graduated from the Undergraduate Nursing course at the Integrated Health Institute - Federal University of Mato Grosso do Sul.

<sup>2</sup> Doctor. Professor of the Nursing Course at the Integrated Institute of Health/UFMS.

<sup>3</sup> Undergraduate Nursing Student INISA/UFMS.

<sup>4</sup> Nurse. Master's student in the Master's Program in Nursing/INISA/UFMS.

<sup>5</sup> Nurse. Master's student in the Master's Program in Nursing/INISA/UFMS.

<sup>6</sup> Nurse at SESAU / Campo Grande-MS. Master's student in the Graduate Program in Health and Development in the Midwest Region of UFMS.

<sup>7</sup> Nurse at the Women's Unit. Maria Aparecida Pedrossian University Hospital-HUMAP/EBSERH/MEC/UFMS.

<sup>8</sup> Nurse. Master in Nursing from the Graduate Program in Nursing, INISA/UFMS.

<sup>9</sup> Obstetric Nurse. State Department of Health (SES) - Mato Grosso do Sul.



## INTRODUCTION

Urinary tract infection (UTI) is a common complication during pregnancy, affecting approximately 10%-12% of pregnant women, due to the hormonal, anatomical and physiological changes that occur in the maternal body during this period<sup>(1)</sup>. Among these changes, urinary stasis caused by the reduction of ureteral peristalsis, increased urine production, glycosuria and aminoaciduria, which favor bacterial growth and promote infections, can be highlighted<sup>(2)</sup>.

Organisms that cause UTI in pregnancy are the same uropathogens that commonly cause UTI in non-pregnant patients. *Escherichia coli* is the most commonly isolated organism. Other bacteria that can be observed include the species *Klebsiella pneumoniae*, *Staphylococcus*, *Streptococcus*, *Proteus* and *Enterococcus*<sup>(3)</sup>.

Clinically, UTI can be classified as lower tract infection, as in cases of Asymptomatic Bacteriuria (BA) and cystitis, and urinary tract infection

Above all, BA is defined by the presence of 10<sup>5</sup> colony-forming units (CFU) per milliliter of a single pathogen, in a urine sample obtained from the midstream, and in the absence of symptoms. Its incidence is around 9% to 11% of all pregnancies. If BA is not treated, approximately 30% of the cases will progress to cystitis or pyelonephritis<sup>(1)</sup>.

On the other hand, cystitis is an uncomplicated inflammation, usually treated on an outpatient basis, not requiring hospitalization. They usually present with dysuria, urinary urgency, frequency, nocturnal urination, and suprapubic pain, and are unlikely to occur with fever<sup>(4)</sup>.

Pyelonephritis, in turn, is considered the most serious type of UTI and consists of infection of the renal parenchyma and its adjacent structures. The diagnosis is made by bacteriuria accompanied by systemic symptoms such as fever, tachycardia, chills, nausea, vomiting and low back pain, with a positive Giordano sign. After detection, hospitalization is mandatory due to the risk of septic syndrome, and intravenous antibiotic treatment should be initiated immediately<sup>(1)</sup>.

To detect UTI cases early and prevent their complications, the Ministry of Health recommends two urine tests during pregnancy. The first should be performed in the first trimester, and the second exam in the third trimester<sup>(4)</sup>.

However, if urinary tract infection is not treated correctly after its diagnosis, it can generate serious complications for both the mother and the fetus, which is the main cause of sepsis throughout pregnancy, associated with the risk of prematurity, premature rupture of amniotic membranes, abortion, low birth weight and perinatal death<sup>(5)</sup>.

The recurrence of UTI can often lead women to frequent hospitalizations during pregnancy, due to the aforementioned aspects, and requires continuous surveillance from professionals who work in prenatal care as well as in hospital services, for this, control by urinalysis tests and health education have been important in the management of UTI complications in pregnant women<sup>(6)</sup>.



Nursing works in primary and hospital care environments and provides care to pregnant women with UTI in different scenarios, so the study of obstetric and neonatal complications is of interest to the profession, as it broadens the scope of knowledge and improves its care practices. In view of the above, the objective of this review is to summarize the studies that evaluate possible outcomes of labor and puerperium in women who had UTI during pregnancy.

## METHOD

The Integrative Literature Review (RIL) is a research method that allows the search, critical evaluation and synthesis of the available evidence on the topic investigated, with its final product being the current state of knowledge on the topic itself, the implementation of effective interventions in health care and cost reduction, as well as the identification of gaps that direct the development of future research<sup>(7)</sup>. Thus, for this RIL, the following steps were carried out: elaboration of the guiding question, literature search, evaluation of the studies, critical analysis of the included studies, discussion of the results and presentation of the integrative review<sup>(8)</sup>.

The guiding question of the research (What are the outcomes of childbirth and puerperium in women who had Urinary Tract Infection during pregnancy?) was defined using the mnemonic PVO (*Population, Variables, and Outcome*), which ensured better traceability of the publications. The PVO strategy was proposed by the Latin American and Caribbean Center on Health Sciences Information (Bireme) in 2011, with the objective of facilitating the diagnosis of the various needs of research questions, optimizing the response time in document retrieval<sup>(9)</sup>. In the present study, the acronym PVO was defined as follows: P- Pregnant women; V- Urinary Tract Infection; O- Outcome in childbirth and puerperium.

The search for studies took place from March to June 2023, in the Virtual Health Library (VHL), *National Library of Medicine National Institutes of Health (PubMed)*, *Web of Science*, and CINAHL databases. The Health Science Descriptors (DeCS) and MeSH Database were *Pregnant Women, Pregnancy, High-Risk, Urinary Tract Infections, Pregnancy Complications, Infant, Premature*, combined using Boolean connectors AND or OR, (Chart 1).

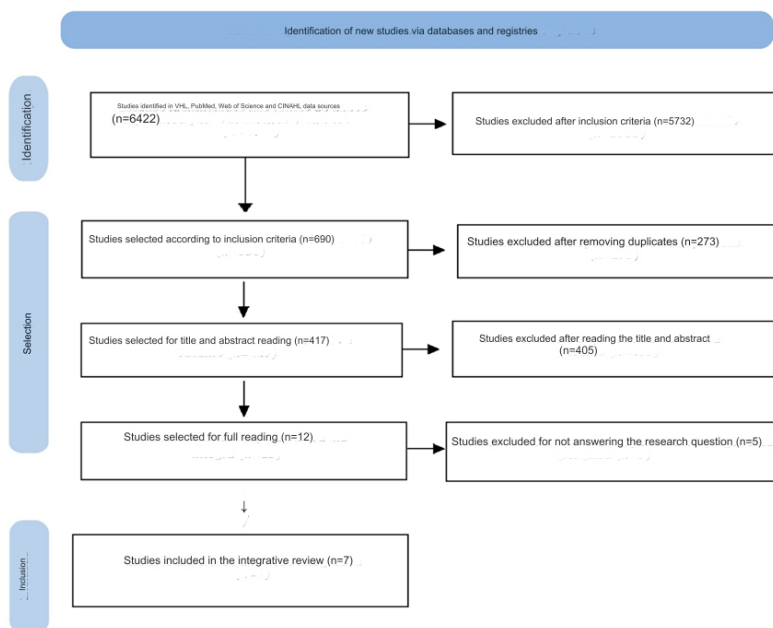
Chart 1 - Combinations of descriptors used in the search strategies. Campo Grande- MS, 2023.

DATABAS E	CROSSINGS
VHL	("urinary tract infections") AND (pregnant women) AND (pregnancy complications) ("urinary tract infections") AND ("pregnancy complications") ("urinary tract infections") AND ("premature newborn") ("urinary tract infections") AND (pregnant women)
PUBMED	("Urinary Tract Infections") AND ("Pregnancy Complications") ("Urinary Tract Infections") AND ("Pregnant Women") ("Urinary Tract Infections") AND (Pregnancy) AND ("Infant, Premature")
<i>Web of Science</i>	(ALL=("Urinary Tract Infections")) AND ALL=(("Pregnancy Complications")) (ALL=("Urinary Tract Infections")) AND ALL=("Pregnant Women") (ALL=("Urinary Tract Infections")) AND ALL=(Pregnancy)
CINAHL	( urinary tract infection or uti or tract infection or urinary infection ) AND ( pregnancy or pregnant ) AND pregnancy complications ( urinary tract infection or uti or tract infection or urinary infection ) AND pregnancy complications AND infant, premature ( urinary tract infection or uti or tract infection or urinary infection ) AND pregnancy, high risk ( urinary tract infection or uti or tract infection or urinary infection ) AND ( pregnancy or pregnant women )

Published primary studies, full articles available in full in English, Spanish, and Portuguese were used as inclusion criteria; between 2018 and 2022, whose theme addressed the outcomes of childbirth and puerperium in women who had UTI during pregnancy. The exclusion criteria were publications resulting from letters to the editor, reviews, editorials, expert opinions, and reviews. In addition, duplicate articles were considered only once.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (*PRISMA*) instrument was adopted to show the process of identification, screening, eligibility and inclusion of studies<sup>(10)</sup>. From the search carried out in the databases, 6422 studies were found, after the inclusion criteria, 690 articles were selected, in which after the removal of duplicates there were 417 studies. Thus, a detailed reading of the title and abstract was carried out and 12 articles were selected and read in full, in which 7 answered the research question, according to the flowchart (Figure 1).

Figure 1 - PRISMA flowchart: steps for article selection, Campo Grande- MS, 2023.



After these steps, the data were extracted using a structured instrument developed by the researchers, with the following items: author, year, title, country, method, sample, objective, results, and Level of Evidence.

To assess the Level of Evidence of the studies, the *Hierarchy of Evidence for Intervention Studies* was used, which proposes an analysis with seven levels of evidence: Level I, for systematic review of meta-analyses; Level II, for randomized controlled trials; Level III, for controlled trials without randomization; Level IV, for case-control or cohort study; Level V, for systematic review of qualitative and descriptive studies; Level VI, for qualitative and descriptive study, and Level VII, for expert opinion or consensus<sup>(11)</sup>.

## RESULTS

Seven studies were selected from the following countries: Cuba, the United States, Ethiopia, the Netherlands, Mexico, Romania and Turkey, with a total number of 146,556 pregnant women studied. Regarding the characterization of the studies, most 42.9% were developed in North American countries<sup>(12-14)</sup>, all used quantitative methods and 85.8% were published in English<sup>(13-18)</sup> and 14.3% in Spanish<sup>(12)</sup>. The Levels of Evidence indicate that all studies analyzed are considered Level IV. (Chart 2).

Chart 2 - Characterization of the studies included in the integrative review. Campo Grande- MS, 2023.

Author/year	Title/Country	Method/Sample	Objective	Results	Level of evidence
IRONING; GARCIA; PEDRO./ 2021	Pregnant women with urinary tract infection belonging to a health area of the municipality of Guanabacoa, Havana/ CUBA	Cohort/ 129 pregnant women	To characterize pregnant women with urinary tract infection, belonging to the health area of the University Polyclinic "Ángel Machaco Ameijeiras" in Guanabacoa, La Havana, Cuba, from January 2019 to January 2020.	The pregnant women included in the study were characterized, with a predominance of urinary tract infection. Low birth weight was the most represented complication.	Level IV
MICLE et al./ 2020	The prevalence of urinary tract infections in Pregnancy and implications on foetal development/ ROMANIA	Control case/ 427 pregnant women	To assess the type of bacterial etiology causing urinary tract infections, the pattern of antibiotic susceptibility in pregnant women, and whether there are correlations between asymptomatic bacteriuria and maternal and neonatal adverse effects	We found an association between UTIs and mean birth weight and prematurity.	Level IV
BECSAK et al./ 2019	Uropathogens and Gestational Outcomes of Urinary Tract Infections in Pregnancies that Need Hospitalization/ TURKEY	Cohort/ 30 pregnant women	Identify uropathogens that cause urinary tract infections (UTIs), assess hospitalization, and analyze pregnancy outcomes	Preterm labor seems to be an important complication in the pregnancies with UTIs accompanied by fever and urinary problems.	Level IV
WERTER et al./ 2021	Risk Indicators for Urinary Tract Infections in Low Risk Pregnancy and the Subsequent Risk of Preterm Birth/ HOLLAND	Cohort/ 4918 pregnant women	Identify potential risk indicators for developing a UTI in pregnancy. In addition, we explored whether the risk of preterm birth was increased in women with these risk indicators.	The risk of preterm birth was increased in women with UTI during pregnancy, however, this risk does not appear to exist in a subset of women with a history of recurrent UTI as well and with ASB in the current pregnancy.	Level IV
BAER et al./ 2019	Risk of preterm birth among women with a urinary tract infection by trimester of pregnancy./ UNITED STATES	Cohort/ 140,910 pregnant women	To assess the risk of preterm birth among women with an emergency department (ED) visit or urinary tract infection (UTI)	UTIs increase a woman's risk of having a PTB, particularly a spontaneous PTB. This risk is high	Level IV



			hospitalization per trimester of pregnancy.	regardless of the trimester of pregnancy.	
GEBREME DHIN et al./ 2021	Maternal Complications and Adverse Pregnancy Outcomes among Pregnant Women who Acquired Asymptomatic Bacteriuria in Addis Ababa, Ethiopia/ ETHIOPIA	Cohort/ 43 pregnant women	To prospectively follow the pregnancy of women with confirmed asymptomatic bacteriuria in Addis Ababa and to explore the type and rate of occurrence of maternal complications and adverse pregnancy outcomes.	Some of the The most prevalent adverse pregnancy outcomes observed were perinatal death, miscarriage, preterm birth, low birth weight, and asphyxia.	Level IV
DAUTT-LEYVA et al./ 2018	Maternal and perinatal complications in pregnant women with urinary tract infection caused by Escherichia coli/ MEXICO	Cohort/ 99 pregnant women	OBJECTIVE: To describe maternal and perinatal complications in pregnant women with UTI caused by Escherichia coli and to know the pattern of antimicrobial susceptibility.	According to this study in a Mexican population, the number one admission diagnosis in women with UTI due to E. coli were threatened with preterm birth, fever and threatened miscarriage .	Level IV

Of the articles that make up this review, all brought premature labor as one of the main outcomes, followed by 71.4% that point to low birth weight<sup>(12,14-17)</sup>, 42.9% emphasize neonatal death<sup>(14,15,17)</sup>, 28.6% point to abortion<sup>(14,15)</sup> and premature rupture of membranes<sup>(12,15)</sup> and 14.3% associate neonatal asphyxia and preeclampsia as one of the main findings<sup>(15)</sup>.

Regarding the profile of the women studied, 71.4% of the studies report the mean age of pregnant women with UTI, with the most common interval being 25 to 30 years<sup>(12,14-17)</sup>. In addition, 42.9% of the articles outlined the sociodemographic profile of these women, relating maternal age, multiparity, ethnicity and socioeconomic conditions<sup>(14,15,18)</sup>.

## DISCUSSION

In this review study, preterm birth was shown to be the worst outcome of UTI for maternal and fetal health. Defined as delivery before 37 weeks of gestation, it is the most important cause of neonatal mortality and morbidity worldwide. It is estimated that maternal infection is responsible for 50% of premature births<sup>(19)</sup>. In Mexico, preterm birth is one of the most important causes of perinatal morbidity and mortality, accounting for 75% of perinatal deaths, 50% of neurological sequelae directly attributable to prematurity, and its frequency is estimated at about 5–10% of all



pregnancies<sup>(14)</sup>. In the study conducted in Turkey, the rate of preterm birth associated with UTI was 56.3%, in Ethiopia 48.8%, in Cuba 19.23% and in the Netherlands 12.0%<sup>(12,15,17,18)</sup>.

Low Birth Weight (LBW) was evidenced as one of the main neonatal complications in this study. LBW is considered when the newborn (NB) weighs < 2,500g and is associated with higher neonatal and infant mortality and morbidity, being considered the single most influential factor in survival in the first years of life<sup>(20)</sup>. Regarding the causes, infection may be an etiological factor due to endothelial damage and worsening of maternal inflammatory responses<sup>(19)</sup>. The study conducted in Cuba shows low birth weight as the main outcome of UTI during pregnancy, with its occurrence in 34.6% of the pregnant women in the sample, while in Mexico this rate corresponds to 12% and in Ethiopia 6%<sup>(14,15)</sup>.

Neonatal death is also among the main outcomes of UTI in pregnancy. Understood as the death of the NB up to the 28th day of life. As for the causes, infection, premature birth and birth asphyxia are the main causes of neonatal mortality in the world<sup>(21)</sup>. There was an association of this outcome due to complications of UTI during pregnancy, and its occurrence was found in 10.0% of the cases in Turkey, 5.9% in Mexico and 4.3% in Ethiopia<sup>(17,14,15)</sup>, these numbers being higher than the annual global neonatal mortality rate<sup>(22)</sup>. From this perspective, these findings are in line with the Sustainable Development Goals (SDGs), which aim to reduce neonatal mortality worldwide to at least 12 per 1,000 live births by 2030<sup>(23)</sup>.

Among the obstetric outcomes observed in the components of this review, abortion stands out. According to the Ministry of Health, abortion consists of the interruption of pregnancy before 22 weeks of gestation, or of a fetus < 500g<sup>(23)</sup>. In the study carried out in Mexico, 9.9% of the risk of abortion was identified, of which 3.5% were abortions<sup>(14)</sup>, while in Ethiopia this rate was 2.3%<sup>(15)</sup>.

In addition, there was an association with Premature Rupture of Membranes (PPR) as an outcome found in the articles of this study. Defined as the loss of integrity of the ovular membranes before the onset of labor, regardless of gestational age, RPM usually occurs in about 8% of pregnancies<sup>(25)</sup>. This finding was found in a study carried out in Cuba, corresponding to 21.15% of the sample<sup>(12)</sup>. Thus, RPM has been shown to be a relevant factor for the worsening of fetal and neonatal health resulting from UTI.

In addition, one of the articles brought perinatal asphyxia as a neonatal complication due to UTI in pregnancy. Perinatal asphyxia develops when there is significant tissue hypoperfusion and decreased oxygen supply due to the most diverse etiologies during the peripartum period, at birth and in the first minutes of life<sup>(26)</sup>. According to the WHO, this condition is the third leading cause of neonatal death<sup>(27)</sup>. Perinatal asphyxia was found in 32.6% of Ethiopia (Ethiopia), i.e., one in three newborns were asphyxiated in their first minutes of life<sup>(15)</sup>. This finding was different from that found



in Turkey, in which the mean APGAR score, a scale that assesses the global health of the newborn, was found to be within normal parameters<sup>(17)</sup>.

Furthermore, it can be seen in one of the articles that there may be a relationship between preeclampsia (PE) and UTI during pregnancy. PE is a multisystem vascular syndrome of pregnancy characterized by hypertension and proteinuria, which usually occurs after 20 weeks of pregnancy. Although its etiology remains unknown, it is believed that excessive activation of the systemic inflammatory response plays a fundamental role in its pathogenesis, and can therefore be associated with UTI<sup>(28)</sup>. In a study carried out in Ethiopia, 14% of pregnant women with BA had PE and 18.6% developed eclampsia<sup>(15)</sup>.

However, it is possible to associate the influence of the Social Determinants of Health with the unfavorable outcomes of UTI during pregnancy. Thus, UTI and its complications have been shown to be more intense in low- and middle-income countries<sup>(15)</sup>. The study conducted in the Netherlands includes seven significant risk indicators for the development of UTI during pregnancy, such as: maternal age, non-European ethnicity, does not live with a partner, low education, smokers, has a history of recurrent UTI, and the presence of BA at around twenty weeks of gestation<sup>(18)</sup>.

According to this, in a study conducted in Mexico, UTI is associated with ethnicity, parity, number of prenatal consultations, and socioeconomic status of women<sup>(14)</sup>. In the study carried out in Ethiopia, sexual frequency, vaginal douche, presence of anemia and history of UTI prior to pregnancy were pointed out<sup>(15)</sup>. Therefore, a study carried out in Pakistan shows the socioeconomic profile of women who have a higher risk of developing UTI during pregnancy, 74% of whom belong to the lowest economic class, multiparous, aged 26 to 30 years, with low education and a previous history of UTI<sup>(29)</sup>. These findings are similar to the articles that make up this review<sup>(14,15,18)</sup>.

There is also a relationship between the number of prenatal visits and complications of UTI in pregnancy. In Mexico, 41.67% of pregnant women with UTI had inadequate prenatal control with less than four visits during pregnancy, which makes it difficult to screen for and control this disease during pregnancy<sup>(14)</sup>. In Brazil, a minimum of six consultations is recommended, and screening for BA during pregnancy occurs through urine and urine culture tests, usually requested in the first and third trimesters, depending on the protocol of each municipality<sup>(1)</sup>.

Regarding Asymptomatic Bacteriuria (BA), research shows different results regarding its severity. In the Dutch study, no association was found between prematurity and BA pregnancy<sup>(18)</sup>, while in Ethiopia 48.8% of premature births were identified, as well as other complications in pregnant women and newborns<sup>(15)</sup>. This difference can be explained by the disparity in relation to the economic conditions of these countries, which directly impact access to health services.

From another angle, 57.14% of the articles selected for this review provide information on the highest occurrence of UTI per trimester of pregnancy<sup>(12-14,16)</sup>. In Cuba, the study indicates that the



prevalence is higher in the first and third trimesters<sup>(12)</sup>, while in Romania 68.30% of BA occurred more frequently in the third trimester<sup>(16)</sup>. On the other hand, studies conducted in the United States and Mexico indicate the severity of UTI in the second trimester, and in the USA, women in this gestational period were at greater risk of hospitalization and prematurity<sup>(13)</sup>. In Mexico, neonatal deaths and intrauterine deaths were more frequent in pregnant women exposed to the infection during the second trimester<sup>(14)</sup>. From this perspective, it can be inferred that in the second trimester of pregnancy, the occurrence and diagnosis of other morbidities that result from pregnancy, such as Pregnancy-Specific Hypertensive Syndrome (SHEG), and its pathophysiology is a factor that, associated with UTI, can aggravate the clinical condition<sup>(1)</sup>.

Thus, prematurity that occurs in the second trimester of pregnancy is a major risk factor for newborns. The second trimester corresponds to between 14 and 28 weeks of gestation, and the neonate in this period is considered extremely preterm<sup>(31)</sup>. One of the major concerns of birth at this gestational age (GA) is the fact that the NB presents anatomical-physiological immaturity of the respiratory tract<sup>(32)</sup>. The maturity of this system occurs around 35 gestational weeks, when anatomical and functional adaptations allow the premature newborn to survive in the extrauterine environment. Therefore, birth before this GA is related to greater pulmonary dysfunctions<sup>(33)</sup>, and the use of Invasive Mechanical Ventilation (IMV) and Noninvasive Mechanical Ventilation (NIMV) may be necessary, and prolonged ventilation time, in turn, is associated with a high morbidity and mortality rate in this neonatal period<sup>(32)</sup>.

Another finding of this review concerns the relationship between single UTI and recurrent UTI. Recurrent UTI is the diagnosis of three episodes of infection over the course of 12 months, or two episodes in six months<sup>(34)</sup>. Studies conducted in the United States and the Netherlands show that the only UTI diagnosed during pregnancy has a higher chance of complications such as prematurity compared to pregnant women with recurrent UTI<sup>(13,18)</sup>. One explanation for the results found may be that the immune system has an inadequate response in women with recurrent UTI, which may result in lower prostaglandin release and, consequently, less chance of premature birth<sup>(18)</sup>.

The limitations of this review include the number of publications that had been reduced in the last five years and the clinical association with other morbidities or that did not answer the question of this study.

## CONCLUSION

Prematurity, low birth weight, and neonatal death were the main outcomes found in this review. It is suggested that further studies investigate whether there is a relationship between neonatal asphyxia and preeclampsia as complications of UTI in pregnancy.



It can be inferred that UTI in pregnant women is a global public health problem, especially in poorer countries, and its consequences can lead to hospitalization, as well as conditions that threaten the life of pregnant women and their fetuses. Thus, investigations that seek to understand obstetric outcomes in pregnant women with UTI should be of interest to broaden the discussion of the topic, predict negative outcomes in maternal and fetal health, and improve the practices of health teams.

It is important to emphasize that UTI is a clinically important condition for maternal, fetal/neonatal complications, prenatal care is an opportune moment of health care for pregnant women. It is essential for professionals who work in prenatal care at usual risk to appropriate soft and hard technologies in UTI monitoring.

The findings of this study highlight the importance of greater adherence to prenatal care, and that prenatal care is qualified and has professionals trained to manage UTI to screen for Asymptomatic Bacteriuria in the second trimester of pregnancy, to prevent prematurity and other unfavorable outcomes in this period.

In addition, public health policies need to be aimed at women with greater risk factors for developing UTI during pregnancy. The nurse works in prenatal care at usual risk and classifies gestational risk, which is up to this in the daily care in the maternal-infant line, seeking to improve the morbidity and mortality indicators of the mother and child binomial.

### **ACKNOWLEDGMENT**

The Dean of Research and Graduate Studies of the Federal University of Mato Grosso do Sul who enabled the development of this investigation Notice UFMS/PROPP N.107/2022 – Selection PIBIC, PIBIC, PIBIC-AF and PIBITI 2022.



## REFERENCES

1. Brasil. Ministério da Saúde, Secretaria de Atenção Primária à Saúde, Departamento de Ações Programáticas. (2022). \*Manual de gestação de alto risco\* [Recurso eletrônico]. Brasília: Ministério da Saúde.
2. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. (2012). \*Atenção ao pré-natal de baixo risco\* (Série A. Normas e Manuais Técnicos. Cadernos Atenção Básica, n.32). Brasília: Ministério da Saúde.
3. Habak, P. J., & Griggs, J. (2023). \*Urinary tract infection in pregnancy\* [Internet]. PubMed. Treasure Island (FL): StatPearls Publishing. Retrieved from <https://www.ncbi.nlm.nih.gov/books/NBK537047/#:~:text=UTIs%20are%20a%20com>
4. Neto, E. L., & Souza, L. de F. (2021). Infecção do trato urinário, morfofisiologia urinária, etiologia, prevalência, sintomas e tratamento: uma revisão bibliográfica. \*Artigos@\* [Internet], 31, e9166. Retrieved from <https://acervomais.com.br/index.php/artigos/article/view/9166>
5. Darzé, O. I. S. P., Barroso, U., & Lordelo, M. (2011). Preditores clínicos de bacteriúria assintomática na gestação. \*Revista Brasileira de Ginecologia e Obstetrícia\* [Internet], \*33\*(8), 196–200. Retrieved from <https://doi.org/10.1590/S0100-72032011000800005>
6. Arruda, A. C., Marangoni, P. A., & Tebet, J. L. (2021). Perfil de sensibilidade de uropatógenos em gestantes de um hospital de ensino do município de São Paulo. \*Femina, 49\*(6), 373-378.
7. Mendes, K. D. S., Silveira, R. C. de C. P., & Galvão, C. M. (2008). Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. \*Texto & Contexto - Enfermagem\* [Internet], \*17\*(4), 758–764. Retrieved from <https://doi.org/10.1590/S0104-07072008000400018>
8. Souza, M. T. de, Silva, M. D. da, & Carvalho, R. de. (2010). Integrative review: what is it? How to do it?. \*Einstein (São Paulo)\* [Internet], \*8\*(1), 102–106. Retrieved from <https://doi.org/10.1590/S1679-45082010RW1134>
9. Biruel, E., & Rocha, P. R. (2011). Bibliotecário um profissional a serviço da pesquisa. In \*XXIV Congresso Brasileiro de Biblioteconomia, Documentação e Ciência da Informação\*. Retrieved from [https://www.academia.edu/9594560/Bibliotec%C3%A1rio\\_um\\_profissional\\_a\\_servi%C3%A7o\\_da\\_pesquisa](https://www.academia.edu/9594560/Bibliotec%C3%A1rio_um_profissional_a_servi%C3%A7o_da_pesquisa)
10. Galvão, T. F., Pansani, T. de S. A., & Harrad, D. (2015). Principais itens para relatar Revisões sistemáticas e Meta-análises: A recomendação PRISMA. \*Epidemiologia e Serviços de Saúde\* [Internet], \*24\*(2), 335–342. Retrieved from <https://doi.org/10.5123/S1679-49742015000200017>
11. Melnyk, B. M., & Fineout-Overholt, E. (2015). Making the case for evidence-based practice. In B. M. Melnyk & E. Fineout-Overholt (Eds.), \*Evidence-based practice in nursing & healthcare: A guide to best practice\* (pp. 3-24). Lippincott Williams & Wilkins.
12. Cobas Planchez, L., Navarro García, Y. E., & Mezquia de Pedro, N. (2021). Gestantes con infección urinaria pertenecientes a un área de salud del municipio Guanabacoa, La Habana. \*Revista Médica Electrónica\* [Internet], \*43\*(1), 2748–2758. Retrieved from [http://scielo.sld.cu/scielo.php?script=sci\\_arttext&pid=S1684-18242021000102748](http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1684-18242021000102748)



13. Baer, R. J., et al. (2021). Risk of Early Birth among Women with a Urinary Tract Infection: A Retrospective Cohort Study. *\*AJP Reports*, 11\*(1), e5-e14. doi: 10.1055/s-0040-1721668.
14. Dautt-Leyva, J. G., Canizalez-Román, A., Acosta Alfaro, L. F., Gonzalez-Ibarra, F., & Murillo-Llanes, J. (2018). Maternal and perinatal complications in pregnant women with urinary tract infection caused by *Escherichia coli*. *\*Journal of Obstetrics and Gynaecology Research*, 44\*(8), 1384–1390. <https://doi.org/10.1111/jog.13680>
15. Gebremedhin, K. B., Alemayehu, H., Medhin, G., Amogne, W., & Eguale, T. (2021). Maternal complications and adverse pregnancy outcomes among pregnant women who acquired asymptomatic bacteriuria in Addis Ababa, Ethiopia. *\*BioMed Research International*, 2021\*, 1–8. <https://doi.org/10.1155/2021/5520710>
16. Micle, O. (2020). The prevalence of urinary tract infections in pregnancy and implications on foetal development. *\*Farmacia*, 68\*(3), 463–469.
17. Beksac, A. T., Orgul, G., Tanacan, A., Uckan, H., Sancak, B., Portakal, O., ... et al. (2019). Uropathogens and gestational outcomes of urinary tract infections in pregnancies that necessitate hospitalization. *\*Current Urology*, 13\*(2), 70–73.
18. Werter, D. E., Kazemier, B. M., Schneeberger, C., Mol, B. W. J., de Groot, C. J. M., Geerlings, S. E., ... et al. (2021). Risk indicators for urinary tract infections in low risk pregnancy and the subsequent risk of preterm birth. *\*Antibiotics*, 10\*(9), 1055. <https://doi.org/10.3390/antibiotics10091055>
19. Kalinderi, K., Delkos, D., Kalinderis, M., Athanasiadis, A., & Kalogiannidis, I. (2018). Urinary tract infection during pregnancy: Current concepts on a common multifaceted problem. *\*Journal of Obstetrics and Gynaecology*, 38\*(4), 448–453.
20. Tourinho, A. B., & Reis, M. L. B. D. S. (2012). Peso ao nascer: uma abordagem nutricional. *\*Comunicação em Ciências da Saúde\** [Internet], 19–30. Retrieved from <https://pesquisa.bvsalud.org/portal/resource/pt/lil-688289>
21. Yismaw, A. E., & Tarekegn, A. A. (2018). Proportion and factors of death among preterm neonates admitted in University of Gondar comprehensive specialized hospital neonatal intensive care unit, Northwest Ethiopia. *\*BMC Research Notes*, 11\*(1), 867. <https://doi.org/10.1186/s13104-018-3991-6>
22. WHO. (2019). *\*Child-mortality-report\**. Retrieved from <https://www.unicef.org/media/60561/file/UN-IGME-child-mortality-report>
23. Organização das Nações Unidas (ONU). (2015). *\*Transformando nosso mundo: a Agenda 2030 para o Desenvolvimento Sustentável\**. Nova York: ONU. Retrieved from <https://nacoesunidas.org/pos2015/agenda2030/>
24. Moras Filho, O. B. (Ed.). (2018). *\*Aborto: classificação, diagnóstico e conduta\** (Protocolo FEBRASGO - Obstetrícia, nº 21). São Paulo: Federação Brasileira das Associações de Ginecologia e Obstetrícia (FEBRASGO).
25. Kurawasa, K., Yamamoto, M., Usami, Y., Mochimaru, A., Aoki, S., & et al. (2013). Significance of cervical ripening in pre-induction treatment for premature rupture of membranes at term.




\*Journal of Obstetrics and Gynaecology Research, 40\*(1), 32–39.  
<https://doi.org/10.1111/j.1447-0756.2012.01903.x>

26. Burns, D., Júnior, D., Silva, L., & Borges, W. (2017). Neonatologia. In D. A. R. Burns & D. C. Jú (Eds.), \*Tratado Brasileiro de Pediatria\* (4a ed., pp. xxx-xxx). Barueri: Manole.
27. Fernandes, V. L., Moura, M. D. R., Moreira, A. C. G., & Oliveira, T. M. (2020). Fatores de risco para asfixia perinatal em recém-nascidos atendidos em uma maternidade pública terciária. \*Resid Pediatr, 10\*(2), 1-6. <https://doi.org/10.25060/residpediatr-2020.v10n2-56>
28. Yan, L., Jin, Y., Hang, H., & Yan, B. (2018). The association between urinary tract infection during pregnancy and preeclampsia. \*Medicine, 97\*(36), e12192. <https://doi.org/10.1097/MD.00000000000012192>
29. Sial, S. A., Detho, A. B., Memon, F. R., Parveen, K., Memon, S., Bukhari, S., ... et al. (2021). Risk factors during pregnancy for asymptomatic bacteriuria. \*Journal of Pharmaceutical Research International, 21\*(1), 1-6.
30. Brasil. Ministério da Saúde. (2000). \*Portaria n. 570/GM, de 1º de junho de 2000. Institui o Componente I do Programa de Humanização no Pré-Natal e Nascimento – incentivo à assistência pré-natal no âmbito do Sistema Único de Saúde\*. Brasília.
31. WHO, March of Dimes, PMNCH, Save the Children. (2012). \*Born Too Soon: The Global Action Report on Preterm Birth\* (Eds. C. P. Howson, M. V. Kinney, J. E. Lawn). World Health Organization. Geneva.
32. Silva, et al. (2022). Análise temporal do nascimento e hospitalização de crianças prematuras em município brasileiro de fronteira. \*ABCS Health Sci, 47\*(1), e022228. <https://doi.org/10.7322/abcshs.2020255.1703>
33. Gil, B. M. K., Souza, E. de, Silva, C. A. J. da, & Figueiredo, C. P. (2010). Avaliação da maturidade pulmonar fetal pela contagem dos corpos lamelares no líquido amniótico. \*Rev Bras Ginecol Obstet, 32\*(3), 112–117. <https://doi.org/10.1590/S0100-72032010000300003>
34. Haylen, B. T., de Ridder, D., Freeman, R. M., Swift, S. E., Berghmans, B., Lee, J., ... et al. (2009). An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. \*International Urogynecology Journal, 21\*(1), 5–26. <https://doi.org/10.1007/s00192-009-0976-9>



## Leishmaniose visceral

 <https://doi.org/10.56238/sevened2024.016-004>

Carolina Braga Bracarense<sup>1</sup>, Lucas de Oliveira Mesquita<sup>2</sup>, Lucca Piuzana Antunes<sup>3</sup>, Sarah dos Santos Oliveira<sup>4</sup>, Janaina Sousa Campos Alvarenga<sup>5</sup> and Ângela Cardoso Alvarenga<sup>6</sup>

### ABSTRACT

**Introduction:** Visceral Leishmaniasis is a parasitic disease transmitted by sandflies, causing fever, weight loss and inflammation of the spleen. Identified in 1903, its global spread is influenced by socioeconomic and environmental factors. The parasites responsible for this disease are trypanosomatid protozoa that belong to the genus *Leishmania*. The vectors are sandflies, mainly of the species *Lutzomyia longipalpis* infected by *Leishmania chagasi*. Popularly known as sand flies, they reproduce in areas rich in organic matter. The evolutionary cycle of *Leishmania chagasi* is heteroxenic, involving vertebrate hosts such as canids, marsupials or humans, and invertebrate hosts, which are sandfly insects. Initially, Visceral Leishmaniasis may be asymptomatic or present with prolonged fever, weight loss, weakness, and anemia. Then, symptoms such as enlargement of the spleen and liver, pallor, intermittent fever and impairment of the immune system appear. In the advanced stage of infection, serious complications such as hemorrhages, secondary infections, profound anemia, and hepatosplenic insufficiency occur. The diagnosis of Visceral Leishmaniasis involves a series of clinical, laboratory and epidemiological approaches. The treatment of Visceral Leishmaniasis in Brazil is done with pentavalent antimonial compounds, such as the antimoniate N-methyl glucamine, administered intravenously or intramuscularly. Some contraindications include renal or hepatic failure, pregnancy in the first two trimesters, and patients taking beta-blockers or antiarrhythmics. Preventive measures must be carried out in individual and collective environments. These measures include the use of repellents, avoiding exposure at times when the vectors are most active, environmental management, tree pruning, cleaning of pet shelters, among others. Visceral Leishmaniasis represents a complex public health challenge. Understanding the protozoan cycle, diagnostic methods, and treatment options is crucial for effective disease management.

**Keywords:** Visceral Leishmaniasis, *Leishmania chagasi*, Sandflies, Reservoirs.

---

<sup>1</sup> Medical Student at PUC Minas.

<sup>2</sup> Medical Student at PUC Minas.

<sup>3</sup> Medical Student at PUC Minas.

<sup>4</sup> Medical Student at PUC Minas.

<sup>5</sup> Doctor in Parasitology, Professor of the Medicine course at PUC Minas.

<sup>6</sup> Doctor in Parasitology, Professor of Medicine at the University of Itaúna, MG.



## INTRODUCTION

In the year 1903, the first revelations about the agent responsible for Visceral Leishmaniasis (VL) emerged, courtesy of William Boog Leishman and Charles Donovan. Leishman, in examining the preparations of the spleen of a soldier coming from DumDum, India, made a remarkable discovery, while Donovan found these parasites in the splenic aspirates of a young Hindu. At the same time, Charles Louis Alphonse Laveran and Félix Étienne Pierre Mesnil gave birth to the agent under the name *Piroplasma donovani*, later corrected by Ronald Ross to *Leishmania donovani*.

In 1911 and 1912, Carlos Chagas, exploring the Amazon River valley and its tributaries, came across patients with unexplained splenomegaly, fueling initial suspicions of Human Visceral Leishmaniasis (HVL) in South America. Then, in 1913, Migone and his team identified the parasite during an autopsy on a native of Boa Esperança, now part of Mato Grosso do Sul. This event marked the first record of the disease in humans in the Americas.

Visceral leishmaniasis (VL) involves a complex host group with some species of mammals, including man and winged vectors. However, the occurrence of VL in a region does not depend only on these elements; it is also shaped by the geographical changes promoted by human activity. Physical, social, and biological factors play crucial roles in this context. Such factors alter the relationship between the parasite and the host, either favoring the proliferation of vectors due to environmental transformations, such as the accumulation of organic matter in the soil, or enabling the migration of infected animals to areas previously free of VL.

When examining the risks associated with the occurrence of VL in certain geographic regions, it is clear that exposure to sandflies plays a central role, as well as co-infection with HIV, malnutrition, the high prevalence of infected dogs, and the socioeconomic precariousness of the population. These are all ingredients that make up the intricate enigma of Visceral Leishmaniasis, which continues to challenge the medical and scientific community.

## ETIOLOGIC AGENT

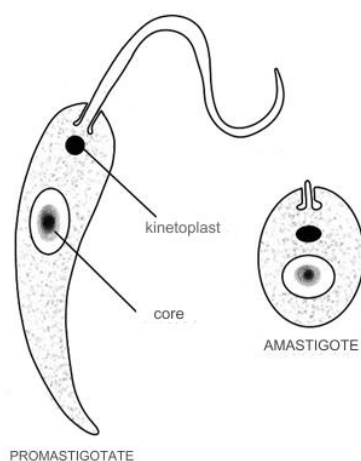
Visceral leishmaniasis is frequently identified in patients with visceral leishmaniasis in South America. The responsible for this disease are trypanosomatid protozoa that belong to the genus *Leishmania*. These protozoa are obligate parasites that inhabit the interior of the cells of the mononuclear phagocytic system of vertebrate hosts. Many authors have considered *L. chagasi* and *L. infantum* to be the cause of infection. However, it is the same species, and therefore both denominations are accepted. In this chapter *Leishmania chagasi* will be adopted. During the biological cycle, the protozoan can be observed in the following forms:

Promastigote: flagellated form found in the intestine of the vector insect. It is an elongated, spindle-shaped cell, about 15 to 20  $\mu\text{m}$  in size, with a kinetoplast anterior to the nucleus and a free

flagellum from the anterior portion of the cell. Its development is characterized by two stages: procyclic (non-infectious) and metacyclic (infectious).

Amastigote: an oval-shaped cell, 1 to 3  $\mu\text{m}$  in size, with a single acentric nucleus and flagellum restricted to the flagellar pouch. Figure 1 shows a schematic drawing of the promastigote and amastigote forms.

Figure 1 – Schematic drawing of the promastigote (left) and amastigote (right) forms of *Leishmania* sp. Source: Prepared by the authors.



## VECTOR

Also known as sand flies, sandflies of the species *Lutzomyia longipalpis* are considered the most common vectors in cases of Visceral Leishmaniasis in Brazil. In the region of Mato Grosso, *Lutzomyia cruzi* has also been associated with the protozoan cycle. Such insects are small diptera, measuring between 1 and 3 millimeters and holometabolous, presenting in their evolutionary cycle the phases of egg, larva, pupa, and adults, males and females, with only the females involved in the transmission of *Leishmania*. The immature stages of this insect develop in areas rich in organic matter and do not depend on water for their hatching. Sandflies are nocturnal insects and have a type of leaping and short flight.

## RESERVOIRS

Visceral leishmaniasis (VL), also known as kala-azar, is a zoonosis of wide distribution in Brazil and has a complex ecology, involving multiple hosts and vectors. The transmission cycle of the disease involves vertebrate hosts, which act as reservoirs, and sandflies (sandflies) which are the vectors. The presence and dynamics of reservoirs are crucial for the maintenance and dissemination of the transmission cycle of this zoonosis, which is widely distributed in Brazil. In the Brazilian context, these reservoirs can be classified as wild and domestic and each plays a crucial role in the



epidemiology of the disease, as they maintain the parasite cycle and facilitate its transmission to humans. In addition, among the various reservoirs, the domestic dog plays a fundamental role, especially in Brazil, where visceral leishmaniasis is a serious public health problem.

## WILD RESERVOIRS

Wild reservoirs, present in forest areas and rural regions, include a variety of mammals. Studies have identified wild canids, including the hoary fox (*Lycalopex vetulus*) and the wild dog (*Cerdocyon thous*) as important natural reservoirs of the parasite. These animals are usually asymptomatic, allowing the parasite to persist in nature and maintain the enzootic cycle. Concomitantly, ecological studies suggest that habitat fragmentation and the proximity of urbanized areas to forest areas favor contact between vectors, wild reservoirs, and humans, increasing the risk of VL transmission.

## DOMESTIC RESERVOIRS

In the Brazilian urban and peri-urban context, domestic dogs (*Canis lupus familiaris*) are recognized as the main reservoirs of VL. Epidemiological and molecular studies have shown the high prevalence of *Leishmania chagasi* infection in canine populations, and these animals are considered the main responsible for the maintenance and dissemination of the parasite in urbanized areas (Ministry of Health, 2020). This situation occurs due to multiple sociocultural factors rooted in the Brazilian territory, such as contact with this domestic animal, the structure of large urban centers, the ineffectiveness or absence of public policies, among others.

## WAYS OF CONTAMINATION

According to the Ministry of Health, visceral leishmaniasis is endemic in 76 countries. Brazil, in particular, is one of the most affected, corresponding to 90% of Latin American cases among the more than 12 countries that register cases of this disease. The transmission of the protozoan that causes visceral leishmaniasis occurs primarily through the bite of the infected female sandfly. Other forms of infection have already been described, such as the use of intravenous drugs, transfusion of infected blood, organ transplantation, congenital infection and laboratory accidents, without however presenting any epidemiological importance.

## BIOLOGICAL CYCLE

The protozoan cycle, to be complete, is composed of the vertebrate host (canid, marsupial or man) and the invertebrate host (insect), being classified as a heteroxenic biological cycle.



The disease is transmitted to the vertebrate host through the bite of the female infected sandfly insect, since during feeding the insect regurgitates the aspirated material; inoculating the protozoan in the metacyclic promastigote form, which penetrates the healthy victim. At the bite site, the parasite can invade a range of cells, such as dendritic cells, fibroblasts, neutrophils, and especially macrophages, when they adhere to the membrane and initiate the internalization process through phagocytosis.

When phagocytosed, the parasite is internalized in the parasitophore vacuole, where it differentiates into the amastigote form, which is the tissue form of the protozoan and has no apparent flagellum. In the cytoplasm of macrophages, lysosomes fuse with the vacuole, discharging their lysosomal enzymes, which do not affect the parasite.

Thus, the amastigote form multiplies by successive binary fissions, until it breaks the macrophage membrane, releasing the amastigote form into the intercellular space. Once in the tissue, the amastigote forms can infect new cells, repeating binary divisions and increasing the number of protozoa, or reach the circulatory stream, being carried to other organs and tissues.

When a female feeds on an infected host, she ingests amastigote forms. In the middle portion of the insect's digestive tract, there is a membranous compartment responsible for digesting the ingested content, called the peritrophic matrix. In this place, the amastigotes transform into promastigotes, moving with the help of the flagellum and attach themselves to the intestinal epithelium of the insect, where they undergo a series of morphological and biochemical transformations. The last of these reactions is called metacyclogenesis, which promotes important changes in the cell structure, which starts to express new membrane proteins and adds the ability to infect a new host. At this time, after several mitotic multiplications, the protozoan passes to the metacyclic promastigote form and migrates to the pharyngeal region of the vector, called the proboscis. These metacyclic promastigotes will be transmitted to new hosts at the next blood meal.

## CLINICAL FORMS AND DIAGNOSIS

The diagnosis must be made accurately and as early as possible, since it is a notifiable disease with serious clinical characteristics. It is essential that diagnoses, treatment, and patient follow-up routines are mandatorily implemented in all areas with transmission or at risk of transmission. Whenever possible, parasitological confirmation of the protozoan should precede treatment, but in situations where serological and/or parasitological diagnosis is not available or there is a delay in releasing the results, the start of treatment should not be postponed.

The infection caused by *L. chagasi* has a wide clinical spectrum, ranging from completely asymptomatic individuals, discrete manifestations (oligosymptomatic), to moderate and severe forms. If left untreated, these manifestations can lead to the patient's death. Therefore, it is crucial to

suspect visceral leishmaniasis when in endemic areas, the patient presents fever and splenomegaly, associated or not with hepatomegaly, and anemia.

### PERIODS OF THE DISEASE/CLINICAL FORMS AND THEIR DIAGNOSIS:

In this topic, for didactic purposes, there will be a discussion of diagnostic methods related to the three different periods of Visceral Leishmaniasis.

- 1) Initial period
  - Complementary laboratory diagnosis
  - Immunological and parasitological diagnosis
- 2) State period
  - Complementary laboratory diagnosis
  - Immunological and parasitological diagnosis
- 3) Final period
  - Immunological Diagnosis
  - Parasitological diagnosis
  - PCR

#### Initial period

The initial phase of the disease, also known as "acute" by some authors, marks the beginning of symptoms, which can vary from patient to patient. In most cases, these symptoms include fever lasting less than four weeks, paleness of the skin and mucous membranes, and hepatosplenomegaly. The patient's general condition is usually preserved, and the spleen usually does not exceed 5 cm from the left costal margin. Often, these patients arrive at the medical service after having used antimicrobials without obtaining a clinical response, and, in some cases, report a history of cough and diarrhea. It is important to note that during clinical examination, especially in children, the stethoacoustic maneuver is quite useful to check for the presence of hepatosplenomegaly.

In areas where the disease is endemic, a small proportion of individuals, usually children, may present with a mild clinical picture lasting approximately 15 days, which often results in spontaneous cure (oligosymptomatic form). These patients present with milder clinical symptoms, such as low-grade fever, mild paleness of the skin and mucous membranes, diarrhea, and/or nonproductive cough, along with a small hepatosplenomegaly. This clinical presentation can be easily confused with other infectious processes of a benign nature. The combination of clinical manifestations and laboratory abnormalities, which seems to better characterize the



oligosymptomatic form, is composed of the following findings: fever, hepatomegaly, hyperglobulinemia, and high blood sedimentation rate.

### Complementary laboratory diagnosis

The blood count usually reveals mild anemia, with hemoglobin levels above 9g/dl. The white blood cell count does not show significant changes, with a predominance of lymphomonocyte cells, and the platelet count may remain normal. The erythrocyte sedimentation rate is often high, exceeding 50mm. Total proteins and their fractions may present discrepancies. In the oligosymptomatic form, laboratory tests usually remain unchanged, with the exception of erythrocyte sedimentation rate, which tends to be elevated, and hyperglobulinemia.

### Immunological and parasitological diagnosis

Serological tests, such as Indirect Immunofluorescence (IFA) and Enzyme-Linked Immunosorbent Assay (ELISA), usually show positive results. Analysis of bone marrow aspirate and spleen usually reveals the presence of amastigote forms of the parasite. In the case of the oligosymptomatic form, bone marrow aspiration may or may not show the presence of the protozoan and, in principle, it is not indicated.

### Status Period

The hallmark feature is the presence of intermittent fever, typically accompanied by progressive weight loss, paleness of the skin and mucous membranes, as well as an increase in hepatosplenomegaly. This clinical form develops in a dragged manner, usually with more than two months of evolution, and is often associated with a compromise of the patient's general condition.

### Complementary laboratory diagnosis

Complementary tests reveal abnormalities, such as anemia, thrombocytopenia, leukopenia with a marked predominance of lymphomonocyte cells and an inversion in the relationship between albumin and globulins. Biochemical changes may also be observed, including an increase in aminotransferase levels (two to three times above normal values), an increase in bilirubins, and a slight increase in urea and creatinine levels.

### Immunological and parasitological diagnosis

Levels of specific *anti-Leishmania* antibodies are increased. At this stage of the disease, the amastigote forms of the parasite can be seen on smears of bone marrow aspirate, spleen, liver, and lymph nodes.



## End period

If diagnosis and treatment are not carried out, the disease progresses continuously to an advanced stage, characterized by constant fever and a more marked impairment of the patient's general condition. At this stage, malnutrition develops, evidenced by brittle hair, elongated eyelashes, and dry skin. Edema of the lower limbs can arise and, in severe cases, progress to anasarca. Other significant manifestations include hemorrhages, such as epistaxis, gingivorrhagia, and petechiae, jaundice, and accumulation of fluid in the abdominal cavity (ascites). In these patients, death usually occurs due to bacterial infections and/or bleeding.

## Immunological diagnosis

In Brazil, the most common immunological test for visceral leishmaniasis is indirect immunofluorescence (IFA) and enzyme-linked immunosorbent assays (ELISA). Indirect Immunofluorescence results are usually expressed in dilutions, and are considered positive from 1:80. If the titers are equal to 1:40, it is recommended to take a new sample after 30 days. The ELISA test presents results in units of light absorbance, with fixed dilutions or, more commonly, simply as a reagent or not.

## Parasitological diagnosis

Aspiration puncture of the spleen is the method that provides the highest sensitivity (90-95%) for the detection of the parasite, although it presents some procedural restrictions. Next, in terms of sensitivity, comes bone marrow aspirate, liver biopsy, and lymph node aspiration. Due to its safety, it is recommended to perform bone marrow aspiration. The collected material should be examined following the following sequence: Direct examination, followed by isolation in *in vitro culture medium*.

## PCR

The PCR (Polymerase Chain Reaction for parasite DNA amplification) method represents a new approach in the diagnosis of Visceral Leishmaniasis (VL), with a sensitivity of approximately 94%. However, the results of this method can vary depending on several factors, including the endemic region where the test is performed, the type of sample collected, and the specific DNA target used for amplification. Another limiting factor for performing the technique is the high cost and the need for specific structure and skilled labor.





## TREATMENT

In Brazil, antimonial compounds, in the form of trivalent salts, were initially used in the treatment of tegumentary leishmaniasis in 1913, by Gaspar Vianna. The treatment of visceral leishmaniasis with these drugs began two years later, in Italy. Pentavalent derivatives (Sb+5) were introduced in the 40s and, since then, have been considered the drugs of choice in the treatment of visceral leishmaniasis.

Currently, there are two formulations of Sb+5 available on the market: sodium stibogluconate and antimoniate-N-methyl glucamine. There do not appear to be significant differences in therapeutic efficacy between these formulations. In Brazil, the only formulation available is the antimoniate N-methyl glutamine (Glucantime), which is distributed by the Ministry of Health in 5 ml ampoules. The ampoules should be stored in a cool place and protected from light to avoid problems with the stability of the drug.

The mechanism of action of antimonials is not completely understood, but it is known that they act on the amastigote forms of the parasite, inhibiting its glycolytic activity and the oxidative pathway of fatty acids. In recent years, the use of progressively higher doses of antimonials has been recommended by the World Health Organization (WHO) and the Center for Disease Control (CDC) of the United States due to the emergence of primary resistance of the parasite to these drugs, especially in countries such as Sudan, Kenya and India.

In Brazil, although there is no record of *L. chagasi* strains resistant *in vitro* to antimonials, the treatment of visceral leishmaniasis is recommended with a dose of 20 mg of Sb+5 per kg/day, administered intravenously (E.V) or intramuscularly (I.M) for a minimum of 20 and a maximum of 40 days, with a maximum limit of 2 to 3 ampoules/day of the product, resulting in high cure rates.

In advanced cases of the disease, in which the clinical response is not evident within the first 20 days, the minimum treatment time should be extended to 30 days. This recommendation is based on the need for longer treatments to achieve satisfactory cure rates.

Before starting treatment, some precautions should be observed, including the evaluation and stabilization of the patient's clinical conditions and the treatment of concomitant infections. In situations where follow-up is feasible, treatment may be administered in an outpatient setting.

In cases of hospital treatment, it is essential to carefully observe the following signs and symptoms: severe anemia (hemoglobin less than 5g%), severe or prolonged diarrhea, generalized edema, severe malnutrition, bleeding, concomitant infections, associated diseases (heart disease, nephropathy, liver disease, hypertension), lack of response to treatment (primary refractoriness), recurrence, jaundice, patients less than 6 months old or over 65 years old.

Intramuscular injections of pentavalent antimonials should be administered in areas with adequate muscle mass, such as the gluteal region. In malnourished patients with low muscle mass



and thrombocytopenia, the preference should be for intravenous administration. It is important to note that there is no difference in serum drug levels in relation to the route of administration. When administered by IV, the infusion should be slow, over 5 to 7 minutes, and the dose may be diluted in 5% glucose solution to facilitate administration.

In cases of disease recurrence, a second treatment with the same dose, but for a longer period (maximum 40 days), should be initiated before labeling the case as refractory to treatment with pentavalent antimonials. Only after this attempt should alternative regimens with second-line drugs be considered. With the therapeutic options currently available, splenectomy is no longer recommended as a therapeutic measure in visceral leishmaniasis.

At the time of diagnosis, an electrocardiogram (ECG) is indicated in all cases of visceral leishmaniasis, and it is mandatory in patients over 50 years of age, during and after treatment. Because of the arrhythmogenic potential of the drug, pentavalent antimonials are contraindicated in patients using beta-blockers and antiarrhythmic drugs. They are also contraindicated in patients with renal or hepatic impairment, pregnant women in the first two trimesters of pregnancy, and in cases where the electrocardiogram shows a QTc interval greater than 400 ms (men) and 450 ms (women).

Alternative treatment options include amphotericin B sodium deoxycholate and its liposomal formulations (liposomal amphotericin B-liposomal and amphotericin B-colloidal dispersion), pentamidines (sulfate and mesylate), and immunomodulators (interferon gamma and GM-CSF). With the exception of the first two drugs, the others are still in the investigation phase. All these drugs should only be administered in referral hospitals. Amphotericin B is the drug of choice for the treatment of visceral leishmaniasis in pregnant patients, with a recommended dose of 1 mg/kg/day for 14 consecutive days.

## PROFILEAXIA

There are several approaches to control visceral leishmaniasis. Today they are constituted in two main groups, namely: vector control and control of infected humans and animals, in order to reduce reservoirs of infection. It is also noteworthy that the entire Brazilian territory is considered potentially endemic. Thus, prophylaxis and disease control depend on epidemiological surveillance developed by a national control program.

## REGARDING VECTOR CONTROL

The Ministry of Health cites as examples of VL prevention several environmental hygiene practices, such as periodic cleaning of backyards, with removal of decomposing organic matter where *Lutzomyia* reproduces.



Barrier methods, such as screens along the windows and doors of the house or insecticide-treated mosquito nets, especially at the end of the night, the time corresponding to the peak of vector activity.

Avoid the construction of houses and camps in areas close to the forest or in regions eminently inhabited by the vector.

The use of insecticides. These should only be used when recommended by health authorities, as is the case of municipalities with intense, moderate transmission or in an outbreak of visceral leishmaniasis, according to the criteria of the Ministry of Health.

#### REGARDING THE REDUCTION OF INFECTION RESERVOIRS:

The main measure is, without a doubt, the rapid diagnosis and effective treatment of anthroponotic visceral leishmaniasis.

The use of repellents on the skin and clothing is indicated, especially when visiting endemic areas.

Attention to domestic animals, such as: regular testing according to the region of residence; the use of repellent collars on domestic animals.


The control of stray animals is also of fundamental importance for the control of this disease.



## REFERENCES

1. Gama, M. do V. F., & Latge, S. G. da C. (2020). Ciclo de desenvolvimento do flebotomíneo *Lutzomyia longipalpis*. Recuperado de <https://educare.fiocruz.br/resource/show?id=6wvYesS6#:~:text=De%20maneira%20geral%2C%20as%20larvas,L2%20e%20L3%20pelo%20tamanho.>
2. Lainson, R., & Rangel, E. F. (2005). *Lutzomyia longipalpis* and the eco-epidemiology of American visceral leishmaniasis, with particular reference to Brazil: A review. \*Memórias do Instituto Oswaldo Cruz, 100\*, 811-827.
3. Lindoso, J. A. L. (2018). Diversidade clínica e tratamento da leishmaniose visceral. \*Revista do Instituto Adolfo Lutz, 77\*, 1-8. Recuperado de <https://periodicos.saude.sp.gov.br/RIAL/article/view/34199>.
4. Marcondes, M., & Rossi, C. N. (2013). Leishmaniose visceral no Brasil. \*Brazilian Journal of Veterinary Research and Animal Science, 50\*(5), 341-352. Recuperado de [http://www.revistas.usp.br/bjvras/article/view/79913/pdf\\_115](http://www.revistas.usp.br/bjvras/article/view/79913/pdf_115).
5. Peña, A. V. (Ed.). (2022). \*Tópicos nas ciências da saúde\* (10th ed.). Pantanal: Pantanal Editora. Recuperado de <https://www.editorapantanal.com.br/ebooks/2022/topicos-nas-ciencias-da-saude-volume-x/ebook.pdf#page=99>.
6. Santos, D. R. dos. (2014). \*Curso de capacitação para coleta e identificação de flebotomíneos\*. Paraná: Copel. Recuperado de [https://www.copel.com/uhecolider/sitearquivos2.nsf/arquivos/apostila\\_curso\\_flebotomineos/%24FILE/APOSTILA%20Curso%20de%20Identifica%C3%A7%C3%A3o%20de%20Flebotom%C3%ADneos.pdf](https://www.copel.com/uhecolider/sitearquivos2.nsf/arquivos/apostila_curso_flebotomineos/%24FILE/APOSTILA%20Curso%20de%20Identifica%C3%A7%C3%A3o%20de%20Flebotom%C3%ADneos.pdf).
7. Saúde, Ministério da. (2014). \*Situação Epidemiológica da Leishmaniose Visceral\*. Brasília: Ministério da Saúde. Recuperado de <https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/l/leishmaniose-visceral/situacao-epidemiologica-da-leishmaniose-visceral>.
8. Saúde, Secretaria de Vigilância em. (2014). \*Manual de Vigilância e Controle da Leishmaniose Visceral\*. Brasília: Ministério da Saúde. Recuperado de [https://bvsmis.saude.gov.br/bvs/publicacoes/manual\\_vigilancia\\_controle\\_leishmaniose\\_visceral\\_1edicao.pdf](https://bvsmis.saude.gov.br/bvs/publicacoes/manual_vigilancia_controle_leishmaniose_visceral_1edicao.pdf).
9. Soares, R. P. P., & Turco, S. J. (2003). *Lutzomyia longipalpis* (Diptera: Psychodidae). \*Anais da Academia Brasileira de Ciências, 75\*(3), 301-330. <http://dx.doi.org/10.1590/s0001-37652003000300005>.

## Outcome of antibiotic treatment in patients with abdominal trauma at the hospital in Ceilândia

 <https://doi.org/10.56238/sevned2024.016-005>

Rolando Gutierrez Rosales<sup>1</sup>, Jandui Gomes de Abreu Filho<sup>2</sup>, Karoliny Araujo Santana<sup>3</sup>, Nailton Gomes da Silva<sup>4</sup>, Déborah de Fatima Diniz Rocha<sup>5</sup>, Mozart Borges de Paula<sup>6</sup>, Bruno Bessa Andrade<sup>7</sup>, Kenyan Correa Rosa<sup>8</sup> and Matheus Savindo Batista Sanches<sup>9</sup>

### ABSTRACT

Infections generate complications capable of causing morbidity and mortality in trauma patients. As a measure to prevent infections, the administration of antibiotics should be early. However, the use of antibiotics for a long time is not recommended, since there is no evidence of a favorable outcome, in addition to increasing health care costs. Due to the need to prevent infections in trauma patients, it is important to adopt strict control measures with the implementation of effective strategies to improve health care for these patients. The aim of this study was to evaluate the impact of antibiotic use in trauma patients in a hospital in Brasília. This research is an observational cross-sectional investigation, based on a retrospective approach through the extraction of data from the health information system "TrackCare". The participants of this research comprise patients with abdominal trauma who underwent surgical treatment from January to December 2021. It is observed that almost half of the 93 patients were assigned to receive antibiotic therapy or antibiotic prophylaxis. Within this selected group, the main antimicrobial agent chosen was Unasyn, a combined composition of Ampicillin with Sulbactam, covering approximately 31% of cases. In this context, it is urgent to consider that the selection of the antimicrobial agent is not only based on its efficacy, but also on its adequacy to the particularities of the clinical picture presented by the patient.

**Keywords:** Antibiotic, Infections, Abdominal trauma, Surgical treatment.

<sup>1</sup> Resident in General Surgery, Ceilândia Regional Hospital, Brasília, DF, Brazil.

<sup>2</sup> Professor, General Surgery Residency, Ceilândia Regional Hospital, Brasília, DF, Brazil.

<sup>3</sup> Student at Centro Universitário Tocantinense Presidente Antônio Carlos. Araguaína, Tocantins, Brazil.

<sup>4</sup> Student at Centro Universitário Tocantinense Presidente Antônio Carlos. Araguaína, Tocantins, Brazil.

<sup>5</sup> Student at Centro Universitário Tocantinense Presidente Antônio Carlos. Araguaína, Tocantins, Brazil.

<sup>6</sup> Physician, graduated from the Catholic University of Brasília, Brasília, DF, Brazil.

<sup>7</sup> Physician, graduated from UNICEPLAC Centro Universitário, Brasília, DF, Brazil.

<sup>8</sup> Physician, graduated from UNICEPLAC Centro Universitário, Brasília, DF, Brazil.

<sup>9</sup> Physician, graduated from UNICEPLAC Centro Universitário, Brasília, DF, Brazil.



## INTRODUCTION

Infections generate complications capable of causing morbidity and mortality in trauma patients. These conditions are included in the trimodal distribution of trauma, established in 1982, which relates time to the outcome of trauma patients, and shows that one of the causes of late mortality in trauma victims is complications resulting from sepsis and organ dysfunction. Therefore, although the traumatic mechanism is not, by itself, capable of generating death in patients, infectious complications can lead to death (Junior, 2016).

The first peak occurs in the immediate post-trauma, seconds or minutes later, due to the extent and degree of the lesions in the brain and spinal cord, in addition to the great vessels. The second peak occurs within minutes or hours of post-trauma, triggered by contusions in the chest, brain hematomas, liver and splenic lesions, and in the pelvis. This time requires a thorough and rapid initial assessment, identifying and treating potentially fatal factors. Thus, due to the need for effective assessment, it is important to follow the recommendations of the Advanced Trauma Life Support® (ATLS). The third peak, in days or weeks post-trauma, is due to sepsis and multiple organ failure (American College of Surgeons, 2009).

A study carried out in a hospital in southern Brazil observed the impact of infections on patients affected by trauma, demonstrating that, of the total number of patients treated, more than 15% contracted some infection during hospitalization. Of this total, 28.8% died, and almost all had systemic inflammatory response syndrome (HAI), and sepsis increases the risk of death in patients by up to 12 times, compared to those who did not contract infection (Watanabe et al, 2015).

As a measure to prevent infections, the administration of antibiotics should be early. However, the use of antibiotics for a long time is not recommended, since there is no evidence of a favorable outcome, in addition to increasing health care costs. Therefore, the decision of the class of antibiotic to be used in trauma surgeries depends on the type of injury, the time of installation and the tissue affected (Rivera, 2008).

Due to the need to prevent infections in trauma patients, it is important to adopt strict control measures with the implementation of effective strategies to improve health care for these patients. The aim of this study was to evaluate the impact of antibiotic use in trauma patients in a hospital in Brasilia.

## METHODOLOGY

This research is an observational cross-sectional investigation, based on a retrospective approach through the extraction of data from the health information system "TrackCare". The participants in this research comprise patients with abdominal trauma who underwent surgical



treatment from January to December 2021, whose data were acquired without direct intervention or individual follow-up.

Considering the population of Ceilândia, estimated at 349,955 inhabitants (IBGE, 2018), it was established that approximately 123 participants were needed to achieve a confidence level of 90%, with a margin of error of 6%. Thus, for the selection of data to be analyzed, the inclusion criterion of patients with abdominal trauma who underwent exploratory laparotomy at the Regional Hospital of Ceilândia (HRC) during the referred period was adopted, excluding those who underwent exploratory laparotomy for other causes or in different periods.

Regarding the conduction of the research, the following steps were followed: submission to the Research Ethics Committee (REC), data collection through medical records, data tabulation, analysis of results, discussion and conclusion.

Data collection took place at the Regional Hospital of Ceilândia (HRC) through electronic medical records, after the informed consent form was waived. The following variables were analyzed: age, gender, cause, use of antibiotics, antibiotic therapy, duration of antibiotic therapy, days of hospitalization, and clinical outcome. The data were processed and analyzed using the IBM SPSS software (version 22.0).

## RESULTS

Table 1 reflects the demographic data, in which age is described using the mean and standard deviation variables, while the gender of the individuals with abdominal trauma is presented in terms of absolute values (n) and percentages (%). Notably, there is a predominance of male patients, with an average age of 30 years.

Table 1 - Age and gender of the patients

Variable	Average	±
Age	30,04	10,703
Gender	n	%
Male	83	89,2
Female	10	10,8

Source - Data from the study itself (2024)

When analyzing the cause of the occurrences (Table 2), of the 93 patients studied, almost half of them were victims of Stab Wound Perforation (PAB). Other etiologies identified include Perforation by Firearm (PAF) with 30.1%, car and motorcycle accidents that together account for 15.1% of the cases, falls with 2.2% and being run over by a car with 1.1% of the patients studied.

Table 2 - Cause of occurrences:

Cause	n	%
HELP	46	49,5
YOUTH	28	30,1
Motorcycle accident	8	8,6
Car accident	6	6,5
Blunt Trauma	2	2,2
Is left	2	2,2
Hit	1	1,1

Source - Data from the study itself (2024)

Tables 3 and 4 present data on antibiotic use and therapeutic choices. Initially, it is observed that almost half of the 93 patients were assigned to receive antibiotic therapy or antibiotic prophylaxis. Within this selected group, the main antimicrobial agent chosen was Unasyn, a combined composition of Ampicillin with Sulbactam, covering approximately 31% of cases. In addition, other frequently chosen substances included Meropenem (8%), the combination of ciprofloxacin with metronidazole (8%), and Tazocin (5.7%), which consists of piperacillin with tazobactam.

Table 3 - Antibiotic use

Antibiotic use	n	%
Yes	43	46,2
No	47	50,5
No registration	3	3,2

Source - Data from the study itself (2024)



Table 4 - Antibiotic therapy chosen:

Antibiotics	n	%
Unasyn	27	31
Meropenem	7	8,0
Ciprofloxacino + Metronidazol	7	8,0
Tazocin	5	5,7
Vancomycin	4	4,6
Linezolid	2	2,3
Piperacilina + Tazobactan	2	2,3
Meropenem + Linezolida	2	2,3
Early	2	2,3
Ciprofloxacino + Clindamicina	2	2,3
Levofloxacina	2	2,3
Tigecycline	2	2,3
Polymyxin B	2	2,3
Meropenem + Vancomicina + Ertapenem	1	1,1
Metronidazole	1	1,1
Imipenem + Amicacina	1	1,1
Ciprofloxacino	1	1,1
Clindamycin	1	1,1

Source - Data from the study itself (2024)

Finally, the last variable examined was the duration of treatment with the antibiotics mentioned (Table 5). In this context, a wide range of periods was observed, ranging from a minimum of 1 day to a maximum of 22 days. This remarkable disparity is attributed to the interaction of several elements, such as the dosage of the drug itself, the severity of the clinical condition, and the underlying reason for therapeutic choice. Thus, the presentation of the results in absolute values was not feasible, due to the variation in the duration of treatment with the same medication. To represent the data, we chose to calculate the mean of the days of treatment, together with the standard deviation, in order to contextualize the amplitude of this temporal variation.

Table 5 - Duration of antibiotic use:

Antibiotic time (days)	Average	±
Unasyn	4,56	2,225
Meropenem	16,29	6,473
Ciprofloxacino + Metronidazol	4,43	2,573
Tazocin	6,20	1,304
Vancomycin	11,75	7,320
Linezolid	15,00	0,00
Piperacilina + Tazobactan	7,00	2,828
Meropenem + Linezolida	7,50	0,707
Early	12,50	12,021
Ciprofloxacino + Clindamicina	4,00	1,414
Levofloxacina	14,00	4,243
Tigecycline	16,00	1,414
Polymyxin B	18,00	8,485
Meropenem + Vancomicina + Ertapenem	22,00	–
Metronidazole	1,00	–
Imipenem + Amicacina	8,00	–
Ciprofloxacino	13,00	–
Clindamycin	8,00	–

Source - Data from the study itself (2024)

## DISCUSSION

In this study, an analysis of the prognosis of patients living in Ceilândia who underwent antibiotic therapy after suffering abdominal trauma was undertaken. The results revealed a myriad of findings of significance, which require in-depth consideration.

Initially, the preponderance of demographic data deserves to be highlighted, showing an average age of 30.04 years, with an exacerbated predominance in males, reaching an expressive proportion of 89.2%. In this scenario, Perforation by a Knife (PAB) emerges as the most prevalent cause, making up 49.5% of the cases, followed by Perforation by Firearm (PAF), responsible for



30.1% of the incidences, among other relevant etiologies. Nevertheless, it emerged that the administration of antibiotic agents in the therapeutic management of patients affected by abdominal trauma at the hospital in Ceilândia obtained a percentage of almost half of the patients (46.2%).

It should be noted that Unasyn was positioned as the most recurrent pharmacological therapy, obtaining a preference of 31% in the aforementioned study, and boasting one of the lowest mean duration of treatment, approximately 4.56 days. However, it is important to emphasize that the study shows the existence of other therapeutic agents with shorter treatment periods, however, underused in the region in similar contexts.


In this context, it is urgent to consider that the selection of the antimicrobial agent is not only based on its efficacy, but also on its adequacy to the particularities of the clinical picture presented by the patient, considering factors such as bacterial resistance, safety profile, and cost-effectiveness. In addition, it is imperative to investigate the underlying reasons for the underutilization of therapeutic alternatives with shorter treatment duration, as this could promote more efficient management of resources and potentially improve clinical outcomes for patients affected by abdominal trauma in Ceilândia.



## REFERENCES

1. American College of Surgeons Committee on Trauma. (2009). \*Advanced Trauma Life Support – ATLS\* (8th ed.).
2. Junior, M. A. F. R. (2016). \*Fundamentos em cirurgia do trauma\* (1st ed.). Rio de Janeiro: Roco.
3. Rivera, M. N. M. (2008). Uso preventivo de antibióticos en trauma. \*Trauma. La urgencia médica de hoy, 11\*(2), 47-53.
4. Watanabe, É. M., et al. (2015). Impacto das infecções relacionadas à assistência à saúde em pacientes acometidos por trauma. \*Semina: Ciências Biológicas e da Saúde, 1\*(Supl), 89-98.
5. Valls Puig, J. C. (2021). Tratamiento del trauma abdominal penetrante desde el final de la Gran Guerra hasta nuestros días. \*Gaceta Médica de Caracas, 129\*(1).
6. Piñango, S., Level, L., & Inchausti, C. (2021). Incidencia de infección del sitio quirúrgico en el Servicio de Cirugía I, hospital Dr. Miguel Pérez Carreño. 2019-2021. Estudio observacional. \*Revista Venezolana de Cirugía, 74\*(2).
7. Silva, L. V. B., et al. (2023). Complicações relacionadas ao pós-operatório de cirurgias provenientes de traumas: uma revisão integrativa. \*Research, Society and Development, 12\*(1), e19112139768-e19112139768.

## Study of the art of facial expressions in the emotion of irony

 <https://doi.org/10.56238/sevened2024.016-006>

Carla Patrícia Hernandez Alves Ribeiro César<sup>1</sup>, Raphaela Barroso Guedes-Granzotti<sup>2</sup>, Claudia Sordi<sup>3</sup>  
and Kelly da Silva<sup>4</sup>

---

### ABSTRACT

Irony, regardless of its subtype, is routinely used in human communication. Verbal, vocal, and non-verbal resources are used to express the irony. In this chapter, the objective is to present a literature review on using irony through facial expression. According to the results obtained, the face can express irony, highlighting the contradiction between oral speech and the facial expression itself, which helps the receiver understand that the speech is ironic. There are still scientific gaps on the subject, and more researchers must investigate the topic.

**Keywords:** Irony, Face, Emotion.

---

<sup>1</sup> Speech therapist, PhD, Professor of the Speech Therapy Course at the Federal University of Sergipe, São Cristóvão, Sergipe, Brazil.

<sup>2</sup> Speech therapist, PhD, Professor of the Speech Therapy Course at the Federal University of Sergipe, São Cristóvão, Sergipe, Brazil.

<sup>3</sup> Speech therapist, PhD, Professor of the Speech Therapy Course at the Federal University of Sergipe, Lagarto, Sergipe, Brazil..

<sup>4</sup> Speech therapist, PhD, Professor of the Speech Therapy Course at the Federal University of Sergipe, Lagarto, Sergipe, Brazil..



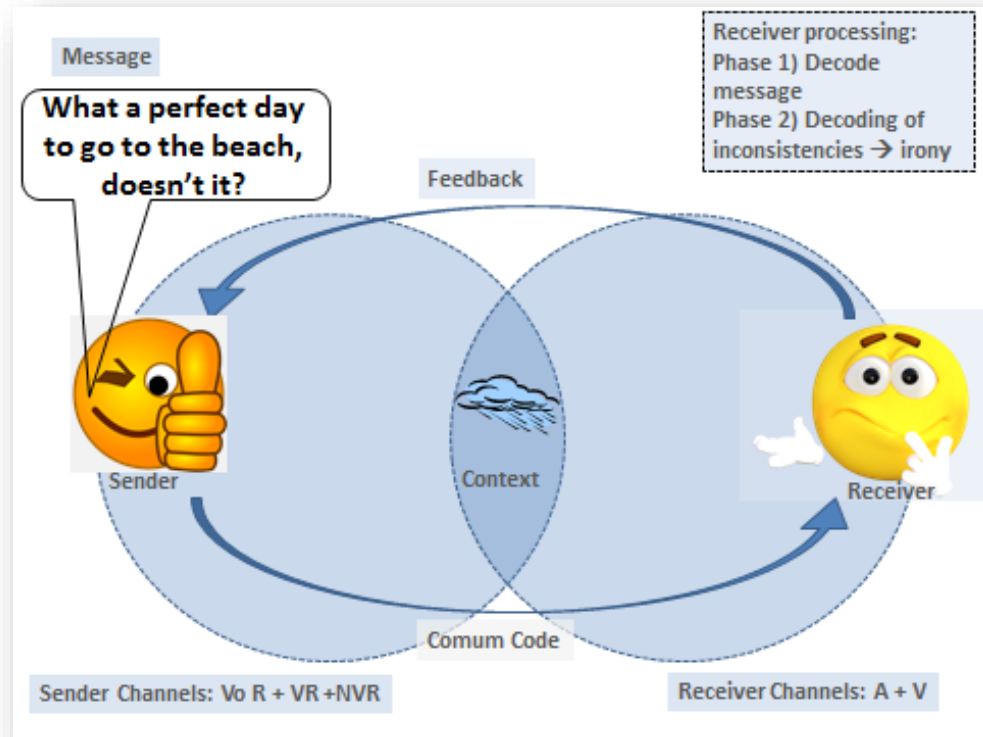
## INTRODUCTION

The word irony is of Greek origin (*eironeia*) and means concealment (Costa, 2016) and is often used in communication, - in about 8% when the dialogue is between friends (Gibbs Jr., 2000).

There are several theories that explain this. According to the classical theory, it is considered a figure of language, expressed by indirect negation. In salience gradation theory, irony is most often used with polysemic words, which have several meanings, and are better understood when there is greater familiarity, frequency of use and understanding of the context of a given word. It is also considered as an act of non-sincere speech, not pragmatic sincere, but which expresses the psychological state of the speaker, and can be understood as an intentional act and violation of the main rule of a speech, that is, of expressing the truth. Other theories that explain the Echoic Mention, is when someone informs something to an interlocutor and, by inference, uses a statement from what he heard or from the Pretension, that is, when there is a conscious desire to make it an ironic attitude. Despite the different theoretical assumptions that explain it, the literature agrees that for irony to be properly interpreted, it is context-dependent (voice, gestures, etc.) and requires two stages of processing, one requiring interpretation of the message, for later (Attardo, 2000), as can be visualized in the diagram below (Diagram 1).

The sender, when using communication with messages intentionally different from a certain fact, as in sarcasm and irony, uses different processes: consistency between the statement and the context. The listener must analyze the statement and the fact, retain the information in his working memory, compare the compatibility between the fact and what has been expressed by different sources and finally detect the inconsistency in the information. At this stage, the listener should analyze the reasons why there are inconsistencies between the facts and what was said, i.e. if it was a mistake of the sender or if its use was intentional, in this way, the listener will make an inference or a judgment of the senders' intention (Ackerman, 1981).

Diagram 1. Diagram of a two-stage verbal irony process.



Legend: R Vo = Vocal Resources (prosody, intonation, rhythm, vowel duration, pitch, loudness etc.); RV = Verbal Resources (articulation of the spoken word); RNV = Non-Verbal Resources (gestures and facial expressions); A = Hearing and V = Vision.

Another important aspect to be emphasized is the influence of the ironic attitude, which depends on both the listener's understanding and its complexity, if more or less explicit (Burgers, Van Mulken, Schellens, 2012), since the sender, using the irony, does it consciously and wants the interlocutor (receiver of the message) to interpret it.

In general, irony expresses an affirmative thought by the negative side, covering and revealing a double intention of the message evidencing, non-explicit subtexts, dichotomies and ambiguities (Costa, 2016).

It is perceived as a secondary emotion and as it implies a content in speech that is different from what one wishes to express (Cheang and Pell, 2008), shows incongruity between what was 'thought' and 'reality' (Alavarce, 2009), it may be a lie to some authors (Duarte, 2006) or not, since their intention is explicit (Taberner, 2016).

Researches that analyze facial expressions and facial micro-expressions, the latter seen as facial muscle contractions that represent a particular emotion, but produced very quickly (Freitas-Magalhães, 2014), may help in this, since the area has little scientific production in this sense, unlike linguistics, which has advanced significantly in the analysis of ironic speeches. Here are the different forms of irony.

## FORMS OF IRONY

There are several forms of irony, according to the literature, which are described in the table below.

Table 1. Types of irony, with definitions endorsed by the authors.

<b>Types of irony</b>	<b>Definition</b>	<b>Author (s) / (year)</b>
<i>Anti-phrase</i>	When exaggerated ideas are exalted or affectionate use is made of offensive terms.	Pires (1981)
<i>Asteica</i>	Subtle and delicate use of ironic criticism to disguise a compliment, which uses rhetoric and is considered a positive irony	Attardo (2000)
<i>Cosmic or Infinite</i>	It is the difference between human desire and reality.	Moisés (2004)
<i>Criticism</i>	Social form of communication, and in this type of irony, the emotional valence differs from the situation and the literal meaning. Its use is used to criticize something, establishing a negative valence of emotion, that is, it evokes a negative attitude towards an object. Positive sentence is used to convey a negative meaning.	Dews et al. (1996), Attardo (2000), Agostino <i>et al.</i> (2016)
<i>Direct</i>	When a comment is the opposite of what it really means and whoever does the irony makes an affirmative sentence *.	Dews <i>et al.</i> (1996)
<i>From destiny</i>	It corresponds to situational / behavioral irony - used in poetry, in which the author does not infer irony, but the reader interprets it, that is, when there is a distinction between intention and result of action and verbal, that used through word / speech that differs from the fact, used in everyday situations.	Moisés (2004).
<i>Dramatic</i>	Who knows the content is the audience, while the actor ignores it - used in the Dramatic Arts.	Moisés (2004).
<i>Ironical praise</i>	Of rarer use, it is expressed by a negative message to convey a positive meaning.	Dews et al. (1996)
<i>Euphemism</i>	When pleasant words are used to express something unpleasant.	Sacconi (2008)
<i>Hyperbole</i>	When one makes use of non-literal expression of exaggeration of a thought or of the reality of a situation.	Gibbs Jr. (2000)
<i>Indirect</i>	When something is the opposite of what has been said, but the speech used by the one who makes the irony makes a	Dews <i>et al.</i> (1996)





	suggestion and not an affirmation *.	
<b><i>Humorous</i></b>	Subtle and indirect commentary that has entertaining and comical intention about a certain non-pleasurable situation or unpleasant person.	Gibbs Jr (2000)
<b><i>Sarcasm</i></b>	When one makes use of words or expressions in a pejorative tone, although with the use of positive words, with the intention of assaulting, offending and hurting.	Gibbs Jr. (2000)
<b><i>Socratic or Rhetoric</i></b>	Used in the pedagogical environment, the speaker knows the subject, but questions it as if he did not know it, that is, the speaker makes an issue and, according to Gibbs Jr, such a question may imply either humor or a critical assertion.	Gibbs Jr. (2000), Moisés (2004).
<b><i>Undervaluation</i></b>	Unlike hyperbole, when one makes use of non-literal minimization expression of a thought or the reality of a situation.	Gibbs Jr (2000)

\* The author uses the following example to differentiate between direct and indirect irony: in a summer camp, children are being divided by classes that will be proposed and one of the children is a failure in diving. In direct irony, you could be told, "You're a funny diver," and in the indirect: "I think diving will be your favourite lesson."

For a better understanding of the subject, let us now look at the neurophysiological aspects of face perception and those involved in irony.

## NEUROPHYSIOLOGICAL ASPECTS OF FACIAL PERCEPTION AND THOSE INVOLVED IN IRONY

Studies using magnetic resonance imaging have shown that during human development there is an increase in the extent of specialization of the cortex for the stimuli related to the face, and the perception of the face begins in early stages of life and is not completed until adolescence, It is evident that the processing of this information is different when cortical activity between children (with less specialization and confidence) and adults is compared (Rysewyk, 2010).

A recent study using functional and quantitative magnetic resonance imaging in 22 children (between 5 and 12 years of age) and 25 adults (between 22 and 28 years of age) found differential development of high-level visual areas involved in facial and spatial recognition. The development of specific and selective facial regions of the brain occurs, in greater concentration, in fusiform gyrus in children. With the development and nervous tissue specialization and the experience with the different faces and expressions the brain is specializing and the areas end up distinguishing between the recognition for the faces and the recognition of places in adult life. These results were validated by the authors with evaluation of post-mortem nervous tissue of ten cadavers. According to the



authors, a new model for the understanding of the improvement of the recognition and differentiation of faces from childhood to adulthood is emerging, whereby emerging brain function and behaviour result from cortical tissue proliferation (assuming the increase Myelin, dendrites, alterations in the iron-protein or glial and astrocytic structural perineuronal matrices) and not exclusively of apoptosis (Gomez et al., 2017).

Because irony is a voluntary emotional facial expression (EFE), it is important to emphasize that voluntary / deliberate facial expressions depends on the pyramidal tract, originating in the motor cortex and the spontaneous, the extrapyramidal tract whose origin occurs in the pre-motor area and subcortical regions (such as the basal ganglia), although there is evidence that the functional independence of these pathways is not total, as reviewed by McCabe et al. (2010).

Channon and Crawford (2000) found that patients with brain lesions in the left frontal lobe had relative losses in the understanding of histories, especially those involving non-literal statements in relation to those with lesions in the right frontal lobe and posterior lesions (temporal, parietal or occipital) to the left or right. Ratifying the above, Wakusawa et al. (2007) found that when the judgment of a certain ironic situation was made, the activated brain areas are the medial orbitofrontal cortex. However, for the production of irony, the right temporal lobe is activated.

Giora et al. (2000) assessed the comprehension of sarcasm and metaphors by adapting a battery of Gardner and Brownell's right hemisphere communication tests in 27 patients with lesions in the right hemisphere (RH), 31 in the left hemisphere (LH) and compared the results with the control group (CG, n = 21). The RH group tended to present lower scores for the understanding of sarcasm and higher scores in the understanding of metaphors when compared to the LH group. In addition, groups with neurological impairment evidenced significant impairments in understanding sarcasm when compared to the CG. There were no statistically significant differences in the interpretation of metaphors between the RH and CG groups, but there was a significant disadvantage for the RH group with regards to the RH and CG. Significant negative correlations were found between the test scores and the extent of the lesion to understand sarcasm in the mid and lower left frontal gyrus and to understand the metaphor in the left mid temporal gyrus and in the junction area of the superior temporal and left supramarginal gyrus. The extent of the lesion in the regions of the RH did not correlate with the performance of the test.

Wang et al. (2006) evaluated the irony comprehension of 24 subjects (12 adults with mean age of 26.9 years and 12 children aged nine to 14 years) with cartoon figures while listening to short stories that ended with a potentially ironic observation and were asked to decide whether the speaker was being sincere or ironic (sarcastic). Both children and adults were instructed to pay attention either to the speaker's facial expression or to the voice inflection of the message accompanied by the test scenes. The results showed that both children and adults activated similar global networks,



including frontal, temporal and occipital cortices bilaterally. Specifically, children recruited the lower left frontal regions more strongly than adults and showed reliable activity in the prefrontal cortex, while adults did not. In contrast, adults activated the occipitotemporal regions more strongly than children. In the condition of "sincere discourse", both groups showed significant activities in the frontotemporal and occipital areas in relation to rest. However, adults exhibited the typical left lateral activation pattern of language processing while children recruited a more bilateral network, similar to that activated under irony conditions. In addition, despite the lack of ambiguity in the speaker's intention in this condition, the activity also activated, but to a lesser extent, the pre-frontal cortex in children. When the task was to pay attention to the facial expression during the ironic discourse, there was greater neural activity in the visual cortex and when the attention was directed to prosody in the superior temporal gyrus, respectively. In general, children involved the medial prefrontal cortex and left lower frontal gyrus more strongly than adults, while adults recruited fusiform gyrus, extra striate areas, and amygdala more strongly than infants. The greater involvement of the prefrontal regions in children may support the integration of multiple clues to reconcile the discrepancy between the literal meaning and the intended meaning of an ironic observation. This shift from the development of a dependency in frontal regions to later occipitotemporal regions may reflect the automation of basic reasoning on mental states.

Spotorno et al. (2012) used functional magnetic resonance imaging to compare the comprehension of 20 healthy subjects from 18 target sentences with ironic or literal contexts. They demonstrated that the Mind Theory (ToM) network becomes active while a participant is understanding the verbal irony, especially of the medial prefrontal cortex, posterior and ventral areas (from Brodmann area 6 to 9), lower frontal gyrus Bilateral (Brodmann's areas: 45, 46, 47), the bilateral temporoparietal junction (Brodmann's areas: 40), the left insula, the right later dorsal fronto parietal cortex (Brodmann's area: 8) and the right middle temporal gyrus Brodmann: 21). In addition, they demonstrated that the ToM activity is directly related to the processes of language comprehension.

Matsui et al. (2016) evaluated the understanding of prosody and context sarcasm in 21 adults using magnetic resonance imaging. In order to do so, vignettes containing short stories were presented to the participants, whose characters had performed good or bad acts, followed by positive statements from their relatives. Thus, participants were asked to judge the degree of sarcasm used in the compliment, which was either accompanied by positive or negative affective prosody. They found a correlation between the context and prosody, with activation of the frontal and frontal portion of the left inferior frontal gyrus, corresponding to Brodmann's area 47. The incongruity between negative prosody and praise activated the insula bilaterally, extending into the lower right frontal gyrus, lower cingulate cortex, and brainstem. They concluded that the lower left frontal gyrus



(BA 47) is involved in the integration of the context of the discourse and the statement with affective prosody in the understanding of sarcasm.

Obert et al. (2016) investigated the neural basis of irony processing by delivering short sentences of ironic and literal speech to 23 healthy young adults who underwent functional magnetic resonance imaging to assess the neural effect of two parameters: degree of irony and enjoyment of the mood. The results revealed the activation of bilaterally inferior frontal gyrus (GFI), the posterior left temporal gyrus, the medial frontal cortex and subcortical regions, as the left caudate nucleus during the irony processing. The degree of irony was shown to be associated with the activation of bilateral frontal and subcortical areas and that these regions were also sensitive to mood. The activation of the bilateral GFI was, therefore, responsible for the processing of humour and reflected the processes of detection and resolution of incongruity. In addition, the activation of subcortical structures may be related to the processing of social event rewards.

Since there is not only one form of irony, let us see how literature classifies it, as follows.

## THE FACE OF IRONY

Facial expressions usually accompany oral discourses and vocal resources in order to ratify what one wishes to express. However, is this what happens during the production of ironic discourses? We don't believe so, since when the emotions are distorted - as in the case of irony, there are differences between the time of maintenance of the expression, being that in these cases, it tends to remain longer than when compared to the facial expressions that represent emotions according to Miguel and Primi (2014).

González-Fuente, Escandell-Vidal, and Prieto (2015) found that 70% of subjects who made ironic speeches demonstrated audio-visual resources and their use favoured the understanding of irony. They checked the lexical-syntactic clues produced during the speech, the face in general (smile, laughter, frown or neutral expression), eyebrow movements (raised or furrowed), eyes (closed, contracted and exaggerated), the eye movements (towards the interlocutor or the material and the deviation of the gaze), the mouth (lips stretched, protruded, with elevation or lowering of the labial commissures), head movements (nod of head forward, of rotation), arms and hands. In addition to vocal resources (pitch, loudness, prosody, vocal quality, syllable duration, in milliseconds and speech elocution rate - measured by speech time divided by the number of syllables). For that, friendly subjects, arranged in pairs, discussed two videos presented, these discussions were recorded. Among the ironic manifestations, the jocose was the most frequent (34%) and the most vocal clues were: the use of emphases, sentences with interrogative configurations (ascending inflection), prosodic breaks / pauses and longer duration of syllables. In general, the audio-visual clues in the most ironic speeches that stood out were the face in general and the head, with the greatest change in



the direction of the gaze (deviation of the gaze during the ironic speech) and smile and / or laughter during the ironic statement, movements (inclination and lateral movements), stretched lips and raised eyebrows.

The literature describes that irony can be expressed facially as both scorn and aversion (Wilson and Sperber, 2012).

Ekman, Friesen and Hager (2002) suggested the analysis of the face by checking the muscular units of action (AUs) in the upper and lower thirds of the face, by the Facial Action Coding System - FACS). Thus, we will present the literature findings from this division.

In the upper third of the face, especially in the eye region, there was a greater production of aversive look in the sarcasm, which is a kind of irony (Williams, Burns and Harmon, 2009). According to the literature (Ekman, Friesen, Hager, 2002, Freitas-Magalhães (1998)), there may be a change in the direction of the gaze (the deviation of the gaze during the production of the ironic discourse), according to González-Fuente, Escandell-Vidal, Prieto, 2011a, Roberto and Luigi, 2015), correspond to AUs 61 and 62, characteristics of the emotion of contempt.

Another aspect reported in the literature refers to mixed facial expressions, a situation in which there may be contraction of the corrugator of the eyelashes, approaching the eyebrows at the moment of a smile, not showing at the moment neither happiness nor anger (Ekman, 2003). As Williams, Burns and Harmon (2009) cite an aversive look at ironic speeches and, in the aversion, according to Ekman (2003), the eyebrows may present a drop, this signal can be found during the production of the irony, being visible to AU4. However, González-Fuente, Escandell-Vidal, Prieto (2015) found elevated eyebrows during the production of ironic speech. Therefore, the AUs that may be involved in irony may be AU1 and AU2.

In the lower face, the literature cited the presence of smile in the irony (Freitas-Magalhães, 2009 and González-Fuente, Escandell-Vidal, Prieto, 2015) and/or laughter (González-Fuente, Escandell, Freitas-Magalhães (2011) pointed out that in the posed/falsified smile it involves consciousness on the part of the emitter, being activated cerebral structures such as the pre-motor cortex, the frontal and the zygomatic muscles (major and minor) and the orbicularis of the eyes and, in the true/genuine, the motor cortex, the amygdala and the orbicularis oculi muscle (central part).

In relation to the smile, according to Freitas-Magalhães (2009), this is one of the main organizers of the human psyche and can assume the voluntary, induced and dissimulated configuration, adding that "(...) is associated with positive feelings such as happiness, pleasure, amusement or friendship, but also expresses irony, sadness, dissatisfaction, disgust and embarrassment" (50). It would be similar to the false smile, according to the author, a situation in which it appears and disappears quickly, is exaggerated, "frozen" and asymmetrical, revealing mixed expressions and non-verbal indiscretions.



It should be emphasized that fake facial expressions can be detected because they generate conflict in the observer due to the overlap of emotions (Freitas-Magalhães, 2011).

So how do you differentiate it? By context. According to Freitas-Magalhães (2009), the context is one of the moderators studied in the display of smile, intensity and frequency mode.

The context may affect the judgment of emotional facial expressions, favouring their accuracy (Izard, 1998).

Head movement was also observed in the literature, with the visualization of head tilt or movements on the horizontal axis (González-Fuente, Escandell-Vidal, Prieto, 2015). Thus, according to the FACS, the motion units involved could be 51, 52, 55, or 56.

Agostino et al. (2016) evaluated children and adolescents with figures and statements that represented truth, critical irony (negative valence), and emphatic (positive valence) praise - the latter two represent incongruity between the speech and the actual fact; Critical irony the intention of the message is negative and what was expressed does not correspond to the fact and in emphatic praise the intention of the message corresponds to the literal meaning but not to the situation with differences in the intonation of the sentences. Both are intended to affect the listener's emotional state (feeling bad or good, respectively for critical irony and emphatic praise), considered as indirect language. In the example of one of the authors' test figures the speech was incompatible with EFE - depicting irony - and, in this situation, they used illustration with head tilt to the right (corresponding to M56 of the FACS) associated with the eyebrow elevation of the (Corresponding to FACS R1) and contralateral side lip enhancement (corresponding to FACS L12).

Rockwell (2000) and Conz (2010) also reported that in irony there may be inexpressiveness, "rolling eyes" or "mockery", without describing what this characteristic would be, justifying research in this area.

As noted, the EFE of irony still lacks further studies.

## FINAL CONSIDERATIONS

Secondary emotions, such as irony, are also called complex, because they are combinations of the primaries and are considered as the awareness of the emotional state with somatic changes, being linked to previous experiences, that is, to acquired dispositions (Damasio, 1998). According to Tabernero and Politis (2013), basic emotions seem to be involved in the formation of secondary emotions, but the presence of double dissociations between tasks may indicate that their execution involves partially independent processes.

In addition to the above, secondary emotions depend on complex mental states, in which there is attribution of belief or intention, i.e. a mental cognitive state for the person (Baron-Cohen et al., 2001), as in the case of irony.



Thus, this secondary emotion is widely used in discursive situations, in different contexts such as in arts, in media communication (television, newspaper, radio, magazines, etc.) and everyday life (Pereira, 2015), as evidenced in preliminary research in a development phase (César, Freitas-Magalhães, 2017).

Irony can be used as the basis for the creation of an identity and as a survival strategy of oppressive ideologies (Cardeña, 2003), to diminish the force of a muting function or an implicit criticism (in the case of critical irony) or implicit compliment (in an ironic praise), or for use in mood situations, according to Dews et al. (1996).

As a figure of speech, it can be used as rhetoric, to express something different from what is actually thought, as well as to provoke laughter in humour (laughing at or with the other /world) and as a "powerful critical instrument" (Loureiro, 2007, p.14).

It is inferred that irony is an emotion of a more complex order for its decoding, since there is a need to understand the affective intention and, in its expression, requires of those who evokes it, a control of the social expression of false affection, as affirmed by Agostino et al. (2016).

As a mixed emotion, the hypothesis of its use is associated with a form of moral judgment.

Literature has described that emotional facial expressions (EFEs) evolved from a sensorial and adapted regulation of the use of facial muscles for the expression of moral judgment (Benitez-Quiroz, Wilbur and Martinez, 2016).

In this type of judgment the aforementioned, authors reported that there are the inclusion of expressions such as anger, aversion and contempt. At the moment when irony as EFE is expressed in a mixed way (hypothesized its expression with the mixed manifestation of happiness with aversion or contempt) and interpreted in a contextual way, it can be considered as a co-articulator of speech (Benitez-Quiroz, Wilbur and Martinez, 2016).

In addition, we emphasize the importance of emotional facial expressions being always analysed concomitantly to the context, because as affirmed by Righart and Gelder (2008), they favour the understanding of the EFEs and, we add here, irony.



## REFERENCES

1. Ackerman, B. P. (1981). Young children's understanding of a speaker's intentional use of false utterance. *\*Developmental Psychology, 17\**, 472-480.
2. Agostino, A., Im-Bolter, N., Stefanatos, A. K., & Dennis, M. (2016). Understanding ironic criticism and empathic praise: the role of emotive communication. *\*British Journal of Developmental Psychology\**.
3. Alavarce, C. S. (2009). *\*A ironia e suas refrações: um estudo sobre a dissonância na paródia e no riso\**. São Paulo: Cultura Acadêmica.
4. Arrais, K. C. (2013). *\*Correlatos do reconhecimento de emoções faciais com medidas fisiológicas do teste de controle postural em indivíduos com transtorno de ansiedade social\** [tese]. São Paulo: Universidade de São Paulo de Ribeirão Preto.
5. Attardo, S. (2000). Irony as relevant inappropriateness. *\*Journal of Pragmatics, 32\**(6), 793-826.
6. Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" test revised version: A study with normal adults, and adults with Asperger syndrome or high-functioning autism. *\*Journal of Child Psychology and Psychiatry, 42\**(2), 241-251.
7. Benitez-Quiroz, C. F., Wilbur, R. B., & Martinez, A. M. (2016). The not face: a grammaticalization of facial expressions of emotion. *\*Cognition, 150\**, 77-84.
8. Burgers, C., Van Mulken, M., & Schellens, P. J. (2012). Type of evaluation and marking of irony: The role of perceived complexity and comprehension. *\*Journal of Pragmatics, 44\**(3), 231-242.
9. Cardeña, I. (2003). On humour and pathology: the role of paradox and absurdity for ideological survival. *\*Anthropology & Medicine, 10\**(1), 115-142.
10. Channon, S., & Crawford, S. (2000). The effects of anterior lesions on performance on a story comprehension test: left anterior impairment on a theory of mind-type task. *\*Neuropsychologia, 38\**(7), 1006-1017.
11. Cheang, H. S., & Pell, M. D. (2008). The sound of sarcasm. *\*Speech Communication, 50\**, 366-381.
12. Conz, J. (2010). *\*Ironia verbal: teorias e considerações\**. Monografia [Licenciatura em Letras], Universidade Federal do Rio Grande do Sul, Porto Alegre, Brasil.
13. Costa, A. M. M. (2016). Dualidade e ironia em Esaú e Jacó. *\*Machado de Assis em Linha, 9\**(18), 64-73.
14. Damásio, A. (1998). *\*O erro de Descartes: emoção, razão e o cérebro humano\**. São Paulo: Schwarcz.
15. Dews, S., Winner, E., Kaplan, J., Rosenblatt, E., Hunt, M., Lim, K., McGovern, A., Qaulter, A., & Smarsh, B. (1996). Children's understanding of the meaning and functions of verbal irony. *\*Child Development, 67\**, 3071-3085.
16. Duarte, L. P. (2006). *\*Ironia e humor na literatura\**. Belo Horizonte: Editora PUC Minas, São Paulo: Alameda.





17. Ekman, P. (1999). Basic emotions. In T. Dalgleish & M. J. Power (Eds.), *\*Handbook of cognition and emotion\** (pp. 45-60). New York: John Wiley & Sons.
18. Ekman, P. (2003). *\*Emotions revealed: understanding faces and feelings\**. London: Weidenfeld & Nicolson.
19. Ekman, P., Friesen, W. V., & Hager, J. C. (2002). *\*Facial action coding system: investigator's guide\** (2nd ed.). Salt Lake: Research Nexus eBook.
20. Fox, E., Yates, A., & Ashwin, C. (2012). Trait anxiety and perceptual load as determinants of emotion processing in a fear conditioning paradigm. *\*Emotion, 12\**(2), 236-249.
21. Freitas-Magalhães, A. (2009). *\*A psicologia das emoções: o fascínio do rosto humano\** (2ª ed.). Porto: Universidade Fernando Pessoa.
22. Freitas-Magalhães, A. (2011a). *\*O código de Ekman: o cérebro, a face e a emoção\**. Porto: Universidade Fernando Pessoa.
23. Freitas-Magalhães, A. (2011b). Emotion: from the brain to the face and back. In A. Freitas-Magalhães (Ed.), *\*Emotional expression: the brain and the face\** (pp. 1-40). Porto: FeeLab Science Books.
24. Freitas-Magalhães, A. (2014). *\*Micro-expressão e macro-expressão: vestígios e consequências\**. Porto: FeeLab Science Books.
25. Gao, X., & Maurer, D. (2009). Influence of intensity on children's sensitivity to happy, sad, and fearful facial expressions. *\*Journal of Experimental Child Psychology, 102\**(4), 503-521.
26. Gibbs Jr., R. W. (2000). Irony in talk among friends. *\*Metaphor and Symbol, 15\**(1-2), 5-27.
27. Giora, R., Zaidel, E., Soroker, N., Batori, G., & Kasher, A. (2000). Differential effects of right-and left-hemisphere damage on understanding sarcasm and metaphor. *\*Metaphor and Symbol, 15\**(1-2), 63-83.
28. Gomez, J., Barnett, M. A., Natu, V., Mezer, A., Palomero-Gallagher, N., Weiner, K. S., Amunts, K., Zilles, K., & Grill-Spector, K. (2017). Microstructural proliferation in human cortex is coupled with the development of face processing. *\*Science, 355\**(6320), 68-71.
29. González-Fuente, S., Escandell-Vidal, V., & Prieto, P. (2015). Gestural codas pave the way to the understanding of verbal irony. *\*Journal of Pragmatics, 90\**, 26-47.
30. Guimarães, M. J. (2001). Ironia: uma primeira abordagem. *\*Revista da Faculdade de Letras, Língua e Literaturas, 18\**, 411-422.
31. Izard, C. E. (1998). Emotions and facial expressions: a perspective from differential emotions theory. In J. A. Russell & J. M. Fernández-Dols (Eds.), *\*The psychology of facial expression\** (2nd ed., pp. 57-77). New York: Cambridge University Press.
32. Leime, J. L., Rique Neto, J., Alves, S. M., & Torro-Alves, N. (2013). Recognition of facial expressions in children, young adults and elderly people. *\*Estudos de Psicologia, 30\**(2), 161-167.




33. Loureiro, I. (2007). Ironia(s) em Freud: da escrita à ética. *\*Ide, 30\*(45), 13-19.*
34. Matsui, T., Nakamura, T., Utsumi, A., Sasaki, A. T., Koike, T., Yoshida, Y., Harada, T., & Tanabe, H. C., & Sadato, N. (2016). The role of prosody and context in sarcasm comprehension: behavioral and fMRI evidence. *\*Neuropsychologia, 87\*, 74-84.*
35. McCabe, D. L., Borod, J. C., Meltzer, E. P., Spielman, J., & Ramig, L. O. (2010). Masked faces in Parkinson's disease: emotional and motoric factors, neuropathology, Duchenne smiling, and treatment. In A. Freitas-Magalhães (Ed.), *\*Emotional expression: the brain and the face\** (2nd ed., Vol. 2, pp. 3-41). Porto: Universidade Fernando Pessoa.
36. Miguel, F. K., & Primi, R. (2014). Criação de vídeos de expressões emocionais por meio de estímulos multimídia. *\*Psicologia: Teoria e Prática, 16\*(1), 155-168.*
37. Moisés, M. (2004). *\*Dicionário de termos literários\** (12ª ed., rev. e ampl.). São Paulo: Cultrix.
38. Obert, A., Gierski, F., Calmus, A., Flucher, A., Portefaix, C., Pierot, L., Kaladjian, A., & Caillies, S. (2016). Neural correlates of contrast and humor: processing common features of verbal irony. *\*PloS One, 11\*(11), e0166704.*
39. Pereira, H. B. (2015). O estudo da ironia em sala de aula. *\*Todas as Letras - Revista de Língua e Literatura, 17\*(3), 25-35.*
40. Pierrehumbert, J. B. (2003). Phonetic diversity, statistical learning, and acquisition of phonology. *\*Language and Speech, 46\*, 115-154.*
41. Pires, O. (1981). *\*Manual de teoria e técnica literária\**. Rio de Janeiro: Presença.
42. Righart, R., & Gelder, B. (2008). Recognition of facial expressions is influenced by emotional scene gist. *\*Cognitive, Affective, & Behavioral Neuroscience, 8\*(3), 264-272.*
43. Roberto, M., & Luigi, T. (2015). *\*A face e suas emoções\**. São Paulo: Laços.
44. Rockwell, P. (2000). Lower, slower, louder: vocal cues of sarcasm. *\*Journal of Psycholinguistic Research, 29\*(5), 483-495.*
45. Rodrigues, S. I. C. (2013). *\*O papel da ansiedade traço no reconhecimento de expressões faciais emocionais e prosódia emocional\** [dissertação]. Faro: Universidade do Algarve.
46. Rysewyk, S. V. (2010). Towards the developmental pathway of face perception abilities in the human brain. In A. Freitas-Magalhães (Ed.), *\*Emotional expression: the brain and the face\** (2nd ed., Vol. 2, pp. 111-131). Porto: Universidade Fernando Pessoa.
47. Sacconi, L. A. (2008). *\*Gramática comunicativa Sacconi\**. São Paulo: Nova Geração.
48. Snaith, R. P. (2003). The hospital anxiety and depression scale. *\*Health and Quality of Life Outcomes, 1\*(1), 29-32.*
49. Spotorno, N., Koun, E., Prado, J., Van Der Henst, J. B., & Noveck, I. A. (2012). Neural evidence that utterance-processing entails mentalizing: the case of irony. *\*NeuroImage, 63\*(1), 25-39.*
50. Tabernero, C. (2016). Con no sé qué vislumbres de ironía: indicadores y marcas de la ironía en el viaje del parnaso. *\*Alpha, 43\*, 205-217.*



51. Taberero, M. E., & Politis, D. G. (2013). Reconocimiento de emociones básicas y complejas en la variante conductual de la demencia frontotemporal. *\*Neurología Argentina, 5\*(2), 57-65.*
52. Vieillard, S., & Guidetti, M. (2009). Children's perception and understanding of (dis)similarities among dynamic bodily/ facial expressions of happiness, pleasure, anger, and irritation. *\*Journal of Experimental Child Psychology, 102\*(1), 78-95.*
53. Wakusawa, K., Sugiura, M., Sassa, Y., Jeong, H., Horie, K., Sato, S., Yokoyama, H., Tsuchiya, S., Inuma, K., & Kawashima, R. (2007). Comprehension of implicit meanings in social situations involving irony: A functional MRI study. *\*NeuroImage, 37\*(4), 1417-1426.*
54. Wang, A. T., Lee, S. S., Sigman, M., & Dapretto, M. (2006). Developmental changes in the neural basis of interpreting communicative intent. *\*Social Cognitive and Affective Neuroscience, 1\*(2), 107-121.*
55. Williams, J. A., Burns, E. L., & Harmon, E. A. (2009). Insincere utterances and gaze: eye contact during sarcastic statements. *\*Perceptual and Motor Skills, 108\*(2), 565-572.*
56. Wilson, D., & Sperber, D. (2012). Explaining irony. In D. Wilson & D. Sperber (Eds.), *\*Meaning and relevance\** (pp. 123-146). New York: Cambridge University Press.
57. Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *\*Acta Psychiatrica Scandinavica, 67\*, 361-370.*

## Use of essential oils extracted from the Caatinga as an alternative for the treatment of infectious diseases and inflammation

 <https://doi.org/10.56238/sevned2024.016-007>

**Bárbara Mendes de Sousa<sup>1</sup>, Anna Clara Silva Torres<sup>2</sup>, Pedro Henrique Alves Guedes<sup>3</sup>, Liz Helena Pereira Silva<sup>4</sup>, Thais Freitas de Lira<sup>5</sup>, Teresa Dávila Cruz Matias<sup>6</sup>, Cicero Igno Guedes Bezerra<sup>7</sup>, Maria Adriana Simão Figueirêdo<sup>8</sup>, Lucas de Oliveira Sá<sup>9</sup>, Sabrina Kaylane da Silva Alves<sup>10</sup> and Mariana Gomes Vidal Sampaio<sup>11</sup>**

### ABSTRACT

Secondary plant metabolites, such as essential oils from the Caatinga, have diverse therapeutic properties, including antimicrobial and anti-inflammatory action. Studies highlight its effectiveness against infections, promoting alternative use in medicine. The research addressed in this work provides a comprehensive view of the therapeutic potential of essential oils extracted from medicinal plants found in the Caatinga Morphoclimatic Domain, located in Northeast Brazil. Thus, this is a systematic review of the qualitative literature, based on descriptors that follow the direction of the Health Sciences Descriptors (DeCS), used in the VHL (Virtual Health Library) search engine: "Caatinga", "Medicinal Plants", "Volatile Oils", "Anti-inflammatory", "Antibacterial", "Antiparasitic" and "Antioxidant", which were applied in the following databases: Scielo; Medline; Lilacs; PubMed and Elsevier. Several plant species and their respective essential oils were investigated, highlighting their antioxidant, antimicrobial, anti-inflammatory and antiparasitic properties. The results showed that the essential oils of Caatinga plants have a wide range of chemical

<sup>1</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [barbaramendes23@aluno.fapce.edu](mailto:barbaramendes23@aluno.fapce.edu)

<sup>2</sup> Resident Pharmacist in Collective Health and Network Management SES-PE

E-mail: [annaclaratorresfal@gmail.com](mailto:annaclaratorresfal@gmail.com)

<sup>3</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [pedroguedes@aluno.fapce.edu.br](mailto:pedroguedes@aluno.fapce.edu.br)

<sup>4</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [liz\\_silva@aluno.unifapce.edu.br](mailto:liz_silva@aluno.unifapce.edu.br)

<sup>5</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [thaisfreitas@aluno.fapce.edu.br](mailto:thaisfreitas@aluno.fapce.edu.br)

<sup>6</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [teresadavilaem@aluno.fapce.edu.br](mailto:teresadavilaem@aluno.fapce.edu.br)

<sup>7</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [ignobezerra@aluno.unifapce.edu.br](mailto:ignobezerra@aluno.unifapce.edu.br)

<sup>8</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [mariaadriana@aluno.fapce.edu.br](mailto:mariaadriana@aluno.fapce.edu.br)

<sup>9</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [lucasoliv.sa@aluno.unifapce.edu.br](mailto:lucasoliv.sa@aluno.unifapce.edu.br)

<sup>10</sup> Pharmacy student

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [sabrinakaylane@aluno.unifapce.edu.br](mailto:sabrinakaylane@aluno.unifapce.edu.br)

<sup>11</sup> PhD in Biological Sciences

Institution: Centro Universitário Paraíso - (UniFAP)

E-mail: [mariana.sampaio@fapce.edu.br](mailto:mariana.sampaio@fapce.edu.br)



compounds, such as terpenes, aldehydes, phenols and esters, which confer their medicinal properties. These compounds have the potential to be used as therapeutic alternatives in the treatment of various health conditions, including bacterial, parasitic and inflammatory infections. In addition, the study highlights the importance of preserving the biodiversity of the Caatinga and the traditional knowledge associated with the use of medicinal plants in the region. The integration between popular knowledge and scientific research is essential to fully explore the therapeutic potential of these plants, contributing to the promotion of public health and the development of new therapies. In addition, it is essential to ensure sustainable practices for the use and management of medicinal plants in the Caatinga, to preserve their biodiversity and the ancestral knowledge associated with their use.

**Keywords:** Caatinga, Medicinal Plants, Volatile Oils.



## INTRODUCTION

Secondary metabolites are substances produced by plants from their primary metabolism in specific situations. Currently, much has been invested in research on the application of these substances for various purposes. Among them, it is worth mentioning studies on antioxidant, antimicrobial, anti-inflammatory, anticarcinogenic, cardioprotective action and in use outside the field of medicine (Cunha, 2016).

Volatile oils, or essential oils, are volatile compounds, a product of the secondary metabolism of plants, extracted from them through complex laboratory techniques for various uses in therapy, as they are capable of modifying the homeostasis of organisms by mechanisms that are often unknown, due to their high molecular complexity (Simões, 2017).

For Moura et al. (2019), Brazil is a country rich in plant species with therapeutic potential through the extraction of essential oils. According to the authors, the main genera of plants conducive to providing essential oils as a product of secondary metabolism are *Myrtaceae*, *Lauraceae*, *Rutaceae*, *Lamiaceae*, *Asteraceae*, *Apiaceae*, *Cupressaceae*, *Poaceae*, *Zingiberaceae* and *Piperaceae*, with species spread in these families.

Among the species found in Brazil, it is important to highlight that the Caatinga semi-arid morphoclimatic domain, found predominantly in the northeast region of the country, is the source of a diversity of essential oil-producing species. The volatile oils found in the Caatinga represent an important component due to their biodiversity, their application in aromatherapy, and their therapeutic purposes (Sampaio *et al.*, 2023).

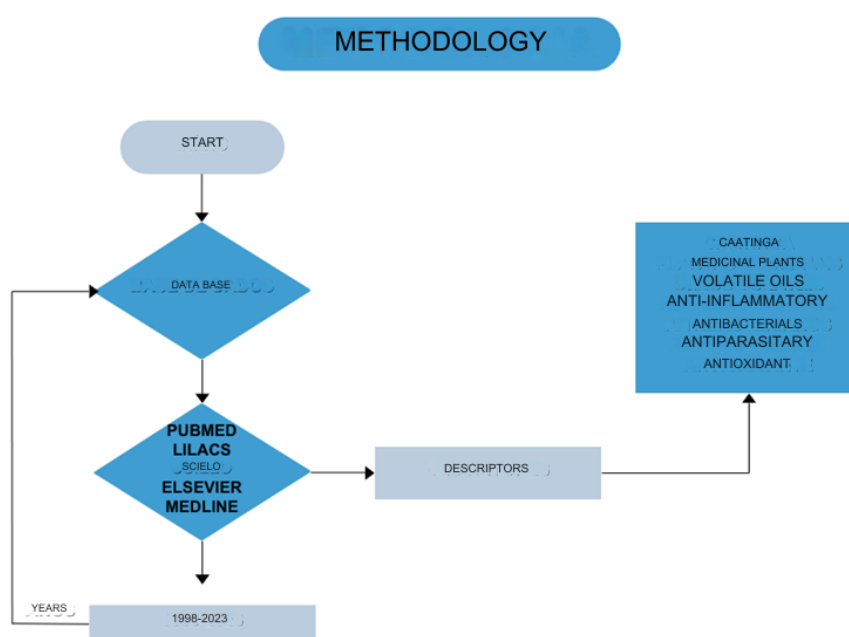
In addition to being known for their fragrance, essential oils have a medicinal function due to their antiseptic, bactericidal, fungicidal and anti-inflammatory properties. According to the National Institute of the Semi-Arid Region, in 2017, the essential oil extracted from the leaves of Jatobá (*Hymenaea courbaril*) in the city of Buíque-PE, in the northeastern region of Brazil, showed properties such as sesquiterpenes and caryophyllene oxide, substances with antimicrobial action, which proved effective as an alternative treatment for infections such as candidiasis, caused by fungi of the genus *Candida* (Gomes, 2017).

In addition, this work seeks to present a fraction of the diversity of essential oils extracted from medicinal plants present in the Caatinga biome, which play an important role as a complementary treatment of infections. It is of paramount importance that its compounds and therapeutic benefits are identified to promote alternative treatment options for the population, and it is necessary that new research be carried out and continue to look at the Caatinga in order to scientifically prove what has been rooted in popular knowledge for thousands of years, the therapeutic effectiveness of the vegetation of this biome.

## LITERATURE REVIEW METHODOLOGY

For the construction of the present work, a systematic review of the qualitative literature was carried out. In which, in the search phase, the search was carried out in journal articles, books, simple abstracts, monographs, master's dissertations and theses. The present study selected some descriptors, following the guidelines of the Health Sciences Descriptors (DeCS), used in the VHL (Virtual Health Library) search engine, as shown in the figure below. With this, the following databases were selected: Scielo (Scientific Electronic Library Online); Medline (Medical Literature Analysis and Retrieval System Online); Lilacs (Latin American and Caribbean Literature on Health Sciences), PubMed (U.S. National Library of Medicine) and Elsevier. The inclusion criteria were publications between the years 1998 and 2023, in which articles in English and Portuguese were searched. In addition, articles that addressed the theme and classes of secondary metabolites describing their use were included, and those that did not fit the cited content and outside the preferred date were excluded.

Figure 1: Methodology flowchart



Source: Authorship

## RESULTS AND DISCUSSION

### MEDICINAL PLANTS OF THE CAATINGA MORPHOCLIMATIC DOMAIN

Brazil is a country rich not only in cultural plurality, but also in biodiversity. This is reflected thanks to the well-established characteristics of each region, bringing their richness in fauna and flora, as well as the study and search for therapeutic effectiveness of the medicinal plants of each biome (Sganzerla, 2022).



According to Dos Reis *et al.* (2023), when it comes to the Caatinga, it is important to note that it is an exclusively Brazilian biome with a semi-arid climate located in the Northeast of Brazil. This biome is characterized by high temperatures, long periods of drought and drought. For this reason, its vegetation had to develop survival mechanisms due to the low availability of water. The vegetation of the Caatinga is basically formed by xerophytic plants, shrubs and low trees that have the capacity to store a large amount of water. Despite the peculiarity of characteristics, they also have therapeutic effects when used for medicinal purposes (Emiliano; Balliano, 2019).

Popular knowledge about the therapeutic benefit of plants is rooted and passed on to the community from generation to generation, since the beginning, coming from indigenous and African culture and all the peoples that represent the matrix of Brazil. However, the region is impacted by exploratory activities of agriculture and extractivism, thus forming areas of desertification, in addition, with the advance of the pharmaceutical industry and the insertion of synthetic products, diversity and popular knowledge are threatened, requiring studies and new analyses for this knowledge and use to remain alive (Sá-filho, 2023).

Thanks to the continuity of these studies, evidence of *the* efficacy of Caatinga plants is found in the scientific literature in vitro tests. A great example is the *Amburana cearensis* (umburana-de-cheiro), used by the population in the form of teas. This plant has scientific proof of its effectiveness in the treatment of inflammations of the respiratory system such as sinusitis, bronchitis, cough and flu. It has also shown effectiveness for the treatment of rheumatism and cardiovascular problems. For this reason, a more in-depth study of other pharmaceutical forms with *Amburana cearenses* as the base active ingredient is feasible (Araújo; Amorim, 2023).

Another example to be cited is the study by Souza *et al.* (2021) which points out that *Myracrodruon urundeuva* (Aroeira) is composed of flavonoids and phenolics. Due to the presence of these compounds, the plant exhibits anti-inflammatory, antifungal, and antioxidant activities.

### Essential oils extracted from Caatinga plants

According to the International Standard Organization (ISO) "Volatile oils, also called essential oils, ethereal oils or essences, are complex mixtures of volatile, lipophilic, generally odorous and liquid substances, obtained from plant raw materials" (Heinzmann; Spitzer; Simões, 2017, p. 311).

The Caatinga is a region that has many medicinal plants that produce essential oils that can be found in some parts of the plants such as: leaves; Flowers; Roots; Rhizomes; seeds and peels. These regions are responsible for characterizing the aroma of each species, with these oils performing various functions such as attracting pollinators and protecting against insects. In this way, oils also





have pharmacological effects, used for therapeutic purposes, with the main chemical compounds present: terpenes, aldehydes, phenols and esters (Fischer, 2014).

The main extraction methods for volatile oils are carried out by: water vapor drag and soxhlet apparatus. The water vapor drag method is carried out with the addition of water in the first balloon, this water needs to be heated through the heating plate. In the second flask is added the plant material that you want to remove the essential oil, the material must be crushed with a little water. When the vapor from the heated water reaches the plant material that is in balloon two, the substances present in the sample are transformed into vapor, where they are taken to the condenser. To pass from the gaseous to the liquid state, in which the liquid is collected by a beaker (Heinzmann; Spitzer; Simões, 2017).

Extraction with the soxhlet device takes place as follows: The extracting solvent is added to the flask in liquid or solid form, this flask is heated by means of a thermal blanket. With heating, a vapor is formed, which passes through the condenser, in the glass reservoir is present the plant sample, which is solubilized with the condenser. This step occurs several times, when the solvent reaches a certain limit of the condenser it comes back to repeat the entire extraction cycle (Menezes, 2016).

Thus, some examples of medicinal plants from the caatinga that are extracted from essential oils for therapeutic purposes are *Lippia sidoides*, popularly known as rosemary-pepper, *Hymenaea courbaril*, a plant known as Jatobá, from which it has in its leaves the production of essential oil and *Cymbopogon flexuosos*, called lemongrass. According to table 01, the essential oils of these plants can be found in the leaves and/or in other structures such as roots, stems and rhizomes. *Mentha piperita*, for example, has its essential oil extracted from the glandular trichomes of the plant, in which an intense amount of menthol is found (Roque, 2010).

Table 01: Main medicinal plants found in the Caatinga, producers of essential oils.

Popular name	Scientific name
Mint	<i>Mentha piperita</i>
Citronella	<i>Cymbopogon winterianus</i>
Lemongrass	<i>Cymbopogon flexuosos</i>
Eucalyptus	<i>Eucalyptus benthamii</i>
Camomile	<i>Chamomilla recutita</i>

Source: Brito, 2010.

### Antibacterial activity of essential oils from the Caatinga

The medicinal flora of the caatinga presents, in many studies, antimicrobial activity, highlighting essential oils as secondary metabolites that can be applied in medicine for the treatment of microorganisms of medical interest, stating that these are a promising source for this (Dantas *et al.*, 2010). On the other hand, due to having several components in their composition, essential oils

provide a lower probability of developing bacterial resistance, since their mechanism of action is not based on just one target (Farisa, 2017).

One of the plant species in which inhibition of bacterial growth can be observed is *Croton tetradenius*, in which Silva (2019) verified the antibacterial activity of the essential oil extracted from its leaves, where the size of the halo should be greater than 10mm to consider the sample active against the strain. In this study, inhibition of the growth of *Staphylococcus aureus* and *Escherichia coli* strains was observed in front of paper discs soaked with pure essential oil in two different concentrations, both compared to the antibiotic amikacin, where the mean growth inhibition (in triplicate) was shown in Table 1.

Table 1: Diameter of the inhibition halos after analysis of the antimicrobial activity of *Croton tetradenius essential oil*.

Microorganism	Essential oil at 10 $\mu$ L/disc	Essential oil at 15 $\mu$ L/disc	Amicatin 30 $\mu$ g/disc
<i>Staphylococcus aureus</i>	18mm	21mm	29mm
<i>Escherichia coli</i>	10mm	13mm	20mm

Adapted from Silva, 2019.

It can be observed that the essential oil of this species from the Caatinga can be promising, especially in strains of *S. aureus*. Nevertheless, it is observed that the Gram-positive strains have a greater susceptibility to the action of some of the essential oils from the caatinga. This factor is due to the action of secondary metabolites together, or isolated, such as the essential oil extracted from the bark and leaf of *Myroxylon peruiferum*, where the isoflavones 7-hydroxy-4', 6-dimethoxy-isoflavones showed both antibacterial (for Gram-positive strains), antifungal and antioxidant activities, indicating the need for a study of these in order to investigate their mechanism of action in depth (Pereira, 2018).

Not restricted only to Gram-positive bacteria, the species *Lippia gracilis* showed good results against the inhibition of the growth of strains of *Listeria monocytogenes*, as well as of the Gram-positive *Staphylococcus aureus* and *Staphylococcus epidermis*, where the diameter of the inhibition halos of the undiluted essential oil presents promising results when compared to the antibiotic chloramphenicol at 4mg/mL, as can be used to prevent the growth of *Listeria monocytogenes*. can be seen in Table 2 (Dantas *et al.*, 2010).

Table 2: Diameter of the largest observed inhibition halos obtained from the undiluted O.E of *Lippia gracilis* compared to the antibiotic chloramphenicol.

Microorganism	<i>Lippia gracilis essential oil</i> (mm)	Clorafenicol 4mg/mL (mm)
<i>Listeria monocytogenes</i>	34	32
<i>Staphylococcus aureus</i>	36	33
<i>Staphylococcus epidermis</i>	40	21

Fonte: Adaptado de Dantas *et al.* (2010).

In this sense, it is evident from the presentation of the studies that the essential oils of plants from the caatinga can be promising antibiotics, however more research must be done in order to find, in the flora, therapeutic options for the pathologies that afflict the population (Dantas *et al.*, 2010).

The essential oil of *Eugenia uniflora* showed antimicrobial activity against eight bacteria, in a disk diffusion test. The antibiotics used for comparison purposes were sulfadiazine and cephalothin. Its greatest antimicrobial potential was against *Listeria monocytogenes* and *Staphylococcus aureus*, and was not effective against gram-negative bacteria. The values of the tests are expressed in the following table (Silva, 2019).

Table 3 . Antibacterial activity of the leaf essential oil of *Eugenia uniflora*

Bacteria	Inhibition zone (mm)		
	<i>Eugenia uniflora</i>	Sulfadiazine	Cephalotin
<i>Listeria monocytogenes</i>	18 ± 3.2	30	24
<i>Staphylococcus aureus</i>	26 ± 7.0	36	40
<i>Escherichia coli</i>	10 ± 0.6	28	32
<i>Salmonella disenteriae</i>	N/A	30	26
<i>Pseudomonas aeruginosa</i>	8 ± 0.5	22	27
<i>Salmonella enteritidis</i>	N/A	44	28
<i>Aeromonas hidrophila</i>	13 ± 3.0	20	24

Source: Victoria (2012).

### Antiparasitic activity of essential oils from the Caatinga

The knowledge of the native peoples of the northeast region of Brazil becomes essential for understanding the diversity of plants and their effects. A study carried out in the village of Baixa das Pedras, located in the state of Bahia, brings to light the main indications for the use of medicinal plants with antiparasitic action used daily by these peoples. In this way, plants such as aloe, mastruz, caçatinga and among other species mentioned, evidence the rich knowledge of these peoples about the medicinal properties of these plants (Santos-Lima *et al.*, 2016).

Parasitosis represents one of the main causes of death worldwide and a worrying health problem, covering about two to three million deaths per year. These pathologies are associated with social, environmental, cultural and economic factors, with most of those affected living in areas that still lack adequate infrastructure and are routinely exposed to contaminated food and infected soils (Wiebbelling, 2015).

Rosa *et al.*, (2003) conducted a study of the anti-*Leishmania amazonensis* activity of the essential oil of *Croton cajucara leaves*, and noted that the plant acted in the reduction of the association between parasites and macrophages. In this study, it was identified that linalool, a substance present in the essential oil, could be responsible for the effects described in addition to inhibiting macrophages. Under this bias, the selectivity of this oil has been proven and new studies cite the oil as a promising source for the treatment of leishmaniasis.

In addition, the essential oils of *Copaifera reticulata* and *Lippia sidoides* were also tested against the promastigote forms of *Leishmania*, the results showed that the aforementioned oils were effective compared to the positive control pentamidine (Rondon *et al.*, 2012). Furthermore, Zheljaskov *et al.*, (2008) also showed that minority constituents such as  $\delta$ -cadinene, found in basil essential oil, had inhibitory effects against *Leishmania donovani*.

In a study carried out by researchers from the Institute of Physics of São Carlos (IFSC) of USP, the activity of Citronellol, a chemical compound present in essential oils of several species, including the essential oil of *Lippia Citriodora*, which showed an important antiparasitic action against *Schistosoma mansoni*, was described. etiological agent of schistosomiasis. In this research, it was found that the terpene Citronellol is capable of damaging the external body structure of the parasite, causing difficulty in its survival (Mafud *et al.*, 2016).

### Antioxidant activity of essential oils from the Caatinga

It is highlighted how the *Libidibia ferrea* plant has several groups, such as terpenes, phenolic compounds and flavonoids, which justify its popular use as anti-inflammatories, in addition to its use as hypoglycemic agents, corroborated by its enzymatic activity that helps control glucose levels. (Jacob *et al.*, 2022)

*Urera bacifera* has in its composition the presence of flavonoids, in addition to antioxidant and anti-inflammatory and even gastroprotective activity, in view of its action of reducing pepsin and modulating the action of interleukins 10, 6 and 4 (Benvenuti *et al.*, 2020). While *Hymenaea cangeceira*, popularly known as jatobá has anti-inflammatory, antioxidant and analgesic properties in the ethanolic and organic extracts of its essential oil, its anti-inflammatory capacity has been compared to other analgesics in mouse models, in addition, it also has antimicrobial activity against the formation of colony films of Gram positive and negative bacteria. (Veras *et al.*, 2020)

According to studies carried out with mice, the essential oils of *Alibertia edulis* have an enzymatic potential to protect against hyperglycemia and dyslipidemia, even in animals exposed to diets that put them at risk with hypercaloric, influencing catabolism without signs of toxicity (Aquino *et al.*, 2020).

*Amburana cearensis*, which is popularly used in urinary and respiratory tract infections, also has its antioxidant property discussed, highlighting how in vivo models its extract protects cells of the nervous system against inflammation. (Pereira *et al.*, 2017).

*Syzygium jambos* has in its phytochemical activity a large amount of flavonoids, associated with antioxidant activity, in addition to the *in vivo studies* discuss the influences of the aqueous extract of this plant on the action of catalytic enzymes such as peroxidase and glutathione, in addition



to the potential to modulate the action of nitrous oxide, and protection against oxidative stress in neuronal cells. (Bonfanti *et al.*, 2013).

In a study where more than 30 plants were analyzed with possible antioxidant activities and belonging to the Caatinga Morphoclimatic Domain, the following were highlighted: *Passiflora cincinata*, *Callisia repens*, *Byrsonima gardneriana*, *Serjania glabrata*, *Diospyros gaultheriifolia*, *Cordia globosa* and *Myrsine coriacea*. None of these plants has antioxidant activity comparable to a drug, however, in addition to having low toxicity, they can be very important sources of substances that protect against oxidative stress (David *et al.*, 2007).

In one of the studies developed with ethanolic extract of *Achyrocline satureioides*, a high amount of flavonoids was found, more than 80%, however, in vivo, this extract showed toxicity, encouraging the peroxidation of lipid membranes very easily (Polydoro *et al.*, 2005).

The aqueous extract of the stem of *Ziziphus joazeiro* has medium potential activity against plaque-forming bacteria and caries, in addition to presenting low toxicity (Alviano *et al.*, 2008). In addition, the aqueous and methanolic extract of *Achyrocline satureioides*, popularly known as marcela, had its oxidation modulating activity proven (Desmachelier *et al.*, 1998).

### Anti-inflammatory activity of essential oils from the Caatinga

Essential oils obtained from plants of the genus *Croton* (*Euphorbiaceae*) have a pleasant aroma and represent sources of biologically active molecules, which give rise to chemically distinct compounds of great scientific relevance and widely used in popular therapy. The objective of this study was to investigate the anti-inflammatory effect of OECz and anethole in mouse models of paw edema in mice, both in carrageenan-induced non-immune animals and in ovalbumin-induced sensitized animals. Both showed anti-edematogenic activity, inhibiting kinins and nitric oxide in acute inflammations. (Bridges *et al.*, 2009).

*Eugenia gracilima*, an important plant in the Caatinga with anti-inflammatory properties, is widely used by the population, despite the scarcity of reports in the literature about its medicinal potential. Thus, the essential oil was obtained by hydrodistillation of the leaves, identified for its chemical composition and evaluated for acute toxicity and anti-inflammatory activity. In the paw edema test, tested concentrations of OEEg inhibited inflammation by up to 98.20%, indicating safety and efficacy in reducing inflammation. (Guedes, 2021).

The Caatinga biome also has plants of the genus *Lippia* (*Verbenaceae*), traditionally used in the treatment of disorders related to the respiratory system and gastrointestinal problems. Such plants have been studied as essential oils in the treatment of edema, acting as an anti-inflammatory (Lima, 2018).

*Eugenia brejoensis* is a species used in traditional medicine for the treatment of inflammatory diseases, pain in general and fever. Although essential oils have interesting biological activities, their pharmaceutical use is limited due to their physicochemical properties. Oral administration of the oil and the inclusion complex showed no acute toxicity or genotoxicity. The results obtained validate its relevant use in formulations developed for application in new pharmaceutical presentations (Silva, 2022).

*Myracrodruon urundeuva* Allemão (Aroeira-do-Sertão), belonging to the *Anacardiaceae* family, is widely used in folk medicine in the Brazilian Northeast due to its anti-inflammatory, healing and anti-ulcer properties. The study investigated replacing the bark of the adult tree with developing shoots to conserve the species and provide raw material. The extracts of the sprouts were chemically characterized and evaluated for their gastroprotective and anti-inflammatory activities, similar to those of the inner bark, indicating viability for sustainable pharmaceutical use (Galvão *et al.*, 2018)

*Plectranthus species*, mainly *Plectranthus barbatus* (Boldo), due to their analgesic and anti-inflammatory potentials. The results show that extracts from various species possess significant anti-inflammatory activity, demonstrated by the inhibition of pro-inflammatory mediators and inflammatory enzymes. These results highlight the potential of *Plectranthus species* as sources of bioactive compounds with therapeutic applications (Barbosa *et al.*, 2023).

*Hymenaea martiana*, known as "Jatobá" in northeastern Brazil, is used in folk medicine to treat pain and inflammation. In order to prove its applicability, tests were carried out on mice to evaluate its antinociceptive and anti-inflammatory activity. The results obtained in the tests proved the efficacy of *Hymenaea martiana* in reducing the migratory activity of the inflammatory process. Highlighting the importance of studies focused on the powers of the Caatinga, as another source of therapeutic resources (Pacheco *et al.*, 2022).

## CONCLUSION

In view of the above, it is evident that the caatinga is a biome rich in biodiversity, in addition to several species of medicinal plants can be found in its flora. The secondary metabolites present in these plants are the target of constant research to understand the pharmacological mechanisms they present.

One of the ways in which the caatinga plants are used medicinally is through essential oils, which demonstrate antimicrobial, antioxidant and anti-inflammatory activities, serving as an incentive for new study targets with this metabolite.

Therefore, it is essential to deepen interdisciplinary studies in order to fully explore the therapeutic potential of medicinal plants from the Caatinga, through the integration of traditional



knowledge with contemporary scientific approaches. This approach not only allows the appreciation and preservation of the unique biodiversity of this biome, but can also result in significant contributions to the promotion of public health, expansion of the therapeutic network and the progress of scientific knowledge, for the benefit of society as a whole.



## REFERENCES

1. Albuquerque, A. M. C., et al. (2021). Conhecimentos populares sobre plantas medicinais da caatinga na construção de uma oficina didática para o ensino de ciências. \*Experiências em Ensino de Ciências, 16\*(1), 567-584.
2. Alviano, W. S., Alviano, S. D., Dinis, C. G., et al. (2008). In vitro antioxidant potential of medicinal plant extracts and their activities against oral bacteria based on Brazilian folk medicine. \*Archives of Oral Biology, 53\*(6), 545-552. <https://doi.org/10.1016/j.archoralbio.2007.12.001>
3. Aquino, D. F. S., Monteiro, T. A., Cardoso, C. A. L., et al. (2020). Investigation of the antioxidant and hypoglycemic properties of *Alibertia edulis* (L.C. Rich.) A.C. Rich. leaves. \*Journal of Ethnopharmacology, 253\*, e112648. <https://doi.org/10.1016/j.jep.2020.112648>
4. Araújo, F., & Amorim, N. (2023). Atividade terapêutica da *Amburana Cearensis*. \*Revista Multidisciplinar do Nordeste Mineiro, 12\*(1).
5. Barbosa, M. O., et al. (2023). *Plectranthus* species with anti-inflammatory and analgesic potential: A systematic review on ethnobotanical and pharmacological findings. \*Molecules (Basel, Switzerland), 28\*(15), 5653. <https://doi.org/10.3390/molecules28155653>
6. Benvenuti, R. C., Vecchia, C. A. D., Locateli, G., et al. (2020). Gastroprotective activity of hydroalcoholic extract of the leaves of *Urera baccifera* in rodents. \*Journal of Ethnopharmacology, 250\*, e112473. <https://doi.org/10.1016/j.jep.2019.112473>
7. Bonfanti, G., Bitencourt, P. R., Bona, K. S., et al. (2013). *Syzygium jambos* and *Solanum guaraniticum* show similar antioxidant properties but induce different enzymatic activities in the brain of rats. \*Molecules, 18\*(8), 9179-9194. <https://doi.org/10.3390/molecules18089179>
8. Brito, H. R. (2010). Caracterização química de óleos essenciais de *Spondias mombin* L., *Spondias purpurea* L. e *Spondias* sp (cajarana do sertão)\* (Dissertação de mestrado). Universidade Federal de Campina Grande, Patos, Paraíba.
9. Carneiro, N. S., Alves, J. M., Alves, C. C. F., Esperandim, V. R., & Miranda, M. L. D. (2017). Óleo essencial das flores de *Eugenia klotzschiana* (MYRTACEAE): sua composição química e atividades tripanocida e citotóxica in vitro. \*Revista Virtual de Química, 9\*(3).
10. Cunha, A. L., et al. (2016). Os metabólitos secundários e sua importância para o organismo. \*Diversitas Journal, 1\*(2), 175-181.
11. Dantas, L. I. S., et al. (2010). Atividade antibacteriana do óleo essencial de *Lippia gracilis*\* Schauer sobre patógenos de importância na indústria de alimentos. \*Holos, 5\*, 114-123.
12. David, J. P., Meira, M., David J. M., et al. (2007). Radical scavenging, antioxidant and cytotoxic activity of Brazilian Caatinga plants. \*Fitoterapia, 78\*(3), 215-218. <https://doi.org/10.1016/j.fitote.2006.11.015>
13. De, S. F., Geovan, F., et al. (2021). Plantas medicinais utilizadas na caatinga brasileira e o potencial terapêutico dos metabólitos secundários: uma revisão. \*Research, Society and Development, 10\*(13), e140101321096-e140101321096.
14. Desmarchelier, C., Coussio, J., & Ciccio, G. (1998). Antioxidant and free radical scavenging effects in extracts of the medicinal herb *Achyrocline satureioides* (Lam.) DC. ("marcela"). \*Brazilian



15. Emiliano, S. A., & Balliano, T. L. (2019). Prospecção de artigos e patentes sobre plantas medicinais presentes na caatinga brasileira. *\*Cadernos de Prospecção*, 12\*(3), 615-615.
16. Farisa, B., et al. (2017). Antivirulent properties of underexplored *\*Cinnamomum tamala\** essential oil and its synergistic effects with DNase against *\*Pseudomonas aeruginosa\** Biofilms—an in vitro study. *\*Frontiers in Microbiology*, 8\*, 1144.
17. Galvão, W. R. A., et al. (2018). Gastroprotective and anti-inflammatory activities integrated to chemical composition of *\*Myracrodruon urundeuva\** Allemão - A conservationist proposal for the species. *\*Journal of Ethnopharmacology*, 222\*, 177–189.  
<https://doi.org/10.1016/j.jep.2018.04.024>
18. Guedes, J. B. (2021). Composição química e avaliação da toxicidade aguda e atividades antinociceptiva e anti-inflamatória do óleo essencial das folhas de *\*Eugenia gracillima\** Kiaersk (Dissertação de mestrado). Universidade Federal de Pernambuco, Recife.
19. Heinzmann, B. M., Spitzer, V., & Simões, C. M. O. (2017). Óleos voláteis. In C. M. Simões et al. (Eds.), *\*Farmacognosia: do Produto Natural ao Medicamento\** (pp. 310-337). Porto Alegre: Editora Artmed.
20. Jacob, M. C. M., Silva, M. J. K., Albuquerque, U. P., & Pereira, F. O. (2022). Culture matters: A systematic review of antioxidant potential of tree legumes in the semiarid region of Brazil and local processing techniques as a driver of bioaccessibility. *\*PLoS One*, 17\*, e0264950.  
<https://doi.org/10.1371/journal.pone.0264950>
21. Mafud, A. C., et al. (2016). Structural parameters, molecular properties, and biological evaluation of some terpenes targeting *\*Schistosoma mansoni\** parasite. *\*Chemico-Biological Interactions*, 244\*, 129-139. <https://doi.org/10.1016/j.cbi.2015.12.018>
22. Menezes, E. G. T. (2016). Obtenção de óleos de sementes de frutos do cerrado utilizando diferentes processos de extração (Tese de doutorado). Universidade Federal de Lavras, Lavras.
23. Moura, R. M. R., et al. (Eds.). (2019). *\*Anais VI JOIN / Brasil - Portugal\**. Campina Grande: Realize Editora.
24. Pacheco, A. G. M., et al. (2022). Antinociceptive and anti-inflammatory activities of *\*Hymenaea martiana\** Hayne (Fabaceae) in mice. *\*Brazilian Journal of Biology*, 82\*, e240359.
25. Pereira, E. P. L., Souza, C. S., Amparo, J., Ferreira, R. S., et al. (2017). *\*Amburana cearensis\** seed extract protects brain mitochondria from oxidative stress and cerebellar cells from excitotoxicity induced by glutamate. *\*Journal of Ethnopharmacology*, 209\*, 157-166.  
<https://doi.org/10.1016/j.jep.2017.07.017>
26. Pereira, R. (2018). Atividade antimicrobiana e antioxidante de metabólitos bioativos e óleo essencial de plantas da caatinga: *\*Myroxylon peruiferum Lf\** e *\*Combretum leprosum\**.
27. Polydoro, M., Souza, K. C. B., Andrades, M. E., Silva, E. G., et al. (2004). Antioxidant, pro-oxidant and cytotoxic effects of *\*Achyrocline satureioides\** extracts. *\*Life Sciences*, 74\*(23), 2815-2826. <https://doi.org/10.1016/j.lfs.2003.09.073>




28. Ponte, E. L. (2009). Efeito Anti-Inflamatório do Óleo Essencial de *Croton Zehntneri Pax Et Hofm*\*. Dissertação de mestrado não publicada, Universidade Estadual do Ceará, 2009. Recuperado de <http://siduece.uece.br/siduece/trabalhoAcademicoPublico.jsf?id=53699>
29. Rondon, F. C. M., Bevilaqua, C. M. L., Accioly, M. P., Morais, S. M., Andrade-Júnior, H. F., Carvalho, C. A., Lima, J. C., & Magalhães, H. C. R. (2012). In vitro efficacy of *Coriandrum sativum*\*, *Lippia sidoides*\* and *Copaifera reticulata*\* against *Leishmania chagasi*\*. *Revista Brasileira de Parasitologia Veterinária*, 21\*(3), 185-191.
30. Rosa, M. S. S., Mendonça-Filho, R. R., Bizzo, H. R., Rodrigues, I. A., Soares, R. M. A., Souto- Padrón, T., Alviano, C. L., & Lopes, A. H. C. S. (2003). Antileishmanial activity of a linalool-rich essential oil from *Croton cajucara*\*. *Antimicrobial Agents and Chemotherapy*, 47\*(6), 1895-1901.
31. Sampaio, P. S. (2023). Extração de óleos essenciais de plantas da caatinga. Iniciação científica apresentada no 62º Congresso Brasileiro de Química, Natal, Rio Grande do Norte, 2023. Recuperado de <https://www.abq.org.br/cbq/2023/trabalhos/13/24733-30056.html>
32. Santiago, A. C. (2016). Efeito anti-inflamatório do óleo essencial de *Lippia gracilis*\* Schauer. In *I Congresso Internacional da Diversidade do Semiárido do Centro Multidisciplinar de Estudos e Pesquisas*\*, 5 p., Campina Grande.
33. Santos-Lima, T. M., et al. (2016). Plantas medicinais com ação antiparasitária: conhecimento tradicional na etnia Kantaruré, aldeia Baixa das Pedras, Bahia, Brasil. *Revista Brasileira de Plantas Medicinais*, 18\*(1), 240–247.
34. Sganzerla, C. M., et al. (2021). Revisão integrativa aplicada a levantamentos etnobotânicos de plantas medicinais no Brasil. *Revista Acta Ambiental Catarinense*, 19\*(1), 01-16.
35. Sharifi-Rad, J., Sureda, A., Tenore, G. C., Daglia, M., et al. (2017). Biological activities of essential oils: From plant chemocology to traditional healing systems. *Molecules*, 22\*(1), 70.
36. Silva, G. C. (2022). Desenvolvimento de formulações com o óleo essencial de *Eugenia brejoensis* Mazine\* (Myrtaceae): estudo toxicológico, genotóxico e avaliação das atividades antinociceptiva e anti-inflamatória. Tese de doutorado, Universidade Federal de Pernambuco, Recife.
37. Silva, M. A. N. A. (2019). Atividade antibacteriana do óleo essencial de *Croton tetradenius*\* Baill frente a espécies de bactérias patogênicas. Trabalho de Conclusão de Curso não publicado, Universidade Federal Rural de Pernambuco, Serra-Talhada.
38. Sousa, D. S., et al. (2021). Análise prospectiva científica e tecnológica sobre *Myracrodruon urundeuva*\* (aroeira do sertão) e a resistência bacteriana. *Research, Society and Development*, 10\*(11), e138101119505.
39. Souza, G. S., Bonilla, O. H., Lucena, E. M. P., Barbosa, Y. P. (2017). Chemical composition and yield of essential oil from three *Croton*\* species. *Ciência Rural*, 47\*(8).
40. Tischer, B. (2014). Avaliação do efeito de diferentes métodos de secagem, moagem e extração no óleo essencial de *Baccharis articulata*\* (Lam.) Pers. Dissertação de mestrado não publicada, Universidade Federal de Santa Maria, 2014.



41. Veras, B. O., Melo, M. B., Oliveira, F. G. S., Santos, Y. Q. (2020). Chemical composition and evaluation of the antinociceptive, antioxidant and antimicrobial effects of essential oil from \*Hymenaea cangaceira\*. \*Journal of Ethnopharmacology, 247\*, e112265. <https://doi.org/10.1016/j.jep.2019.112265>
42. Victoria, F. N., et al. (2012). Essential oil of the leaves of \*Eugenia uniflora\* L.: Antioxidant and antimicrobial properties. \*Food and Chemical Toxicology, 50\*(8), 2668-2674.
43. Wiebbelling, A. M. P., Mezzari, A., Schirmer, H., Severo, C. B., Silva, R. K. V., Hanemann, T. (2015). Parasitoses intestinais em crianças de creches/escolas de Porto Alegre: prevalência e profilaxia. \*Raízes e Rumos, 3\*(1), 182-183.
44. World, H. (2003). Intensified control of neglected diseases: Report of an international workshop Berlin 10–12. Geneva: WHO.
45. Zheljazkov, V. D., Cantrell, C. L., Tekwani, B., Khan, S. I. (2008). Content, composition, and bioactivity of the essential oils of three basil genotypes as a function of harvesting. \*Journal of Agricultural and Food Chemistry, 56\*, 380–385.

## Spatial distribution of patients with pressure injuries treated at a teaching hospital

 <https://doi.org/10.56238/sevned2024.016-008>

**Juliana de Oliveira Musse<sup>1</sup>, Cristina Braga<sup>2</sup>, Marcelo Marreira<sup>3</sup>, Maria José dos Reis<sup>4</sup>, Christian Douradinho<sup>5</sup>, Cristina Nunes Capeloa<sup>6</sup>, João Carlos de Andrade Menezes<sup>7</sup>, Carlos Alberto Ocon<sup>8</sup>, Adriana Paula Jordão Isabella<sup>9</sup>, Fernanda Sebastian Mendes Pitanga<sup>10</sup>, Claudia Cristina Soares**

---

<sup>1</sup> Doctor in Health and Environment

Institution: Tiradentes University

EBSERH

E-mail: julimusse@hotmail.com

<sup>2</sup> Doctor in Health Sciences from the Institute of Medical Assistance to the State Public Servant of S. Paulo (IAMSPE)

Institution: Universidade Nove de Julho, Institute of Medical Assistance to the State Public Servant of S. Paulo

E-mail: cris.br@terra.com.br

<sup>3</sup> PhD in Biophotonics Applied to Health Sciences

Institution: Universidade Nove de Julho (UNINOVE)

E-mail: marcelo.marreira@uni9.pro.br

<sup>4</sup> Doctor in Women's Health from the Faculty of Medical Sciences of the State University of Campinas (UNICAMP)

Institution: State University of Campinas (UNICAMP)

E-mail: mjreis03@hotmail.com

<sup>5</sup> Master in Medical Sciences Focus on Gerontology from the Faculty of Medicine of the University of São Paulo (FMUSP)

Institution: Universidade Nove de Julho

E-mail: c.douradinho@uni9.pro.br

<sup>6</sup> Doctor in Biophotonics Applied to Health Sciences

Institution: Universidade Nove de Julho (UNINOVE)

E-mail: cristina.capeloa@uni9.pro.br

<sup>7</sup> Specialist in Urgency and Emergency - FANESE.

Faculty of Administration and Business of Sergipe (FANESE).

EBSERH

E-mail: carlosmzs@yahoo.com.br

<sup>8</sup> Doctor of Health Sciences in Medicine

Institution: Universidade Nove de Julho (UNINOVE)

E-mail: cocion@uni9.pro.br

<sup>9</sup> Doctor in Biophotonics

Institution: Universidade Nove de Julho (UNINOVE)

E-mail: apji@uninove.br

<sup>10</sup> Master in Psychiatry and Mental Health

Institution: Universidade Nove de Julho (UNINOVE)

E-mail: fernandasmp@uninove.br

## ABSTRACT

**Introduction:** Pressure injury (PI) is characterized by pressure exerted mainly on bony prominences, or even related to the use of medical devices. As epidemiological aspects are still scarce in the country, it is appropriate to produce studies that delimit the information for a better characterization of this public health problem, with extraterritorial dimensions. Geoprocessing is a revolutionary technology that encompasses the most diverse disciplines, data, equipment, analysis and interpretations from certain locations and geographic data, thus obtaining maps and/or spreadsheets with information relevant to that region that, when used in the health area, allows the identification and mapping of risks and injuries that affect the population. **Objective:** To demonstrate the technical experience of spatial demarcation and geoprocessing of patients with pressure injuries treated at a teaching hospital in the state of Sergipe. **Method:** A descriptive epidemiological study was carried out from a data sheet of patients with pressure injuries treated by the Skin Care Service team of a teaching hospital in Sergipe, between 2018 and 2022. Georeferencing and geoprocessing were developed in conjunction with Google Maps and Google Earth software. **Results:** The study sample consisted of 215 patients with pressure injuries (PI) in which the age group that stood out was the elderly (54.8%), followed by adults (40.0%). It is noted, in the spatial representation, that most of the patients with PI were residents of Greater Aracaju (n=130), followed by the East of Sergipe (n=23) and Central Agreste (n=18). Most of the PIs were acquired prior to admission to the institution studied (55.8%), while the others (44.2%) appeared during the hospital stay. **Conclusion:** In view of the analysis presented, it was possible to verify that most patients affected by PIs are men and elderly, and that the Greater Aracaju regional was the one that stood out the most because it concentrated most of the patients with PI, whether pre-existing or acquired at hospitalization.

**Keywords:** Pressure Injury, Spatial Distribution of the Population, Primary Health Care, Public Health Policies.

---

<sup>11</sup> PhD in Health Sciences Heart Institute INCOR FMUSP

Institution: Universidade Nove de Julho

E-mail: claudiafcr@gmail.com

ORCID: 0000-002-2472-8182

<sup>12</sup> Master in Pharmacy Uniban

Institution: Universidade Nove de Julho.

E-mail: arfmm@uol.com.br

<sup>13</sup> Specialist in Stomatherapy at Escola Bahiana de Medicina e Saúde Pública

Institution: Brazilian Company of Hospital Services (EBSERH).

E-mail: lidi\_lima88@hotmail.com

<sup>14</sup> Master's Degree in Nursing from the Federal University of Sergipe

MBA from Unifesp in Hospital Management and Specialist in Infection Control in Adult and Elderly Health from the Federal University of Sergipe

Postgraduate student in stomatherapy at Faculdade Venda Nova do Imigrante - FAVENI

Institution: Federal University of Sergipe and Brazilian Company of Hospital Services – EBSERH

<sup>15</sup> Specialist in Stomatherapy at Escola Bahiana de Medicina e Saúde Pública

Institution: Brazilian Company of Hospital Services (EBSERH).

E-mail: wilde\_br@yahoo.com.br

<sup>16</sup> Specialist in Adult and Elderly Health from the Federal University of Sergipe.

Institution: Brazilian Company of Hospital Services (EBSERH).

E-mail: enf.joaatorres@gmail.com

<sup>17</sup> Specialist in Collective Health from the Faculty of Medical Sciences of the State University of Campinas (UNICAMP)

Institution: State University of Campinas (UNICAMP)

E-mail: aloisio6@unicamp.br



## INTRODUCTION

One of the ways to better understand the distribution of events in epidemiology and which has become a reference point for analyzing the problems found in public health is the use of space. The territory in which individuals live, coexist and socialize is the *locus* where the social determinants of health directly interfere in the dynamics of the health-disease process (Lima; Brook; Santos, 2022).

Spatial analysis itself has been used for many years in the context of geoenvironmental features, soil contamination and mineral dispersion. However, currently, this analysis has gained notoriety in the health area as a result of the emergence of epidemics of various infectious diseases distributed in the regions of the country (Santos, 2018).

Geoprocessing is a revolutionary technology that encompasses the most diverse disciplines, data, equipment, analysis and interpretations from certain locations and geographic data, thus obtaining maps and/or spreadsheets with information relevant to that particular region that, when used in the health area, allows the identification and mapping of the risks and injuries that affect the population (Santos, 2018).

Thus, the use of geoprocessing in health is considered a powerful analysis tool, as it allows guiding the understanding of public health issues, with a view to controlling diseases, through the identification of priorities and the implementation of agile and problem-solving policies (Ribeiro et al., 2021).

In this scenario, spatial analysis and mapping has become a great ally of public management, as it provides a broad and detailed interpretation of the information collected, which facilitates the early diagnosis of the problems contained in the analyzed territory. This makes it possible to provide rapid responses that positively impact the management of the health service and that ensure the development of actions for the equal distribution of processes and resources (Pereira; Moschini; Uehara, 2021).

The problems identified are several in the territorial context of the municipalities. However, one that stands out and is configured as a global public health problem is pressure injury (LP) that brings individuals several losses such as discomfort, pain, emotional suffering, social distancing, in addition to increasing the risk of more serious complications interfering with morbidity and mortality (Farias; Queiroz, 2022).

Pressure injury is characterized by pressure exerted, mainly, on bony prominences, or even related to the use of medical devices. Thus, the compressed blood capillaries are ruptured, preventing the body region from being oxygenated and nourished, thus causing cell death, ischemia and the appearance of the lesion itself (Araújo; Soares, 2022).

Several factors contribute to the development of PL and, in a didactic way, are classified as intrinsic and extrinsic: the first are focused on the patient's problems, such as immobility, skin



changes, incontinence, age, nutrition, associated pathologies, vasopressor medications, and altered sensory perception; extrinsic problems refer to problems external to the patient, such as pressure, friction, shear, poor hygiene, humidity, inadequate seats and mattresses (Carvalho; Cigre2022).

A study published in the United States of America on the prevalence of PL, with a sample of 104,266 patients, elucidated a rate of 19.9% of medical device-related pressure injury (LPRDM), while 14.3% were PF in the sacral region, 10.2% in the calcaneus, and 8.8% in the buttocks (Cavalcanti, 2019).

In Brazil, in 2017, 13,834 cases of PF and 5 deaths were reported by health institutions due to this problem, corresponding to 18.37% of the notifications of adverse events and 1.14% of the deaths resulting from this type of event. However, the National Health Surveillance Agency (ANVISA) recognizes the possibility of underreporting, so the true magnitude of this problem still remains uncertain (Lima et al., 2020).

In general, this technology will provide a better evaluation of public policies, directing them to the most vulnerable groups, as well as areas of greater risk, aiming to meet the needs of those who need it most at that given moment (Santos, 2018). Thus, the present study aims to describe the spatial distribution of patients with pressure injuries treated by the Skin Care Service of the University Hospital of the Aracaju Campus, in the state of Sergipe, showing the regions with the highest number of affected users.

From this perspective, it will be possible to analyze which health regions are home to the largest number of people affected by pressure ulcers, in order to improve care in addition to providing the structuring of a specific care network for patients affected by this disease.

Thus, this study aims to demonstrate the technical experience of spatial demarcation and geoprocessing of patients with pressure injuries treated at a teaching hospital in the State of Sergipe.

## **METHOD**

This is a descriptive epidemiological study, carried out at the University Hospital of Sergipe, a public institution linked to the Federal University of Sergipe and managed by the Brazilian Company of Hospital Services (EBSERH), which has an installed physical capacity of 111 beds for hospitalization, distributed as follows: 36 beds for the Surgical Clinic, 36 for the Medical Clinic, 18 for Oncology, 11 for Pediatrics and 10 for the Intensive Care Unit.

The hospital is located in the state of Sergipe, the smallest unit of the Brazilian federation, with 75 municipalities and 2,210,004 inhabitants. Its territorial area is estimated at 21,938 km<sup>2</sup> and its demographic density is 100.74 inhabitants/km<sup>2</sup>, according to IBGE data (SERGIPE, 2022). According to the Multi-Year Health Pact Plan, the State is subdivided into 7 health regions, as described in figure 1.

Figure 1 - Health service regions in the State of Sergipe



Source: <https://saude.se.gov.br/120/> accessed in January 2024.

Sociodemographic and health data were collected from a spreadsheet of data from the Skin Care Care Service (SACP) of the researched institution, which includes all patients assisted by the service. Only patients with pressure injuries treated between August 2019 and September 2022 were extracted from this spreadsheet. The research population consisted of 221 patients. However, after the analysis, it was found that six of them had incomplete data. Thus, the final sample of the study consisted of 215 patients with pressure ulcers.

The statistical approach was developed based on the descriptive analysis of the data, performed in the Statistical Package for Social Sciences (SPSS, v. 20, Chicago, IL) software. The analysis was also synthesized with the help of the Google Maps program, in which the spatial distribution was verified, at the individual and/or collective level, with data aggregated by health regions, making it possible to use the ArcView program (ESRI, Redlands, CA) for the preparation of digital geographic maps.

The inclusion criteria were designed to ensure a homogeneous and representative sample, covering the following points: patients with pressure injuries acquired prior to or during hospitalization at the institution studied, located in any area of the body, regardless of age group and gender.

Patients for whom the diagnosis of pressure injury was not clearly defined were excluded from the sample; and those whose medical records had incomplete or missing data.

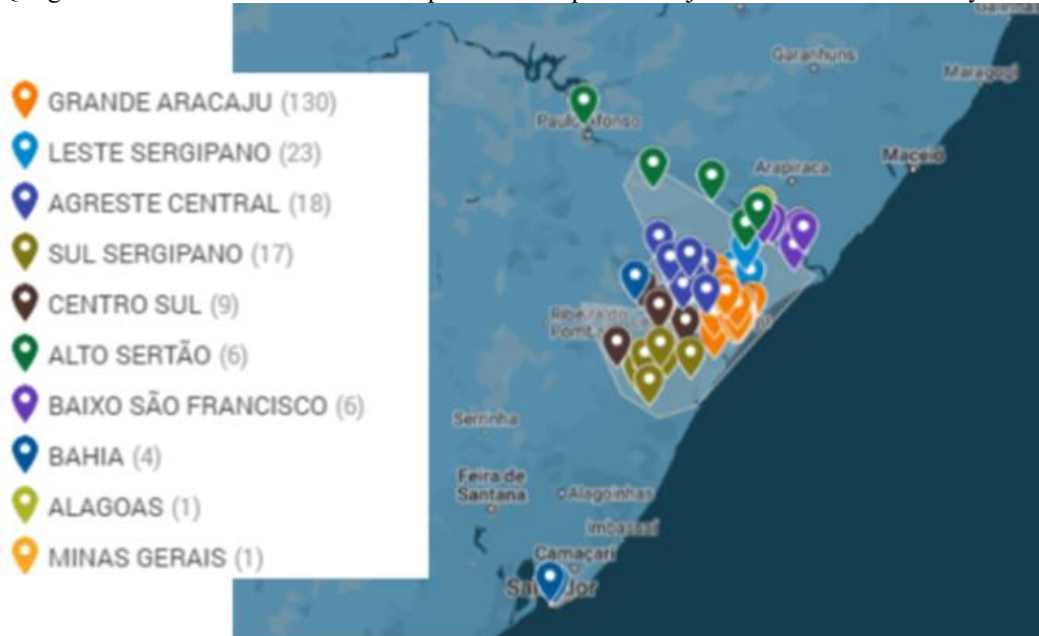
The study was submitted to the evaluation of the Research Ethics Committee (CEP) via Plataforma Brasil, in compliance with resolution number 466/12, of the National Health Council of the Ministry of Health, with CAAE code 68846923.1.0000.5546.



## RESULTS

The study showed that most patients with pressure ulcers (PL) are residents of greater Aracaju (n=130), followed by eastern Sergipe (n=23) and central agreste (n=18). The participation of patients from other states such as Alagoas (n=1), Bahia (n=4) and Minas Gerais (n=1) is also noteworthy.

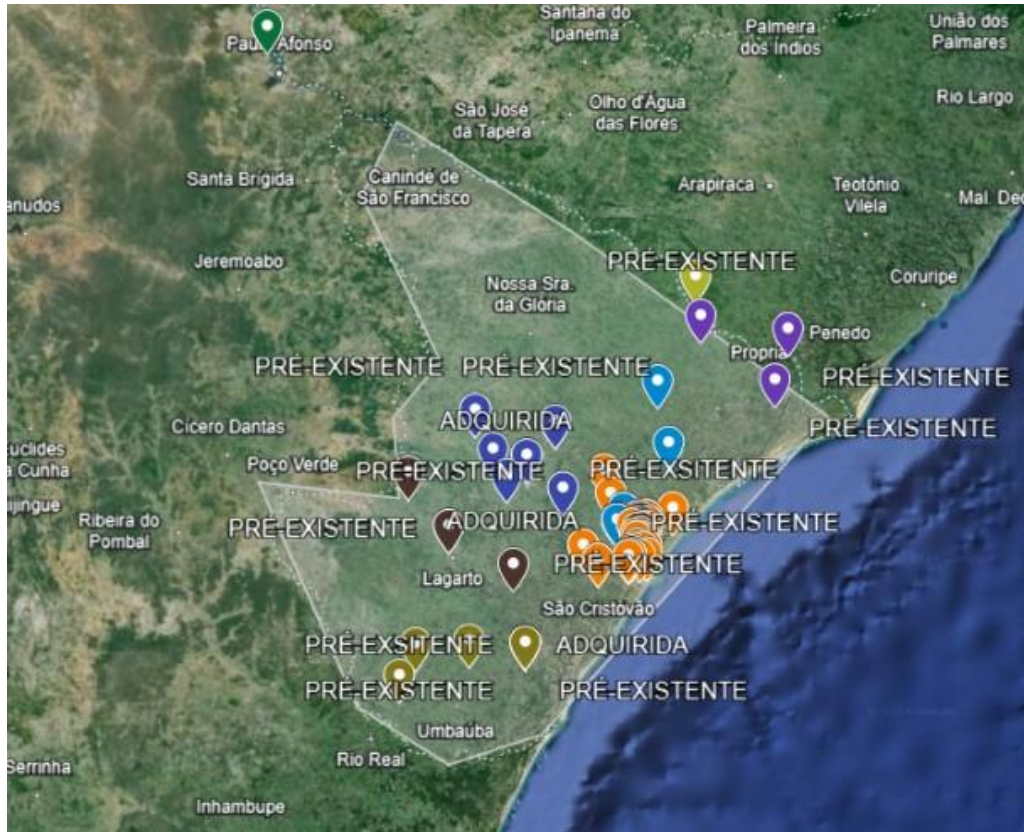
Figure SEQ Figure\\*ARABIC 2 – Distribution of patients with pressure injuries treated at the UH. By health region.



Source: Authors, 2024.

Regarding the origin of the pressure ulcer, it was observed that the majority (55.8%) was acquired prior to admission to the researched institution, while the remainder (44.2%) developed during the hospital stay.

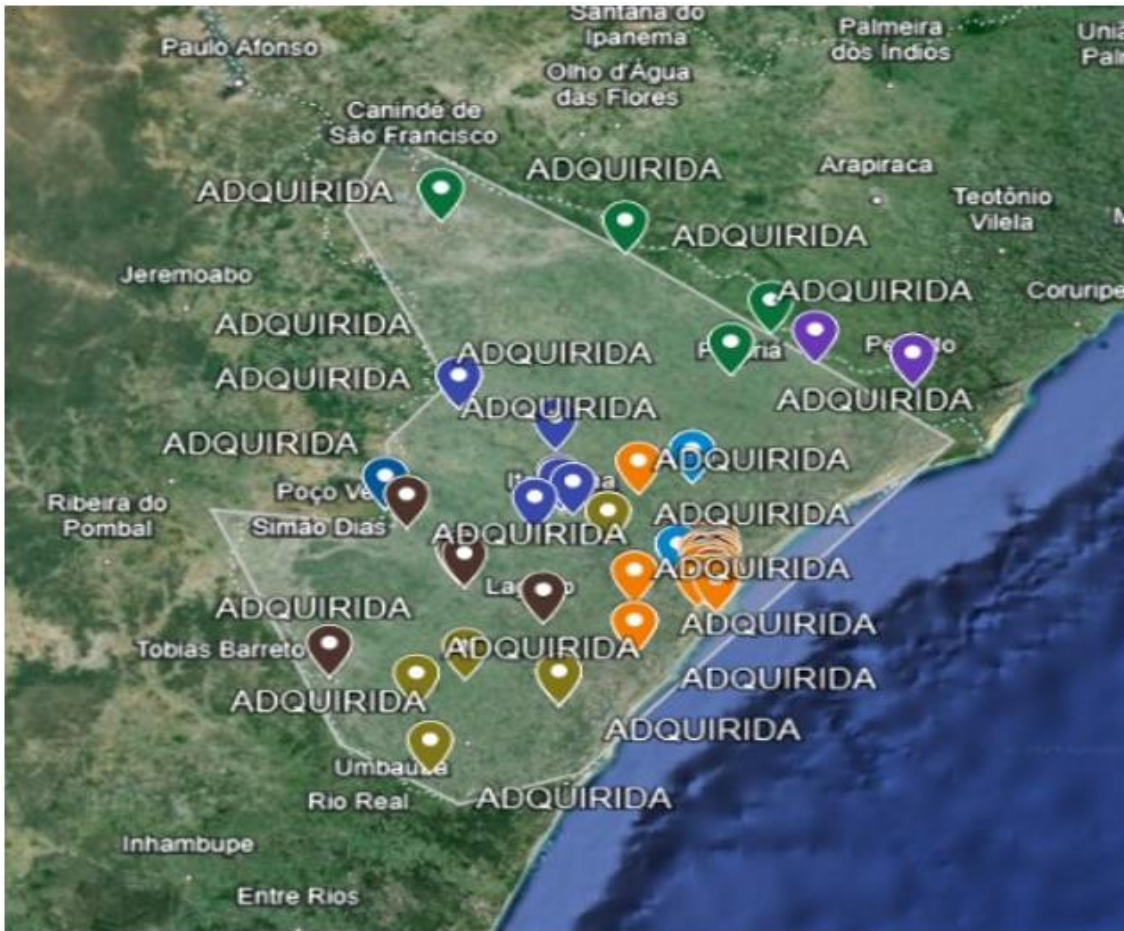
Figure SEQ Figure\\* ARABIC 3 – Spatial distribution of patients with pressure injuries pre-existing to hospitalization, treated at the UH



Source: Authors, 2024.

Of the patients with pre-existing PLs at admission, those from Greater Aracaju (n=83) stood out, followed by those from the East Sergipe (n=13), Agreste Central Sergipano (n=08), South Sergipe (N=07), South Central Sergipe (n=03), Baixo São Francisco (n=03), Alto Sertão Sergipano (n=01), Alagoas (n=01) and Bahia (n=01), making a total of 120 users with pre-existing PLs (Figure 3).

Figure SEQ Figure\\* ARABIC 4 – Spatial distribution of patients with pressure injuries acquired during hospitalization, treated at the UH



Source: Authors, 2024.

With regard to LPs acquired at the institution, the regional region that stood out was Greater Aracaju (n=47), followed by Agreste Central Sergipano (n=10), East Sergipe (n=10), South Sergipe (n=10), South Center Sergipe (n=06), Alto Sertão Sergipano (n=05), Lower São Francisco (n=03), Bahia (n=03) and Minas Gerais (n=01), totaling 95 clients with LPs acquired during hospitalization (Figure 4).

The age group that stood out the most was the elderly (54.8%), followed by adults (40.0%). In relation to gender, men prevail (58.6%) while women follow behind (41.4%). Among the clinical disorders during admission, respiratory (19.5%), infectious (13.9%) and neoplasms (11.6%) stood out (Table 1).

The "high risk" classification, according to the Braden scale, was seen in most cases (86%), and the most affected region of the body is the sacral (72.1%) and the calcaneus (7.4%). Regarding staging, most of them were classified as stage 2 (33.4%), followed by non-classifiable (25.5%) (Table 1).

Table 1. Sociodemographic and clinical aspects and characterization of Pressure Injuries in patients treated by the Skin Care Service of the University Hospital, Aracaju Campus (SE), Brazil, (n=215) - 2023.

<b>Age group</b>	<b>n° (%)</b>
Elderly (60 years or older)	118 (54,8)
Adult (20 - 59 years)	86 (40,0)
Preschool (2 – 4 years)	5 (2,3)
Teenager (11 - 19 years old)	2 (0,9)
School (5 – 10 years old)	2 (0,9)
Infant (0 - 1 year)	2 (0,9)
<b>Gender</b>	<b>n° (%)</b>
Male	126 (58,6)
Female	89 (41,4)
<b>Clinical disorders in the admission</b>	<b>n° (%)</b>
Respiratory	42 (19,5)
Infectious	30 (13,9)
Neoplasia	25 (11,6)
Not Specified	20 (9,3)
Digestive	18 (8,3)
Neurological	16 (7,4)
Cardiovascular	13 (6,0)
Renal	12 (5,5)
Hematologic	11 (5,1)
Hepatic	10 (4,6)
Endocrine	7 (3,2)
Player	4 (1,8)
Dermatological	3 (1,4)
Muscular	2 (0,9)
Feed	1 (0,4)
<b>Origin of the LP (n=215)</b>	<b>n° (%)</b>
Prior to hospitalization	120 (55,8)
Acquired at the institution	95 (44,2)
<b>Risk of LP</b>	<b>n (%)</b>
High risk	185 (86,0)
Medium risk	20 (9,3)
No risk	5 (2,3)

Low risk	5 (2,3)
<b>Anatomical location</b>	<b>n (%)</b>
Sacral	155 (72,1)
Calcaneus	16 (7,4)
Trochanter	8 (3,6)
Occipital	6 (2,8)
Narina	4 (1,8)
Comissura labial	4 (1,8)
Malleolus	4 (1,8)
Thorax	3 (1,4)
Coccyx	3 (1,4)
Ischium	3 (1,4)
Ear	2 (0,9)
Gluteus	2 (0,9)
Cheek	1 (0,4)
Scapula	1 (0,4)
Vertebral processes	1 (0,4)
Urethra	1 (0,4)
Tibia	1 (0,4)
<b>LP Standings</b>	<b>n (%)</b>
Stage 2	72 (33,4)
Unsortable	55 (25,5)
Deep tissue	27 (12,5)
Stage 4	23 (10,7)
Stage 1	14 (6,5)
Stage 3	14 (6,5)
Device-related Doctor	7 (3,02)
Pressure Injury in mucous membrane	3 (1,4)

Source: Authors, 2024.

## DISCUSSION

The present study obtained and analyzed a total of 215 medical records in which the patients had a pressure ulcer as a prerequisite. The regional in which the most cases prevailed was Greater Aracaju, which is composed of 9 municipalities (Aracaju, Barra dos Coqueiros, Itaporanga d'Ajuda,

Laranjeiras, Maruim, Nossa Senhora do Socorro, Riachuelo, São Cristóvão and Santo Amaro das Brotas); the same happens for cases of pre-existing LPs at hospitalization and for those acquired during hospitalization. It is possible to infer that this fact happens because most of the inhabitants live in these places, especially when the regional includes a capital.

Based on the observation of the georeferencing of the regions in question and considering the problem of pressure injuries, it is possible to infer that the health networks are well established in terms of structuring and organizing the levels of primary, secondary and tertiary care. With this perspective, patients who seek care in tertiary services in their respective regions, such as those in the Agreste Central Sergipe, East Sergipe and South Sergipe, often end up prolonging their hospitalization due to the lack of resolution of the primary problem, which can result in complications, including the development of pressure injuries. This often leads them to seek treatment in the capital in search of better clinical outcomes, leaving open the possibility of underreporting of PL cases upon entering the hospital. This finding highlights the importance of a detailed analysis of local health structures, in order to ensure that patients receive appropriate and timely treatment, thus avoiding the emergence of this disease.

During the study period, it was observed that most of the LPs were prior to hospitalization (55.8%), thus totaling an incidence rate of 44.2%. According to Silva et al. (2019), in their longitudinal study carried out in a hospital in Vitória da Conquista (BA), an incidence of PF of 47% was found; Ferreira et al. (2018), in their cross-sectional epidemiological research in southern Brazil, showed an incidence of 39.4%; the study by Prado et al. (2021) in two public hospitals in Rio de Janeiro, remains statistically similar, even higher, listing an incidence of 65.3%. All of them corroborate the data of the present research.

However, some studies, such as those by Mejía et al. (2015), Rocha et al. (2020), and Santos et al. (2020), contradict these results, presenting, respectively, an incidence of 11.5%, 13.3%, and 5.6%. This suggests the absence of a consistent pattern in the incidence of pressure injuries in the studies analyzed. Despite the disparity in results, both incidents in hospital services and in LPs have high numbers, as recorded in the Patient Safety Bulletin. While hospital incidents occupy the initial position in terms of notifications, pressure injuries rank second among the types of incidents reported (Jesus et al., 2020).

With regard to pre-existing LPs, which covers most of the study, it is important to highlight the role that Primary Health Care establishes, since the vast majority of injuries are prior to hospitalization; And, even if they are acquired in a hospital environment, it is important to emphasize the care, guidance, and follow-up that these patients will need to have continuously when they are at home.



During the transition from the hospital environment to the home, after medical discharge, it is crucial to maintain continuity of care and ensure effective communication between health teams. However, this integration often doesn't go as expected. Studies conducted in Ribeirão Preto/SP highlight the urgency of better coordination among health services, especially when the patient is at risk or has already developed pressure injuries and needs home care after hospital discharge (Moro; Caliri, 2016).

In this sense, it is important to emphasize that factors such as the type of housing, quality of sanitation, socio-environmental environment, socioeconomic level, education, and prevalence of diseases have a direct impact on the health of both individuals and the community in general. These elements influence the health and disease process and, with adequate prior knowledge, it is possible to intervene to reduce or eliminate the risks and damage caused by the environment, thus reducing the risk of a pressure injury arising (Paudarco et al., 2021).

The emergence of LPs entails a significant financial burden for health institutions, in addition to being recognized as a socioeconomic and educational challenge. Therefore, it is essential to direct resources to prevention, since the costs involved in this stage are lower than those necessary for subsequent treatment (Guerra et al., 2021). From a study carried out in a palliative care unit in Minas Gerais, it was possible to identify the annual cost for the treatment of LP, which resulted in R\$445,664.38, thus concluding the association of the inappropriate use of materials proportionally direct with the cost of care (Lima et al., 2020).

In a certain study, a high number of records of elderly people were observed in the health units, but few medical records contained relevant information about the existence of skin lesions. In view of the lack of details in the records of health professionals who did not identify these lesions, during the home visit it was possible to verify the presence of wounds. This evidenced the lack of information on the health status of the users on the part of the team that provided care to them (Freitas; Alberti, 2013). As a result, there is a great possibility that many cases of pressure injuries at home are still not being reported. However, more research is needed to actually show that this problem is recurrent.

It is important to emphasize that the occurrence of the development of these lesions in the home environment indicates the need for a different approach and, above all, suggests that changes are necessary in the scope of practices within the context of Primary Care (Soares et al., 2015).

From this perspective, it is of great relevance that the multidisciplinary team constantly seeks to update its knowledge to provide high-quality care to the patient, focusing on promoting the care and treatment of injuries both at the systemic and local levels (Freitas; Alberti, 2013).



## CONCLUSION

In summary, the in-depth analysis of pressure injuries (PI) clearly reveals their magnitude as a public health problem that demands more careful attention. This study highlighted the relevance of directing efforts to understand and mitigate PI, emphasizing that the population most impacted by this disease is predominantly composed of men and elderly people with respiratory and infectious diseases. The majority of PIs were located in the sacral region and calcaneus with stage 2 and high risk on the Braden scale.

In addition, it is evident that the capitals emerge as areas particularly susceptible to this health problem due to the high number of populations, such as Aracaju/SE, covering the Greater Aracaju region, which concentrates most of the patients with PI, whether pre-existing or acquired at hospitalization, emphasizing the need for preventive and specific strategies, as well as targeted interventions to effectively address this public health issue.

In addition, the indispensability of effective public policies to address this problem is emphasized, since the performance of Primary Care, with its emphasis on territorialization and preventive care, plays a crucial role in this scenario, playing a proactive role in reducing the incidence and impact of PI, contributing to a more comprehensive and effective approach to the care of this vulnerable group.






## REFERENCES

1. Araújo, T. C. V. de, & Soares, A. M. L. (2022). COVID-19: um resgate bibliográfico sobre práticas exitosas na prevenção de lesões por pressão. \*Revista Ciência Plural, 8\*(3), 1-16. Universidade Federal do Rio Grande do Norte - UFRN. <http://dx.doi.org/10.21680/2446-7286.2022v8n3id28520>
2. Carvalho, A. A., & Cigre, A. I. de C. (2022). Fatores relacionados com a prevalência de lesões por pressão em contexto comunitário. \*Revista Baiana de Enfermagem, 36\*. Revista Baiana de Enfermagem. <http://dx.doi.org/10.18471/rbe.v36.43443>
3. Cavalcanti, E. de O. (2018). Lesão por pressão relacionada a dispositivos médicos: frequência e fatores associados (Dissertação de Mestrado). Departamento de Enfermagem, Faculdade de Ciências da Saúde, Universidade de Brasília, Brasília, Distrito Federal.
4. Ceranto, B. F. (2022). Perfil epidemiológico e tratamento dos pacientes atendidos pelo serviço de cirurgia plástica do Hospital do Servidor Público Municipal portadores de úlcera por pressão (Trabalho de Conclusão de Residência Médica). São Paulo.
5. Farias, A. P. do E. C. de, & Queiroz, R. B. de. (2022). Risk factors for the development of pressure injury in the elderly: integrative review / fatores de risco para o desenvolvimento de lesão por pressão em idosos. \*Revista de Pesquisa Cuidado É Fundamental Online, 14\*, 1-8. Universidade Federal do Estado do Rio de Janeiro - UNIRIO. <http://dx.doi.org/10.9789/2175-5361.rpcfo.v14.11423>
6. Ferreira, D. L., et al. (2018). Incidência de lesão por pressão e medidas preventivas em pacientes críticos/ Pressure injury incidence and preventive measures in critical patients. \*Ciência, Cuidado e Saúde, 17\*(1), 1-7. Universidade Estadual de Maringá. <http://dx.doi.org/10.4025/cienccuidsaude.v17i2.41041>
7. Freitas, J. de P. C., & Alberti, L. R. (2013). Aplicação da Escala de Braden em domicílio: incidência e fatores associados a úlcera por pressão. \*Acta Paulista de Enfermagem, 26\*(6), 515-521. FapUNIFESP (SciELO). <http://dx.doi.org/10.1590/s0103-21002013000600002>
8. Guerra, M. J. C., et al. (2021). Abordagem e tratamento de úlcera de pressão infectada em idosa sob cuidado domiciliar: da atenção primária à especializada. \*Revista de Saúde, 12\*(1), 30-34. Universidade Severino Sombra. <http://dx.doi.org/10.21727/rs.v12i1.2220>
9. Jesus, M. A. P. de, et al. (2020). Incidência de lesão por pressão em pacientes internados e fatores de risco associados. \*Revista Baiana de Enfermagem, 34\*, 1-11. <http://dx.doi.org/10.18471/rbe.v34.36587>
10. Lima, L. S., et al. (2020). Perfil clínico-epidemiológico dos pacientes com lesão por pressão no contexto hospitalar. \*Estima, Brazilian Journal Of Enterostomal Therapy\*. SOBEST Associação Brasileira de Estomaterapia. [http://dx.doi.org/10.30886/estima.v18.917\\_pt](http://dx.doi.org/10.30886/estima.v18.917_pt)
11. Lima, S. V. M. A., Ribeiro, C. J. N., & Santos, A. D. dos. (2022). The use of geoprocessing to strengthen the epidemiological surveillance of COVID-19. \*Revista Brasileira de Enfermagem, 75\*(1). FapUNIFESP (SciELO). <http://dx.doi.org/10.1590/0034-7167.202275suppl101>
12. Mejía, E. M. Stegensek, et al. (2015). Úlceras por presión en diversos servicios de un hospital de segundo nivel de atención. \*Enfermería Universitaria, 12\*(4), 173-181. Universidad Nacional Autónoma de México. <http://dx.doi.org/10.1016/j.reu.2015.08.004>

13. Moro, J. V., & Caliri, M. H. L. (2016). Pressure ulcer after hospital discharge and home care. \*Escola Anna Nery - Revista de Enfermagem\*. FapUNIFESP (SciELO). <http://dx.doi.org/10.5935/1414-8145.20160058>
14. Paudarco, L. da S., et al. (2021). A visita domiciliar sob olhar do usuário da atenção primária. \*Saúde.Com, 17\*(4), 2393-2401. Universidade Estadual do Sudoeste da Bahia/Edições UESB. <http://dx.doi.org/10.22481/rsc.v17i4.7710>
15. Pereira, H. N. S., Moschini, L. E., & Uehara, S. C. da S. A. (2021). Influência dos indicadores econômicos na distribuição espacial de internações relacionadas às doenças crônicas não transmissíveis. \*Revista Enfermagem Uerj, 29\*, 1-10. Universidade do Estado do Rio de Janeiro. <http://dx.doi.org/10.12957/reuerj.2021.58644>
16. Prado, A. R. de A., et al. (2021). Incidence of pressure ulcer in spinal cord injured patients admitted to intensive care units / Incidência de lesão por pressão em lesados medulares internados em unidades de terapia intensiva. \*Revista de Pesquisa Cuidado É Fundamental Online, 13\*, 1135-1141. Universidade Federal do Estado do Rio de Janeiro - UNIRIO. <http://dx.doi.org/10.9789/2175-5361.rpcfo.v13.9119>
17. Ribeiro, S. F., et al. (2021). Representação Espacial das Doenças Negligenciadas no Estado do Tocantins. \*Saúde em Redes, 7\*(1), 99-113. Associação Brasileira da Rede Unida. <http://dx.doi.org/10.18310/2446-4813.2021v7n1p99-113>
18. Rinaldi, E. C. A. (2012). Prevalência de úlcera por pressão: estudo epidemiológico em um hospital no interior do Paraná (Dissertação de Mestrado em Enfermagem). Universidade Federal do Paraná, Curitiba.
19. Rocha, S. de S., et al. (2020). Análise da presença de lesão por pressão em pacientes hospitalizados e as principais comorbidades associadas. \*Research, Society And Development, 9\*(4), 1-14. Research, Society and Development. <http://dx.doi.org/10.33448/rsd-v9i4.3009>
20. Santos, J. B. da S., et al. (2020). Incidência de lesão por pressão em pacientes na unidade de terapia intensiva de um hospital filantrópico. \*Nursing (São Paulo), 23\*(265), 4233-4244. MPM Comunicação. <http://dx.doi.org/10.36489/nursing.2020v23i265p4233-4244>
21. Santos, V. da F. (2018). Geoprocessamento da coinfeção tuberculose/HIV drogarr resistente no Estado do Ceará.
22. Sergipe. IBGE. (2022). Censo Demográfico: Panorama da População e do Território. Recuperado de <https://cidades.ibge.gov.br/brasil/se/panorama>. Acesso em: 10 out. 2023.
23. Silva, S., et al. (2019). Lesão por pressão: incidência em unidades críticas de um hospital regional. \*Estima, Brazilian Journal Of Enterostomal Therapy\*. SOBEST Associação Brasileira de Estomaterapia. [http://dx.doi.org/10.30886/estima.v16.655\\_pt](http://dx.doi.org/10.30886/estima.v16.655_pt)
24. Soares, C. F., et al. (2015). Úlcera por pressão no contexto da atenção primária: reflexão com enfermeiros sobre a escala de braden.
25. Soares, L. C. B., et al. (2022). Desenvolvimento de lesão por pressão e complexidade assistencial em pacientes de um serviço de emergência. \*Cogitare Enfermagem\*, 27, 1-11. FapUNIFESP (SciELO). <http://dx.doi.org/10.5380/ce.v27i0.82550>

## Child and adolescent psychological care in a Basic Health Unit in the triple border: Characterization and analysis

 <https://doi.org/10.56238/sevened2024.016-009>

Cristina Elizabeth Pessoa<sup>1</sup>, Nandra Martins Soares<sup>2</sup> and Monica Augusta Mombelli<sup>3</sup>

### ABSTRACT

Primary Health Care (PHC) plays an essential role in health promotion, being considered the gateway to other services in the Unified Health System. The present study aimed to characterize and analyze the demands related to child and adolescent psychotherapy services at a Mental Health outpatient clinic in a city of the triple border. For this, a documentary, descriptive, cross-sectional and quantitative research was carried out. The study period comprised September 2022 to September 2023. 54 children and adolescents were assisted, predominantly female, aged between 10 and 12 years. Among girls and boys, the demand for anxiety stood out, with 43.3% and 29.2%, respectively. It is noteworthy that, at the time of data collection, 31.5% of the patients were still undergoing psychological follow-up and, among these, one patient was already in the 25th session, and the average session for this group was 14 sessions. Finally, the results of this study reinforce the need to strengthen and expand mental health actions in Primary Health Care, investing in professional training, community awareness, and the implementation of effective public policies that promote access, quality, and comprehensiveness of mental health care for children and adolescents.

**Keywords:** Unified Health System, Primary Health Care, Mental Health.

---

<sup>1</sup> Psychologist. Postgraduate in Psychology in Public Health from the State University of Western Paraná (UNIOESTE).

<sup>2</sup> Doctor student in Education at the State University of Western Paraná, with a period of academic mobility at the University of Lisbon. Master's degree in Community Development from the State University of the Midwest (2015). Specialist in Neuropsychology and Education from Faculdade Itecne de Cascavel (2014). Degree in Psychology from the Regional Integrated University of Alto Uruguai and Missions (2010). She is currently a professor of higher education at the Centro Universitário Dinâmica das Cataratas. She has experience in Psychological Assessment, Neuropsychology, School Psychology and Professional Guidance, as well as experience in clinical psychology and teaching in higher education.

<sup>3</sup> Professor of the undergraduate course of Medicine at the Federal University of Latin American Integration (UNILA). Coordinator of the Multiprofessional Residency Program in Family Health at UNILA. Member of the INEP Evaluators Bank (BASIS) since 2019, as an Evaluator of Undergraduate Courses. Postdoctoral internship in Teaching at the State University of Western Paraná (UNIOESTE - 2021). Doctor in Sciences from the Public Health Nursing Program of the University of São Paulo - USP. Master's degree in Health Sciences from the State University of Maringá - UEM (2010). Specialist in Psychological Assessment (2020); Specialist in Behavior Analysis applied to Autism - ABA (2021); Specialist in Mental Health and Psychosocial Care for Children and Adolescents at the School of Health of Paraná (2011). Specialist in Psychopedagogy Clinical and Institutional Scope (ESAP, 2006). Graduated in Psychology from Universidade Paranaense UNIPAR (2005), Cascavel campus - PR. She has experience in Clinical Psychology, Social Psychology in Health, Public Health and Psychological Assessment. Areas of interest: Psychology and Popular Health Education; Primary Health Care and Active Teaching-Learning Methodologies.



## INTRODUCTION

Health promotion and prevention strategies and actions play an important role in people's lives, regardless of the social and economic context. However, for users of public health services, these actions are mediated by Primary Health Care (PHC), the gateway to the services of the Unified Health System (SUS) and, among its actions, should advocate the quality of life of individuals, groups and populations. Additionally, it is worth noting that the Family Health Strategy (FHS), as a proposal for the organization of PHC, has among its objectives the purpose of offering interprofessional care to the enrolled population (LEMOS; LHULLIER, 2020).

Based on the assumption of a comprehensive approach to care, which includes the social determinants of health, it is relevant that PHC incorporates activities that contemplate the mental health of the population in its actions, so that the individual assumes an active role in the management of his or her health (LEMOS; LHULLIER, 2020).

In public health, the presence of Psychology has brought this support as an instrument that transforms, discussing aspects of subjectivity, emotional, historical and social reality. The proposal of the health psychologist is to understand and observe individuals, seeking to solve issues, and to act in the prevention and treatment of mental problems (intervention), so that performance is in the private or public sector (ALMEIDA; MALAGRIS, 2011). Additionally, in this scenario, the integration of the psychologist also represented a tactic to avoid the decline that the profession had been facing. As psychologists lost their credibility in social issues, professionals were forced to look for new opportunities to enter the professional area (CHAGAS et al., 2022).

Thus, it is emphasized that, in the multidisciplinary team in the environment of the Basic Health Units (UBS) and working with the Family Health Strategy (FHS) team, the primary level of care, the psychologist adopts a central place. Their work has a decisive force, helping to improve the care offered to the population, approaching both individual and collective issues. This reinforcement is manifested in more active and extensive intervention strategies, directly benefiting the community served. It is verified that health promotion happens from a psychological origin such as habits, attitudes, motivation, personal and family interactions (CAVALER et al., 2020).

Historically, the psychologist has become the recognized professional who proved to be the most appropriate to assist in the promotion of mental health, playing an important role in management in critical situations, who could intervene with other health professionals in stressful situations in society, assisting with psychotherapeutic techniques oriented to the improvement and prevention of the community (CHAGAS et al., 2022).

In Brazil, there was a set of suggestions and demands aimed at substantial changes in the approach to health problems, highlighting the importance of incorporating psychologists and their knowledge into multiprofessional groups in the health service (JIMENEZ, 2011).

In the area of health, there were large investments, coming from the Federal Council of Psychology (CFP), with the purpose of building a professional identity of health, so that it is no longer considered a specific area of interest to the psychologist, but becomes a space for conversation and dialogue between psychology and society (DIMENSTEIN; MACEDO, 2012).

Thus, in the context of mental health, the psychologist can also work in mental health outpatient clinics, a context of action that nowadays seems to resonate as an inadequate nomenclature. In fact, little is mentioned about the work carried out in these establishments. There is a sense of silence in the air, sometimes accompanied by a negative impression and possibly a general lack of knowledge about them. However, recognizing and highlighting the relevance of outpatient clinics in the discourse and structure of the mental health network, considering them as essential elements for their integration and for the effective reception and care of the public is urgent. After all, the Psychosocial Care Centers (CAPS), the ESF, hospitals and matrix support actions are often discussed, but what about mental health outpatient clinics? (DAMOUS; ERLICH, 2017).

The mental health outpatient clinic, as a legitimate and powerful clinical device in the field of psychosocial care, is at the level of secondary care and can be physically located in a Primary Care Unit. Its objective, through individual or collective psychological care for all age groups, is to offer specialized and continuous assistance through actions and strategies not foreseen by PHC (DAMOUS; ERLICH, 2017).

However, it is worth noting that reflection on outpatient clinics in the context of mental health is fundamental, because, despite their existence and relevance in the country, these services are not yet formally integrated into the Psychosocial Care Network (RAPS), as defined by the ordinance that organizes the field of psychosocial care (CARDOZO; MONTEIRO, 2019).

In view of this, regardless of the level of health care, it is up to the psychologist, when listening, to consider the person in his/her singular form and in his/her biopsychosocial complexity. According to the Federal Council of Psychology (CFP), the psychologist in his work should seek to reduce the conditions of vulnerability of the population and enable people's quality of life, acting in line with the principles of the SUS (FEDERAL COUNCIL OF PSYCHOLOGY, 2019).

Thus, the care of children and adolescents needs strategies and services specifically suited to their needs. However, until the 1980s, Brazil needed clear norms for the field of mental health, with the objective of developing guidelines for the care network for this group of children and adolescents, especially for those with mental problems or psychological suffering. In that period, the social assistance and education sectors ended up exercising this task in a corrective and disciplinary manner, instead of the focus having a clinical and psychosocial aspect (SERAFIM et al., 2019).



It is valid for the psychologist that in his insertion and performance in the SUS he can appropriate the legislation, ordinances, documents and/or technical notes that can support his performance. Namely, in the scenario of child and adolescent work in environments such as mental health outpatient clinics, it should be noted that the principles for a National Policy on Child and Youth Mental Health are: a. Children and adolescents are subjects of rights and holders of authentic places of speech; b. Universal reception: means that the doors of the services must be open to all those who arrive with some health and mental health need, that is, any and all demands directed to the health service of the territory must be welcomed, that is, received, heard and answered; c. Referral involved and co-responsible and, d. Intersectoriality in the action of care (MINISTRY OF HEALTH, 2005).

Evaluating the aspects involved in childhood and adolescence, it is currently identified that the family needs support to deal with various issues in the course of the children's growth; challenges that arise in this period of human development. Consequently, family members and/or legal guardians seek child and adolescent psychotherapy, to help them with the most different factors that influence their daily lives. It is notorious that psychotherapy is an act of listening that focuses on the patient's care and its relationship with its relational and social context. Consequently, the path and outcome of therapeutic interventions are related to the family and social determinants that involve the patient (BRITO et al., 2020).

In view of the above, the present study aimed to characterize and analyze the demands related to child and adolescent psychotherapy services at a Mental Health outpatient clinic in a city of the triple border. It is noteworthy that fostering research and data analysis related to child and adolescent mental health is essential to promote a holistic and integrated approach, ensuring the emotional, psychological and social well-being of this portion of the population, especially in scenarios such as mental health outpatient clinics, in order to consolidate the relevance of these care spaces in the RAPS and, consequently, qualify or develop public health policies that aim to improve the quality of mental health services and promote the integral well-being of children and adolescents.

## **METHOD**

It is a documentary, descriptive, cross-sectional research with a quantitative approach. Documentary research is characterized by the use of materials internal to the institution as a source of data, with institutional documents being the most frequently used. In addition, it should be noted that these materials have not yet received an analytical treatment, or can be re-elaborated, according to the objectives of the research. Additionally, for the development of this modality of study, the author describes a process composed of the following steps: formulation of the problem, preparation of the work plan, identification of sources, location of sources and obtaining material, analysis and



interpretation of data, and writing of the report. Finally, it is worth noting that this type of research has a number of advantages, namely: the documents constitute a rich and stable source of data; the cost of the research becomes relatively low and does not require contact with the research subjects, which given some demands can be difficult or even impossible (GIL, 2017).

The data for the research were collected in a Basic Health Unit (BHU) in the Southern District, in the municipality of Foz de Iguaçu, a city located in the extreme west of the State of Paraná. Triple border region, bordered by two other countries, Argentina and Paraguay. Geographically, the city is divided into five health districts, namely: east, north, west, northeast, and south. The southern district comprises the UBS named: Profilurb I, Profilurb II, Padre Monti, Ouro Verde and Vila Carimã.

The child and adolescent population under study is assigned to the territory of a UBS that is located in an urban area, 7.8 km away from the center of Foz do Iguaçu. It is noteworthy that this scenario was the place where the researcher worked during her time of in-service training through the Graduate Program in Psychology in Public Health, operated by the University of Western Paraná (UNIOESTE) in partnership with the Municipality of Foz do Iguaçu.

Regarding the description of this UBS, it is worth mentioning that linked to it are two Family Health teams (eSF) and one oral health team (eSB). The FHTs are formed by a doctor, a nurse, two nursing assistants, three community agents, and work in different shifts. The eSB is composed of a dentist and an oral health assistant. The researcher's work included individual clinical care linked to the mental health outpatient clinic, and patients were called to care according to their position in the queue for consultation, stratification by color and most urgent complaint (BRITO; SILVA, 2022).

The instrument for data collection was developed by the author based on the literature. It consisted of an Excel spreadsheet with the following items for data collection: gender, age, referral, complaint, region of the patients, family configuration, number of sessions and therapy status.

The data were collected in January and February 2024 in the RP system, a program related to the health area, which aims to manage health information or services in the Foz do Iguaçu region. Additionally, they refer to patients treated in child and adolescent psychotherapy, by the researcher, in the period between September 2022 and September 2023.

A quantitative, descriptive and comparative analysis of the data was carried out, aiming to synthesize the characteristics of the patients treated in child and adolescent psychotherapy. This included frequencies and percentages for variables such as age, gender, and complaints, among others. Thus, differences or patterns between different groups of patients were analyzed.

The research followed the ethical principles established by the National Research Ethics Commission (CNS), in Resolution No. 466 of December 2012, which aim to regulate studies

involving human beings. The research was submitted to the Ethics Committee, via Plataforma Brasil, receiving approval number 6,532,353. Only after obtaining a favorable opinion, the research began.

## RESULTS

Between September 2022 and September 2023, 54 children and adolescents were treated at the Mental Health outpatient clinic of the USF under study. In view of this, it was found that the largest number of patients were female (55.6%). There was a predominance of the age group between 10 and 12 years (37.0%), followed by 7 to 9 years (31.5%) and, with regard to the self-declared family configuration, 51.9% stated that they were single-parent, that is, where only one person is directly responsible for raising children and for daily care. (Table 1).

Table 1. Characterization of child and adolescent patients treated from September 2022 to September 2023, Foz do Iguaçu, PR.

<b>Variables</b>	n(54)	%
<b>Gender</b>		
Female	30	55,6
Male	24	44,4
<b>Age group</b>		
4 to 6 years	8	14,8
7 to 9 years	17	31,5
10 to 12 years	20	37,0
13 to 15 years old	5	9,3
16 to 18 years old	4	7,4
<b>Family Setup</b>		
Single-parent	28	51,9
Nuclear	23	42,6
Extended family	3	5,6

Source: PR Health Records.

The referrals to the psychology sector were predominantly carried out by professionals from the Family Health team (FHT), of which the family is a resident of its assigned territory. Thus, regarding the analysis of the demands for the first consultation, it was identified that in 37.0% of the cases, there was a record in the medical record for anxiety, followed by aggressiveness (16.7%). (Table 2). It is noteworthy that, considering the gender variable and relating it to demand, it was identified that there was a predominance of anxiety in girls (43.3%), with reports from the age of nine; followed by demands for aggressiveness and bullying, 5.6% respectively; attention deficit, depression and learning difficulties, 10.0% respectively and; enuresis, encopresis and family issues, 3.3%, respectively. Among boys, 29.2% reported anxiety; 25.0% aggressiveness; autism spectrum disorder 16.6%; attention deficit and family issues, 8.3% and, finally; depression, enuresis, and attention deficit hyperactivity disorder (ADHD), 4.2%, respectively.



It is worth noting that, regarding the situation of care during the data collection period, 31.5% of the patients were still undergoing psychological follow-up and, among these, one patient was already in the 25th session, and the average for this group was 14 sessions. (Table 2). Of the 54 patients attended, 87% underwent psychological counseling and 13% went to reception sessions.

Table 2. Characterization of child and youth care provided from September 2022 to September 2023, Foz do Iguaçu, PR.

<b>Variables</b>	<b>N (54)</b>	<b>%</b>
<b>Referrals</b>		
School	1	1,9
ESF Professionals	51	94,4
The Council of	2	3,7
<b>Demands</b>		
Aggressiveness	9	16,7
Anxiety	20	37,0
<i>Bullying</i>	3	5,6
Attention deficit	4	7,4
Depression	3	5,6
Learning disability	2	3,7
Encoprese	1	1,9
Enuresis	2	3,7
Family issues	3	5,6
ADHD	1	1,9
TEA	4	7,4
Gaming addiction	1	1,9
Violation of rights	1	1,9
<b>Condition of care</b>		
Discharge	19	35,2
Waiver	18	33,3
In follow-up*	17	31,5

Source: PR Health Records.

Note: \*Patient under follow-up at the time of data collection.

## DISCUSSION

A priori, it is necessary to emphasize that the study focused on the provision of psychological services for children and adolescents in a specific region, the Triple Border. Thus, an epidemiological survey, through a literature review, regarding depression in the triple border: Brazil, Argentina and Paraguay, describes that cases of depression in this context have increased considerably in recent years and the reality of each country is different, especially not regarding pharmacological treatment as a therapeutic alternative. In view of this, this research concludes that it is of paramount relevance to develop initiatives that can contribute to the performance of the well-being of the population regardless of age group (RAFEH; SOUZA, 2023).

It is noteworthy that the study in question, which addresses the characterization of child and adolescent mental health demands in a USF of the Triple Border, is aligned with the conclusions of



the research *Health on the Brazilian Border: Public Policies and Access to Service*, since it highlights that the Brazilian border region faces a significant lack of interdisciplinary research and interventions by health professionals. In addition, there is an urgent need to develop and maintain public policies that promote health with an integrated approach at both the local and regional levels (MONDARDO; STALIANO, 2020).

In relation to the participants, there was a predominance of females (55.6%) and the age group of 10 to 12 years (37%). It is observed that this information is different in the literature, especially with regard to gender. A study published in 2013, which aimed to characterize the population of children and adolescents who sought psychological care in a school service in the Metropolitan Region of Porto Alegre, RS, identified that of the 194 children attended, 64% were male and between 5 and 9 years old (45.9%) (VIVIAN; TIMM; SOUZA, 2013). Additionally, in another study that aimed to characterize the child clientele attended in psychodiagnostic evaluation, in the period from 2007 to 2013, in the city of São Paulo, it was verified through a survey and analysis of books, registration forms and medical records of children attended that of the total number of children enrolled (N=150), 67.4% were male and, most of the children enrolled were concentrated in the age groups of 9 to 10 years (36.7%) (VAGOSTELLO et al., 2017).

Finally, a survey of the characteristics of the people assisted and the services of a psychology clinic-school inserted in the public health network of the city of Belo Horizonte (MG) also showed that from the survey of medical records of 410 people assisted by the psychology service, between February and December 2019, a prevalence of females (60%) was observed in the total population, however, for males in the child and adolescent population, representing 80% (CAMPOS; MARQUES; BACELAR, 2022) It can be seen that this is a recurrent phenomenon in these services, considering that, in the 1980s, a certain study found that in this public the male sex has a predominance in the services (LOPEZ, 1983).

Analyzing the self-reported family configuration of the participants in this study, a predominance of single-parent families was observed. A priori, it is understood that family configuration refers to the set of elements/characters that make up the family nucleus. Therefore, the single-parent family can originate from situations such as family crises, separations, divorces, loss of a spouse or when there is a single parent. This concept diverges from the expression family structure, conceptualized by the same authors as the form of interaction and relationship between family members. Thus, it is emphasized that understanding the complexity and diversity of families in different cultural, social and historical contexts is fundamental for any analysis or intervention related to family well-being, public policies and therapeutic practices (WAGNER et al., 2011).

Regarding single parenthood, a research was carried out with the aim of investigating the perception of mothers in female single-parent families about their family capacities, the social



support received and their mental health. The study involved 43 mothers who led single-parent families. These women, with an average age of 38, were single or divorced/separated. To collect data, the Family Forces Questionnaire (FFQ), the Social Support Scale (EAS) and the Mental Health Inventory (MHI5) were used. The results revealed that women presented a positive and significant perception in relation to family strengths, social support and their mental health, observing a positive correlation between these variables. Mothers with a smaller number of children and those who reported higher psychological well-being showed a more positive perception of family strengths, unlike mothers with more children who showed signs of psychological distress (LUCAS, 2012).

Still, with regard to family configuration, a study involving 51 middle-class women, divorced and responsible for child custody, aimed to analyze female single-parent families in relation to five areas of satisfaction: economic/professional, psychological, affective-sexual, parental and social support. The evaluation was carried out using a specific scale for the study. The results indicated that these families perceive their family satisfaction in a more negative way than expected. Consequently, it can be inferred that, in general, the single-parent families studied are not satisfied in several aspects of the relationship – whether professional, affective, family or friendship – evidencing a strong inclination towards centering on the mother-child relationship (Grzybowski, 2003).

The discussion regarding the single-parent family configuration converges on the relevance of the development of public policies and psychological practices aimed at this target audience. It is notorious that investments in education, professional training and mental health services are essential to promote the stability and well-being of these single mothers or fathers and their children. This does not exclude the analysis of other family configurations, the family structures resulting from these and their respective demands, given that each family, regardless of its configuration, has its particularities, challenges and specific needs that must be considered.

Regarding referrals, that is, how these children and adolescents arrived at psychological care, it was observed in this study that most of these were carried out by health professionals (94.4%). According to the literature, the valorization of the various areas acting with a purpose in health encourages professionals to refer patients (GONÇALVES; PURITY; PRANDO, 2011). A study developed in 2013, referring to the characterization of children and adolescents attended at a teaching clinic of a University in Brasília, pointed out that most referrals were made by physicians, namely: those performed by neurologists (39%) predominated, followed by cases from psychiatrists (23.7%), neuropsychiatrists (10.2%) and psychologists (5.1%). The school (5.1%) and psychopedagogy professionals (3.4%) were also among the sources of referrals, as well as speech therapists (1.7%) (BORSA et al., 2013).

Thus, one study indicates that children referred to psychotherapy by their families adhered less than the others, while children referred by psychiatrists were more adherent and, unlike the

findings of this study, found that the main source of referral of children to psychotherapy was school, representing (34.3%) of the sample studied, followed by family members (12.7%), psychologist (7.8%), neurologist (6.8%), pediatrician (6.3%), other care institutions (6.0%), other medical modalities (5.4%), psychiatrist (3.3%), Guardianship Council (1.2%), pedagogue (1.0%), social worker (0.9%), others (7.4%) and not listed (6.9%). In addition, it was found that children who receive treatments combined with psychotherapy, such as psychiatric or speech therapy, have greater adherence (GASTAUD et al., 2011)

It is relevant to highlight the formation of a collaboration between health professionals and psychologists in the context of detection, evaluation and referral to child psychotherapy. It is assumed that it is challenging to identify and evaluate behaviors in children. In addition, they highlight that the family's trust in the professional who makes the referral positively influences adherence to psychological treatment (WARD-ZIMMERMAN; CANNATA, 2012).

Considering the present study, it was identified that the largest number of demands for child and adolescent psychotherapy was anxiety (37%). Similarly, a study carried out in 2017, in a survey referring to the characterization of 150 children attended at a teaching clinic in São Paulo, from 2000 to 2010, found that internalizing complaints regarding anxiety, depression and somatic symptoms predominated in girls, as did this study (VAGOSTELLO et al., 2017). Furthermore, the main manifestation of anxiety is described as a non-specific, vague feeling of the existence of some kind of threat to well-being (CASTILLO et al., 2000). And, finally, it was observed in this study that aggressiveness (16.36%) had a high rate of complaint, corroborating the article by Vagostello et al. (2017).

Several studies describe and analyze the characterization of the child and adolescent population served (Grzybowski, 2003; VIVIAN; TIMM; SOUZA, 2013; VAGOSTELLO et al., 2017). Characterization studies such as this one seek to analyze and describe this population, seeking to identify behavioral patterns, risk factors, prevalence of psychological disorders, and environmental and social influences that can affect their development and well-being. This information is essential to guide public policies, prevention and treatment programs, in addition to contributing to academic training and evidence-based clinical practice.

It is worth noting that, of the 54 people assisted, 19 were discharged by the professional and 17 remain in psychological follow-up, indicating different results achieved during the therapeutic process. It is noteworthy that, in a study developed in 2019, it pointed out difficulty in welcoming and linking users to the service; high rates of service dropout and non-return to care after the screening interview (SEI et al., 2022).

The analysis of these data and the literature can provide valuable insights into the effectiveness of the treatment, the characteristics of the population served, and the clinical practices



adopted. First, it is observed that a significant number of people have been discharged or continue to be in psychological counseling. This suggests that psychological intervention was considered beneficial for most individuals attended, either providing sufficient improvements for treatment completion or indicating the need for continued follow-up.

Finally, the 19 cases that were discharged may indicate that these people have achieved the established therapeutic goals, demonstrating sufficient progress to address the emotional and behavioral challenges without the need for ongoing professional intervention. This can be seen as a positive indicator of the effectiveness of the treatment and the role of the psychologist in promoting the well-being and mental health of patients. On the other hand, the 17 individuals who remain in psychological counseling may be facing more complex or persistent issues that require a more prolonged therapeutic approach. The importance of continuity of care and psychological support for those who are still in the process of recovery or facing continuous emotional and psychological difficulties is emphasized. In addition, it reinforces the relevance of continuous psychological follow-up as a valuable tool in the management of emotional and psychological issues, even after the completion of a successful initial treatment.

## FINAL CONSIDERATIONS

The study in question describes relevant information about the profile and demands of children and adolescents cared for in a USF, in a limited period of time. The main reason for referral to the psychology sector was anxiety for both females and males, which highlights the importance of preventive approaches and early intervention in this regard. In addition, the differences in demands between girls and boys highlight the need for personalized intervention strategies, considering the particularities of each age group and sexual orientation.

It is relevant to highlight that a significant number of patients were undergoing psychological follow-up during the data collection period, with an average of 14 sessions per patient. This demonstrates the commitment and continuity of the treatment offered by the Outpatient Clinic, contributing to the well-being and improvement of the quality of life of this population.

In view of this, it is noteworthy that studies such as this one are of paramount importance to understand and assess the mental health needs of children and adolescents in different contexts. They provide valuable indicators that can guide public policies, clinical practices, and intervention programs, aiming to improve access, quality, and effectiveness of mental health services offered to the child and adolescent population.

Finally, it is recommended that new studies be carried out that can converge the analysis of the effectiveness of prevention and early intervention programs for mental health disorders in children and adolescents, also longitudinal research that follows the development and well-being of



children and adolescents over time can help identify risk factors, growth patterns and long-term outcomes of interventions. Also, studies that evaluate the involvement of the family in the treatment and support of the mental health of children and adolescents, given the relevance of this care.



## REFERENCES

1. Almeida, R. A. de, & Malagris, L. E. N. (2011). A prática da psicologia da saúde. \*Revista da SBPH, 14\*(2), 183–202. [http://pepsic.bvsalud.org/scielo.php?script=sci\\_arttext&pid=S1516-08582011000200012&lng=pt](http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S1516-08582011000200012&lng=pt)
2. Borsa, J. C., Segabinazi, J. D., Stenert, F., Yates, D. B., & Bandeira, D. R. (2013). Caracterização da clientela infanto-juvenil de uma clínica-escola de avaliação psicológica de uma universidade brasileira. \*Psico, 44\*(1). <https://revistaseletronicas.pucrs.br/ojs/index.php/revistapsico/article/view/10599/8850>
3. Brito, J. C., & Silva, P. F. (2022). Diagnóstico situacional da equipe de saúde da família 034 e 113 da unidade de saúde da família Carimã [Trabalho de Conclusão de Curso]. Foz do Iguaçu: Programa de Residência Multiprofissional em Saúde da Família, Universidade Federal da Integração Latino-Americana.
4. Brito, R. A. C., Montezuma, S., Melo, A. K., & Moreira, V. (2020). A psicoterapia infantil no setting clínico: uma revisão sistemática de literatura. \*Contextos Clínicos, 13\*(2), 696-721. <http://dx.doi.org/10.4013/ctc.2020.132.15>
5. Campos, J. G. de F., Marques, L. F. N., & Bacelar, T. D. (2022). Caracterização dos usuários e serviços prestados em uma clínica escola de psicologia no contexto de saúde pública. \*Revista Interdisciplinar de Ciências Médicas, 6\*(1), 12–18. <https://revista.fcmmg.br/index.php/RICM/article/view/138/133>
6. Cardozo, T. B., & Monteiro, R. A. de P. (2019). Da psiquiatria tradicional à reforma psiquiátrica: o ambulatório de saúde mental como serviço de tratamento. \*Revista Psicologia e Saúde, 2\*(12), 31-44. <http://dx.doi.org/10.20435/pssa.v0i0.768>
7. Castillo, A. R. G., Recondo, R., Asbahr, F. R., & Manfro, G. G. (2000). Transtornos de ansiedade. \*Revista Brasileira de Psiquiatria, 22\*(2), 20-23. <http://dx.doi.org/10.1590/s1516-44462000000600006>
8. Cavaler, C. M., Vitali, M. M., Castro, A., Soratto, J., & Amboni, G. (2020). O profissional de psicologia na residência multiprofissional: o papel do psicólogo na ESF. \*Revista Baiana de Saúde Pública, 43\*(1), 107-131. <http://dx.doi.org/10.22278/2318-2660.2019.v43.n1.a2903>
9. Chagas, A. F. L. das, Ramos, T. C. S., Souza, C. C. M. de, & Santos, T. M. dos. (2022). A identidade social na atuação do psicólogo da saúde. \*Revista Científica Multidisciplinar Núcleo do Conhecimento\*, 189-202. <http://dx.doi.org/10.32749/nucleodoconhecimento.com.br/psicologia/psicologo-da-saude>
10. Conselho Federal de Psicologia. (n.d.). Referências técnicas para atuação de psicólogas(os) na Atenção Básica à Saúde. Disponível em: [https://site.cfp.org.br/wp-content/uploads/2019/11/CFP\\_atencaoBasica-2.pdf](https://site.cfp.org.br/wp-content/uploads/2019/11/CFP_atencaoBasica-2.pdf)
11. Damous, I., & Erlich, H. (2017). O ambulatório de saúde mental na rede de atenção psicossocial: reflexões sobre a clínica e a expansão das políticas de atenção primária. \*Physis: Revista de Saúde Coletiva, 27\*(4), 911-932. <http://dx.doi.org/10.1590/s0103-73312017000400004>
12. Dimenstein, M., & Macedo, J. P. (2012). Formação em Psicologia: requisitos para atuação na atenção primária e psicossocial. \*Psicologia: Ciência e Profissão, 32\*, 232-245. FapUNIFESP (SciELO). <http://dx.doi.org/10.1590/s1414-98932012000500017>




13. Gastaud, M. B., Basso, F., Soares, J. P. G., Eizirik, C. L., & Nunes, M. L. T. (2011). Preditores de não aderência ao tratamento na psicoterapia psicanalítica de crianças. *\*Revista de Psiquiatria do Rio Grande do Sul, 33\*(2), 109-115. FapUNIFESP (SciELO). <http://dx.doi.org/10.1590/s0101-81082011005000011>*
14. Gil, A. C. (2017). *\*Como elaborar projetos de pesquisa\** (6ª ed.). São Paulo: Atlas.
15. Goncalves, H. A., Pureza, J. R., & Prando, M. L. (2011). Transtorno de déficit de atenção e hiperatividade: breve revisão teórica no contexto da neuropsicologia infantil. *\*Revista Neuropsicologia Latinoamericana, 3\*(3), 20-24. <http://dx.doi.org/10.5579/rnl.2011.0076>*
16. Grzybowski, L. (2003). Famílias monoparentais: reflexo da pós-modernidade? In P. Guareschi, A. Pizzinato, L. Krüger, & M. Macedo (Eds.), *\*Psicologia em questão: reflexões sobre a contemporaneidade\** (pp. 113-123). Porto Alegre: Edipucrs.
17. Jimenez, L. (2011). Psicologia na Atenção Básica à Saúde: demanda, território e integralidade. *\*Psicologia & Sociedade, 23\**, 129-139. FapUNIFESP (SciELO). <http://dx.doi.org/10.1590/s0102-71822011000400016>
18. Lemos, V. S., & Lhullier, C. (2020). A Psicologia na Atenção Básica e a Saúde Coletiva. *\*Revista Psicologia e Saúde\**, 177-188. <http://dx.doi.org/10.20435/pssa.vi.1076>
19. Lopez, M. A. (1983). Características da clientela de clínicas-escola de Psicologia em São Paulo. *\*Arquivos Brasileiros de Psicologia, 35\*(1), 78-92. <https://periodicos.fgv.br/abp/article/view/18887>*
20. Lucas, M. (2012). *\*Forças nas famílias monoparentais femininas\** (Dissertação de Mestrado). Escola Superior de Altos Estudos do Instituto Superior Miguel Torga.
21. Ministério da Saúde. (2005). *\*Caminhos para uma Política de Saúde Mental Infanto-Juvenil\**. Brasília. Disponível em: [https://bvsmms.saude.gov.br/bvs/publicacoes/05\\_0887\\_M.pdf](https://bvsmms.saude.gov.br/bvs/publicacoes/05_0887_M.pdf)
22. Mondardo, M., & Staliano, P. (2020). Saúde na Fronteira Brasileira: políticas públicas e acesso a serviços. *\*Espaço Aberto, 10\*(1), 99-116. <http://dx.doi.org/10.36403/espacoaberto.2020.29948>*
23. Rafeh, L. Y. A., & Souza, L. F. A. de. (2023). Levantamento epidemiológico da depressão na tríplice fronteira: Brasil, Argentina e Paraguai. *\*Brazilian Journal of Health Review, 6\*(6), 29718-29726. <http://dx.doi.org/10.34119/bjhrv6n6-241>*
24. Sei, M. B., Trevisan, F. M., Skitnevsky, B., & Sujiguchi, I. (2022). Caracterização dos usuários adultos de um serviço-escola de psicologia paranaense. *\*Revista Mental, 14\*(25). [http://pepsic.bvsalud.org/scielo.php?script=sci\\_arttext&pid=S1679-44272022000100002](http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S1679-44272022000100002)*
25. Serafim, M. P. da S., Silva, D. M. da, Brunel, J. L., & Gomes, K. M. (2019). Perfil das crianças usuárias do ambulatório de saúde mental do município de Içara – SC. *\*Estudos Interdisciplinares em Psicologia, 10\*(2), 192. Universidade Estadual de Londrina. <http://dx.doi.org/10.5433/2236-6407.2019v10n2p192>*
26. Vagostello, L., Albuquerque, D. S. M., Queiroz, F. T., Lopes, G. P., & Silva, L. V. (2017). Caracterização das demandas de psicodiagnóstico infantil em uma clínica-escola de São Paulo. *\*Psicologia Revista, 26\*(1), 41. <http://dx.doi.org/10.23925/2594-3871.2017v26i1p.41-58>*





27. Vivian, A. G., Timm, J. S., & Souza, F. P. (2013). Serviço-escola de psicologia: caracterização da clientela infanto juvenil atendida de 2008 a 2012, em uma universidade privada do RS. \*Revista Aletheia\*, 42, 152-136. <https://www.redalyc.org/pdf/1150/115035315012.pdf>
28. Wagner, A., & cols. (2011). \*Desafios Psicossociais da Família Contemporânea- Pesquisas e Reflexões\* (1ª ed.). Porto Alegre: Artmed.
29. Ward-Zimmerman, B., & Cannata, E. (2012). Partnering with pediatric primary care: lessons learned through collaborative colocation. \*Professional Psychology: Research and Practice\*, 43\*(6), 596-605. <https://psycnet.apa.org/record/2012-24745-001>

## Association between polymorphisms in the gene encoding the vitamin D receptor, lipid profile and anthropometric parameters in elderly Brazilians

 <https://doi.org/10.56238/sevenced2024.016-010>

Ivone Freires de Oliveira Costa Nunes<sup>1</sup>, Cecilia Maria Resende Gonçalves de Carvalho<sup>2</sup>, Gabriella Magalhães Silva<sup>3</sup>, Gleyson Moura dos Santos<sup>4</sup>, Maria Eduarda Raielly da Silva<sup>5</sup>, Elane Natielly da Conceição Silva<sup>6</sup>, Nauale Lopes de Araújo<sup>7</sup>, Lynda Sthefanny Alves dos Santos<sup>8</sup>, Laura Beatriz Guimarães Sousa<sup>9</sup>, Gleicer Vívian da Silva Lodoro<sup>10</sup>, Ruth Hellen do Nascimento Gomes<sup>11</sup> and Sarah Celeste Rodrigues de Sousa Val<sup>12</sup>

### ABSTRACT

Polymorphisms in the vitamin D receptor gene are associated with the severities of several diseases, including overweight and cardiovascular disease. In addition, vitamin D is an important determinant of health and has several functions in bone homeostasis and in various physiological and metabolic mechanisms. From this perspective, this study aimed to evaluate whether there is an association between the genetic variants FokI (rs2228570) and BsmI (rs1544410) with circulating metabolic markers of the lipid profile and anthropometric measurements in the elderly. This is a cross-sectional study conducted with 173 elderly people from Teresina, Piauí State, Brazil, whose sociodemographic and health characterization occurred through interviews. 25-hydroxyvitamin D [25(OH)D] was measured by chemiluminescence. The cut-off values used as a reference for serum lipids were from the Update of the Brazilian Guideline on Dyslipidemias and Prevention of Atherosclerosis. Genotyping was performed using the restriction fragment length polymorphism technique. The results showed that there were no statistically significant differences between the association of VDR FokI and BsmI gene polymorphisms with BMI, blood pressure and vitamin D concentrations. However, elderly carriers of the BsmI genotype, specifically Bb heterozygotes, were associated with lower values of triglycerides and HDL-cholesterol.

**Keywords:** Dyslipidemias, Vitamin D, Polymorphism, Vitamin D Receptor.

<sup>1</sup> Doctor, Professor at the Department of Nutrition/UFPI

<sup>2</sup> Doctor, Professor of the Department of Nutrition, Tutor of the Tutorial Education Program/UFPI.

<sup>3</sup> Student of the Nutrition Course, Scholarship holder of PIBIC/CNPq/UFPI

<sup>4</sup> Doctor, Professor Professor at the Facid Wyden University Center

<sup>5</sup> Students of the Nutrition Course, scholarship holders of the Tutorial Education Program/UFPI

<sup>6</sup> Students of the Nutrition Course, scholarship holders of the Tutorial Education Program/UFPI

<sup>7</sup> Students of the Nutrition Course, scholarship holders of the Tutorial Education Program/UFPI

<sup>8</sup> Students of the Nutrition Course, scholarship holders of the Tutorial Education Program/UFPI

<sup>9</sup> Students of the Nutrition Course, scholarship holders of the Tutorial Education Program/UFPI

<sup>10</sup> Students of the Nutrition Course - Facid Wyden University Center

<sup>11</sup> Students of the Nutrition Course - Facid Wyden University Center

<sup>12</sup> Students of the Nutrition Course - Facid Wyden University Center

## INTRODUCTION

Most of the biological functions of the active form of vitamin D are mediated by the VDR nuclear receptor that regulates the transcription of target genes. This receptor is found in several organs, which implies a broad action of vitamin D, in the regulation of many physiological and metabolic processes, with important repercussions on human health.

The VDR gene is located on chromosome 12q12-q14 and comprises 11 exons and 11 introns, with more than 600 identified single nucleotide polymorphisms (SNPs) in its coding region, however, FokI (rs2228570) and BsmI (rs1544410), located in intron 8, are arguably the most studied SNPs. VDR gene variants have the potential to influence biological outcomes (Abouzid et al., 2018; Jolliffe et al., 2016), as demonstrated its effect on skeletal muscles independent of vitamin D, and decreased expression of the VDR protein is related to the development of various diseases and aging (Manuel et al., 2018).

Studies have related vitamin D deficiency with a higher prevalence of abdominal obesity and/or dyslipidemia in several populations, where blood concentrations of this vitamin have been inversely associated with the atherogenic lipid profile (Cheng et al 2010; Jorde et al., 2010; Skaaby et al., 2012; Ponda et al., 2012; Wang et al., 2016). This type of association has been a cause for concern, since the expression of some genes related to lipid metabolism is regulated by calcitriol (Ramagopalan et al., 2010) and some are activated by VDR (Martínez-Sena et al., 2020), demonstrating that both vitamin D status and VDR function have the potential to affect gene expressions associated with lipid metabolism (Mei et al., 2022).

However, for each of the lipid parameters, such as triglycerides (TG), total cholesterol (TC), low-density lipoprotein (LDL), and high-density lipoprotein (HDL), the results are inconsistent, as suggested by Dibaba 2019; Wang et al., 2012 in a human study and meta-analyses.

When verifying the effect of polymorphisms on Body Mass Index (BMI), the ff/FF (FokI) and Bb/BB (BsmI) genotypes and the F and B alleles were related to higher BMI (De Oliveira, 2018; Swapna et al., 2011). Another study revealed an association between serum concentrations of 25(OH)D, VDR SNPs (FokI and BsmI) with nutritional status (Bienertová-Vasku et al., 2017).

Although research indicates genetic interactions between the VDR and the lipid profile, anthropometric changes, development of overweight and associated diseases, the results are not consistent. In this scenario, the objective of this study was to evaluate whether there is an association between the genetic variants FokI (rs2228570) and BsmI (rs1544410) with circulating metabolic markers of the lipid profile and anthropometric measurements in the elderly.



## METHODOLOGY

### STUDY DESIGN

This study is an excerpt from the doctoral thesis entitled "Global nutritional status of the elderly: Association with sociodemographic factors, Vitamin D Status, arterial hypertension and genetic polymorphisms" of the Graduate Program in Food and Nutrition (PPGAN) of the Federal University of Piauí (UFPI).

### POPULATION AND SAMPLE

For this study, the data correspond to a sample composed of 173 (one hundred and seventy-three) elderly people of both sexes, living in the city of Teresina, Piauí, Brazil, where only the variables defined to meet the objectives of this research are included.

### SAMPLE SELECTION

Elderly people aged 60 years or older were selected through a random sample from the elderly identification database. The sample calculation was based on the estimate of the standard deviation of 9.3 ng/mL of 25(OH)D, from the population-based study with the elderly in São Paulo, adopting a confidence interval of 95% and an error of 1.39 ng/mL. The distribution of the number of individuals was calculated according to the proportion of elderly people registered in each health care zone, as follows: Central-North (32.6%; n=59), East-Southeast (32.1%; n=58) and South (35.1%; n=64). Data collection took place between 2017 and 2018, at the home, of the elderly randomly selected from the list provided by the health units.

### ANTHROPOMETRIC ASSESSMENT AND NUTRITIONAL DIAGNOSIS

For anthropometric evaluation, weight (kg) and height (cm) were measured according to the recommendations of Chumlea; Roche; Steinbaugh (1985). Waist circumference (WC) was obtained by measuring the abdominal region, in its smallest perimeter and was classified as recommended by the World Health Organization (2000): no risk (< 94 cm for men and < 80 cm for women); increased risk (> 94 cm for men and > 80 cm for women) and very high risk (> 102 cm for men and > 88 cm for women).

The Body Mass Index (BMI) was calculated by dividing the weight in kilograms by the height in meters squared. The classification of nutritional status was according to the Pan American Health Organization (2002) for the elderly, which considers the following values and classification: underweight ( $\leq 23$  kg/m<sup>2</sup>), normal weight (> 23 and < 28 kg/m<sup>2</sup>), overweight ( $\geq 28$  and < 30 kg/m<sup>2</sup>) and obesity ( $\geq 30$  kg/m<sup>2</sup>).



## BLOOD PRESSURE MEASUREMENT

Initially, arterial hypertension was defined based on the medical diagnosis and use of antihypertensive drugs reported by the patients. In addition, the measurement of diastolic and systolic blood pressure (mmHg) was performed in triplicate, as recommended by the Brazilian Guideline on Arterial Hypertension of the Brazilian Society of Cardiology – SBC (2021), using a stethoscope and an aneroid sphygmomanometer of the Premium® brand.

## BIOCHEMICAL PARAMETERS

Blood collection was performed by a nursing technician with experience in the area, on the premises of the Basic Health Unit (BHU) to which the elderly person was registered or at the participant's home. The appointment was made by telephone call, one week in advance. Individuals received orientations, following a standardized script, including: fasting for 8 hours from non-alcoholic foods and beverages, fasting for 72 hours for alcoholic beverages, and not performing physical activities or physical exertion on the day scheduled for collection.

For the biochemical evaluation, a 10 mL blood sample was collected by venipuncture, in plastic test tubes with a vacuum polyethylene cap (*vacutainer* type), with separator gel, using disposable plastic syringes, stainless steel and sterile needles. Tubes without anticoagulant were used to determine the lipid profile and with EDTA to evaluate vitamin D and genetic polymorphisms. The transport to the laboratory took place immediately after the harvest, under refrigeration, in a Styrofoam box closed with ice. The samples were analyzed on the day of collection, in a specialized private laboratory according to the methods standardized by the laboratory, using an immunoassay analyzer (Architect c8000).

Serum concentrations of total cholesterol, high-density lipoprotein (HDL-c) and triglycerides (TG) were determined by the colorimetric enzymatic method, using Labtest kits®. The low-density lipoprotein (LDL-c) fraction was calculated according to the formula of Friedwald, Levy & Fredrickson (1972):  $LDL-c = CT - HDL-c - TG/5$ .

Vitamin D was measured using the Diasorin LIAISON TM (USA) method. The standardized assay is based on the recognition of vitamin D binding proteins through chemiluminescence. Hypovitaminosis D was defined when 25(OH)D concentrations were  $< 30$  ng/mL and sufficiency occurred when it was  $\geq 30$  ng/mL, based on the stratified reference intervals for the elderly population according to the Brazilian Society of Endocrinology and Metabolism (2018).



## GENOTYPING

Genomic DNA from peripheral blood was extracted using the QIAGEN kit. The evaluation of purity and quality were defined after quantification in the NanoDrop 2000 spectrophotometer, whose 260/280 ratio should be  $\geq 1.8$  and have a defined band in 1.5% agarose gel. DNA samples were normalized to 20 ng and conventional polymerase chain reaction (PCR) was performed in a Bioer Gene Pro® thermal cycler. and for PCR, 5  $\mu\text{L}$  of Solis BioDyne 5xFIREPol® master mix and 0.8  $\mu\text{L}$  of Forward and Reward primers were used for each SPNs. In all samples, the endogenous gene (GADPH) was tested and the reactions included a negative control.

The products amplified in the PCR of BsmI (825 bp) and FokI (265 bp) were visualized in 1.5% agarose gel in UV light in a MiniBIS Pro photodocumenter. To determine the genotypes of the SNPs, the samples were submitted to restriction by the Restriction Fragment Length Polymorphism (RFLP) method, using 1  $\mu\text{L}$  of the fast digest enzyme for FokI. and for BsmI. The products of FokI digestion were submitted to electrophoresis in 8% polyacrylamide gel (80 v) and those of BsmI in 1.5% agarose gel (100v). For staining of the gels and subsequent visualization of the DNA fragments, ethidium bromide was used.

## STATISTICAL ANALYSIS

The data were entered and calculated using *the Statistical Package for the Social Sciences (SPSS)* software, version 22.0, which calculated the data with the presentation of the results in tables expressed in numbers and percentages for categorical variables. The Hardy-Weinberg equilibrium was tested by the chi-square test, and was considered an imbalance when  $p < 0.05$ .

For the quantitative variables, the measures of central tendency (means) and dispersion (standard deviation) were calculated. To compare the mean of a continuous variable in two independent groups, the Student's t-test was performed. Pearson's chi-square test was used to evaluate differences between the variables. In cases in which more than 25% of the cells presented values below 5, Fisher's Exact Test was applied. Thus, in the results section, the statistical methods used for each of the variables presented are specified. For the statistical tests, the level of significance adopted was 5% or  $p < 0.05$ .

## ETHICAL ASPECTS

The approval of the UFPI Research Ethics Committee was obtained in the original project (opinion no. 2.216.538).

## RESULTS AND DISCUSSION

### CLINICAL, BIOCHEMICAL AND ANTHROPOMETRIC CHARACTERISTICS OF THE ELDERLY

The study sample consisted of 173 elderly people, of both sexes, aged between 60 and 93 years, with a predominant age group of 60 to 70 years (52.6%). Among the elderly, the majority were female (68.2%), reflecting the phenomenon of feminization of old age, that is, a higher proportion of women than men, especially at more advanced ages. In all regions of the world, the proportion of women exceeds half of the elderly population (Cortez et al., 2019; Ferreira et al., 2018) and this needs to be considered in studies on aging.

The data regarding the study variables are described in Table 1. The mean age was approximately 72 and 70 years for men and women, respectively. Regarding BMI, it was found that the mean remained similar for both sexes, around 24 kg/m<sup>2</sup>, with a predominance of adequate values. It is noteworthy that overweight and obesity were present in 20.2% of the elderly (Data not shown in the table).

The waist circumference measurement was higher in males, as in the study by Alves et al. (2021), being within the increased risk category (97.99 cm), while the mean value of women presented a very increased risk (93.67 cm), according to the WHO classification (2000).

Table 1. Mean and standard deviation of the variables studied in the group of elderly people. Teresina, PI, 2020-2021.

Variables	Sex	N	Average	Standard Deviation	P* value
Age	But	55	72,35	8,44	0,296
	Fem	118	70,95	7,44	
IMC	But	55	24,90	4,24	
	Five	118	24,30	4,95	0,421
Waist circumference	But	55	97,99	9,09	
	Five	118	93,67	12,11	<b>0,020</b>
Systolic Blood Pressure	Five	118	136,16	20,98	0,91
	But	55	84,05	9,92	
Diastolic Blood Pressure	Five	118	82,91	8,22	0,426
	But	55	47,80	8,20	
HDL	Five	118	49,75	10,74	0,234
	But	55	224,61	36,84	
Colesterol Total	Five	118	191,27	38,53	<b>&lt;0,001</b>
	But	55	173,61	40,12	
Triglycerides	Five	118	147,28	56,11	<b>0,001</b>
	But	55	141,88	32,92	
LDL	Five	118	112,19	33,35	<b>&lt;0,001</b>
	But	55	35,02	15,64	
25-Hydroxyvitamin D	Five	118	23,84	10,97	<b>&lt;0,001</b>

Legend: But: Male; Fem: Female; BMI: Body Mass Index; HDL: High-intensity lipoprotein; LDL Low-density lipoprotein; \* Student's t-test. Source: Survey data.

In addition, the categorization of WC data indicated that 41.8% of men presented increased risk and 30.9% very increased risk. For the elderly, the values were 9.3% and 75.4%, respectively (Data not shown in the table). Jansen et al. (2020) and Souza et al. (2013) explain that in addition to the increase in adipose tissue, in aging there is also a redistribution of abdominal fat, thus, with increasing age, subcutaneous fat becomes more centralized, leading to an increase in abdominal fat, a fact observed in the population in question.

The accumulation of fat in the abdominal region is an important risk factor for several diseases, which is differentiated when compared to other forms of body fat distribution (Da Silva et al., 2017; Rocha, 2013). There is a correlation between waist circumference measurement and the development of dyslipidemia, hypertension, and insulin resistance, in addition to an association with alterations in biochemical tests (Bueno et al., 2017; Rossi; Caruso; Galante, 2015).

Similar values were verified by Oliveira et al. (2014), in a study with 359 elderly people from Teresina-PI, assisted by teams of the Family Health Strategy (ESF), where the mean BMI of the elderly was 25.2 for both sexes, and a higher percentage of men with high weight compared to women, 33.8% and 29.5%, respectively. And similar values of waist circumference were observed in men, with a mean of 96.8 cm. However, contrary to the present study, elderly women had a higher mean abdominal circumference value, which was 98.5 cm.

Also in relation to Table 1, it is observed that the mean values of Systolic and Diastolic Pressure (mm Hg) were normal in both sexes, and there was no statistical difference between men and women. Arterial hypertension occurred in more than half of the elderly (56.1%). Bento, Mambrini, and Peixoto (2020) evaluated factors associated with hypertension in older adults and report that there is no significant difference between men and women. However, they state that there are generally higher rates of hypertension among women and this can be explained by a greater tendency to self-care and a greater perception of their health status, that is, women tend to make medical visits more frequently than men.

Medeiros (2018) in a study carried out with 179 elderly people in Paraíba identified a high prevalence of arterial hypertension (AH), and observed that the main factors associated with AH were non-white race/color and high triglyceride levels. In a study with 273 elderly people in Teresina-PI, Rocha et al. (2020), observed biochemical changes mainly in increased levels of triglycerides and SBP, between both sexes.

Table 1 also shows the means and standard deviations of the lipid profile of the elderly, where it is evident that the concentrations of cholesterol, triglycerides and LDL-c for males were significantly higher, and HDL-c was lower. According to the V Brazilian Guideline on Dyslipidemias and Prevention of Atherosclerosis, of 2017, the reference values of the lipid profile desirable for individuals over 20 years of age (including the elderly) are: TC: < 200; TG: < 150; HDL-c: > 40 and



LDL-c: < 100. Therefore, both sexes had desirable HDL concentrations, men had total cholesterol and triglyceride concentrations above the desired levels, in contrast to the data for women, and both groups had LDL-c concentrations above the desired levels. Different results were found in the study by Neves-Souza et al. (2015), with lipid profile values above the desirable values most prevalent in the female group.

Changes in serum concentrations of cholesterol, triglycerides, LDL-c and HDL-c are among the main risk factors for the development of cardiovascular diseases, including hypertension and atherosclerosis (SANTOS; CHIACHIO, 2020; BASIC et al., 2019; GUEDES et al., 2016). In addition, low concentrations of vitamin D are related to increased risk of hyperlipidemia. A correlation was found between vitamin D deficiency and increased total cholesterol and LDL-c.

On the other hand, a decrease in HDL-c concentration was observed. However, the mechanism of vitamin D's lipid-lowering effect remains unknown. Vitamin D probably increases serum calcium by increasing intestinal calcium absorption, which in turn reduces serum triglycerides by suppressing the formation and secretion of hepatic triglycerides. Another explanation may be through the inhibitory effect of vitamin D on serum PTH concentrations. The low concentration of this hormone can reduce TG by increasing its peripheral absorption.

## ASSOCIATION BETWEEN POLYMORPHISMS AND THE VARIABLES ANALYZED

The frequency distribution of genotype characteristics and alleles of the polymorphisms verified in the present study are described in Table 2.

Table 2. Frequency distribution of traits of genotypes and SNP alleles of the VDR gene.

<b>Feature</b>	<b>N</b>	<b>%</b>
<b>GENOTYPE</b>		
FF	80	46,2
Ff	79	45,7
Ff	14	8,1
<b>ALLELE</b>		
F		
f		
<b>GENOTYPE</b>		
BB	34	19,7
Bb	95	54,9
bb	44	25,4
<b>ALLELE</b>		
B		
b		

Source: Survey data.

The association between the genotypes in the sample and the variables analyzed: BMI, serum vitamin D concentration, blood pressure values and alteration in the lipid profile of the elderly are shown in tables 3 and 4.

Of the 173 elderly people analyzed, 20.2% were overweight or obese, according to BMI. Of these, a higher frequency of overweight/obesity can be observed in relation to the FF genotype (12.7%) (Table 3) and the Bb genotype (10.4%) (Table 4). However, no statistically significant association was found (Table 3).

Table 3. Association between FokI genotypes (rs2228570) and anthropometric and clinical variables in the elderly. Teresina, PI, 2020-2021.

Variables	FF n = 80		Ff n = 79		Ff n = 14		Total n=173		p
	N	%	N	%	N	%	N	%	
<b>IMC</b>									
Non-obese	58	33,5%	69	39,9%	11	6,4%	138	79,8%	0,053
Overweight/obesity	22	12,7%	10	5,8%	3	1,7%	35	20,2%	
<b>Vitamin d</b>									
Inadequacy	57	32,9%	48	27,7%	10	5,8%	115	66,5%	0,381
Sufficiency	23	13,3%	31	17,9%	4	2,3%	58	33,5%	
<b>Hypertension</b>									
No	37	21,4%	36	20,8%	4	2,3%	77	44,5%	0,484
Yes	43	24,9%	43	24,9%	10	5,8%	96	55,5%	
<b>Dyslipidemia</b>									
No	39	22,5%	46	26,6%	5	2,9%	90	52,0%	0,221
Yes	41	23,7%	33	19,1%	9	5,2%	83	48,0%	

Fisher's exact. Source: Survey data.

Table 4. Association between BsmI genotypes (rs1544410) and anthropometric and clinical variables in the elderly. Teresina, PI, 2020-2021.

Variables	BB n=34		Bb n= 95		bb n= 44		Total n=173		p
	N	%	N	%	N	%	N	%	
<b>IMC</b>									
Non-obese	26	15,0%	77	44,5%	35	20,2%	138	79,8%	0,849
Overweight/obesity	8	4,6%	18	10,4%	9	5,2%	35	20,2%	
<b>Vitamin d</b>									
Inadequacy	24	13,9%	63	36,4%	28	16,2%	115	66,5%	0,811
Sufficiency	10	5,8%	32	18,5%	16	9,2%	58	33,5%	
<b>Hypertension</b>									
No	14	8,1%	45	26,0%	18	10,4%	77	44,5%	0,705
Yes	20	11,6%	50	28,9%	26	15,0%	96	55,5%	
<b>Dyslipidemia</b>									
No	15	8,7%	49	28,3%	26	15,0%	90	52,0%	0,419
Yes	19	11,0%	46	26,6%	18	10,4%	83	48,0%	

Chi-square. Source: Survey data.

Some studies have shown that FokI and BsmI are genetic variants associated with markers of adiposity (Al-Daghri et al., 2014; Ochs-Balcom, 2011). While, others reported a lack of association

(Khan et al., 2016; Maria et al., 2018). Although some VDR variants are associated with high BMI and WC, however, in relation to VDR BsmI and FokI were also not related to BMI and WC in the studies by Dorjgochoo et al. (2012), Walsh et al. (2016) and Pramono et al. (2021).

Thus, the evidence for the relationship between VDR genetic variants and obesity remains inconclusive. It should be noted that adiposity based only on BMI does not take into account the more accurate determination of body composition.

Regarding the association with plasma vitamin D concentration, of the 66.5% who had vitamin D insufficiency, a greater relationship was also observed with the FF (32.9%) and Bb (36.4%) genotypes, but without significant association. A non-association of these polymorphisms with circulating vitamin D concentrations was also verified by Al-Ghafari, Balamash, and Al Doghaither (2019). In addition, Rai et al. (2017) mention that little is known about how these polymorphisms affect circulating vitamin D levels.

The association of genotypes with blood pressure values showed a greater relationship between the FF and Ff genotypes, both with 24.9%, and the Bb genotypes (28.9%) with the elderly who had Arterial Hypertension. With the analysis of the alteration in the lipid profile, it was found that dyslipidemia was present in 48% of the elderly analyzed, and of these there was a greater relationship with the FF genotype (23.7%). The relationship between dyslipidemia and the BsmI polymorphism was more frequent in the Bb genotype (26.6%).

In all the variables analyzed, the relationship with the genotype evaluated was higher in the most frequent genotypes, genotypes "FF" and "Bb", but in none of the associations analyzed was a statistically significant difference found. The results found differ from other studies that; found an association between polymorphisms and changes in the lipid profile (Jin et al., 2021; Kazemian et al., 2019) and association between FokI and the risk of hypertension (Wang et al., 2013).

Table 5 shows the relationship between the lipid profile and the genotypes of FokI (rs2228570) and BsmI (rs1544410). A statistically significant relationship between triglycerides and low HDL-c was identified with the Bb genotype of the BsmI polymorphism. There was no significant relationship between the lipid profile and the genotypes of the FokI polymorphism. The literature is still scarce in the study of genetic variations related to the vitamin D pathway, so the evidence of the findings of the present study strengthens this relationship. Although the physiological mechanism responsible for the relationship between vitamin D and cholesterol is not well understood, it is important to mention that both molecules have the same precursor, 7-dehydrocholesterol (Grave et al., 2016).

Table 5. Lipid profile in relation to VDR genotypes. Teresina, PI, 2020-2021.

Genotypes	TG N / %	p	CT N / %	p	LDL-c alto N / %	p	HDL-c baixo N / %	p
<b>FokI (rs2228570)</b>								
FF	18 / 22,5		15 / 18,8		9 / 11,3		22 / 27,5	
Ff	13 / 16,5	0,13	14 / 17,7	0,89	11 / 13,9	0,57	18 / 22,8	0,94
Ff	7 / 50,0		4 / 28,6		2 / 14,3		3 / 21,4	
<b>BsmI (rs1544410)</b>								
BB	9 / 26,5		7 / 20,6		4 / 11,7		9 / 26,5	
Bb	15 / 15,8	<b>0,01*</b>	14 / 14,7	0,15	10 / 10,6	0,48	30 / 31,6	<b>0,02*</b>
bb	14 / 31,8		12 / 27,3		8 / 18,1		4 / 9,1	

Fischer's Exato test. Legend: TG: Triglycerids; CT: Total cholesterol; HDL: High-intensity lipoprotein; Low-density LDL Lipoprotein.

Source: Survey data

The study by Gussago et al. (2016) revealed a significant impact of VDR gene polymorphisms in an older population on some variables measured in the study, including HDL-c. In addition, VDR polymorphisms are known to have an impact on BMI, triglycerides, and HDL-c (Carvalho, 2015).

Evidence has shown that the BsmI polymorphism of the VDR gene may be closely associated with dyslipidemia. Karonova et al. (2018) and Sangkaew, Nuinoon, Jeenduang (2018) observed the relationship of BsmI with hypertriglyceridemia. Jin et al. (2021) found that HDL-c levels were lower in individuals in BsmI genotypes. A previous study revealed the similar finding that BsmI genotypes were associated with lower HDL-c and obesity, respectively (Al-Daghri et al., 2014).

From a biological point of view, the active form of vitamin D (1,25-dihydroxyvitamin D) contributes to obesity and alterations in lipid metabolism through several pathways, including increased adipocyte apoptosis; activation of fatty acid oxidation; upregulation of uncoupling protein expression and reduction of lipolysis (Beydoun et al., 2018; Morrison et al., 2005).

BsmI, positioned in the 3' region of the VDR affects the stability of the VDR mRNA and its transcriptional activity. Therefore, any change in this axis, including vitamin D concentrations or in the variation of VDR genes, can modify energy production, lipid metabolism and cause an increase in VDR expression in adipocytes. In addition, longer and repeated BsmI genes represent less mRNA stability and reduced VDR protein traction, resulting in reduced vitamin responses such as adipocyte inhibition and muscle mass differentiation (Kazemian et al., 2019; Al-Daghri et al., 2014).

In addition, according to Wang et al (2016) and Sharif-Askari et al (2020), 25(OH)D deficiency is associated with an unfavorable lipid profile, particularly HDL-c, especially in people with risk factors associated with cardiovascular diseases, such as obesity, for example. On the other hand, the study by Gendy et al. (2019) did not demonstrate an association between lipid



concentrations and VDR polymorphisms. However, vitamin D is associated with regulation of lipid metabolism, fatty acid oxidation, and inhibition of lipid synthesis (San et al., 2004).

In this context, Alquaiz et al. (2020) found a strong relationship between vitamin D deficiency and dyslipidemia and proposed several mechanisms that probably work simultaneously, such as the role of vitamin D in altering the function of pancreatic cells causing metabolic disorders in lipoproteins, eventually with greater alteration in TG and lower concentrations of HDL-c. In addition, The vitamin may also play a role in the synthesis of bile acids in the liver with a direct impact on lipid metabolism. These findings suggest that low concentrations of 25(OH)D function as a predictor of increased atherogenic lipoproteins.

These mismatches in the results of the studies are often totally misunderstood for several reasons such as: variations in genetic characteristics, different ethnicities and geographic areas and different individuals may be exposed to different environmental factors, in addition to the design of the studies that may present limitations or be unsatisfactory in relation to sampling and the biases presented. Future research on deep sequencing is needed

## CONCLUSION

It was observed that there were no statistically significant differences between the association of VDR FokI and BsmI gene polymorphisms with BMI, blood pressure and vitamin D concentrations. It is understood that the results of this study provide important information about the relationship between polymorphisms in the lipid profile and suggest that the presence of the Bb allele can predict the risk of association, however, more studies addressing the same theme are needed to verify these results in different ethnic groups.



## REFERENCES

1. Al-Daghri, N. M., Al-Attas, O. S., Alokail, M. S., Alkharfy, K. M., Yakout, S. M., Aljohani, N. J., ... & Kumar, S. (2014). Vitamin D receptor gene polymorphisms are associated with obesity and inflammosomal activity. *\*PloS one\**, 9(7), e102141.
2. Alimirah, F., Peng, X., Murillo, G., Mehta, R. G., & Mehta, R. R. (2011). Significado funcional do polimorfismo FokI do receptor da vitamina D em células de câncer de mama humano. *\*PloS one\**, 6(1), e16024.
3. Alves, L. F., Bueno, D. R., Farias, J. P., Peixoto, S. V., & Mambrini, J. V. M. (2021). Performance of adiposity indicators in predicting metabolic syndrome in older adults. *\*Archives of Endocrinology and Metabolism\**.
4. Basic, J., Zdravković, M., Ivanović, I., Stojanović, R., Pavlović, D., Jevtović Stoimenov, T., & Jovanović, I. (2019). Vitamin D receptor gene polymorphism influences lipid profile in patients with juvenile idiopathic arthritis. *\*Clinical Rheumatology\**, 38, 117-124.
5. Bento, I. C., Mambrini, J. V. M., & Peixoto, S. V. (2020). Contextual and individual factors associated with arterial hypertension among Brazilian older adults (National Health Survey-2013). *\*Revista Brasileira de Epidemiologia\**, 23.
6. Beydoun, M. A., Boueiz, A., Shroff, M. R., Beydoun, H. A., Wang, Y., & Zonderman, A. B. (2018). Vitamin D metabolism-related gene haplotypes and their association with metabolic disturbances among African-American urban adults. *\*Scientific Reports\**, 8(1), 1-11.
7. Bienertová-Vašků, J., Zlámál, F., Tomášková, V., Nezhybová, H., Táborská, K., Vcelák, J., & Šerý, O. (2017). Variantes alélicas no gene do receptor de vitamina D estão associadas a medidas de adiposidade na população da Europa Central. *\*BMC Medical Genetics\**, 18(1), 1-9.
8. Bueno, D. R., Marucci, M. F. N., & Gobbo, L. A. (2017). Abdominal obesity and healthcare costs related to hypertension and diabetes in older adults. *\*Revista de Nutrição\**, 30, 209-218.
9. Carvalho, L. S. F., & Sposito, A. C. (2015). Vitamin D for the prevention of cardiovascular disease: are we ready for that? *\*Atherosclerosis\**, 241(2), 729-740.
10. Cortez, A. C. L., Silva, R. A. D., Pinheiro, M. C. F., & Monteiro, W. M. (2019). Aspectos gerais sobre a transição demográfica e epidemiológica da população brasileira. *\*Enfermagem Brasil\**, 18(5).
11. Da Silva, L. A. R., Oliveira, G. B. V. P., Santos, L. F., & Furtado, L. M. (2017). Correlação entre índice de massa corporal e circunferência abdominal em adultos e idosos. *\*Revista Brasileira de Ciências do Envelhecimento Humano\**, 14(3).
12. De Oliveira, G. B. V. P., Furtado, L. M., Da Silva, L. A. R., & Santos, L. F. (2018). Relação dos índices antropométricos e Vitamina D com o desempenho funcional de idosos. *\*Estudos Interdisciplinares sobre o Envelhecimento\**, 23(1).
13. Elamin, M. B., Abu Elnour, N. O., Elamin, K. B., Fatourehchi, M. M., Alkatib, A. A., Almandoz, J. P., ... & Montori, V. M. (2011). Vitamina D e desfechos cardiovasculares: uma revisão sistemática e meta-análise. *\*The Journal of Clinical Endocrinology & Metabolism\**, 96(7), 1931-1942.



14. Faludi, A. A., Izar, M. C. O., Saraiva, J. F. K., Chacra, A. P. M., Bianco, H. T., Afiune Neto, A., & Bertolami, M. C. (2017). Atualização da diretriz brasileira de dislipidemias e prevenção da aterosclerose – 2017. *\*Arquivos Brasileiros de Cardiologia\**, 109(2), 1-76.
15. Ferreira, C. E. S., Maeda, S. S., Batista, M. C., Lazaretti-Castro, M., Vasconcellos, L. S., Madeira, M., ... & Borba, V. Z. C. (2018). Posicionamento oficial da Sociedade Brasileira de Patologia Clínica/ Medicina Laboratorial e da Sociedade Brasileira de Endocrinologia e Metabologia. Intervalo de referência de vitamina D – 25(OH)D. *\*Atualização\**.
16. Ferreira, N., Souza, D. L. B., & Santiago, L. M. (2018). Envelhecimento ativo: prevalência e diferenças de gênero e idade em estudo de base populacional. *\*Cadernos de Saúde Pública\**, 34(11), 1–16.
17. Grave, N., Costa, J. A., Silva, R. P., Vieira, V. G., & Borges, R. M. (2016). A vitamin D pathway gene-gene interaction affects low-density lipoprotein cholesterol levels. *\*The Journal of Nutritional Biochemistry\**, 16(9), 1-21.
18. Guedes, R. F., Santos, L. R., Rodrigues, C. G., & Lima, V. F. (2016). Análise do perfil lipídico e dos fatores de risco associados a doenças cardiovasculares em acadêmicos da área da saúde. *\*HU Revista\**, 42(2).
19. Gussago, C., Nocella, C., Nocentini, G., & Pignatelli, P. (2016). Impact of vitamin D receptor polymorphisms in centenarians. *\*Endocrine\**, 53(2), 558-564.
20. Issa, C. T. M. I., Vieira, V. C., Santos, D. M., & Silva, M. S. (2016). Relationship between cardiometabolic profile, vitamin D status and BsmI polymorphism of the VDR gene in non-institutionalized elderly subjects: Cardiometabolic profile, vitamin D status and BsmI polymorphism of the VDR gene in non-institutionalized elderly subjects. *\*Experimental Gerontology\**, 81, 56-64.
21. Jansen, A. K., Melo, M. C., Souza, T. F., & Lima, S. R. (2020). Comparação da estatura aferida e estimada em idosos com diferentes classificações funcionais. *\*O Mundo da Saúde\**, 1(44), 445-453.
22. Jin, T., Zhang, X., Tong, L., & Zhang, M. (2021). Association of vitamin D receptor polymorphisms with metabolic syndrome-related components: A cross-sectional study. *\*Journal of Clinical Laboratory Analysis\**, 35(1), e23829.
23. Jorde, R., & Grimnes, G. (2010). Rastreamento dos níveis séricos de 25-hidroxivitamina D durante 14 anos em um estudo de base populacional e durante 12 meses em um estudo de intervenção. *\*Jornal Americano de Epidemiologia\**, 171(8), 903-908.
24. Jorde, R., & Grimnes, G. (2011). Vitamin D and metabolic health with special reference to the effect of vitamin D on serum lipids. *\*Progress in Lipid Research\**, 50(4), 303-312. doi: 10.1016/j.plipres.2011.05.001. PMID: 21640757.
25. Jorge, A. J. L., Soares, R. P., & Silva, M. R. (2018). Deficiência da Vitamina D e doenças cardiovasculares. *\*International Journal of Cardiovascular Sciences\**, 31(4), 422-432.
26. Karonova, T., Zhukova, E., Rozhinskaya, L., Vasil'eva, E., & Gurevich, M. (2018). Relationship between vitamin D status and vitamin D receptor gene polymorphisms with markers of metabolic syndrome among adults. *\*Frontiers in Endocrinology\**, 9(1), 1-7.



27. Kazemian, E., Mahjub, R., Rafatmanesh, A., Fakhari, S., & Hashemi, S. (2019). Vitamin D receptor gene polymorphisms affecting changes in visceral fat, waist circumference and lipid profile in breast cancer survivors supplemented with vitamin D3. *\*Lipids in Health and Disease\**, 18(1), 1-10.
28. Medeiros, J. B. (2018). Fatores associados à hipertensão arterial em idosos longevos residentes em um município do nordeste brasileiro. (Dissertação de mestrado, Programa de Pós-Graduação em Saúde Pública, Universidade Estadual da Paraíba).
29. Milani, P. (2014). Correlação da vitamina D com o perfil lipídico e glicídico em indivíduos com síndrome metabólica. (Dissertação de mestrado, Universidade Federal da Fronteira do Sul, Chapecó).
30. Morrison, N. A., Qi, J. C., Tokita, A., Kelly, P. J., & Eisman, J. A. (2005). Vitamin D receptor genotypes influence the success of calcitriol therapy for recurrent vertebral fracture in osteoporosis. *\*Pharmacogenetics and Genomics\**, 15(2), 127-135.
31. Nam, S. W., Choi, J., Jeon, H. J., Oh, T. K., & Lee, D. H. (2021). The Associations Between Vitamin D Receptor BsmI and ApaI Polymorphisms and Obesity in Korean Patients with Type 2 Diabetes Mellitus. *\*Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy\**, 14, 557–564.
32. Neves-Souza, R. D., Guimarães, A. C., Andrade, C. R., & Sichieri, R. (2015). Associação entre perfil lipídico, estado nutricional e consumo alimentar em idosos atendidos em unidades de saúde, Londrina, Pr. *\*Estudos Interdisciplinares sobre o Envelhecimento\**, 20(1).
33. Neyestani, T. R., Nikooyeh, B., Alavi-Majd, H., & Shariatzadeh, N. (2013). O polimorfismo Fok-I do receptor de vitamina D modula a resposta do hospedeiro diabético à ingestão de vitamina D: necessidade de uma abordagem nutrigenética. *\*Cuidados com a Diabetes\**, 36(3), 550-556.
34. Norman, P. E., & Powell, J. T. (2014). Vitamina D e doenças cardiovasculares. *\*Circulation Research\**, 114(2), 379-393.
35. Oliveira, G. B. V. P., Guedes, D. P., & Souza, K. S. (2014). Perfil antropométrico e níveis séricos de vitamina D de idosos participantes do programa saúde da família de Teresina. *\*Revista Interdisciplinar Ciências da Saúde\**, 1(1), 48-55.
36. OPAS - Organização Pan-Americana da Saúde. (2003). *\*Doenças crônico-degenerativas e obesidade: estratégia mundial sobre alimentação saudável, atividade física e saúde\**. Brasília.
37. Peters, B. S. E., Giudici, K. V., & Martini, L. A. (2017). Vitamina D e doenças crônicas não transmissíveis. [S.l.: s.n.].
38. Rocha, F. L., Corrêa, H. L., & Silva, A. M. (2013). Correlação entre indicadores de obesidade abdominal e lipídeos séricos em idosos. *\*Revista da Associação Médica Brasileira\**, 59(1), 48-55.
39. Rocha, M. S., Silva, T. P., & Barbosa, A. R. (2020). Síndrome metabólica e estado nutricional de idosos residentes em capital do nordeste brasileiro. *\*Research, Society and Development\**, 9(10), e8029109161.
40. Rossi, L., Caruso, L., & Galante, A. P. (2015). *\*Avaliação Nutricional: novas perspectivas\** (2nd ed.). Guanabara Koogan.






41. Rodríguez-Carrio, J., Prado, C., López, P., & Suárez, A. (2019). O polimorfismo do receptor da vitamina D e o DHCR7 contribuem para a interação anormal entre a vitamina D e o perfil lipídico na artrite reumatóide. *\*Scientific Reports\**, 9(1), 1-11.
42. Sangkaew, B., Nuinoon, M., & Jeenduang, N. (2018). Association of vitamin D receptor gene polymorphisms with serum 25(OH)D levels and metabolic syndrome in Thai population. *\*Gene\**, 659, 59-66.
43. Santos, T. O., & Chiachio, N. C. F. (2020). Fatores de Risco Associados a Dislipidemia entre os Funcionários Atendidos no SESI–Serviço Social da Indústria de Vitória da Conquista, Bahia/Risk Factors Associated with Dyslipidemia among Employees Served at SESI-Social Service of the Victory Industry of Conquista, Bahia. *\*ID on line Revista de Psicologia\**, 14(51), 191-201.
44. Souza, R., Oliveira, D., & Carvalho, A. (2013). Avaliação antropométrica em idosos: estimativas de peso e altura e concordância entre classificações de IMC. *\*Revista Brasileira de Geriatria e Gerontologia\**, 16, 81-90.
45. Swapna, N., Vamsi, U. M., & Usha, A. (2011). Risco conferido pelo polimorfismo FokI do gene do receptor da vitamina D (VDR) para hipertensão essencial. *\*Journal of Indian Society of Human Genetics\**, 17(3), 201.
46. Wang, L., Manson, J. E., Song, Y., & Sesso, H. D. (2013). Um estudo prospectivo dos metabólitos da vitamina D no plasma, polimorfismos do gene do receptor da vitamina D e risco de hipertensão em homens. *\*European Journal of Nutrition\**, 52, 1771-1779.
47. World Health Organization. (1995). *\*Physical status: the use and interpretation of anthropometry\**. WHO Technical Report Series, 452.
48. World Health Organization. (2000). *\*Obesity: preventing and managing the global epidemic\**. Report of a World Health Organization Consultation, 284, 256.
49. Al-Ghafari, A. B., Balamash, K. S. A. L., & Doghaither, H. A. (2019). Relationship between Serum Vitamin D and Calcium Levels and Vitamin D Receptor Gene Polymorphisms in Colorectal Cancer. *\*Biomed Research International\**, 2019, Article 8571541.
50. Rai, V., Abdo, J., Agrawal, S., & Agrawal, D. K. (2017). Vitamin D Receptor Polymorphism and Cancer: An Update. *\*Anticancer Research\**, 37(8), 3991-4003.
51. Sun, X., & Zemel, M. B. (2004). Role of Uncoupling Protein 2 (UCP2) Expression and 1alpha, 25-Dihydroxyvitamin D3 in Modulating Adipocyte Apoptosis. *\*The FASEB Journal\**, 18, 1430–1432.
52. Gendy, H. I., Sadik, N. A., Helmy, M. Y., & Rashed, L. A. (2019). Vitamin D Receptor Gene Polymorphisms and 25(OH) Vitamin D: Lack of Association to Glycemic Control and Metabolic Parameters in Type 2 Diabetic Egyptian Patients. *\*Journal of Clinical and Translational Endocrinology\**, 15, 25.
53. Wang, Y., Si, S., Liu, J., Wang, Z., Jia, H., Feng, K., ... Song, S. J. (2016). The associations of serum lipids with vitamin D status. *\*PLoS One\**, 11(10), e0165157.
54. Alquaiz, A. M., Kazi, A., Youssef, R. M., Alshehri, N., & Alduraywish, S. A. (2020). Association between standardized vitamin 25(OH)D and dyslipidemia: a community-based study in Riyadh, Saudi Arabia. *\*Environmental Health and Preventive Medicine\**, 25(1), 4.



55. Saheb Sharif-Askari, F., Saheb Sharif-Askari, N., Halwani, R., Abusnana, S., Hamoudi, R., & Sulaiman, N. (2020). Low vitamin D serum level is associated with HDL-C dyslipidemia and increased serum thrombomodulin levels of insulin-resistant individuals. *\*Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy\**, 13, 1599-1607.

## Areas of expertise of forensic nursing in Brazil

 <https://doi.org/10.56238/sevened2024.016-011>

Jhuliano Silva Ramos de Souza<sup>1</sup>, Zélia Marilda Rodrigues Resck<sup>2</sup> and Sueli de Carvalho Vilela<sup>3</sup>

### ABSTRACT

Forensic Nursing is an area of Nursing that works at the interface between health and law, contributing to the collection of evidence in criminal investigations and to the identification of victims and perpetrators in situations of violence. In Brazil, according to the Federal Council of Nursing, the areas of expertise of Forensic Nursing include working in health institutions, prison and psychiatric units, institutes of forensic medicine, consulting and forensics, mass disasters, catastrophes and humanitarian missions, and everything that involves violence by life cycle. Forensic nurses perform examinations on victims of physical, sexual or psychological aggression, collect traces, document injuries and provide specific care to preserve the integrity of the evidence. In addition, they work in the investigation of suspicious deaths, identification of bodies and support for victims of violence. Forensic Nursing in Brazil plays a fundamental role in the search for justice and in the protection of the rights of people involved in situations of violence and crime.

**Keywords:** Forensic Nursing, Professional Competencies, Nursing Performance, Brazil.

---

<sup>1</sup> Highest degree of education: PhD candidate in Nursing.

Academic institution: Federal University of Alfenas

E-mail: [jhuliano.souza@sou.unifal-mg.edu.br](mailto:jhuliano.souza@sou.unifal-mg.edu.br)

ORCID: <https://orcid.org/0000-0002-4338-4433>

<sup>2</sup> Highest degree of education: Post-Doctorate in Nursing.

Academic institution: Federal University of Alfenas

E-mail: [zelia.resk@unifal-mg.edu.br](mailto:zelia.resk@unifal-mg.edu.br)

ORCID: <https://orcid.org/0000-0002-3752-8381>

<sup>3</sup> Highest degree: Doctor of Science.

Academic institution: Federal University of Alfenas

E-mail: [sueli.vilela@unifal-mg.edu.br](mailto:sueli.vilela@unifal-mg.edu.br)

ORCID: <http://orcid.org/0000-0003-3034-3904>



## INTRODUCTION

Forensic Nursing is an important specialty for Nurses working in criminal or violent situations. Forensic nurses help preserve evidence for use in criminal investigation and court proceedings. They can also provide assistance to victims of violence and help collect medical information for consultations (IAFN, 2023; Lynch; Duval, 2011).

This aspect is a growing field of Nursing and is important for public safety and justice. The work of a Forensic Nurse helps to ensure that criminals are held accountable for their actions and that victims receive justice. In addition, Forensic Nurses can play an important role in preventing violence and developing policies and programs to improve community safety and health (IAFN, 2023; Lynch; Duval, 2011).

Forensic Nurses can work in a variety of settings, including healthcare institutions, governmental, educational, non-governmental, and private consulting institutions, described below.

- **Health institutions:** hospitals, emergency rooms, clinics, and primary care services to collect medical evidence and provide health care to victims of violence.
- **Government institutions:** police departments, medical forensics, and forensic science laboratories.
- **Educational institutions:** teaching as professors or researchers in universities and schools of Nursing.
- **Non-governmental organizations:** Forensic Nurses can work with non-governmental organizations (NGOs) that deal with issues related to violence, such as sexual abuse, domestic violence, and human trafficking.
- **Private Consulting:** Forensic Nurses can offer consulting and forensic services to businesses, organizations, and individuals.

In general, these professionals need to have a specialized training in Forensic Nursing and usually require experience in basic Nursing before specializing. Additionally, some positions may require additional certification or licensing.

## AREAS OF COMPETENCE OF FORENSIC NURSING

In 2015, the Brazilian Association of Forensic Nursing (ABEFORENSE, 2015) regulated the construction of the areas of technical competence of Brazilian Forensic Nursing, with the objective of outlining the competence profile of the Forensic Nurse, which covers a range of clinical and specialized attributions, in order to facilitate the regulation of the competence certification framework, making it publicly available and ensuring clarity to society about its performance.

Next, the eight areas proposed by COFEN (2017) will be addressed.



## PERFORMANCE OF FORENSIC NURSING IN VIOLENCE

In the aspects of violence, COFEN (2017) points to sexual violence, however, such actions can extend to any type of violence, respecting some specific peculiarities in each type and in each population, whether woman, man, child, elderly, among others.

Some actions will be pointed out according to Marcelo and Barreto (2019), COFEN (2017), Hammer, Moynihan and Pagliar (2013) and Lynch and Duval (2011) as described below.

### Forensic Nursing Actions:

- Reception of victims and family members involved in all forms of violence;
- Develop service strategies and identify their priorities;
- Adopt preventive measures to address possible health risks arising from sexual violence;
- Implement protocols for the collection and preservation of traces;
- Ensure that victims receive psychological assistance and refer them to programs that help restore their psychosocial status;
- For aggressors, refer them to rehabilitation programs and specific treatments;
- Collection, storage and processing of forensic traces;
- Analysis of physical and psychological conditions, trauma, questionable deaths and/or psychopathological evaluations related to forensic cases.

In the different scenarios of action, it is responsible for caring for survivors, whether they are children, adolescents, adults or the elderly, in the collection of forensic evidence, physical examination, reception and therapeutic listening, in addition to participating in investigations of sexual crimes and trials (Silva *et al.*, 2021; Kings *et al.*, 2020; COFEN, 2017).

Forensic care is often episodic, primary, and acute in nature, and unplanned, especially when the need arises in a specific treatment setting, e.g., an emergency clinic, mobile unit, suicide prevention center, crime scene, death, or a forensic pathology laboratory (Hammer; Moynihan; Pagliar, 2013).

This type of care includes health assessment and treatment, as well as forensic evaluation, evidence collection, and documentation to maintain the chain of custody. A differentiated and specific aspect of Forensic Nursing is the expert examination that Nursing can perform and raises evidence in a criminal case.

The expert examination is usually performed by a specialist called an expert, but, in his absence, it can be performed by a nurse who works in the emergency room, where he must follow the institution's protocols regarding the collection of evidence from the evidence.



This type of care should be composed of the entire interdisciplinary team with the free and informed consent of the victim, signed by the victim or by a legal guardian (Amar; Sekula, 2015; Barder; Gabriel, 2010).

#### Nurse's performance in an Expert Examination:

- Respect the needs and rights of the abused person, for example: lawyer present/or temporarily interrupt the procedure due to fatigue.
- Be extremely careful in the physical examination and in the collection of traces and with clothing so as not to contaminate the forensic evidence.
- Specific tests such as collection of secretions (saliva, urine, blood, sperm and others) in order to maintain the integrity of the test.

According to Barder and Gabriel (2010) and Pyrek (2006), some aspects are essential in the performance of nurses in an expert examination: Some examinations must be performed according to the protocol for care regarding violence. In the case of sexual violence, for example, some conducts follow (BRASIL, 2015; BRAZIL, 2012).

#### Examinations carried out on victims of violence:

- **Vaginal contents:** Bacterioscopic examination (Chlamydia, Gonococcus and Trichomonas). Culture for gonococcus, PCR for Chlamydia if possible to describe if there is presence of sperm in the material.
- **Blood:** Anti HIV; Hepatitis B (HbsAG and anti Hbs); Hepatitis C (anti HCV); Syphilis; Transaminases; Blood count and b-HCG (for women of childbearing age).

In addition, the victim must undergo the following procedures for the prevention of injuries, among them (BRASIL, 2015; BRAZIL, 2012):

- Antibiotic prophylaxis for sexually transmitted infections;
- Immunization against hepatitis B;
- HIV prevention is based on the assessment of the risk of exposure and the prevention of pregnancy.

#### Prophylactic treatment in situations of violence:

- Emergency contraception.
- Prophylaxis of sexually transmitted infections. The recommended regimen for adult women and adolescents consists of benzathine penicillin, ceftriaxone, and azithromycin.
- Immunoprophylaxis against hepatitis B is indicated in cases of sexual violence in which there is exposure to the semen, blood or other body fluids of the aggressor.



- Prophylaxis for HIV/AIDS is recommended in all cases of vaginal and/or anal penetration up to 72 hours after violence, even when the serological status of the aggressor is unknown.

As for the training and development of competencies of the Sexual Assault Examining Nursing, they should include the following contents (Hammer; Moynihan; Pagliar, 2013; Lynch; Duval, 2011):

#### Training of Sexual Assault Examining Nursing:

- Forensic photography;
- First aid responsibilities and work;
- Interpretation and analysis of bite marks;
- Death inquiry;
- Psychological abuse;
- Evaluation of deviant behavior and psychopathology;
- Interpretation of blunt, cutting, or rapid trauma (e.g., gunshot);
- Sexual abuse and rape;
- Jurisprudence;
- Compensation for damages to people imprisoned under the law;
- Elder abuse;
- Child abuse and neglect;
- Substance abuse;
- Psychological and physical abuse;
- Adoption of tissues and organs for occult or religious practices.

Thus, the performance of Nursing is fundamental to care for people in situations of violence, in which it works together with the multiprofessional team. The service is provided in a welcoming, neutral and understanding way, providing peace of mind to the victims. Professionals specialized in this area are essential to intervene appropriately with victims and assist justice in the trial of criminals (Matos; Sales Junior, 2021).

Technical assistance in expert reports consists of the monitoring and guidance of technical expert investigations, based on the effective contribution to the expert acts, collecting all the information essential to the preparation and presentation of medical and technical opinions:

#### How to act in expert proceedings:

- Accompany the judicial expert in the diligence carried out;
- Provide subsidies to the legal sector for the formulation of questions;



- Produce the technical opinion;
- Represent the company as an assistant expert (technical assistant);
- Challenge the report if necessary;
- With a great tradition in expert technical assistance in labor lawsuits (unhealthy, dangerous, occupational accident and occupational disease).

## PERFORMANCE OF FORENSIC NURSING IN THE PRISON SYSTEM

Nurses working at the interface of health and criminal justice systems, wherever they are in the world, face daily challenges unique to their roles, the individuals they care for, the security environment in which they work (including prisons, correctional systems, and various community settings), and the laws governing their administration (Love; Sekula, 2015).

Correctional, institutional, or custodial nurses specialize in providing care, treatment, and rehabilitation to individuals convicted or incarcerated for criminal law violations that require medical evaluation and intervention (Lynch; Duval, 2011).

Custodial nursing is the practice of nursing and the provision of patient care in a service that belongs to the criminal justice system. The legal system includes jails, prisons, juvenile detention, substance abuse treatment, and other detention facilities (Pyrek, 2006).

Areas of expertise may include prisons and/or institutions in judicial custody, where assistance is specialized in both the treatment and rehabilitation of those sentenced to prison or imprisonment for infractions of the criminal law, requiring medical evaluation and intervention (Hammer; Moynihan; Pagliar, 2013).

In Brazil, the work of nursing professionals in the prison system is guided by the National Policy for Comprehensive Health Care for Persons Deprived of Liberty in the Prison System (PNAISP), which guarantees health promotion, disease prevention, and protection, especially when these people are legally in state custody (COFEN, 2021; Carvalho, 2017; BRAZIL, 2014).

In prison environments, nurses, according to IAFN (2022) and Baccon *et al.* (2022), should:

### Nurses' Conducts in the Prison System:

- To assess the physical, psychological, social and spiritual conditions that affect the process of caring for people deprived of liberty, consequently improving the quality of life of this population.
- Screen inmates for medical and psychiatric needs, such as substance withdrawal, chronic alcohol or other drug treatment, suicide attempt, trauma, and infectious diseases. This classification assists inmates in being housed, initiating scheduling ongoing health visits,





and determining whether critical care should be attended to immediately that assists in custody.

- Care for chronic diseases, considering that prisoners must have regular visits to medical facilities for the treatment of hypertension, asthma, arthritis, and other medical conditions.
- Follow-up or management of pregnancy. Although visits involve contact with doctors or other professionals, nurses provide key elements of managing this care.
- Provide health education according to demands found, for example, adherence to medication, prevention of communicable diseases, etc.
- They perform specific nursing procedures and techniques such as medication administration, dressings and others that aim to meet individual needs.

In addition, they assist people deprived of liberty, preventing various situations of violence, in which they develop treatment plans for victims and aggressors, identifying priorities and structures to safeguard their human and legal rights to incarcerated people with institutional protocols for expert care, referring these individuals to public services for a more accurate evaluation, if necessary (COFEN, 2017).

Assessing health needs is a priority for all interns and Nursing Systematization contributes to comprehensive, broad, systematized and unified care. They enable the nurse-patient bond, as well as understanding the nature of corrective care, the risks associated with incarceration and the problems and responses common to these experiences lived within the prison (Amar; Sekula, 2015).

Thus, the performance of Nursing in the prison system contributes to the health of incarcerated people, through comprehensive care that meets their practical and clinical needs, such as screening and listening, exams, palliative care, especially for communicable, infectious-contagious, mental diseases, as well as the development of actions that encompass other levels of health care (Lima *et al.*, 2020; Barbosa *et al.*, 2019).

## PERFORMANCE OF FORENSIC NURSING IN THE PSYCHIATRIC SYSTEM IN ASYLUMS OR JUDICIAL HOSPITALS

The reform of psychiatric care in Brazil encouraged the reorganization of the Psychosocial Care Network, with emphasis on multitherapeutic practices carried out by an interdisciplinary team in the community, that is, with active and constant participation within the family (BRASIL, 2001; BRAZIL, 2005).

However, it seems that such guidelines do not contemplate people with behavioral mental disorders in conflict with the courts. People with mental disorders (PTM) in conflict with the law are



referred to judicial hospitals, that is, they are institutions that house them for treatment and rehabilitation.

The type of psychiatric hospitalization in these cases are the so-called compulsory hospitalizations that are determined by the courts, that is, by a judge through a judicial decision considering a risk to society and the health of the person himself. The premise is that hospitalization will force the person to be treated. To make the decision, a psychiatric doctor's report is required to base the judge's decision, this report contains data about the person's physical and mental health as well as the risks it represents (BRASIL, 2002).

Forensic Nursing in mental health is the intersection of mental health and the legal system, as they work with criminals who have been found to be mentally disturbed and need additional attention separate from the judicial/penitentiary system (Love; Sekula, 2015).

Forensic psychiatric nurses who work with offenders with mental disorders in safe psychiatric services should promote the following actions: (Love; Sekula, 2015):

#### **Actions of the Forensic Psychiatric Nurse:**

- Evaluate the person (victim or perpetrator) according to demands;
- Reception and qualified listening;
- They collect evidence that can influence conviction, recidivism, treatment and prevention, and not health promotion.
- They attend to psychiatric and clinical emergencies and urgencies or other health problems that occur in prison services.
- They use their training to assist in the rehabilitation of criminals.
- Assess the well-being of victims of crime and perpetrators.
- Act as specialized consultants in criminal cases.
- Carry out records and documentation necessary for expertise.
- Application of adherence to institutional protocols in the provision of forensic care.
- Perform the mental examination (detailed anamnesis).

Unlike the other areas of Forensic Nursing, the mental examination is essential to monitor the evolution of the case, confirmation, evolution or remission of psychiatric conditions.

The work of these specialists in correctional services is comprehensive as described above, that is, they involve therapeutic, clinical, rehabilitation and violence prevention activities.

He points out that it can happen that incarcerated people develop mental disorders in correctional institutions. In this context, it is essential to have an interdisciplinary psychiatric evaluation that can be done in the institution or be referred to specific services such as the Psychosocial Care Center (CAPS) to undergo psychiatric evaluation and, depending on such



evaluation, the prisoner can be referred to hospitals or judicial clinics (BRASIL, 2015; BRAZIL, 2002).

In Brazil, it has a program called the Comprehensive Attention Program for the Judicial Patient (PAI-PJ) with the role of "advising the Justice of First and Second Instances" in the individualization of the application and execution of socio-educational measures, penalties and security measures for judicial patients, through propositions based on Federal Law No. 10,216, of April 6, 2001 (BRASIL, 2001). Currently, in this resolution, the professionals listed to work with the PAI/PJ are psychologists and social workers, but this can be another care strategy in which the Forensic Nurse can conquer his space in the future.

When people with mental disorders are referred to judicial hospitals, that is, they are institutions that shelter for treatment.

The main types of mental and behavioral disorders that can lead to compulsory hospitalizations are: personality disorders, post-traumatic stress disorder, and substance abuse related to sexual crimes. In view of this, the professional has a forensic clinical look to recognize, intervene and take measures against acts of violence committed for humanized and qualified care (Januario *et al.*, 2022).

It is important to note that people with mental and behavioral disorders can be victims or perpetrators and will be welcomed by Forensic Nursing in both situations.

According to Franjic (2018) and Amar and Sekula (2015), Forensic Psychiatric Nurses usually work in:

#### Areas of expertise of Forensic Psychiatric Nursing:

- Psychiatric hospitals;
- Other custodial institutions/clinics;
- Juvenile detention centers.

In summary, the field of professional activity in psychiatric and mental health services ranges from the implementation of care protocols, evaluation of injuries and risk of violence through clinical and psychiatric nursing consultations, to promoting prevention and rehabilitation actions. These professionals usually work with diverse populations, whether those who have committed violent crimes or those with suspected mental and behavioral disorders (SOBEF, 2019).

Thus, the work of these specialists can play an important role in the care of PTM people, as their functions include treating victims, identifying injuries, collecting evidence, since forensic psychiatry is the application of psychiatric nursing techniques to legal proceedings (Leodoro *et al.*, 2023).



## PERFORMANCE OF FORENSIC NURSING IN EXPERTISE, TECHNICAL ASSISTANCE AND CONSULTING

The Expert Nurse is one of the categories of professionals who can contribute to the judicial system together with an interdisciplinary team consisting of biologists, engineers, chemists, physicists, geologists, among other degrees.

According to COFEN Resolution No. 556/2017 (COFEN, 2017), the Expert Nurse works in the following situations:

### Actions of the Expert Nurse:

- Judicial expertise activities;
- Testify at trials;
- Provide technical assistance;
- Cooperate with the judiciary in the analysis and interpretation of medical records involving official documents;
- Cooperate in the implementation of safety measures in relation to the health of the teams;
- Act in cases of professional negligence;
- Bodily injury;
- Litigation in nursing homes;
- Responsibility for forensic and criminal evidence or evidence.

### Technical Assistance Actions:

These experts may work in a variety of areas, especially child abuse, elder abuse, domestic violence, sexual assault, alcohol and drug trafficking, and homicide investigations.

Its mission is to review the facts of forensic cases, map clinical and biopsychosocial findings, and analyze reports from professionals involved in patients in situations of violence (Pyrek, 2006), as follows.

- Assists lawyers in clarifying technical health terms;
- Installation of institutional protocols;
- Medical history and physical, mental, and neurological examination;
- It assists justice in the analysis of reports and opinions.

### Consulting Actions

The preparation of reports should include various information provided by the medical records of patients in different situations of violence, whether they are living or dead (Pyrek, 2006), as follows.



- Free and consented consent form;
- Promotion and prevention of human and legal rights of victims, family members and offenders;
- Summary and discharge instructions (homicides and survivors);
- Medical history and physical, mental, and neurological examination in situations of violence;
- Annotations and reports.

### Expert actions

This expert may be called to testify in court. You will be asked to testify about the facts, what you have observed and what you have documented in detail, so it is important to consult with you before testifying. As determining "what happened" is beyond the nurse's attributions, but only documenting what was evidenced through clinical evaluation of the patient when entering the health system is essential in this process (Love; Sekula, 2015), and is seen below.

- Testimony in court;
- Preparation of expert reports and reports;
- Medical history and physical, mental, and neurological examination;
- Notes and various reports in relation to the condition of the person or situation examined (anesthesia, surgical pathology, reports related to consultations, medical evolution, radiology reports, laboratory records, medical requests);
- Nursing reports and documents in progress (ethical-legal infractions).

Therefore, forensic assistance, both in the criminal and civil spheres, is essential to help clarify crimes, support and focus on victims and aggressors, as well as family members. In the civil sphere, the role of the nurse becomes important, as he can contribute to audits and consultations on matters related to nursing (Furtado *et al.*, 2021).

### PERFORMANCE OF FORENSIC NURSING IN THE COLLECTION, COLLECTION AND PRESERVATION OF TRACES

In 1997, the International Association of Forensic Nursing (IAFN) together with the American Association of Nurses (ANA) advocated the roles and responsibilities of the North American Forensic Nurse in advanced practice. One of the priorities would be the safety of the living victim and the body of the deceased victim, collecting and preserving evidence of the victim without compromising their safety and physical integrity. In addition, this specialist should develop interview techniques for victims, suspects of the crime, the convicted perpetrator, family members, friends and all those who can add to the investigation (Barder; Gabriel, 2010).



The Forensic Nurse has his or her performance established according to the protocol, which attests to his or her ability to cooperate with the chain of custody and implement the procedures provided for in its guidelines, in addition to being a professional with a holistic view, that is, he or she has an accurate perception, which allows him or her to scrupulously inspect the area, capture more traces and become a powerful ally of justice (Marcelo; Barreto, 2019; COFEN, 2017).

In addition, these professionals will collect and preserve traces of victims and perpetrators of crimes, whether in the pre-hospital and intra-hospital environment, in the community or in other professional environments, within the applicable legal limits (COFEN, 2017).

Let's make an addendum to understand what a vestige is in criminalistics, according to Bertolini (2018). Trace is the raw material found and/or collected at the scene of the crime. They can be classified as Transient and Permanent. In other words, it is information that will serve to confirm the existence of a crime; allow the reconstruction of facts, the identification or association of perpetrators.

- Transient traces: these are those that disappear quickly, for example: papillary impressions, stains of certain organic or inorganic substances, and braking marks, among others (Bertolini, 2018).
- Permanent traces: are those that remain for a longer time, sometimes decades, for example: such as signs of violence against things (doors, windows, safes, among others), or against people (injuries and scars, among others) (Bertolini, 2018).

As a result, the expert examinations, especially the examination of the direct corpus delicto, must be carried out as soon as the fact becomes known to the expert authority, because the more perfect the expertise, the closer it will be to the crime that was committed. The more hours that pass, the fewer traces can be found. Therefore, the Criminal Procedure Code (Law No. 3,689, of October 3, 1941) allows this procedure to be carried out on any day and at any time, that is, including Sundays, holidays, regardless of the time and even at night.

Another classification of traces according to Prof. Wagner Luiz can be the presence of false or simulated traces: these are the modifications or alterations that are intentionally introduced at the scene of the crime, with the aim of leading to false interpretations. There are also the so-called pseudo-traces, which would be alterations or pre-existing signs at the scene of the crime or in it, involuntarily introduced, by negligence or professional malpractice. They can also be classified according to their dimensions: Macroscopic (macro="large", visible) are usually related to objects and microscopic those that require the use of instruments or technicians to be detected, such as the use of forensic light, microscope, and others (Bertolini, 2018).

The Forensic Nurse usually does the forensic examination. According to the legal dictionary, the corpus delicto is the set of material elements or traces that indicate the existence of a crime. It



constitutes expert evidence since its absence can generate the nullity of the process (Amar; Sekula, 2015).

The examination of the corpus delicto can be direct, when the experts perform it directly on the person or object of the criminal action, or indirect, when it is not exactly an examination, but done through testimonial evidence, that is, testimonies of witnesses. Law No. 13,721/2018 added a single paragraph to article 158 of the CPP, which determines that priority is given to the performance of the corpus delicto examination when it comes to a crime that involves: domestic and family violence against women, violence against children or adolescents, violence against the elderly or violence against people with disabilities (BRASIL, 2018).

- In summary, the "corpus delicto" constitutes the materiality of the alleged criminal offense, that is, it is all the material elements of the incriminating conduct, including the means or instruments used by the criminal.

### Forensic examination of the body of crime

The Forensic Nurse must perform the forensic examination in order to identify and collect evidence that was transferred from the aggressor to the victim at the crime scene. Evidence must be collected in an organized and careful manner, without any form of discrimination and/or that induces any physical or psychological damage to the victim (whether living or deceased) (Barder; Gabriel, 2010).

Regardless of the place of collection, whether in a hospital or pre-hospital environment, the traces that may be considered evidence must be collected very carefully. The expert must be careful not to contaminate the traces and must not, therefore, handle or touch the trace without gloves, nor speak, sneeze or cough on or near it without a mask. For this he must wear a vestment, gloves, mask, glasses, and on certain occasions with shoe covers. As for the crime scene, it is isolated so as not to be contaminated, that is, to isolate and protect as quickly as possible, in addition, before the collection itself it is necessary to photograph all traces.

Any type of tissue or biological fluid found at the crime scene that may be a source of DNA can be: urine; saliva; semen; blood; placenta; bones and teeth; hair and hair; fecal material; Nails and skin are considered biological traces.

In addition to the presence in the person himself, Bertolini (2018) points out that these traces can be found in clothes, jewelry, cars, captive environments, among others that are at the crime scenes. **Other non-organic traces are also important, such as:** any items in the pockets removed from the body; plant material; dirt; paint chips; fabric; soils; explosives; projectile; controlled substances (narcotics, opioids) and notes, among others. **There are also morphological traces:** footprints; tracks; marks of objects; fingerprints and bite marks.



According to Amar and Sekula (2015), each crime scene is unique and each case has its own challenges, with different types of evidence.

The forensic nurse will perform a complete physical examination, caudal skull, looking for injuries such as abrasions, bruises, standardized injuries, lacerations, bites, marks and burns, using a topographic ruler of the body.

When you find lesions or marks, you should photograph and document them thoroughly in the medical record. In addition, the following are also collected: nail shavings, saliva, hair samples, pubic hair, and beard hair, and anal and genital swabs.

If it is performed on a female child, she must be sedated for the examination, however, if she has not had the first menarche and/or has never had a vaginal examination, it is not indicated (Barder; Gabriel, 2010).

The collection will always be done with the use of new and disposable gloves, which will be changed before handling a new trace. All collected material must be packed in bags and/or weak bags, individually separated and identified.

After the collection, preservation must be carried out, which depends on the type of material collected, and documentation that requires the identification of all evidence, preservation and retention method (chain of custody) is essential (Barder; Gabriel, 2010).

Regarding the documentation, it must be objective, legible, clear, timely and descriptive, as it will not provide a precise diagnosis, but it will serve as an indirect report for the investigation of violence, as the professional will describe, for example, the types of injuries resulting from violence such as cuts, wounds, cause of death, among others (Barder; Gabriel, 2010).

Unfortunately, there are some traces that are usually lost, ranging from dust, blood and wounds, to be lost or contaminated by Nurses and Doctors who provide care in an unprepared way (Franjic, 2018).

## PERFORMANCE OF FORENSIC NURSING IN THE POSTMORTEM

Nurses have their main role in the preservation of life, striving to ensure dignified treatment for all individuals, from conception to after death. And in the afterlife?

In the past, nurses made body preparations, bathing, taponing and clothing. Today these activities have been transferred to funeral directors. Currently, in most health services, the nursing team removes the body from the hospital bed to the morgue, from then on it is up to the funeral home to make other preparations for an integral outcome.

In the forensic field, the IAFN, the entity responsible for regulating the practice of Forensic Nursing at the international level, defines three components as being indispensable in an investigation: The medical and social history, the examination of the body and the analysis of the





crime scene (IAFN, 2014). The lack of any of these components renders the investigation incomplete, and can affect its credibility and accuracy, negatively impact family members, public health agencies, civil and criminal actions, and even public safety.

The nurse who assists in the investigation of a death must have significant experience in the emergency room and/or Intensive Care Unit (ICU). It is in the clinical environment that the professional will develop and improve skills and competencies with regard to the situations of psychosocial events that often accompany unexpected or traumatic death, in addition to having a clinical perspective on the medical/social history, body examination, and crime scene investigation (IAFN, 2023).

In Brazil, the domain of death investigation by Forensic Nurses is regulated in detail by ABEFORENSE (2015), according to which the domain in question has two competencies: the application of the Nursing Process to the investigation of violent or indeterminate death that occurs at any stage of the life cycle and the interaction with family members and survivors in the process of overcoming grief throughout the criminal investigation process.

As for the Nursing Process in the investigation of death, this professional must apply the knowledge of Nursing and forensic sciences in an analytical evaluation regarding the context of death, observing the psychosocial aspects inherent to the death process and using the scientific methodology that belongs to the Nursing Process.

In the aforementioned regulation, the following table is presented with the units of competence and the evaluation criteria to be followed.

<b>Unidades de competência</b>	<b>Crterios de avaliao</b>
A1.1. Identifica o processo de morte, iniciando a investigao, numa avaliao inicial, em colaborao com o sistema judicial	A1.1.1. Procede a coleta de informao pertinente, atravs de foto documentao e documentao escrita A1.1.2. Analisa o cenrio da morte e suas circunstncias A1.1.3. Analisa o cadver da vtima atravs de metodologia forense A1.1.4. Observa os comportamentos e interaes da famlia e/ou outros intervenientes presentes A1.1.5. Interage com as vrias entidades envolvidas, na investigao da morte, colaborando com o sistema judicial A1.1.6. Faz juzo acerca do local da morte e questes de segurana
A1.2. Estabelece diagnsticos das condies que possam ter levado a morte	A1.2.1. Identifica as condies de sade da vtima A1.2.2. Determina que informao subsequente a necessria para obteno da causa e mecanismo de morte A1.2.3. Define que entrevistas so necessrias ao progresso da investigao da morte
A1.3. Constrói objetivos e planeia estratgias de interveno, com vista a determinar a trajetria da investigao da morte	A1.3.1. Orienta a direo a dar as entrevistas A1.3.2. Planeia a obteno da informao atendendo as medidas legais possveis, sem por em causa o valor dos achados e informao A1.3.3. Reune com a equipe multidisciplinar, discute estratgias de investigao e debate dificuldades do caso
A1.4. Implementa o plano traado para obter informao adicional, contribuindo para o desenvolvimento da investigao, conduzindo a confirmao dos achados e respondendo a novas questes	A1.4.1. Realiza entrevistas forenses, com sensibilidade, conscincia e respeito pelas respostas ao trauma A1.4.2. Gere processos internos de transferncia e contra-transferncia A1.4.3. Recolhe histrico mdico e social da vtima A1.4.4. Realiza a autpsia psicolgica A1.4.5. Aplica os princpios relevantes a garantir a segurana e colabora na aplicao de planos de emergncia A1.4.6. Cumpre medidas para garantir a segurana dos dados obtidos e registros efetuados
A1.5. Avalia os resultados face os objetivos e rumo traados, identificando alteraes necessrias ao processo investigativo e reajustando as intervenes at ao trmino da investigao da morte	A1.5.1 Analisa e avalia os resultados da investigao da morte A1.5.2. Determina a necessidade de mais resultados at obter as respostas da situao da morte A1.5.3. Revê intervenes e objetivos se identifica necessidade de mudana de trajetria no processo de investigao da morte

Source: <http://www.abeforense.org.br/wp-content/uploads/2016/06/Compet%C3%A2ncias-Tcnicas-da-Enfermagem-Forense.pdf>

As for the interaction with survivors and family members, helping in the grieving process, the Forensic Nurse must obtain the necessary information, that is, relevant to the understanding of the health status of the victim's family members and/or significant people during the process of adaptation to the loss, promoting emotional, social, informative and organizational support for them (ABEFORENSE, 2015).

As for competence, the nurse must prevent or minimize health damage to family members and significant people in the grieving process. To do so, it must meet the following guidelines:

- Assess the health repercussions of the victim's death process on family members and significant persons;



- Anticipate the responses of family members or significant others in the face of loss and the evolution of the grieving process;
- To support family members and people in struggle during the investigation of deaths;
- Promote multidisciplinary partnership work in order to ensure the greatest efficiency in intervention results;
- Use specialized skills in negotiation processes, with the aim of acquiring multidisciplinary collaboration, ensuring respect for the individual responses of family members and/or bereaved significant people;
- Monitor and control their emotional and behavioral reactions during the process of investigating and supporting the bereaved people involved.

In COFEN Resolution No. 556 of 2017, it establishes the following guidelines for the performance of Forensic Nurses in the post-mortem process:

- To deal with the psychosocial aspects inherent to the death process, using the scientific methodology of the Nursing Process;
- Interact with survivors and family members, and provide assistance in the grieving process, throughout the investigation of the death;
- Participate in the recovery of dead victims or remains, recognizing a scenario of risk of death and deterioration of health;
- Apply knowledge from the disciplines of Nursing and forensic sciences in an analytical evaluation in the context of death;
- Identify the process of death and initiate evaluation with the interdisciplinary team, in cooperation with the judicial system;
- Issue opinions on the conditions that may have led to death in the context of ill-treatment, sexual violence, trauma and other forms of violence;
- Apply the Nursing Process in the investigation of violent or undetermined death;
- Apply the Nursing Process in the post-mortem (violent) assessment that occurs in any age group;
- Implement the plan outlined to obtain additional information, contributing to the development of postmortem assessment, leading to confirmation of findings and answering new questions.

## ROLE OF FORENSIC NURSING IN MASS DISASTER, HUMANITARIAN MISSIONS AND CATASTROPHES

Mass disasters are collective accidents in which there are a large number of serious or fatal victims. Such accidents are, in most cases, due to the form of human coexistence, led to inhabit



reduced geographical areas and a high rate of demographic concentration (UN, 1989). They are usually sudden accidents, natural or produced directly by the action or influence of man, which result in suffering or the loss of human life (Skinner; Sterenberg, 2005).

Catastrophes, on the other hand, are defined as the result of an adverse event, natural or artificial, in (fragile) ecosystems, resulting in human, material and/or environmental damage and consequent economic and social losses (Lourenço; Vieira, 2020).

In these two aspects, Forensic Nursing actions are (COFEN, 2017):

- Dimensioning of personnel for the Nursing team;
- Execute the planned intervention program and adapt it to the needs of the population affected by disasters, catastrophes and missions;
- Interact with survivors and family members and provide assistance in the grieving process to family members;
- Participate in measures for the preservation of corpses;
- Apply the Nursing process;
- Plan interventions and document all data of criminal relevance.

In the case of mass disasters and catastrophes, Nurses can (COFEN, 2017):

- Participate in the development of strategies for the search and recovery of living victims, recognizing scenarios of risk of death and deterioration of health;
- Collaborate with sanitary, epidemiological and disease control surveillance;
- Collection and preservation of forensic evidence;
- Participate in measures for the preservation of corpses;
- Promote the protection of human rights and legal guarantees;
- Execute the intervention program planned and adapted to the needs of the affected population;

In the case of humanitarian missions, they are related to interdisciplinary assistance in the field of health in an emergency manner in which national/international administrations often do not have the capacity to respond to catastrophes, such as hurricanes, tsunamis, among others (Ribeiro, 2008).

The role of Forensic Nursing in these special cases is usually to work in field hospitals, formulate strategies prioritizing Forensic Nursing activities, according to the needs assessed, and collaborate with sanitary, epidemiological and disease control surveillance (COFEN, 2017).

These professionals plan intervention strategies, which can be due to natural or unnatural causes. They will meet the needs of the population, working together with health surveillance, epidemiological surveillance, disease control and health problems regarding catastrophic accidents (COFEN, 2017). In addition, they do a careful job to identify not only the victims, but also the



survivors of disasters and understand what they need to obtain quality help, such as in conditions of post-traumatic stress disorder (PTSD) after a traumatizing episode (Bader; Gabriel, 2010).

Forensic Nurses will provide emotional support to survivors and their families during the grieving process, providing support during the cause-of-death investigation process and participating in body preservation measures in the context of disasters, large-scale catastrophes and humanitarian missions (COFEN, 2017).

Assistance in this area ranges from providing technical assistance to victims and their families, emphasizing the importance of disaster awareness, identifying vulnerable groups through triage, and evaluating potential shelters; as well as developing policies and understanding the terminology and role in responding to the types of multi-casualty disasters (Santos *et al.*, 2022; BRAZIL, 2007).

In addition, Forensic Nurses and interdisciplinary teams perform several tasks involving large-scale incidents, one of which is to assist in the collection and identification of victims after a fatal incident, including temporary morgues, processing and preparations of the body, human remains, clothing identification, medical history information, among other functions (Bader; Gabriel, 2010).

The task of the professional team is to ensure the identification and transport of the deceased, so that the family can identify him, so that his burial takes place with dignity and respect (Rocha; Silva; Silva, 2020; Bader; Gabriel, 2010).

This work involves volunteering, as well as that of all relevant professionals, especially from the Institute of Legal Medicine (IML), who work together to receive the remains of fatal victims and welcome their families and provide them with security. Carry out forensic work, various examinations, autopsies, identification and release of the bodies of the victims. The necessary information is also provided to the investigators of the judicial police and society through the press and the Public Prosecutor's Office (Rocha; Silva; Silva, 2020).

Nursing professionals still have a vital role in humanitarian expertise, including documentation and providing psychological support to victims, their families and the health team. They help prevent the spread of epidemics and do forensic work when several people die as a result of them. In addition, they act in disaster situations of natural or unnatural origin. Forensic Nurses need to possess effective communication skills to be successful in humanitarian forensic work (Gorea, 2020).

Therefore, the preparation of professionals in the face of disasters is essential not only for them to act appropriately to provide quality and efficient care to victims, but also to ensure urgent and emergency care in situations of catastrophic disasters (Franco, 2022).



## ROLE OF FORENSIC NURSING IN MALTREATMENT, TRAUMA AND OTHER FORMS OF VIOLENCE

The Brazilian Penal Code, in Article 136, makes the following mention about mistreatment (BRASIL, 1940):

[...] "Exposing to danger the life or health of a person under his authority, custody or surveillance, for the purpose of education, teaching, treatment or custody, either by depriving him of food or indispensable care, or by subjecting him to excessive or inadequate work, or by abusing means of correction or discipline."

Nursing attributions in cases of maltreatment, individuals who come forward in search of their services are: (Oliveira; Costa, 2015):

- Identify and characterize mistreatment;
- Observe the need for a multidisciplinary approach;
- Carry out compulsory notification;
- To report and forward to the competent bodies;
- Know the current legislation;
- Raise awareness among the family about the support, care and legal measures to be taken in case of new episodes of abuse.

Based on the incidence of similar cases, COFEN decided to delimit the concept of trauma as being related to "injuries produced in the form of violence on the human body, whether recent or late" (BRASIL, 2017).

The tasks of the nursing professional when receiving a patient with physical trauma is (Silva *et al.*, 2022):

- Perform cephalocaudal evaluation on the victim;
- Identify (existing) bodily injuries (cuts, scratches);
- Document/record injuries by photographic means;
- Identify physical and non-physical traces;
- Physical evaluation, evidence collection, and documentation of assault and injury;
- Collaboration with the authorities.

In their daily reality, nurses experience and witness extreme situations of human behavior, whether through child abuse, domestic violence, crimes against the elderly, catastrophic accidents, self-mutilation, negligence, mistreatment and torture. These incidents must be reported to the competent and specialized bodies for their appropriate legal measures and technical competences, which are required of these professionals who provide care or court-ordered assessments to patients in legal custody (Hammer; Moynihan; Pagliar, 2013).



The nurse who works with the population of patients who have suffered intimate partner violence, elder abuse and child maltreatment, is usually responsible for the screening and evaluation of abuse, forensic evaluation of the patient, development and implementation of safety plans, in which this professional usually works with a multidisciplinary team to develop a care plan for patients in situations of violence (IAFN, 2023b).

In addition, its work will develop a care plan for victims and their families, from admission, intervention, evaluation, care process and diagnosis to the identification of injuries and types of violence (physical, moral, family, psychological, human trafficking, private imprisonment, torture, negligence, obstetrics and suicide), promoting the protection of human rights and their legal guarantees in the implementation and monitoring of health systems (COFEN, 2017).

The practice of Forensic Nursing places nurses in relationships that involve criminal activities and victims injured or killed as a result of the crime. The specialist in the field carries many responsibilities and expectations, including those of the patient, client or victim, medical staff, administrators, colleagues, family, friends or support systems, and the care team itself (Bader; Gabriel, 2010).

With regard to working with trauma victims, these professionals must accurately describe the physical characteristics of all wounds they identify and report in medical records, as well as perform physical examinations using appropriate terminology. Forensic care of trauma victims requires clinical observation and careful physical evaluation to determine the type of injury caused and its main characteristic, such as size, extension, depth, among others (Amar; Sekula, 2015).

With regard to the role of identifying injuries resulting from trauma, the professional will identify different types of injuries resulting from violence. For example, cuts have sharp edges and are caused by piercing the skin with a sharp instrument (knife, glass, razor blade, or scalpel). Superficial and/or parallel incisions should be considered self-inflicted (Love; Sekula, 2015).

Lacerations with irregular edges are the result of blunt force trauma, for example, identifiable in victims of strangulation, firearms, or stab wounds. Nurses who care for people in traumatic situations must acquire such knowledge and skills (Love; Sekula, 2015).

In addition, the work of these specialists can range from urgent and emergency clinics and hospitals for victims and sexual assault, child abuse, elder abuse, and other violent incidents. The performance of forensic procedures is a component of hospital nursing practice in which they will act in the identification, collection and preservation of evidence without contaminating the evidence, as they are responsible for detailed documentation and their testimony in court, if it is in the interest of justice (Pyrek, 2006).

Thus, the role of Forensic Nursing in maltreatment, trauma and other forms of violence is in the identification of signs and symptoms that characterize suspicion and/or confirmation of some



type of violence, home visit, physical examination, detailed anamnesis, nursing consultation, documentation in medical records, as well as referral to competent bodies and other professionals, whether in the social sphere, psychological, educational and judicial (COFEN, 2017; Pinto *et al.*, 2013; Souza; Santos, 2013).

## ACTIVITY

In this chapter, the eight areas of Forensic Nursing were presented according to COFEN. As a nurse, read the four case studies and reflect below. Both studies were referenced by Amar and Sekula (2015) and Brasil (2008).

### CASE STUDY 1: PRISON CARE

*"You are the Nurse in the Urgent and Emergency Sector. F.D.S, 32, was the victim of several stab wounds in the chest area. She was bleeding heavily and would be sent to the operating room soon. The victim said that her boyfriend became violent and attacked her. The police had to intervene with the main suspect because he had shouted that his girlfriend was "Crazy and that he had tried to kill her". Confirming the act.*

### CASE STUDY REFLECTION

*In the care of incarcerated patients, the Emergency Sector Nurse plays a key role in assessing and meeting the health needs of the inmate. It must consider the specific conditions of the prison environment, such as exposure to diseases, treatment of injuries, mental health issues and ensure humanized care that respects the dignity and rights of the patient, maintaining confidentiality and security.*

### CASE STUDY 2: CHILD VIOLENCE

*"An 8-year-old child has injuries on both sides of the body and with different degrees of evolution and claims that these injuries were caused by a fall from a bicycle. Logic suggests that in this type of accident, injuries are observed at the site where the patient refers to the fall, especially in exposed areas and bony prominences."*

### CASE STUDY REFLECTION

*The Family Health Strategy nurse plays a crucial role in the care and health promotion of patients, performing assessments, chronic follow-up, health education, nursing procedures, and disease prevention. Its practice has a direct impact on health outcomes, influencing patient satisfaction, treatment adherence, and prevention of complications. Empathetic communication,*





*promotion of autonomy, and teamwork are key to achieving good clinical outcomes. The competence and engagement of nursing professionals are essential to ensure quality care, promoting the health and well-being of the community served.*

### **CASE STUDY 3: PATIENT IN CUSTODY IN A HOSPITAL**

*"You are the Nurse in the Urgent and Emergency Sector of a Hospital. Charles is a 46-year-old carpenter who is unemployed. He told you that he may have some serious illness. According to him, the professionals who treated him in prison ignored his complaints, as well as the desire to be hospitalized. Then you took the physical and mental health history and laboratory tests were performed. He reported that he used alcohol and other drugs and the end of his marriage was because of them. The reason he was arrested was because he was unjustly accused of theft at his old job.*

*Charles told him that he was the first person who seemed to care about what he has been reporting. "You are really a good Nurse! I know you can help me. I wanted to be hospitalized!"*

### **REFLECTION OF THE CASE STUDY**

*The nursing professional reflects on the importance of offering compassionate and respectful care to the patient in custody at the hospital, ensuring their safety, dignity and well-being throughout the treatment process.*

### **CASE STUDY 4: INTIMATE PARTNER VIOLENCE**

*"You are the Nurse in the Urgent and Emergency Sector. F.D.S, 32, was the victim of several stab wounds in the chest area. He was bleeding heavily, requiring surgical intervention. The victim reported that her husband became violent and attacked her. The police had to intervene with the main suspect, who shouted that his girlfriend was "crazy" and that he tried to kill her, thus confirming the act.*

### **CASE STUDY REFLECTION**

*The performance of nursing professionals has a significant impact on the outcome of this case, as their competence, sensitivity and ethics in the provision of care can be decisive for the progress and evolution of the patient's clinical condition. The quality of care provided, the ability to establish a therapeutic relationship and the readiness to deal with critical situations directly reflect on the safety, comfort and recovery of the individual under the care of the nurse in the Emergency Sector.*



## REFERENCES

1. Amar, A., & Sekula, L. K. (2015). \*A practical guide to forensic nursing: Incorporating forensic principles into nursing practice\*. Sigma Theta Tau. <https://doi.org/10.7748/nm.23.8.17s25> (Acesso em: 26 fev. 2023)
2. Associação Brasileira de Enfermagem Forense (ABEFOR). (2015). \*Regulamento das competências técnicas da enfermagem forense\*. Aracaju. Disponível em: <https://www.abeforense.org.br/parecer-sobre-campo-de-atuacao-da-enfermagem-forense-brasileira-protocolado-no-cofen/>. (Acesso em: 26 fev. 2023)
3. Barder, D. M. G., & Gabriel, S. (2010). \*Forensic nursing: A concise manual\* (1ª ed.). Taylor & Francis Group. Disponível em: <https://books.google.com/books?id=dEoDZ3q62uIC&lpq=PP1&hl=ptPT&pg=PP1#v=onepag&q&f=false> (Acesso em: 26 fev. 2023)
4. Barbosa, M. L., et al. (2019). Ações de enfermagem para as pessoas privadas de liberdade: uma scoping review. \*Esc. Anna Nery, 23\*(3), e20190098.
5. Berbel, N. N. (1998). "Problematization" and problem-based learning: Different words or different ways? \*Interface – Comunic, Saúde, Educ, 2\*(2).
6. Berbel, N. A. N. (2012). \*A metodologia da problematização com o Arco de Maguerez: Uma reflexão teórico-epistemológica\*. Londrina: EDUEL.
7. Berbel, N. A. N. A problematização e a aprendizagem baseada em problemas: Diferentes termos ou diferentes caminhos? Disponível em: <https://www.scielo.br/j/icse/a/BBqnRMcdxXyvNSY3YfztH9J/?format=pdf&lang=pt> (Acesso em: 11 mar. 2023)
8. Bertolini, W. L. H. M. (2017-2018). \*Criminalística regular: Teoria e exercícios\*. Estratégia Concursos, pp. 1-44.
9. Brasil. Conselho Nacional do Ministério Público. (2021). \*Resolução nº 243, de 18 de outubro de 2021: Dispõe sobre a política institucional de proteção integral e de promoção de direitos e apoio às vítimas\*. Brasília, DF. Disponível em: <https://www.cnmp.mp.br/portal/images/Resolucoes/2021/Resoluo-n-243-2021.pdf> (Acesso em: 26 abril. 2023)
10. Brasil. (1940). \*Código Penal: Decreto-lei nº 2.848, de 7 de dezembro de 1940\*. Brasília, DF. Disponível em: [https://www.planalto.gov.br/ccivil\\_03/decreto-lei/del2848.htm#:~:text=Entende%2Dse%20em%20leg%C3%ADtima%20defesa,direito%20seu%20ou%20de%20outrem.&text=Excesso%20culposo-,Par%C3%A1grafo%20%C3%BAnico.,%C3%A9%20pun%C3%ADvel%20como%20crime%20culposo.](https://www.planalto.gov.br/ccivil_03/decreto-lei/del2848.htm#:~:text=Entende%2Dse%20em%20leg%C3%ADtima%20defesa,direito%20seu%20ou%20de%20outrem.&text=Excesso%20culposo-,Par%C3%A1grafo%20%C3%BAnico.,%C3%A9%20pun%C3%ADvel%20como%20crime%20culposo.) (Acesso em: 12 jun. 2023)
11. Brasil. (2001). \*Lei nº 10.216, de 06 de abril de 2001: Dispõe sobre a proteção e o direito das pessoas portadoras de transtornos mentais e redireciona o modelo assistencial em saúde mental\*. Diário Oficial da União, Brasília, DF. Disponível em: <https://www.mpac.mp.br/wpcontent/uploads/portaria-gm-ms-2391-2002.pdf> (Acesso em: 06 jun. 2023)



12. Brasil. (2018). \*Lei nº 13.721, de 2 de outubro de 2018: Altera o Decreto-Lei nº 3.689, de 3 de outubro de 1941 (Código de Processo Penal), para estabelecer que será dada prioridade à realização do exame de corpo de delito quando se tratar de crime que envolva violência doméstica e familiar contra mulher ou violência contra criança, adolescente, idoso ou pessoa com deficiência\*. Brasília, DF.
13. Brasil. Ministério da Integração Nacional. Secretaria Nacional de Defesa Civil. (2007). \*Manual de medicina de desastres - Volume 1\* (3ª ed.). Ministério da Integração Nacional. Secretaria Nacional de Defesa Civil.
14. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância de Doenças e Agravos Não Transmissíveis e Promoção da Saúde. (2016). \*Viva: Instrutivo de notificação de violência interpessoal e autoprovocada\* (2ª ed.). Brasília, DF. Disponível em: [https://bvsmms.saude.gov.br/bvs/publicacoes/viva\\_instrutivo\\_violencia\\_interpessoal\\_autoprovocada\\_2ed.pdf](https://bvsmms.saude.gov.br/bvs/publicacoes/viva_instrutivo_violencia_interpessoal_autoprovocada_2ed.pdf) (Acesso em: 03 mar. 2023)
15. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. (2012). \*Prevenção e tratamento dos agravos resultantes da violência sexual contra mulheres e adolescentes: Norma técnica\* (3ª ed.). Brasília, DF.
16. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. DAPE. Coordenação Geral de Saúde Mental. (2005). \*Reforma psiquiátrica e política de saúde mental no Brasil\*. Documento apresentado à Conferência Regional de Reforma dos Serviços de Saúde Mental: 15 anos depois de Caracas. OPAS. Brasília.
17. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Especializada e Temática. (2015). \*Centros de atenção psicossocial e unidades de acolhimento como lugares da atenção psicossocial nos territórios: Orientações para elaboração de projetos de construção, reforma e ampliação de CAPS e de UA\*. Brasília, DF. Disponível em: [https://bvsmms.saude.gov.br/bvs/publicacoes/centros\\_atencao\\_psicossocial\\_unidades\\_acolhimento.pdf](https://bvsmms.saude.gov.br/bvs/publicacoes/centros_atencao_psicossocial_unidades_acolhimento.pdf) (Acesso em: 06 jun. 2023)
18. Brasil. Ministério da Saúde. (2002). \*Portaria n. 2.391, de 26 de dezembro de 2002: Regulamenta o controle das internações psiquiátricas involuntárias e voluntárias\*. Brasília, DF. Disponível em: <http://www.mpac.mp.br/wpcontent/uploads/portaria-gm-ms-2391-2002.pdf> (Acesso em: 04 set. 2022)
19. Cachoeira, D. B. C., Evangelista, H. R. F., & Souza, W. de L. (2020). Enfermagem forense: contexto histórico, atuação do enfermeiro, contribuições para saúde e segurança pública. \*Grupo Tiradentes\*, 1-20. Aracaju, Sergipe. Disponível em: <https://openrit.grupotiradentes.com/xmlui/bitstream/handle/set/3223/Enfermagem%20Forense%20atualizado%20%2005.12.18%20wbiratan%20PDF.pdf?sequence=1&isAllowed=y> (Acesso em: 26 fev. 2023)
20. Conselho Federal de Enfermagem (COFEN). (2018). \*Anexo da Resolução nº 581/2018: Especialidades do enfermeiro por área de abrangência\*. Brasília, DF.
21. Conselho Federal de Enfermagem (COFEN). (2022). \*COFEN cria protocolo de Enfermagem Forense para vítimas de violência\*. Brasília, DF. Disponível em: [http://www.cofen.gov.br/cofen-cria-protocolo-de-enfermagem-forense-para-vitimas-de-violencia\\_100170.html](http://www.cofen.gov.br/cofen-cria-protocolo-de-enfermagem-forense-para-vitimas-de-violencia_100170.html) (Acesso em: 26 fev. 2023)



22. Brasil. Conselho Federal de Enfermagem. (2017). \*Resolução nº 556, de 14 de agosto de 2017: Das áreas de atuação do enfermeiro forense (ANEXO)\*. Diário Oficial da União, Brasília, DF. Disponível em: <http://www.cofen.gov.br/wp-content/uploads/2017/08/ANEXORESOLU%C3%87%C3%83O-556-2017.pdf> (Acesso em: 26 fev. 2023)
23. Franco, L. T. (2022). Desastres: Atuação dos enfermeiros nos atendimentos às vítimas em massa. \*Revista Científica Mais Pontal, 1\*(1), 32–45. Disponível em: <https://revistas.facmais.edu.br/index.php/maispontal/article/view/4> (Acesso em: 06 mai. 2023)
24. Furtado, B. M. A. S. M., et al. (2021). Investigation in forensic nursing: Trajectories and possibilities of action. \*Revista da Escola de Enfermagem da USP, 55\*, e20200586. Disponível em: <http://dx.doi.org/10.1590/1980-220X-REEUSP-2020-0586> (Acesso em: 10 abr. 2023)
25. Gorea, R. (2020). Forensic nursing in humanitarian forensics. \*International Journal of Ethics, Trauma & Victimology, 6\*(2), 1-5.
26. Hammer, R. M., Moynihan, B., & Pagliaro, E. M. (2013). \*Forensic nursing: A handbook for practice\* (2ª ed.). Jones & Bartlett Learning. Disponível em: <https://books.google.com.br/books?id=APgVX1WcuYcC&printsec=frontcover&dq=forensic+nursing&hl=ptBR&sa=X&ved=0ahUKewjguciyxezjAhVHH7kGHTN0BhQQ6AEIRTAD#v=onepage&q=forensic%20nursing&f=false> (Acesso em: 06 abr. 2023)
27. International Association of Forensic Nurses (IAFN). (2023). \*Forensic nursing\*. Silver Spring, Maryland. Disponível em: <https://www.forensicnurses.org/page/WhatisFN/> (Acesso em: 24 fev. 2023)
28. International Association of Forensic Nurses (IAFN). (2014). \*The forensic nurse as a death investigator\*. Disponível em: <https://www.forensicnurses.org/page/DeathInvest> (Acesso em: 12 jun. 2023)
29. Januario, R. C. B., et al. (2022). Atuação dos enfermeiros na ótica da enfermagem forense em relação ao infrator com transtorno mental: Revisão integrativa. In: \*Anais do Congresso de Biomedicina e Simpósio de Estética e Cosmética da UNIFENAS\*. Alfenas, MG.
30. Ladeira, L. M. P., & Leal, M. T. (2020). \*A gestão do cuidado de enfermagem à pessoa em situação crítica em contexto de hospital de campanha\* (Dissertação de Mestrado). Escola Superior de Enfermagem Lisboa, Lisboa, Portugal.
31. Leodoro, A. M. (2023). O campo da responsabilidade criminal da enfermagem forense: A intersecção entre a psiquiatria, o direito e a justiça. \*Sínteses: Revista Eletrônica do SimTec\*, (8), e0220048. Disponível em: <https://econtents.bc.unicamp.br/inpec/index.php/simtec/article/view/17808> (Acesso em: 2 mai. 2023)
32. Lima, M. H. D. S., et al. (2020). Assistência de enfermagem no sistema prisional. \*Revista Saúde em Foco, 12\*, 438-445.
33. Lynch, V., & Duval, J. (2011). Evolution of forensic nursing science. In: \*Forensic nursing science\* (2ª ed.). Maryland Heights: Elsevier Mosby. Disponível em: <https://books.google.com.br/books?id=nD6VAFvKGC0C&printsec=frontcover&dq=forensic+nursing&hl=ptBR&sa=X&ved=0ahUKewjguciyxezjAhVHH7kGHTN0BhQQ6AEISzAE#v=onepage&q=forensic%20nursing&f=false> (Acesso em: 26 fev. 2023)




34. Lourenço, L., & Vieira, A. (2020). Catástrofes naturais: uma abordagem global. In L. Lourenço & A. Vieira (Coords.), *\*Riscos e catástrofes\** (pp. 1-50). Coimbra, Portugal. Disponível em: <https://repositorio-aberto.up.pt/bitstream/10216/126175/2/385206.pdf> (Acesso em: 12 jun. 2023)
35. Marcelo, K. C. F. R., & Barreto, C. A. (2019). Enfermagem Forense: Sobre a regulamentação no Brasil. *\*Revista Saúde em Foco, 11\**, 560-566. Disponível em: [https://portal.unisepe.com.br/unifia/wp-content/uploads/sites/10001/2019/05/050\\_ENFERMAGEM-FORENSE.pdf](https://portal.unisepe.com.br/unifia/wp-content/uploads/sites/10001/2019/05/050_ENFERMAGEM-FORENSE.pdf) (Acesso em: 12 jun. 2023)
36. Matos, L. S., & Sales Junior, C. A. F. (2021). Assistência de enfermagem ao indivíduo vítima de violência sexual. *\*Revista de Enfermagem UFPE On Line, 15\*(2)*, e245695.
37. Melo, C. A. de S., et al. (2021). Perfil do agressor e fatores associados à violência contra mulheres no Município de Marabá – PA. *\*Research, Society and Development, 10\*(11)*, e334101119572.
38. Morse, J. (2019). Legal mobilization in medicine: Nurses, rape kits, and the emergence of forensic nursing in the United States since the 1970s. *\*Social Science & Medicine, 222\**, 323-334.
39. Pinto, E. C., et al. (2013). Maus tratos físicos contra crianças e adolescentes: Percepção da equipe de enfermagem pediátrica. *\*Revista de Enfermagem UFPE On Line, 7\*(6)*, 4411-4420.
40. Pyrek, K. M. (2006). *\*Forensic nursing\**. Taylor & Francis Group. Disponível em: <https://doi.org/10.1201/EBK0849335402> (Acesso em: 06 abr. 2023)
41. Reis, I. O., et al. (2021). Atuação do enfermeiro forense em casos de agressão sexual no contexto norte-americano. *\*J. Nurs. Health, 11\*(1)*, 1-12. Disponível em: <https://periodicos.ufpel.edu.br/ojs2/index.php/enfermagem/article/view/20111> (Acesso em: 29 jun. 2023)
42. Ribeiro, L. C. (2008). Missões humanitárias: A exigência de interdisciplinaridade. *\*Cadernos de Estudos Africanos [online], 15\**. Disponível em: <http://journals.openedition.org/cea/369> (Acesso em: 12 jun. 2023)
43. Rocha, C. S. D., Silva, J. M. D., & Silva, L. S. (2020). Atuação da equipe multidisciplinar do instituto médico legal de Belo Horizonte frente ao rompimento da barragem B1, da mina do córrego do feijão, em Brumadinho, Minas Gerais, Brasil (Dissertação de Mestrado). Universidade Federal de Minas Gerais, Belo Horizonte, MG.
44. Santos, J. D., & Carmo, C. N. D. (2023). Características da violência por parceiro íntimo em Mato Grosso do Sul, 2009-2018. *\*Epidemiologia e Serviços de Saúde, 32\*(1)*, e2022307.
45. Silva, J. O. M., et al. (2021). Planning and implementation of the Sexual Assault Nurse Examiner course to assist victims of sexual violence: An experience report. *\*Revista da Escola de Enfermagem da USP, 55\**, e03739. Disponível em: <https://doi.org/10.1590/S1980-220X2020029803739> (Acesso em: 10 abr. 2023)
46. Silva, R. X., et al. (2022). Preservation of forensic traces by nursing in emergency services: A scoping review. *\*Revista Latino-Americana de Enfermagem, 30\**, e3540.



47. Sociedade Brasileira de Enfermagem Forense (SOBEF). (2019). Enfermeira Psiquiátrica Forense. Aracaju, SE. Disponível em: <https://sobef.com.br/tag/enfermeiro-forense/> (Acesso em: 13 jul. 2023)
48. Souza, R. G. S., & Santos, D. V. D. (2013). Enfrentando os maus-tratos infantis nas Unidades de Saúde da Família: Atuação dos enfermeiros. \*Revista de Saúde Coletiva, 23\*(2), 783-800.
49. Skinner, M., & Sterenberg, J. (2005). Turf wars: Authority and responsibility for the investigation of mass graves. \*Forensic Science International, 151\*(2-3), 221-232.
50. Oliveira, P. C. C., & Costa, M. L. A. de. (2015). Percepção e responsabilidade do enfermeiro frente às situações de maus tratos contra a criança e adolescente. \*Saúde Em Foco: Temas Contemporâneos, 3\*(39), 467-481. Disponível em: <https://downloads.editoracientifica.org/articles/200901405.pdf> (Acesso em: 12 jun. 2023)
51. Organização das Nações Unidas (ONU). (1989). Década internacional de redução de riscos de desastres naturais (1990-1999) - DIRDN. \*Resolução n. 44/236, de 22 de dezembro de 1989\*.

## Gestational Hypertensive Syndromes: Understanding the pathological aspects and treatment of preeclampsia with the 4P rule

 <https://doi.org/10.56238/sevned2024.016-012>

Ryan Cândido Barros de Oliveira<sup>1</sup>, Ruan Cândido Barros de Oliveira<sup>2</sup>, Beatriz de Souza Nunes e Silva<sup>3</sup>, Solange Cavalcante Costa<sup>4</sup> and Welly Minghun Chiang<sup>5</sup>

### ABSTRACT

Gestational Hypertensive Syndromes (GHS) represent a significant challenge in obstetrics, associated with severe maternal and fetal complications. This study aims to review and synthesize information on GHS, addressing its pathophysiology, epidemiology, treatment and prevention. The review was conducted through the search and analysis of relevant scientific articles in databases such as PubMed and SciELO, following inclusion and exclusion criteria defined to ensure the relevance and quality of the selected studies. The theoretical framework included fundamental concepts related to GHS, based on contributions from recent studies and recognized clinical guidelines. It is noteworthy that the interruption of pregnancy is considered the definitive therapeutic approach for GHS, although preventive measures such as the use of aspirin and calcium can reduce the risk of developing these syndromes. Blood pressure-lowering drug therapy, while important, is accompanied by disagreements as to the appropriate time to start treatment. In summary, understanding the complexity of GHS and the importance of a multidisciplinary approach are emphasized, highlighting the need for early identification, adequate prenatal care, and timely therapeutic intervention to mitigate adverse impacts on maternal and fetal health.

**Keywords:** Gestational Hypertensive Syndrome, Pathophysiology, Prevention and Treatment.

---

<sup>1</sup> Graduating in Medicine

Institution: State University of Roraima

E-mail: Ryancbarros@gmail.com

<sup>2</sup> Graduating in Medicine

Institution: Federal University of Roraima

E-mail: Ruancbo@gmail.com

<sup>3</sup> Medical Student

Institution: Federal University of Roraima

E-mail: Beatrizsilva.bsns@gmail.com

<sup>4</sup> Gynaecologist and Obstetrician

Institution: State University of Roraima

E-mail: Solbv31@gmail.com

<sup>5</sup> Gynaecologist and Obstetrician

Institution: University of São Paulo - USP

E-mail: welly.chiang@gmail.com



## INTRODUCTION

In pre-Hippocratic Greece, the observation of headache accompanied by sleepiness during pregnancy, which occasionally triggered seizures, was already considered a worrisome condition. There is even evidence of this in historical records. For example, the Egyptian papyrus of Kahun, dated to approximately 3,000 years ago, also mentioned the occurrence of seizures during pregnancy. According to Chesley (2004), this possibly represents the oldest historical record of pregnancy-specific hypertensive disease and one of its most fearful and severe manifestations, eclampsia.

Currently, Gestational Hypertensive Syndromes (GHS) is the term that encompasses several conditions related to high blood pressure during pregnancy. This includes gestational hypertension, preeclampsia, and eclampsia (ZUGAIB, 2019). Each of these conditions has specific characteristics, but all are associated with high blood pressure during pregnancy.

Thus, in both a global and national public health panorama, hypertensive complications in pregnancy stand out as the third leading cause of maternal mortality worldwide and the main cause in the Brazilian context. In developed countries, the incidence of this syndrome varies from two to eight out of every 100 pregnant women, while in Brazil this occurrence can be observed in 5-10% of all pregnancies (WATANABE et al, 2020).

Due to the severity associated with this disease, it is considered a significant criterion for hospitalization in Maternal Intensive Care Units (ICUs) and is sometimes included as a cause of severe maternal morbidity (NETO, 2007). Although most pregnancies progress naturally and without complications, a portion that has specific characteristics or is affected by other conditions can result in fatalities, putting the health of both mother and fetus at risk.

Gestational Hypertensive Syndromes, among the various maternal conditions that may arise during this period, stand out as the one that most causes harmful effects to both the maternal and fetal organisms, as well as this condition is one of the most prevalent causes of maternal and/or fetal death. (CHAIM et al, 2008).

Gestational hypertension is characterized by an increase in blood pressure, reaching or exceeding 140 x 90 mmHg, measured under ideal conditions on at least three occasions, and is diagnosed for the first time during pregnancy, from the 20th week of Gestational Age (GA). At baseline the blood pressure should be recorded in both arms and, in cases of discrepancy, the arm with the higher reading should be considered as a reference for subsequent measurements. The recommended position for measurement is the sitting position (CPPAS, 2018).

In view of the above, it is important that, when diagnosed with hypertensive syndrome during pregnancy, the woman receives special attention, including differentiated prenatal care with specific laboratory tests. In addition to carrying out a fetal evaluation with greater care, in view of the harmful effects that it can cause to the fetus and the pregnant woman (ALMEIDA, 2017).





Protecting the mother and fetus against serious complications resulting from high blood pressure during pregnancy is essential, because if left unchecked, this condition can progress to preeclampsia, eclampsia, or HELLP syndrome (characterized by H = hemolysis, EL = elevated liver enzyme levels, and LP = low platelet counts) which are the prevalent complications of maternal-fetal mortality (LIMA et al., 2018).

Therefore, this condition represents a significant challenge for maternal and fetal health, and understanding the clinical-epidemiological profile of pregnant women with gestational hypertensive syndrome is essential for its adequate prevention and treatment.

## **THEORETICAL FRAMEWORK**

### **CONCEPT OF SHG**

Gestational hypertension, preeclampsia, eclampsia and chronic hypertension superimposed by preeclampsia represent the different spectrums of Gestational Hypertensive Syndromes (DINES; KATTAH, 2020).

Gestational hypertension represents the most prevalent form of hypertension during the gestational period, characterized by an increase in blood pressure to values equal to or greater than 140x90 mmHg after 20 weeks of gestation. This condition does not include proteinuria or end-organ dysfunction and lasts up to 12 weeks after delivery. When the pregnant woman presents proteinuria or end-organ dysfunction, the diagnosis is changed to preeclampsia (SHAH; GUPTA, 2019).

Thus, this concept of gestational hypertension refers to the situation in which there is an increase in blood pressure during pregnancy or in the first 24 hours after delivery, without the presence of other signs indicative of preeclampsia or preexisting hypertension. This condition seems to anticipate the subsequent development of essential hypertension and has a propensity to recur in subsequent pregnancies (PACOAL, 2002).

On the other hand, preeclampsia manifests itself through the appearance of high blood pressure, often accompanied by a significant amount of protein in the urine (proteinuria) and/or edema in the hands and face. In specific cases, this condition may occur before the twentieth week, as in the context of gestational trophoblastic disease (OLIVEIRA et al., 2006).

Thus, preeclampsia represents a form of Gestational Hypertensive Syndrome with multisystem manifestations. It is characterized by an increase in blood pressure after 20 weeks of gestation in previously normotensive women, with blood pressure values of 140x90 mmHg in two measurements with an interval of 4 hours, or greater than 160x110 mmHg in a shorter time interval. In addition, it is diagnosed with the presence of proteinuria equal to or greater than 300 mg/24h, or protein/creatinine ratio greater than 0.3. The definition of preeclampsia can be established even in the absence of proteinuria if there is evidence of end-organ dysfunction, such as creatinine elevation



above 1.1 mg/dl (or twice baseline), thrombocytopenia ( $<100,000/\mu\text{L}$ ), transaminase elevation above twice normal, pulmonary edema, or cerebral or visual manifestations (SHAH; GUPTA, 2019).

The condition in which preeclampsia overlaps with chronic hypertension is characterized by the existence of high blood pressure before pregnancy and the appearance of proteinuria after the twentieth week of gestation (SHAH; GUPTA, 2019).

## IMPACTS ON THE HEALTH OF THE MOTHER AND FETUS

Eclampsia is a condition characterized by the occurrence of seizures or coma during preeclampsia. These seizures can manifest themselves in a generalized way, with muscle contractions throughout the body, or focally. It is important to note that such seizures must not have identifiable causes, such as epilepsy, stroke, intracranial hemorrhage, or be related to the use of drug substances (MURALI; MILLER; MCDERMOTT, 2020).

It is important to highlight that non-interruption of pregnancy can lead to the progression of preeclampsia, culminating in placental insufficiency and maternal organizational dysfunction, in addition to being the main cause of maternal death in Brazil, especially when it manifests in a severe form, such as eclampsia or HELLP syndrome (Hemolysis Elevated Liver Enzymes and Low Platelets count), a serious condition that affects 10% and 20% of women with severe preeclampsia. (VEGA et al., 2007).

This hypertensive condition represents the main cause of perinatal death, resulting in a significant number of affected neonates, even those who survive often suffer from the effects of lack of oxygen during delivery (DERHAM et al., 1989).

In addition to the immediate impact during pregnancy, preeclampsia also poses a significant long-term health risk to both women who experience it and their children. Women who have experienced pregnancies affected by preeclampsia have an increased risk of developing metabolic syndromes, cardiovascular disease, and hypertension earlier in their lives (WU et al., 2009).

Several risk factors are associated with preeclampsia, including lack of experience in pregnancy (nulliparity), previous history of preeclampsia, eclampsia or HELLP syndrome, family history of the condition, presence of chronic diseases such as hypertension, diabetes, kidney disease and thrombophilias, obesity, twin pregnancy and gestational trophoblastic diseases (KAHHALE, ZUGAIB, 1995).

## EPIDEMIOLOGY

The incidence of preeclampsia has increased globally due to the advancing age of mothers, the increase in obesity, the use of assisted reproductive techniques, and the prevalence of preexisting medical conditions, such as diabetes, hypertension, and kidney diseases (TOWNSEND, 2016). In



this context, significant research conducted in Norway revealed a considerable increase in the risk of developing preeclampsia in women with multiple pregnancies, however, it did not observe an increase in the development of gestational hypertension compared to singleton pregnancies (LAINE et al, 2019).

According to Kintiraki et al. (2015), other complications include Hemorrhagic Strokes (CVA), acute pulmonary edema, central nervous system dysfunctions, hepatocellular lesions, disseminated intravascular coagulation (DIC), and many of these complications can result in maternal death. As for fetuses and neonates, the same authors highlight Intrauterine Growth Restricted (IUGR), Small for Gestational Age (SGA) fetuses, prematurity and perinatal death.

It is important to note that, according to the World Health Organization (WHO) in 2011, the early occurrence of preeclampsia (before 32 to 34 weeks of gestation) and complications related to the health of the fetus are considered independent criteria to classify preeclampsia as severe in certain regions of the world. The incidence of preeclampsia at the global level varies between 3 and 10% of all pregnancies, standing out as one of the main causes of perinatal mortality (MURALI; MILLER; MCDERMOTT, 2020).

With regard to socioeconomic aspects, it is essential to highlight the role played by factors such as geographic origin - municipalities far from the capital often have characteristics that can hinder adequate prenatal care -, educational level, occupation and marital status, which may be associated with the origin of hypertensive disorders during pregnancy. In this context, research conducted in the Netherlands by Silva et al. (2008) identified a significant correlation between lower educational levels, occupation, and an increased risk of developing hypertensive disorders during pregnancy. These factors were associated with behaviors such as alcohol consumption, smoking, and use of illicit substances, highlighting the importance of a comprehensive approach in the prenatal care of pregnant women at risk of developing gestational hypertensive syndromes.

## PATHOPHYSIOLOGY

Although the understanding of the pathophysiology is partial, studies indicate that factors such as abnormalities in placental implantation, genetic predisposition, and immune intolerance between maternal and fetus-placental tissues may play a significant role (KINTIRAKI et al, 2015). In addition, recent research, according to Phoswa (2019), emphasizes endothelial dysfunction as a result of oxidative stress, influenced by the action of endogenous neurotransmitters such as dopamine, and highlights the crucial role of enzymes that convert it into inactive metabolites, such as monoamine oxidase (MAO) and catechol-O-methyltransferase (COMT), in the origin of this set of pathologies.

In the normal process of placentation, the cytotrophoblast migrates to the spiral arteries, causing changes that result in a decrease in vascular resistance, thus providing adequate nutrition for



the fetus. However, in cases of placentas destined to develop preeclampsia, cytotrophoblasts fail to effectively perform vascular remodeling, resulting in narrowed vessels and a condition of relative placental ischemia. The ischemic placenta releases inflammatory and prothrombotic factors into the maternal circulation, which contribute to the development of hypertension and changes in the coagulation system, thus supporting the clinical presentation of hypertensive syndrome (RANA et al, 2019).

## CLINICAL SUSPICION AND DIAGNOSIS OF PREECLAMPSIA

To identify preeclampsia early during prenatal consultations, especially from the 20th week of gestation, it is essential that the doctor is aware of the symptoms mentioned by the pregnant woman, such as general malaise, headaches, body aches, nausea and vomiting, itching, visual changes, among others. In addition, it is essential to monitor weight gain, especially if it is more than 1 kg per week, and to watch for any edema, often noticed on the hands and face. In the presence of indicative signs or symptoms, especially high blood pressure, additional tests should be ordered to confirm the diagnosis (Peraçoli et. al. 2023).

The diagnostic criteria for preeclampsia have been adjusted over the years. Since the 2013 American College of Obstetricians and Gynecologists (ACOG) and the 2014 International Society for the Study of Hypertension in Pregnancy (ISSHP) guidelines, the presence of proteinuria is no longer a mandatory requirement for diagnosis. In 2018, the ISSHP again updated these diagnostic criteria, which remain in place today (Brown et. al. 2018; Magee et. al. 2022).

Figure 1 - Dysgnostic criteria for preeclampsia

CRITÉRIOS DIAGNÓSTICOS PARA PRÉ-ECLÂMPSIA - 2023	
<b>HIPERTENSÃO</b> + <b>PROTEINÚRIA</b>	PAS > 140 e/ou PAD > 90 mmHg, Medido em duas ocasiões, com intervalo > 4 hours, after 20 weeks of pregnancy. Relação Proteinúria/Creatinúria > 0,3 mg/dL ou > 300 mg/24 horas ou > 1+ no Reagente Tiras
<b>Na ausência de proteinúria</b>	<b>Hipertensão Associada a pelo menos um dos seguintes:</b>
trombocitopenia	Contagem de plaquetas < 150.000 mm <sup>3</sup>
Insuficiência hepática	Elevação de Transaminases (ASL) > 40 U/L
Insuficiência renal	Elevação da creatinina sérica > 1,0 mg/dL
Edema pulmonar	Dispneia, sibilos, palidez, sudorese fria, cianose das extremidades, ansiedade, confusão mental, secreções pulmonares rosadas...
Sinal e/ou sintoma de lesão de órgão-alvo	Dor de cabeça e escotomas e epigastralgia (eclâmpsia iminente)
affected fetal compartment	Placental Insufficiency / Fetal Growth Restriction

Source: Peraçoli JC, Costa ML, Cavalli RC, de Oliveira LG, Korkes HA, Ramos JG, et al. Preeclampsia – Protocol 03. Brazilian Network of Studies on Hypertension in Pregnancy; 2023. Chart 1, Recommended clinical risk factors for the identification of pregnant women in need of prevention; p. 20. Available at: <https://rbehg.com.br/wp-content/uploads/2023/04/PROTOCOLO-2023.pdf>.

After the diagnosis of preeclampsia, hospitalization of the pregnant woman is recommended for careful monitoring of the mother and baby (Peraçoli et. al. 2023).



Regarding the care of the mother, it is essential to perform regular exams to evaluate possible systemic complications. The PIERS calculator can be used to help monitor the risk of maternal adverse events over the next 48 hours. Tests such as transaminases, platelet counts, creatinine, among others, are crucial to determine the severity of the case (Von Dadelszen et. al. 2011). In addition, it is essential to strictly control blood pressure, initiating the use of antihypertensive medications to keep pressure below 140 x 90 mmHg, and to consider the administration of magnesium sulfate, especially if there is clinical or laboratory worsening (Peraçoli et. al. 2023).

As for fetal care, it is important to perform vitality tests such as cardiotocography, fetal biophysical profile and Doppler velocimetry. In pregnancies less than 34 weeks, fetal lung maturation should be assessed and magnesium sulfate should be considered for brain protection in fetuses at risk of birth before 32 weeks.

## TREATMENT

In this scenario, the use of antioxidant substances, such as vitamins C and E, has been indicated as a possible alternative for the prevention of Gestational Hypertensive Syndromes (GHS). However, it is important to note, as emphasized by the World Health Organization (WHO) guidelines, that the only definitive therapeutic approach for preeclampsia is the interruption of pregnancy, although there are cases in which the condition can worsen in the postpartum period.

As preventive measures, the importance of early identification and follow-up of pregnant women with hypertension through prenatal care is highlighted. The use of low doses of aspirin is recognized to reduce the risk of preeclampsia by 10 to 20% and decrease the chances of prematurity and intrauterine growth restriction (IUGR). It is recommended to start administration as early as possible, ideally between 12 and 16 weeks of gestation, in women with risk factors. In populations with low serum calcium concentration, intake of 1500 mg to 2000 mg has been shown to reduce the risk of severe preeclampsia, although its effect on overall risk is limited. As for folic acid, its role in the prevention of preeclampsia remains uncertain, but it is recognized as important in the prevention of neural tube defects (SHAH; GUPTA, 2019).

Several agents can be used to lower blood pressure, including hydralazine, calcium channel blockers, methyldopa, diazoxide, prostacyclin, and magnesium sulfate. Among the most common, intravenous hydralazine, intravenous labetalol, and calcium channel blockers stand out. Hydralazine may lose preference due to its adverse effects compared to calcium channel blockers. For cases of non-severe hypertension, the agents of choice are methyldopa, labetalol, and nifedipine. Angiotensin-converting enzyme inhibitors and angiotensin receptor blockers have been contraindicated due to association with oligohydramnios, intrauterine growth restriction (IUGR), and renal anomalies, as



well as other congenital malformations when women are exposed during the second or third trimester of pregnancy (BRAUNTHAL; BRATEANU, 2019).

There are disagreements regarding the appropriate time to start therapy. Most guidelines indicate that treatment should be initiated only when blood pressure reaches values greater than 150x100 mmHg, while others recommend intervention only when blood pressure levels exceed 160x110 mmHg (BRAUNTHAL; BRATEANU, 2019).

## USING THE 4P RULE TO TREAT PREECLAMPSIA

Hypertensive syndromes, along with hemorrhagic and infectious syndromes, known as the "Cursed Triad of Obstetrics," are unfortunately still responsible for the majority of maternal deaths worldwide (Brown et. al., 2018; UNICEF, 2019). In low- and middle-income countries, such as Brazil, most maternal deaths are associated with hypertensive complications, with preeclampsia being the main cause of maternal mortality and morbidity (Peraçoli et. al., 2023).

A significant proportion of this high maternal mortality due to hypertensive disorders is related to several factors, including the lack of identification of high-risk women, insufficient prevention, difficulties in maintaining adequate prenatal care, late diagnosis, underutilization of magnesium sulfate, late termination of pregnancy, and lack of postpartum follow-up for these high-risk cases (FEBRASGO, 2017).

To address this alarming scenario and reduce mortality rates due to preeclampsia, four main actions are proposed, known as the "4 P Rule": Adequate Prevention, Vigilant Prenatal Care, Timely Delivery, and Safe Postpartum. This simple approach paves the way for a number of important processes and reminders that can help guide the management of preeclampsia.

### First P: Adequate prevention

The best evidence currently available indicates that beneficial interventions are effective in groups at risk for developing preeclampsia. Some of these strategies include the use of low-dose aspirin, calcium supplementation for pregnant women with insufficient intake, regular physical activity during pregnancy, and adequate weight gain control (Peraçoli et. al., 2023; Spradley, Palei, Granger, 2015).

Although these recommendations are widely accepted in the scientific community, adherence to these simple and cost-effective interventions in clinical practice is still low in many places. Guidelines for preventive measures of preeclampsia are based on clinical risk assessment. In this context, for pregnant women identified as at high risk (HIGH risk factor) or moderate risk (two MODERATE risk factors), prophylaxis should be initiated.



Obesity is a prominent factor in this scenario, being a growing global concern due to the increased risk of adverse outcomes (Caballero, 2019). Obesity provokes an intense inflammatory response and may contribute to inadequate vascularization of the placenta due to the high circulation of pro-inflammatory immune cells. The release of pro-inflammatory cytokines (such as TNF- $\alpha$  and IL-6) and other antiangiogenic factors, both from adipose tissue and from the ischemic placenta, can result in maternal hypertension and fetal growth restriction (Spradley, Palei, Granger. 2015; Alston, Redman, Sones. 2022).

## Aspirina

The use of aspirin in the prevention of preeclampsia dates back to 1979, with significant studies by Crandon and Isherwood and a growing literature thereafter. Although its mechanism of action is not completely understood, it is suggested that aspirin may act by mitigating intense endothelial lesions, in addition to influencing platelet aggregation and activation, possibly explaining its preventive effect on preeclampsia (Peraçoli et. al., 2021).

A major 2007 systematic review showed that the use of low-dose aspirin reduced the risk of preeclampsia by 17% (RR 0.83, 95% CI 0.77-0.89) (13). A subsequent meta-analysis in 2017 corroborated these findings, indicating a reduction in the relative risk of severe preeclampsia when aspirin was started before the 16th week of gestation (RR 0.47, CI 0.26-0.83), as well as a decrease in fetal growth restriction (RR 0.56, CI 0.44-0.70) (Roberge et. al., 2017).

Currently, there is consensus on the significant benefits of aspirin not only in preventing preeclampsia, but also in reducing the incidence of preterm births and perinatal mortality (Peraçoli et. al., 2021; Duley et. al., 2019). It is recommended to start aspirin early in high-risk pregnant women to optimize its protective effects (Roberge et. al., 2017). However, challenges persist in resource-limited areas where access to antenatal care is often delayed, making it difficult to implement this preventive measure.

There are discussions about the ideal dosage of aspirin, varying in the literature. While some studies suggest that doses higher than 100 mg may be more effective, safety concerns lead certain groups and clinical societies to recommend lower doses (Peraçoli et. al., 2023; Peraçoli et. al., 2021; ACOG 2020). In Brazil, the dose available in the Public Health system is 100 mg, in line with national guidelines (Peraçoli et. al., 2023; Korke et. al. 2018).

## Calcium

There is a significant prevalence of nutritional deficiencies worldwide, especially related to micronutrients. The minimum recommended intake of calcium for pregnant women is approximately



1000mg per day. In many countries in the southern hemisphere, however, the average intake ranges between 400 and 500mg daily (Balk et. al. 2017).

Calcium supplementation increases the systemic availability of the calcium ion, reducing the need for its intracellular mobilization. This helps prevent contraction of arteriolar smooth muscle, contributing to the regulation of blood pressure levels (Peraçoli et. al. 2020; Hofmeyr et. al. 2018).

A major Cochrane review compared different regimens of calcium supplementation ( $\geq 1$  g/day and  $< 1$  g/day), looking at 27 studies with 18,064 women. It was concluded that high doses of calcium supplementation ( $\geq 1$  g/day) may reduce the risk of preeclampsia and preterm birth, especially in women with low calcium intake (Hofmeyr et. al. 2018). Currently, many protocols recommend calcium supplementation for pregnant women at risk of preeclampsia and low calcium intake, usually above 1.0 grams per day (Peraçoli et. al. 2023; ACOG 2020; NICE, 2019). The World Health Organization suggests slightly higher doses, between 1.5 and 2.0 grams daily (WHO, 2018).

For better absorption, all forms of calcium supplements are preferably taken in smaller doses (500 mg), ideally during meals. Calcium citrate stands out for being absorbed effectively even outside of meals, and is recommended for patients with low stomach acidity, inflammatory bowel disease, or absorption problems (MAYO, 2022).

## Physical activity

Physical activity is defined as planned, structured, and repetitive body movements, with the aim of improving one or more components of physical fitness, being an essential part of life. During pregnancy and after childbirth, exercise is considered to be beneficial for most patients (ACOG, 2020).

Randomized controlled trials conducted in recent decades have shown that physical activity is effective in preventing preeclampsia. Regular exercise during pregnancy reduces the risk of gestational hypertension by 39% (OR 0.61, 95% CI 0.43, 0.85) and preeclampsia by about 41% (OR 0.59, 95% CI 0.37, 0.90) (Davenport et. al. 2018; Mottola et. al. 2018).

Currently, it is recommended that all pregnant women, especially those at risk of diabetes and hypertension, practice physical activity for 140 minutes a week. Examples of moderately intense exercise include walking, water aerobics, stationary bike, weight training, in addition to daily activities such as gardening. To ensure that the activity is not excessive, a safety criterion is that the pregnant woman is able to hold a conversation during exercise. However, women with contraindications to physical activity, such as those with diagnosed preeclampsia or uncontrolled high blood pressure, should be discouraged from following this recommendation (ACOG, 2020).





## Second P: Prenatal care

Thorough prenatal care with timely interventions, based on the best available evidence, is essential for the screening of various complications during pregnancy. This approach can also contribute significantly to disease prevention, either through the use of appropriate medications or through educational guidance.

In the case of hypertensive syndromes, careful prenatal care is crucial to identify preeclampsia early in patients presenting with suggestive signs and symptoms. This provides a vital opportunity for early diagnosis and rapid referral for specialist treatment.

During antenatal visits, the health team, often composed of doctors, nurses and other health professionals, performs various interventions, including regular blood pressure monitoring. In this context, it is important to highlight the persistence of incorrect and routine practices that are still frequently observed.

### Blood Pressure Measurement (ABPM)

Blood pressure measurement (ABPM) should follow correct techniques for an accurate diagnosis of hypertension, including the use of appropriate cuffs or correction tables (Korks et. al. 2018). The procedure recommends that the patient be seated, with their feet flat on the floor and their back and arms supported. The device should be placed on the upper limb, keeping it at the level of the heart (Myers et. al. 2022; Flack, Calhoun, Schiffrin. 2018). Diastolic pressure (DBP) is determined by the 5th Korotkoff sound, which corresponds to the disappearance of the pulsating sound (Barroso et. al. 2020).

It is essential to emphasize that the left lateral position (LEP) is used for the patient's rest, but for blood pressure measurement, the patient should preferably be seated. The use of the left lateral position (LEP), often recommended for pregnant women, can provide false information about the actual pressure, making it difficult to properly manage the case, and should not be adopted (Myers et. al. 2022; ACOG, 2019). Likewise, it is recommended to use cuffs suitable for different arm circumferences. When this is not possible, it is suggested to use correction tables such as that of Maxwell (1982).

Currently, the use of validated electronic devices has facilitated the monitoring of home blood pressure (HMPA), being an important tool for prenatal physicians in controlling pressure, as long as the devices are validated (Flack, Calhoun, Schiffrin. 2018; ACOG, 2019).

In the context of the third point, "Timely Delivery", facing preeclampsia is a significant challenge for the patients involved. It is known that ending a pregnancy is the definitive solution in cases of life-threatening associated with this condition. However, it is crucial to observe several aspects during this process. In severe situations of preeclampsia or deterioration of maternal health,



delivery should be performed only after the mother has stabilized. Tight blood pressure control and administration of magnesium sulfate are essential components of treatment, especially when eclampsia is imminent or confirmed. Evaluating recent laboratory tests or ordering new tests is crucial to identifying any acute change in the condition.

### **Third P: Timely delivery**

In the context of the third point, "Timely Delivery", facing preeclampsia is a significant challenge for the patients involved. It is known that ending a pregnancy is the definitive solution in cases of life-threatening associated with this condition. However, it is crucial to observe several aspects during this process. In severe situations of preeclampsia or deterioration of maternal health, delivery should be performed only after the mother has stabilized. Tight blood pressure control and administration of magnesium sulfate are essential components of treatment, especially when eclampsia is imminent or confirmed. Evaluating recent laboratory tests or ordering new tests is crucial to identifying any acute change in the condition.

Regarding the method of delivery, unless there is an immediate need for intervention, vaginal delivery is usually preferred. Therefore, cervical preparation followed by induction of labor is recommended as a first option (Peraçoli et. al. 2023; NICE, 2019).

Regarding the timing to terminate pregnancy, women who reach 37 weeks should be referred for delivery (Peraçoli et. al. 2023; ACOG, 2020; NICE, 2019). For pregnant women between 23 and 37 weeks with stable maternal-fetal conditions, careful monitoring is appropriate, with continuous assessment of fetal well-being. In pregnancies less than 23 weeks, due to high maternal risks and limited fetal viability, it is crucial that parents are informed of potential severe outcomes in order to make informed decisions about appropriate management (Peraçoli et. al. 2023).

In scenarios involving fetal viability, where the availability of neonatal intensive care is a critical factor, the pediatric team must actively participate in decisions. Fetal viability criteria are under constant review, and a multidisciplinary approach, including patients, family members, obstetricians, and neonatologists, is essential for well-informed and compassionate decisions.

### **Room Q: Safe postpartum**

After immediate delivery and in the subsequent days, it is essential that the medical team maintains continuous vigilance and is on the lookout for possible complications. Blood pressure monitoring is a priority and should be performed every four hours or more frequently as needed for each patient. It is recommended not to abruptly interrupt antihypertensive medication after delivery, even in cases of hypotension secondary to anesthetic procedures. For patients who received magnesium sulfate during delivery, continuation of this medication for 24 hours is indicated.



There are significant concerns regarding the use of potentially unsafe medications during this period, such as nonsteroidal anti-inflammatory drugs, which should be avoided due to the known risk of impaired renal function, especially in postpartum hypertensive patients with significant renal impairment, associated with blood loss during delivery or complications of preeclampsia (Peraçoli et. al. 2023; ACOG, 2019). Similarly, lactation-suppressing medications such as bromoergocriptine and cabergoline should be avoided due to the increased risk of cerebrovascular adverse events (Peraçoli et. al. 2023).

The medical team must be alert to possible clinical or laboratory deterioration. Therefore, laboratory reassessment is recommended after 24 and 48 hours of delivery, followed by new tests as necessary for each case (ACOG, 2018). It is advisable that the patient remain monitored in the hospital environment for at least 72 hours, as it is known that circulation and reabsorption of fluids into the intravascular compartment often normalize between the third and fifth days postpartum, which can raise blood pressure, cause symptoms, and increase the risk of complications (Peraçoli et. al. 2023). Therefore, early hospital discharge (before day three) for these patients is discouraged due to increased risk.

It is also relevant during this period to provide guidance on family planning to patients, discussing safe and effective contraceptive methods. The availability of long-acting methods, such as subdermal implants and intrauterine devices (IUDs), as well as the option of intraoperative tubal ligation, are fundamental strategies for promoting public health (Cameron 2014; Tang et. al. 2014). In addition, it is crucial to guide the woman and her family about the possible future consequences, explaining the seriousness of the situation.

### **Long-term follow-up of women who developed preeclampsia**

In the past, preeclampsia was seen as a hypertensive condition that was limited to pregnancy, with the expectation that hypertension would be cured after childbirth with the removal of the placenta. Beginning in the 1990s, studies began to indicate that hypertensive disorders during pregnancy, especially preeclampsia, increase a woman's lifetime risk of cardiovascular disease (Bellamy L, Casas, Hingorani, Williams, 2007).

In 2018, ACOG published guidelines recommending extended follow-up that goes beyond the six-week postpartum visit (Von Dadelszen et. al. 2011). Currently, pregnant women with hypertension are advised to postpone hospital discharge for more than 72 hours and schedule a follow-up visit within 10 days (Peraçoli et. al. 2023).

The ISSHP, in 2018 and later in 2022, also emphasized the importance of rigorous and continuous follow-up for pregnant women who developed preeclampsia, with clear guidance on future risks and recommending lifelong medical follow-up of these patients (Brown et. al. 2018).



## METHODOLOGY

The methodology is based on a narrative literature review. In which a survey of articles was carried out in the following databases: bibliographic Medline (interface with Virtual Health Library/VHL and PubMed) and in the Lilacs (interface with VHL) and Scielo Brazil portals. The articles used covered a period from 2014 to 2023.

For the selection of articles, descriptors in English and Portuguese of the following terms were used: gestational hypertensive syndrome, pathophysiology, prevention and treatment. It is worth noting that all these terms were used in the databases and that they are part of the DeCS (2021) health science descriptors. The survey was carried out from January to June 2024.

This study included articles that use the cross-sectional methodology, studies that reported prevalence, incidence, and mortality rates, articles in English, and full text available in the research databases mentioned above.

Articles that did not fit the aforementioned descriptors and that did not address the topic under review were excluded from the search.

## RESULTS AND DISCUSSIONS

Gestational Hypertensive Syndromes (GHS) comprise several conditions related to elevated blood pressure during pregnancy, including gestational hypertension, preeclampsia, eclampsia, and chronic hypertension with overlapping preeclampsia (Dines & Kattah, 2020). Gestational hypertension, the most prevalent form, occurs after 20 weeks of gestation, without proteinuria or end-organ dysfunction, and persists until 12 weeks after delivery. On the other hand, preeclampsia is characterized by an increase in blood pressure after 20 weeks, with significant proteinuria or target-organ dysfunction, and may manifest before this period in specific cases, such as gestational trophoblastic disease (Oliveira et al., 2016).

An accurate understanding of the different forms of GHS is essential for early diagnosis, appropriate clinical management, and prevention of serious complications for both the mother and fetus. Therefore, early identification of symptoms, accompanied by a thorough clinical evaluation, is crucial to ensure a favorable outcome during pregnancy and delivery.

In addition to the immediate impact, preeclampsia also poses a significant long-term health risk to both women and their children. Women who have had pregnancies affected by preeclampsia have a higher risk of developing metabolic syndromes, cardiovascular disease, and hypertension early in their lives. Several risk factors are associated with preeclampsia, including lack of experience in pregnancy, previous history of the condition, family history, presence of chronic diseases such as hypertension and diabetes, obesity, twin pregnancies, and gestational trophoblastic diseases.



The global incidence of preeclampsia is on the rise, attributed to maternal aging, obesity, assisted reproductive techniques, and prevalence of preexisting medical conditions such as diabetes and hypertension (Townsend, 2016). Studies, such as one conducted in Norway, point to a significant increased risk of preeclampsia in multiple pregnancies, but not in gestational hypertension compared to singleton pregnancies (Laine et al., 2019). Associated complications include hemorrhagic stroke, acute pulmonary edema, and liver dysfunctions, with the potential for maternal death, in addition to adversely affecting the fetus with IUGR, SGA, and prematurity (Kintiraki et al., 2015).

The pathophysiology of gestational hypertensive syndromes, although partially understood, involves abnormalities in placental implantation, genetic predisposition, and immunological intolerance between maternal and fetus-placental tissues (Kintiraki et al., 2015). In addition, dopamine-influenced oxidative stress and endothelial dysfunction play crucial roles, highlighting the complexity of these conditions (Phoswa, 2019). In placentas intended for preeclampsia, the cytotrophoblast fails to properly remodel vascular, resulting in relative placental ischemia and release of inflammatory factors that contribute to hypertension and coagulation disorders.

As for the treatment of gestational hypertensive syndromes, although antioxidant measures such as vitamins C and E have been suggested for prevention, termination of pregnancy remains the definitive therapeutic approach, especially in severe cases (Shah & Gupta, 2019). Early prenatal care and the use of low doses of aspirin are recommended as preventive measures, along with calcium and folic acid intake to reduce the risk.

In addition, preeclampsia, a hypertensive condition that occurs during pregnancy, is a leading cause of maternal mortality and morbidity, especially in low- and middle-income countries. This problem is often related to the lack of identification of high-risk women, inadequate prevention, difficulties in prenatal care, late diagnosis, insufficient use of magnesium sulfate, late termination of pregnancy, and lack of postpartum follow-up. In order to reduce maternal mortality caused by preeclampsia, the authors propose the "4 Ps Rule" that includes Adequate Prevention, Vigilant Prenatal Care, Timely Delivery, and Safe Postpartum.

To prevent preeclampsia, evidence-based interventions are essential. Among these interventions are the use of low-dose aspirin, calcium supplementation for pregnant women with low intake of this mineral, and the practice of regular physical activity during pregnancy. However, despite being well-established recommendations, adherence to these preventive practices is still low in many regions. Prevention of preeclampsia should be tailored to the individual clinical risks of each pregnant woman, with measures such as aspirin before 16 weeks' gestation when possible.

Aspirin is widely recommended for high-risk women because of its effect on reducing perinatal mortality and preterm birth. Calcium supplementation is equally important, especially in populations with insufficient dietary intake. Studies show that calcium supplementation in doses



above 1 gram per day can significantly decrease the risk of preeclampsia and preterm birth.

Close antenatal care is crucial for early detection and effective management of preeclampsia. This includes regular blood pressure measurement, monitoring weight gain, and performing laboratory tests such as creatinine and platelet measurements. In cases of clinical suspicion of preeclampsia, the use of magnesium sulfate is recommended to prevent hypertensive crises and eclampsia. It is essential that high-risk pregnant women are hospitalized for continued surveillance and safe management of the condition.

The timing of delivery is a critical factor in the management of preeclampsia. For pregnant women with stable clinical conditions, delivery should be planned for after 37 weeks of gestation. However, in cases of clinical instability, it may be necessary to anticipate delivery by using corticosteroids to promote fetal lung maturation if delivery occurs before 34 weeks. Intensive fetal surveillance through doppler velocimetry, biophysical profile, and cardiotocography is essential to ensure the safety of both mother and fetus.

Postpartum follow-up is essential to prevent future complications in women who have suffered from preeclampsia. This period should include continuous monitoring of blood pressure and other medical conditions. Hospital discharge should not be early, and the patient's stay for at least 72 hours after delivery should be considered for surveillance and stabilization. Guidance on contraceptive methods is also crucial for planning future pregnancies and preventing recurrence of preeclampsia.

## CONCLUSION

This review on preeclampsia provided a comprehensive analysis of the factors that may influence the onset of this condition, prevention strategies, existing public policies to combat it, and the challenges associated with this complex condition. Preeclampsia continues to be a leading cause of maternal mortality and morbidity, especially in low- and middle-income countries, which highlights the importance of preventive measures and close follow-up during pregnancy.

The relevance of evidence-based interventions, such as the use of low-dose aspirin and calcium supplementation, to prevent preeclampsia is highlighted, demonstrating the importance of adequate prevention adapted to the individual risks of each pregnant woman. Vigilant antenatal follow-up, with regular blood pressure monitoring and other laboratory measurements, is essential for early detection and effective management of the condition, including the use of magnesium sulfate to prevent hypertensive crises and eclampsia.

However, some significant challenges persist in low- and middle-developed nations, where access to health services is unequal and resources and infrastructure are limited. To address these obstacles and lessen the global impact of preeclampsia, it is imperative to adopt integrated



approaches that include timely delivery and safe postpartum care. Postpartum follow-up should include continuous blood pressure monitoring and guidance on contraceptive methods for planning future pregnancies and preventing recurrence.

In addition, the implementation of the "4 Ps Rule" is a comprehensive and effective approach to reducing maternal mortality associated with preeclampsia. Adequate prevention, vigilant prenatal care, timely delivery, and safe postpartum care are essential pillars that, when well executed, can save lives and significantly improve maternal and newborn outcomes.

The study therefore reiterates the importance of comprehensive, evidence-based strategies to address the challenge of preeclampsia, aiming not only at reducing maternal mortality, but also at promoting equity in access to health care. These measures are essential to achieve the goal of reducing maternal mortality associated with preeclampsia and improving maternal and neonatal outcomes globally.



## REFERENCES

1. ACOG Committee Opinion, Number 222: gestational hypertension and preeclampsia. (2020). \*Obstetrics & Gynecology, 135\*(6). <https://doi.org/10.1097/AOG.0000000000003891>
2. ACOG Committee Opinion No. 736: optimizing postpartum care. (2018). \*Obstetrics & Gynecology, 131\*(5). <https://doi.org/10.1097/AOG.0000000000002633>
3. ACOG Practice Bulletin No. 202 Summary: gestational hypertension and preeclampsia. (2019). \*Obstetrics & Gynecology, 133\*(1), 1. <https://doi.org/10.1097/AOG.0000000000003019>
4. ACOG Practice Bulletin, Number 222: gestational hypertension and preeclampsia. (2020). \*Obstetrics & Gynecology, 135\*(6). <https://doi.org/10.1097/AOG.0000000000003891>
5. Balk, E. M., Adam, G. P., Langberg, V. N., Earley, A., Clark, P., Ebeling, P. R., et al. (2017). Global dietary calcium intake among adults: a systematic review. \*Osteoporosis International, 28\*(12), 3315-3324. <https://doi.org/10.1007/s00198-017-4230-x>
6. Barroso, W. K., Rodrigues, C. I., Bortolotto, L. A., Mota-Gomes, M. A., Brandão, A. A., Feitosa, A. D., et al. (2021). Brazilian guidelines of hypertension - 2020. \*Arquivos Brasileiros de Cardiologia, 116\*(3), 516-658. <https://doi.org/10.36660/abc.20201238>
7. Braunthal, S., & Brateanu, A. (2019). Hypertension in pregnancy: Pathophysiology and treatment. \*SAGE Open Medicine, 7\*, April 2019.
8. Brown, M. A., Magee, L. A., Kenny, L. C., Karumanchi, S. A., McCarthy, F. P., Saito, S., et al. (2018). Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice. \*Hypertension, 72\*(1), 24-43. <https://doi.org/10.1161/HYPERTENSIONAHA.117.10803>
9. Caballero, B. (2019). Humans against obesity: who will win? \*Advances in Nutrition, 10\* Suppl 1. <https://doi.org/10.1093/advances/nmy055>
10. Chesley, L. C. (2014). History and epidemiology of preeclampsia-eclampsia. \*Clinical Obstetrics & Gynecology, 27\*(4), 801-820.
11. Comissão Permanente de Protocolos de Atenção à Saúde da SES-DF (CPPAS). (2018). Manejo da Hipertensão Arterial Sistêmica e Diabetes Mellitus na Atenção Primária à Saúde. Portaria SES-DF N° 161 de 21 de fevereiro de 2018, publicada no DODF N° 37 de 23.02.2018.
12. Derham, R. J., et al. (1989). Outcome of pregnancies complicated by severe hypertension and delivered before 34 weeks; stepwise logistic regression analysis of prognostic factors. \*BJOG: An International Journal of Obstetrics & Gynaecology, 96\*(10), 1173-1181.
13. Dinnes, V., & Kattah, A. (2020). Hypertensive disorders of pregnancy. \*Advances in Chronic Kidney Disease, 27\*(6), 531-538, November 2020.
14. Duley, L., Henderson-Smart, D. J., Meher, S., & King, J. F. (2007). Antiplatelet agents for preventing preeclampsia and its complications. \*Cochrane Database of Systematic Reviews, 2007\*(2). <https://doi.org/10.1002/14651858.CD004659.pub2>





15. Duley, L., Meher, S., Hunter, K. E., Seidler, A. L., & Askie, L. M. (2019). Antiplatelet agents for preventing pre-eclampsia and its complications. \*Cochrane Database of Systematic Reviews, 2019\*(10). <https://doi.org/10.1002/14651858.CD004659.pub3>
16. Duley, L., Meher, S., Hunter, K., & Askie, L. (2017). Antiplatelet therapy before or after 16 weeks' gestation for preventing preeclampsia: an individual participant data meta-analysis. \*American Journal of Obstetrics & Gynecology, 216\*(2), 121-128.e2. <https://doi.org/10.1016/j.ajog.2016.10.016>
17. Fitzgerald, D. E., & Drumm, J. E. (1977). Non-invasive measurement of human fetal circulation using ultrasound: a new method. \*British Medical Journal, 2\*(6100), 1450-1451.
18. Flack, J. M., Calhoun, D., & Schiffrin, E. L. (2018). The New ACC/AHA Hypertension Guidelines for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults. \*American Journal of Hypertension, 31\*(2), 133-135. <https://doi.org/10.1093/ajh/hpx207>
19. Gernand, A. D., Schulze, K. J., Stewart, C. P., West, K. P. Jr., & Christian, P. (2016). Micronutrient deficiencies in pregnancy worldwide: health effects and prevention. \*Nature Reviews Endocrinology, 12\*(5), 274-289. <https://doi.org/10.1038/nrendo.2016.37>
20. Hofmeyr, G. J., Lawrie, T. A., Atallah, Á. N., & Torloni, M. R. (2018). Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. \*Cochrane Database of Systematic Reviews, 2018\*(10). <https://doi.org/10.1002/14651858.CD001059.pub5>
21. Kahhale, S., & Zugaib, M. (1995). Resultados perinatais. In S. Kahhale & S. Zugaib (Eds.), \*Síndromes hipertensivas na gravidez\* (pp. 323-330). São Paulo: Atheneu.
22. Kintiraki, E., et al. (2015). Pregnancy-induced hypertension. \*Hormones (Athens), 14\*(2), April-June.
23. Laine, K., et al. (2019). Prevalência e risco de pré-eclâmpsia e hipertensão gestacional em gestações gemelares: um estudo de registro de base populacional. \*BMJ Open, 9\*(7), June 2019.
24. Lima, J. P., et al. (2018). Perfil socioeconômico e clínico de gestantes com Síndrome Hipertensiva Gestacional. \*Revista da Rede de Enfermagem do Nordeste, 19\*(3455), 1-7.
25. Magee, L. A., Brown, M. A., Hall, D. R., Gupte, S., Hennessy, A., Karumanchi, S. A., et al. (2022). The 2021 International Society for the Study of Hypertension in Pregnancy classification, diagnosis & management recommendations for international practice. \*Pregnancy Hypertension, 27\*, 148-169. <https://doi.org/10.1016/j.preghy.2021.09.008>
26. Mayo Clinic. (2022). Calcium and calcium supplements: achieving the right balance. Available from: <https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/calcium-supplements/art-20047097>. Accessed May 30, 2022.
27. Maxwell, M. H., Waks, A. U., Schroth, P. C., Karam, M., & Dornfeld, L. P. (1982). Error in blood-pressure measurement due to incorrect cuff size in obese patients. \*Lancet, 2\*(8288), 33-36. [https://doi.org/10.1016/s0140-6736\(82\)91163-1](https://doi.org/10.1016/s0140-6736(82)91163-1)
28. Mottola, M. F., Davenport, M. H., Ruchat, S. M., Davies, G. A., Poitras, V., Gray, C., et al. (2018). No. 367-2019 Canadian Guideline for Physical Activity throughout Pregnancy. \*Journal of Obstetrics and Gynaecology Canada, 40\*(11), 1528-1537. <https://doi.org/10.1016/j.jogc.2018.07.001>




29. Murali, S., Miller, K., & McDermott, M. P. (2020). Preeclampsia, eclampsia, and posterior encephalopathy syndrome. *\*Handbook of Clinical Neurology, 172\**, 63-77.
30. Myers, M. C., Brandt, D. S., Prunty, A., Gilbertson-White, S., Sanborn, A., Santillan, M. K., et al. (2022). Effect of positioning on blood pressure measurement in pregnancy. *\*Pregnancy Hypertension, 27\**, 110-114. <https://doi.org/10.1016/j.preghy.2021.12.013>
31. National Institute for Health and Care Excellence. (2019). Hypertension in pregnancy: diagnosis and management. London: NICE. Available from: <https://www.nice.org.uk/guidance/ng133/resources/hypertension-in-pregnancy-diagnosis-and-management-pdf-66141717671365>. Accessed June 12, 2022.
32. Neto, H. C., & Sá, R. A. M. (2007). *\*Obstetrícia Básica\** (2nd ed.). São Paulo: Atheneu.
33. Oliveira, C. A., et al. (2016). Síndromes hipertensivas da gestação e repercussões perinatais. *\*Revista Brasileira de Saúde Materno Infantil, 6\**(1), 93-98.
34. Oliveira, L. G., et al. (2016). Síndromes hipertensivas da gestação e repercussões perinatais. *\*Revista Brasileira de Saúde Materno Infantil, 6\**(1), 93-98.
35. Organização Mundial da Saúde. (2011). Recomendações da OMS para prevenção e tratamento da pré-eclâmpsia e eclâmpsia.
36. Pascoal, I. F. (2002). Hipertensão e gravidez. *\*Revista Brasileira de Hipertensão, 9\**(3), 256-261.
37. Peraçoli, J. C., Costa, M. L., Cavalli, R. C., de Oliveira, L. G., Korkes, H. A., Ramos, J. G., et al. (2023). Preeclampsia – Protocolo 03. Rede Brasileira de Estudos sobre Hipertensão na Gravidez. Available from: <https://rbehg.com.br/wp-content/uploads/2023/04/PROTOCOLO-2023.pdf>.
38. Peraçoli, J. C., De Sousa, F. L., Korkes, H. A., Mesquita, M. R., Cavalli, R. C., & Borges, V. T. (2021). Atualização em preeclampsia: predição e prevenção: Recomendações SOGESP. Available from: <https://www.sogesp.com.br/recomendacoes-sogesp/tema2021/2021-tema-02/>.
39. Phoswa, W. N. (2019). Dopamine in the Pathophysiology of Preeclampsia and Gestational Hypertension: Monoamine Oxidase (MAO) and Catechol-O-methyl Transferase (COMT) as Possible Mechanisms. *\*Oxidative Medicine and Cellular Longevity\**, November 2019.
40. Rana, S., et al. (2019). Preeclampsia: Pathophysiology, Challenges, and Perspectives. *\*Circulation Research, 127\**(7), 1094-1112.
41. Roberge, S., Bujold, E., & Nicolaides, K. H. (2018). Aspirin for the prevention of preterm and term preeclampsia: systematic review and metaanalysis. *\*American Journal of Obstetrics & Gynecology, 218\**(3), 287-293.e1. <https://doi.org/10.1016/j.ajog.2017.11.561>
42. Roberge, S., Nicolaides, K., Demers, S., Hyett, J., Chaillet, N., & Bujold, E. (2017). The role of aspirin dose on the prevention of preeclampsia and fetal growth restriction: systematic review and meta-analysis. *\*American Journal of Obstetrics & Gynecology, 216\**(2), 110-120.e6. <https://doi.org/10.1016/j.ajog.2016.09.076>
43. Shah, S., & Gupta, A. (2019). Hypertensive Disorders of Pregnancy. *\*Cardiology Clinics, 37\**(3), 345-354.



44. Silva, L. M., et al. (2008). Maternal educational level and risk of gestational hypertension: the Generation R Study. *\*Journal of Human Hypertension, 22\*(7)*.
45. Townsend, R., O'Brien, P., & Khalil, A. (2016). Current best practice in the management of hypertensive disorders in pregnancy. *\*Integrated Blood Pressure Control\**, 79-94.
46. Vega, C. E. P., Kahaale, S., & Zugaib, M. (2007). Maternal mortality due to arterial hypertension in São Paulo City (1995-1999). *\*Clinics, 62\**, 679-684.
47. Watanabe, M., et al. (2020). Gestational Hypertension as Risk Factor of Hypertension in Middle-Aged and Older Women. *\*International Journal of Environmental Research and Public Health, 17\*(11)*, 4052.
48. WHO recommendation: calcium supplementation during pregnancy for the prevention of preeclampsia and its complications. Geneva: WHO; 2018. Available from: <https://apps.who.int/iris/bitstream/handle/10665/277235/9789241550451-eng.pdf>
49. Wu, C. S., et al. (2009). Health of children born to mothers who had preeclampsia: a population-based cohort study. *\*American Journal of Obstetrics & Gynecology, 201\*(3)*, 269.e1-269.e10.
50. Zugaib, M., et al. (2000). In: *Vitalidade fetal – propedêutica e avaliação*. São Paulo: Atheneu. Cap. 6, p. 29-39: Princípios básicos de dopplervelocimetria.
51. Zugaib, M., & Francisco, R. P. V. (2019). *\*Zugaib Obstetrícia\** (4ª ed.). São Paulo: Manole.

## Analysis of the prevalence and impact of burnout in university professors

 <https://doi.org/10.56238/sevned2024.016-013>

Maria Nascimento Cunha<sup>1</sup> and Sílvia Costa Pinto<sup>2</sup>

### ABSTRACT

In order to explore the prevalence and factors associated with burnout in university professors and for a detailed assessment of the main and secondary symptoms of burnout, including exhaustion, mental distance, inability to control cognitive and emotional, psychological distress and psychosomatic complaints, we chose to use the BAT - Burnout Assessment Tool.

The results indicate a significant prevalence of burnout among teachers, with emotional exhaustion being the most affected dimension, also highlighting the influence of factors such as workload and intense emotional demands.

The findings underline the need for institutional interventions and management policies to mitigate burnout and promote well-being in the academic environment. This work contributes to the understanding of burnout in higher educational contexts, suggesting future directions for institutional research and practice.

**Keywords:** Burnout, University professors, BAT - Burnout Assessment Tool.

---

<sup>1</sup> Lusofona University, Intrepid Lab, Porto, Portugal

E-mail: maria14276@gmail.com

ORCID: 0000-0002-1291-231X

<sup>2</sup> Fernando Pessoa University

E-mail: 42833@ufp.edu.pt

ORCID: 0000-0002-0606-8255



## INTRODUCTION

### PROFESSIONAL BURNOUT

Burnout is a state of emotional, physical and mental exhaustion caused by prolonged stress or frustration. It is characterized by three main dimensions: emotional exhaustion, where individuals feel drained and unable to recharge their energies, depersonalization, which involves a cynical detachment from work responsibilities and a negative attitude towards colleagues, clients or students, and reduced personal fulfillment, where professionals perceive their contribution to work as insufficient, ineffective or not recognized (Milic et al., 2020). This condition not only affects the mental and physical health of the individual, but can also decrease effectiveness at work, leading to negative consequences for both workers and organizations. Burnout is particularly prevalent in professions with high emotional and interactional needs, such as teaching.

Recent research, such as that carried out by Milic et al. (2020), Pereira, Gonçalves and Assis (2021), Marrinhas et al. (2023), Angelini et al. (2021) and Teles et al. (2020), provide a comprehensive view on the prevalence and impacts of burnout on academics and teachers, underlining the urgent need to address this problem. These studies not only investigate the psychometric properties of instruments such as the Maslach Burnout Inventory or the Burnout Assessment Tool in specific contexts, but also explore the relationships between organizational self-efficacy, self-esteem and burnout, as well as the role of perceived stress and technostress in the well-being of teachers. The introduction of the Burnout Assessment Tool (BAT) by Angelini et al. (2021) and the investigation of the effects of technostress by Marrinhas et al. (2023) during the COVID-19 pandemic represent important advances in the assessment and understanding of this complex phenomenon.

### MEANINGFUL INSIGHTS INTO SPECIFIC DYNAMICS

The research seeks to provide meaningful insights into the specific dynamics of burnout in the academic environment. In this sense, specific Research Questions were defined:

**PII.** What is the prevalence of burnout among university professors in a given period?

**PII.** Are there significant differences in burnout levels between different demographic groups among university professors?

**PIII.** How do burnout symptoms relate to factors such as workload and organizational commitment among university professors?

### INSTRUMENTS

In order to **explore the prevalence and factors associated with burnout in university professors** and for a detailed assessment of the main and secondary symptoms of burnout, including



exhaustion, mental distance, inability to control cognitive and emotional, psychological distress and psychosomatic complaints, we chose to use the BAT - Burnout Assessment Tool.

## ETHICAL OPINION

The researchers opted for quantitative analysis through the application of a questionnaire survey implemented in digital format through the Google Forms platform. The questionnaire survey was submitted to the scrutiny In this way, having obtained the necessary institutional authorizations, we move on to data collection.

## METHOD

The instrument used was the BAT - Burnout Assessment Tool. This instrument consists of 33 items and evaluates main and secondary symptoms of Burnout such as exhaustion, mental distance, inability to control cognitive and emotional, psychological distress and psychosomatic complaints. It was originally developed by Schaufeli et al. (2020) and has been translated and validated for the Portuguese population by Sinval et al. (2022).

The data was collected exclusively through the online questionnaire survey that was published on social media platforms and sent by email, during the period of February and March 2024. It was decided to use a convenience sample, complemented by the "snowball" technique, which represents an effective approach in the field of social and market research, allowing the collection of data in a structured way and the statistical analysis of the information collected.

## DESCRIPTION OF SOCIODEMOGRAPHIC AND PROFESSIONAL CHARACTERISTICS

According to the analysis of Table 1: Gender, the gender distribution in the sample of 39 university teaching respondents shows 17 male respondents (corresponding to 43.6% of the participants) and 22 female respondents (corresponding to 56.4% of the total sample).

Table 1: Gender

		Frequency	Valid percentage	Cumulative percentage
Valid	male	17	43,6	43,6
	female	22	56,4	100,0
	Total	39	100,0	

Source: own

The table indicates that most participants are in the age groups of 40 to 49 years and 50 to 59 years, together representing 69.2% of the sample. The younger and older age groups (less than 20 years and 60 to 69 years) have similar proportions (both with 10.3% of the sample), demonstrating a distribution that is more concentrated in the middle ages.

Table 2: Age Groups

		Frequency	Valid percentage	Cumulative percentage
Valid	< 20 years	3	7,7	7,7
	20-29 years	4	10,3	17,9
	30-39 years	1	2,6	20,5
	40-49 years old	13	33,3	53,8
	50-59 years	14	35,9	89,7
	60-69 years old	4	10,3	100,0
	Total	39	100,0	

Source: own

With regard to the level of education, the percentage of participants with a bachelor's degree (48.7%) and a doctorate (30.8%) together represent 79.5% of the sample, with 20.5% of the participants having a master's degree, indicating a slightly higher proportion of individuals with post-graduate studies (master's and doctorate). These data underline the trend towards a high level of academic training.

Table 3: Education level

		Frequency	Valid percentage	Cumulative percentage
valid	Degree	19	48,7	51,3
	Masters	8	20,5	69,2
	Doctorate	12	30,8	100,0
	Total	39	100,0	

Source: own

Table 4: Marital Status, presents the distribution of marital status among the participants, broken down by "Single", "Married/de facto union", "Divorced/Separated", and "Widowed". In terms of frequency and valid percentage, it is possible to verify that:

1. Single: 11 participants are single, representing 28.2% of the sample.
2. Married/de facto union: 21 participants are married or in a de facto union, representing 53.8% of the sample.
3. Divorced/Separated: 6 participants are divorced or separated, representing 15.4% of the sample.

Widowed: 1 participant is widowed, representing 2.6% of the sample.

Table 4: Marital Status

		Frequency	Valid percentage	Cumulative percentage
Valid	Single	11	28,2	28,2
	Married/De facto partnership	21	53,8	82,1
	Divorced/Separated	6	15,4	97,4
	Widow(er)	1	2,6	100,0
	Total	39	100,0	

Source: own

Table 5 details the distribution of the type of employment contract among the participants of the sample of 39 university professors categorized as "Permanent contract / Effective", "Fixed-term contract / Fixed-term", and "Temporary contract / Green receipts". The table reveals that the vast majority of participants (79.5%) have open-ended contracts or are permanent, indicating job stability for most of the sample. Those with fixed-term or fixed-term contracts form a significant minority (17.9%), while temporary contracts or work with green receipts are very rare among participants (2.6%).

Table 5: Type of Contract

		Frequency	Valid percentage	Cumulative percentage
Valid	Contract of indefinite duration / Effective	31	79,5	79,5
	Fixed-term contract / Fixed-term	7	17,9	97,4
	Temporary Contract / Green Receipts	1	2,6	100,0
	Total	39	100,0	

Source: own

Table 6 shows the distribution with regard to the participants' employment sector, divided into "Public", "Private" and "Public-private". The table shows that the majority of participants work in the public sector (53.8%), followed by a significant proportion in the private sector (41.0%). The public-private category represents the smallest fraction (5.1%).

Table 6: Sector of activity

		Frequency	Valid percentage	Cumulative percentage
Valid	Public	21	53,8	53,8
	Toilet	16	41,0	94,9
	Public-private	2	5,1	100,0
	Total	39	100,0	

Source: own

## PREVALENCE OF BURNOUT IN THE DIFFERENT DIMENSIONS OF BAT

A study of the means of the 4 dimensions that make up the BAT was carried out in order to understand the variables with the highest means. In this way, it was possible to verify that at the level of **Exhaustion**, the variables "At work, I feel mentally exhausted" and "At the end of a working day, I feel mentally exhausted and exhausted" have higher averages (both with an average of 3.33). On the other hand, with regard to the Mental Distance dimension : "At work I don't think much about what I'm doing and I work on autopilot" it has the highest average (2.36). **Cognitive Control Ability**: "Struggle to think clearly" has the highest average, suggesting significant difficulties in this area (2.41). And finally in **Ability in Emotional Control**: "I get irritable when things are not as I want" has the highest average, indicating important emotional difficulties (2.38).



Table 7: Global averages of each BAT dimension

	<b>Average</b>	<b>Interpretation</b>
Exhaustion	3,07	Considerable levels of exhaustion at work
Mental Distance	2,16	Some emotional and cognitive distance from work
Cognitive Control Skills	2,29	Moderate challenges in controlling cognitive processes during work
Ability in Emotional Control	2,13	Moderate challenges in controlling emotions while working

Source: own

As a way to better understand the situation regarding the Burnout of our sample, it also seemed important to interpret the global averages of each dimension, considering that the maximum score in each dimension is 5. Thus, an overall average of 3.07 on the Exhaustion subscale suggests that, on average, participants experience considerable levels of exhaustion at work. An overall average of 2.16 on the Mental Distance subscale indicates that participants, on average, experience a certain emotional and cognitive distance from work. On the other hand, an overall average of 2.29 on the Cognitive Control Ability subscale suggests that participants, on average, face moderate challenges in controlling their cognitive processes during work. An overall average of 2.13 on the Ability in Emotional Control subscale indicates that participants, on average, face moderate challenges in controlling their emotions during work. Based on the averages, it is possible to conclude that the participants have moderate levels of burnout and face considerable challenges in all four dimensions of burnout, with exhaustion being the one that reveals itself most strongly.

### **ANALYSIS OF GLOBAL AVERAGES WITH CUTOFF POINTS**

According to Schaufeli et al. (2019), the cutoff points for the Burnout Assessment Tool (BAT) are organized into three categories, analogous to a traffic light, to indicate the risk of burnout: green (no risk), orange (at risk) and red (high risk). The Burnout Assessment Tool (BAT) uses specific cut-off points to differentiate between individuals at risk of burnout and those with severe burnout. These cut-off points were established based on ROC (Receiver Operational Characteristics) analyses that used samples of healthy employees and employees diagnosed with burnout from countries such as the Netherlands, Belgium, and Finland. The analyses showed good to excellent diagnostic accuracy for the various subscales of the BAT, except for mental distancing, which showed moderate accuracy. Country-specific cut-off values, as well as their specificity and sensitivity, were comparable to those in the all-country pooled sample (Sinval et al. 2022; Schaufeli et al. 2023). These cut-off points are tentative and should be validated by future studies before being applied more widely, especially in countries that were not directly included in the original studies. For Portugal and Brazil, despite having confirmed the original BAT structure and achieved measurement invariance, differentiated cutoff points are not specified directly in the available documents (Sinval et al. 2022; Schaufeli et al. 2023).

Table 8: Cutoff Points

Category	Exhaustion	Mental Distance	Emotional Commitment	Cognitive impairment
Green (Risk-Free)	1.00 – 3.05	1.00 – 2.49	1.00 – 2.09	1.00 – 2.69
Orange (at risk)	3.06 – 3.30	2.50 – 3.09	2.10 – 2.89	2.70 – 3.09
Red (High Risk)	3.31 – 5.00	3.10 – 5.00	2.90 – 5.00	3.10 – 5.00

Fonte: Schaufeli et al. (2019)

The cut-off points serve as a guide to interpret the results of the BAT, allowing to assess whether a user is at risk of burnout and to what degree. It should be reiterated that the interpretation of these results should always be carried out by a professional (Schaufeli et al. 2019). In the case of the sample under study, it is possible to verify that:

**Exhaustion (Overall Average = 3.07):** With an overall average of 3.07, this score suggests that, on average, participants are in the "**Orange**" (at risk) category for exhaustion, as it exceeds the upper limit of the green zone (no risk) and indicates moderate to high levels of exhaustion.

**Mental Distance (Overall Average = 2.16):** With an overall average of 2.16, this score suggests that, on average, participants are in the "**Green**" (no risk) category for mental distance, indicating a certain emotional and cognitive distance from work, but still within a range considered non-problematic.

**Cognitive Control Ability (Overall Average = 2.29):** With an overall average of 2.29, this score also falls into the "**Green**" category (no risk), suggesting moderate challenges in controlling cognitive processes while at work, but without indicating a significant risk of burnout.

**Ability in Emotional Control (Overall Average = 2.13):** With an overall average of 2.13, this score is also in the "**Green**" category (no risk), indicating moderate challenges in controlling emotions during work, but not at a level that suggests a high risk of burnout.

In this sense, it can be concluded that the study participants have a moderate level of burnout, with exhaustion being the most pronounced dimension. This suggests that exhaustion is the main area of concern and may necessitate intervention to prevent the development of more severe burnout.

## INSAT - ASSESSMENT OF PSYCHOSOCIAL RISKS IN THE WORKPLACE

Bearing in mind the objective of this investigation, it was decided to submit the sample to the subscale Psychosocial risk factors at work, consisting of the following dimensions: pace and intensity of work; lack of autonomy; work relationships with co-workers; employment relationships with the organization; emotional demands; ethical and value conflicts. The scale is presented in a likert-like format with 6 response options (1- I am not exposed, 2- Exposed and no discomfort, 3- Exposed and with little discomfort, 4- Exposed and with discomfort, 5- Exposed and with a lot of discomfort, and 6- Exposed and with a lot of discomfort), allowing the participant to indicate the

degree of exposure and discomfort to each of the psychosocial risk factors in their work activity (Barros et al. 2017; Barros et al. 2022).

Table 9: INSAT Averages

Risk Factors Category	Average Values	Risk Level
Pace and Intensity of Work	3.0	medium
Working Times	2.625	medium
Autonomy and Initiative	2.33	medium
Labor Relations	2.54	medium
<b>Employment Relations</b>	<b>3.3</b>	<b>high</b>
Emotional Demands	2.86	medium
Ethical and Value Conflicts	3.0	medium

Source: own

Table 9 shows the means of the Psychosocial Risk Factors at Work subscale. In this sense, it is possible to verify that the categories that have averages equal to 3.0, such as "Pace and Intensity of Work" and "Ethical and Value Conflicts", are categorized as medium risk. The notable exception is "Employment Relations", which has a high average of 3.3. This suggests that, for this category, values slightly above 3.0 are already considered high risk, perhaps due to the critical nature of these factors in the context of workers' well-being. The variation in the means of the values suggests a scale of measurement that allows differentiating subtleties between different levels of exposure to risk factors.

## ANALYSIS OF GLOBAL AVERAGES WITH CUTOFF POINTS

In Portugal, the cut-off points for the Psychosocial Risk Factors at Work subscale are defined by Technical Guide No. 3 of the Directorate-General for Health (Directorate-General for Health, 2021). This guide aims at monitoring the health of workers exposed to psychosocial risk factors in the workplace and provides important guidance for managing these risks. Cut-off points are essential to assess and intervene in the psychosocial aspects of the work environment, promoting the mental health of professionals in Portugal. With regard to the case in question, the cutoff points are usually:

Low (1st tertile from 0 to 2): Indicates less imbalance between needs and control.

Moderate (2nd tertile from 2.1 to 4): Represents an intermediate level of risk.

High (3rd tertile from 4.1 to 6): Signals greater imbalance and greater exposure to psychosocial risks.

In this way, it is possible to verify that all values fall in the second tertile, which suggests a "medium" risk level for each category. This may indicate that, although the average is in the second tertile, other qualitative or contextual aspects may require a higher risk assessment. Strict application



of tertiles would suggest reclassifying "Employment Relations" to "medium" unless specific justifications support the higher classification.

Table 10: Comparison between means and tertiles

Risk Factors Category	Average Values	Original Risk Level	Classification by Tertiles
Pace and Intensity of Work	3.0	medium	medium
Working Times	2.625	medium	medium
Autonomy and Initiative	2.33	medium	medium
Labor Relations	2.54	medium	medium
<b>Employment Relations</b>	<b>3.3</b>	<b>high</b>	<b>medium</b>
Emotional Demands	2.86	medium	medium
Ethical and Value Conflicts	3.0	medium	medium

Source: own

When evaluating Table 10, it is verified that all values were classified as "medium" according to the tertiles, including "Employment Relations", which was originally classified as "high". The reclassification to "medium" follows the strict application of tertiles based on the distribution of values, suggesting that the level of risk for "Employment Relations" could be considered medium, unless other contextual information justifies maintaining the original classification as high.

## DISCUSSION OF THE RESULTS

Based on the results obtained, it is possible for us to answer the research questions of this research.

**PII.** What is the prevalence of burnout among university professors in a given period? From the averages of the dimensions of the BAT (Burnout Assessment Tool), it is observed that the general average of exhaustion is 3.07, indicating considerable levels of exhaustion among teachers. This suggests a moderate to high prevalence of burnout, at least in the exhaustion dimension, among university professors. The means of the other dimensions, although smaller, also indicate the presence of burnout at varying levels.

**PII.** Are there significant differences in burnout levels between different demographic groups among university professors? While detailed demographic data on age, gender, marital status, and type of employment contract are known, direct analysis on significant differences requires specific statistical tests such as ANOVA. However, the gender distribution and the predominant age groups suggest that it may be useful to explore whether these variables influence burnout levels, considering that most teachers are in the older age groups, where an accumulation of stress and responsibilities can be assumed.

**PIII.** How do burnout symptoms relate to factors such as workload and organizational commitment among university professors? The results mention average responses to specific items



that reflect the perception of workload and emotional and cognitive control. For example, high averages in the dimension of exhaustion and cognitive impairment may indicate that a high workload is significantly associated with higher levels of burnout. The relationship between these symptoms and organizational commitment has not been sufficiently studied, but could be inferred through additional analyses that relate job satisfaction, organizational support, and burnout experiences.

## CONCLUSION

This study provided an important insight into the prevalence of burnout among university professors, revealing considerable levels of exhaustion, moderate signs of mental detachment, emotional and cognitive impairment. The results point to the need to address psychosocial factors that may be contributing to these symptoms among teachers, especially considering the demographic structure and contractual conditions.

The research has some limitations, such as the sample of 39 respondents, which may not be representative of all university professors, limiting the generalization of the results. A larger sample could provide a more robust and representative analysis. The study also did not include advanced statistical tests that would allow us to analyze significant differences between groups or explore complex relationships between demographic and psychosocial variables and burnout symptoms.

It would therefore be interesting to include a larger and more diverse sample, covering different types of academic institutions and geographical regions to increase the generalizability of the results. It would also be interesting to conduct longitudinal studies to examine burnout trends over time and determine more precise causes and effects among the variables studied.


By addressing these limitations and implementing the suggestions, future studies could offer deeper insights and practical solutions to mitigate burnout among university teachers, thereby improving educational well-being and effectiveness in the academic environment.



## REFERENCES

1. Angelini, G., Buonomo, I., Benevene, P., Consiglio, P., Romano, L., & Fiorilli, C. (2021). The Burnout Assessment Tool (BAT): A Contribution to Italian Validation with Teachers. *\*Sustainability, 13\*(9065)*. <https://doi.org/10.3390/su13169065>
2. Barros, C., Cunha, L., Oliveira, A., Baylina, P., & Rocha, A. (2017). Development and validation of a health and work survey based on the rasch model among portuguese workers. *\*Journal of Medical Systems, 41\*(79)*, 1-9. <https://doi.org/10.1007/s10916-017-0727-2>
3. Barros, C., Cunha, L., Lacomblez, M., & Baylina, P. (2022). *\*Riscos Psicossociais: Inquérito Saúde e Trabalho 2022\**. Escola Superior de Saúde. INSAT.
4. Direção-Geral da Saúde. (2021). *\*Guia Técnico N° 3: Vigilância da Saúde dos Trabalhadores Expostos a Fatores de Risco Psicossocial no Local de Trabalho - Versão Síntese\**. Lisboa: Direção-Geral da Saúde.
5. Marrinhas, D., Santos, V., Salvado, C., Pedrosa, D., & Pereira, A. (2023). Burnout and technostress during the COVID-19 pandemic: the perception of higher education teachers and researchers. *\*Frontiers in Education, 8\**, 1144220. <https://doi.org/10.3389/educ.2023.1144220>
6. Milic, N., Vukmirovic, M., Rajovic, N., Pavlovic, V., Masic, S., Mirkovic, M., Tasic, R., Randjelovic, S., Mostic, D., Velickovic, I., Nestorovic, E., Milcanovic, P., & Stanisavljevic, D. (2020). The Burnout Syndrome in Medical Academia: Psychometric Properties of the Serbian Version of the Maslach Burnout Inventory—Educators Survey. *\*International Journal of Environmental Research and Public Health, 17\*(16)*, 5658. <https://doi.org/10.3390/ijerph17165658>
7. Pereira, H., Gonçalves, V. O., & Assis, R. M. (2021). Burnout, Organizational Self-Efficacy and Self-Esteem among Brazilian Teachers during the COVID-19 Pandemic. *\*European Journal of Investigation in Health, Psychology and Education, 11\**, 795–803. <https://doi.org/10.3390/ejihpe11030057>
8. Sinval, J., Vazquez, A. C. S., Hutz, C. S., Schaufeli, W. B., & Silva, S. (2022). Burnout Assessment Tool (BAT): Validity Evidence from Brazil and Portugal. *\*International Journal of Environmental Research and Public Health, 19\*(3)*, 1344. <https://doi.org/10.3390/ijerph19031344>
9. Schaufeli, W. B., De Witte, H., Hakanen, J. J., Kaltainen, J., & Kok, R. (2023). How to assess severe burnout? Cutoff points for the Burnout Assessment Tool (BAT) based on three European samples. *\*Scandinavian Journal of Work, Environment & Health\**. <https://read.qxmd.com/read/37042446/how-to-assess-severe-burnout-cutoff-points-for-the-burnout-assessment-tool-bat-based-on-three-european-samples>
10. Schaufeli, W. B., De Witte, H., & Desart, S. (2019). *\*User manual – Burnout Assessment Tool (BAT) – Version 2.0\**. KU Leuven, Belgium: Internal report.
11. Teles, R., Valle, A., Rodríguez, S., Piñeiro, I., & Regueiro, B. (2020). Perceived Stress and Indicators of Burnout in Teachers at Portuguese Higher Education Institutions (HEI). *\*International Journal of Environmental Research and Public Health, 17\*(9)*, 3248. <https://doi.org/10.3390/ijerph17093248>

## Tragedy in Paracambi-RJ: Analysis of the impacts of floods and floods from the perspective of mental health, infectious diseases, absence of socio-environmental intervention and public health in the scenario before and after flooding

 <https://doi.org/10.56238/sevened2024.016-014>

Jeferson Manoel Teixeira<sup>1</sup>, Tiago da Cruz Monteiro<sup>2</sup>, Luis Henrique Brito Barreto Souza<sup>3</sup>, Wenberger Lanza Daniel de Figueiredo<sup>4</sup>, Erick Matheus Garcia Barbosa<sup>5</sup> and Valdete Santos de Araújo<sup>6</sup>

### ABSTRACT

The city of Paracambi-RJ, developed along the Rio dos Macacos, a region susceptible to flooding. With a population of 41,375, inadequate infrastructure and lack of effective drainage increase the municipality's vulnerability to flooding. In February 2024, Paracambi faced one of the largest floods in recent years, exacerbated by the lack of warning systems and proper river management. Poor infrastructure, coupled with inefficient prevention measures, has aggravated outbreaks of infectious diseases such as Dengue, Chikungunya, Leptospirosis and diarrheal diseases. The need for an in-depth analysis of the impacts and responses of public authorities becomes crucial. The study seeks to analyze the causes and consequences of floods in Paracambi, evaluating the actions of local authorities and the measures adopted to mitigate these

<sup>1</sup> Doctor student and Master in Genomic Sciences and Biotechnology at the Catholic University of Brasília (UCB). Physician and Biomedical Psychobiologist and Aesthete. Specialist in Public Health and Infectious and Parasitic Diseases. Specialist in Immunology and Microbiology. Clinical Neuroscientist. Researcher and Lecturer.

LATTES: <http://lattes.cnpq.br/8289666573712255>

ORCID: <https://orcid.org/0009-0004-2923-8626>

E-mail: [drjefersonteixeira@gmail.com](mailto:drjefersonteixeira@gmail.com)

<sup>2</sup> Graduating in Medicine at the Federal University of Montes Claros (UNIMONTES). Researcher. Scholarship holder of the Education through Work for Health Program (PET-Saúde).

LATTES: <https://lattes.cnpq.br/2158511668367454>

ORCID: <https://orcid.org/0009-0007-1630-4526>

E-mail: [tiago.cruz.monteiro@gmail.com](mailto:tiago.cruz.monteiro@gmail.com)

<sup>3</sup> Administrator. Graduating in Medicine from Escola Bahiana de Medicina e Saúde Pública (EBMSP). Researcher. Senior Member of the Academic League of Clinical Anatomy of EBMSP (LAAC - EBMSP).

LATTES: <http://lattes.cnpq.br/1300742050298344>

ORCID: <https://orcid.org/0009-0008-1255-3266>

E-mail: [henriquebarretosouza@gmail.com](mailto:henriquebarretosouza@gmail.com)

<sup>4</sup> Doctor. Researcher. He developed research and training activities essentially focused on the field of otorhinolaryngology, with a focus on multinodular goiter and thyroid cancer, as well as in the area of neurophysiology and rehabilitation project for the physically disabled. He works as a Brazilian Army Medic of the 1st Special Border Platoon - Palmeiras do Javari - Amazonas.

LATTES: <http://lattes.cnpq.br/2589765443287321>

ORCID: <https://orcid.org/0000-0002-0638-2965>

E-mail: [wenbergerf@gmail.com](mailto:wenbergerf@gmail.com)

<sup>5</sup> Biomedical from the University of Mogi das Cruzes (UMC). Specialist in Laboratory Techniques in Virology at the Hospital das Clínicas of the Faculty of Medicine of USP (HC-FMUSP). Master's student at the Department of Infectious and Parasitic Diseases of the Institute of Tropical Medicine of the Faculty of Medicine of USP. (IMT-FMUSP)

LATTES: <http://lattes.cnpq.br/3266303860257917>

ORCID: <https://orcid.org/0009-0004-0908-7170>

E-mail: [erickmgb@usp.br](mailto:erickmgb@usp.br)

<sup>6</sup> Professor at the University of the State of Amazonas and Coordinator of the Civil Engineering Course. He held his Post-Doctorate at the University of Aveiro in Portugal. Master in Urban Engineering. Civil Engineer. Specialist in Environmental Education and Water Resources. Specialist in Valuation and Expertise Engineering. Medical student.

LATTES: <http://lattes.cnpq.br/6667086143477443>

ORCID: <https://orcid.org/0000-0002-8683-9813>

E-mail: [vsaraujo@uea.edu.br](mailto:vsaraujo@uea.edu.br)



disasters. In addition, it is intended to review the global scientific literature on the relationship between floods and public health, correlating data on disease notifications with water quality in the municipality. The public health impacts of floods are vast and multifaceted, including communicable diseases, mental health problems, and direct physical harm. Underreporting of diseases and the lack of an efficient management system are significant barriers to mitigating impacts. The floods in Paracambi underscore the urgent need for improvements in drainage infrastructure and more effective urban planning. It is imperative that municipal management implement measures for prevention, health education and control of zoonoses. Strengthening epidemiological surveillance and continuous training of health workers are essential to prevent future catastrophes and protect public health.

**Keywords:** Health Surveillance, Arboviruses, Infectious Diseases, Flood, Paracambi.





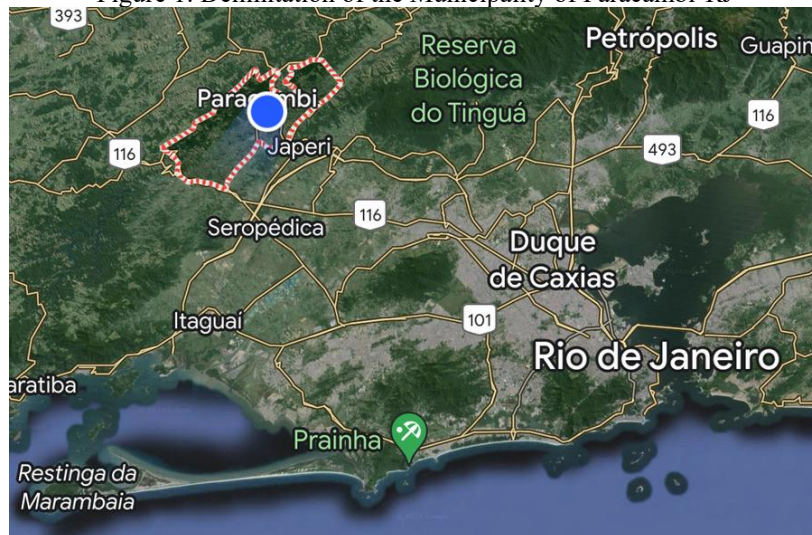
## INTRODUCTION

The city of Paracambi grew due to the installation of the Textile Company Brasil Industrial in 1871, visibly increasing the population of the then called Fazenda dos Macacos, which only in the following century was renamed Paracambi, thus giving rise to the Workers' Village, resulting from the occupation of employees who established residence in a place closer to the Company, on the banks of the river. The city of Paracambi (figure 1) is entirely crossed by the Rio dos Macacos (figure 2). This passes through the central area of the municipality, as well as its tributaries and other various channels that together flow into the Ribeirão das Lages, one of the sources of the Guandu River Basin. The Ribeirão has a considerable volume of water, given from the transposition of the Paraíba do Sul River. In this way, the municipality receives all the water load from the following municipalities: Paulo de Frontin, Piraí and Mendes. Studies of the Sepetiba Basin Macro-region indicate the great fragility of the municipality in terms of flooding, as it developed within the natural flooding area of the Rio dos Macacos, indicating that 43% of the urban area would be located there (Costa and Wilfried, 2001).

According to the Brazilian Institute of Geography and Statistics (IBGE), Paracambi is a municipality in the metropolitan region of the state of Rio de Janeiro (RJ), located 81 kilometers from the state capital, its population, according to the last statistics carried out in 2022 was 41,375 inhabitants in a territory of approximately 190,949 km<sup>2</sup>, divided into 33 neighborhoods, with a demographic density of 216.68 inhabitants/km<sup>2</sup> (IBGE, 2022).

The Rio dos Macacos Sub-Basin, popularly known as Rio dos Macacos, cuts through the city of Paracambi entirely, and thus passes through the central area of the municipality. Being one of the main rivers in the region, it is one of the focuses of rainwater runoff in the city, however, there is neglect in the face of proper drainage and maintenance of the riverbeds that pass through the city, and debris that impairs the river flow is often observed. In addition, according to indicators from the National Sanitation Information System (SNIS), about 45.9% of the municipality's households are subject to flooding and there are no warning systems for hydrological risks. This scenario, added to the enormous amounts of rain, flood phenomena and flooding, caused a calamity in the region (SNIS, 2021).

Figure 1: Delimitation of the Municipality of Paracambi-RJ



Source: Google Maps, 2022

Figure 2: Macacos River Sub-Basin



Source: ANA, 2007.

Arboviruses are diseases caused by arboviruses - viruses transmitted by arthropods (*Arthropod-Borne viruses*) - and are of great importance for public health and the economy (GHASSEM *et al.*, 2023; YOUNG, 2018). In Brazil, the most clinically relevant arboviruses are Dengue, Zika and Chikungunya, however, other arboviruses have been shown to be potential reemerging threats, such as Mayaro Fever and Oropouche Fever. These diseases are similar in terms of vectors, hosts, and clinical symptoms, which ultimately makes diagnosis and clinical management difficult. (MORAIS *et al.*, 2023). Its transmission is via vector by the female mosquito *Aedes aegypti*, in this sense, linked to mosquito breeding foci related to standing water in tires, uncovered water tanks and any other object that favors the accumulation of water. The female *Aedes aegypti* lays her eggs on the edges of containers with standing water. After contact with the liquid and the



combination with high temperatures, the eggs hatch, and it is worth noting the increase in cases of arboviruses after flooding events (SES, 2021).

The dengue virus (DENV) is classified in the *Flaviviridae* family and *Flavivirus* genus, it is an RNA virus, transmitted by the bite of the female *Aedes aegypti*, a mosquito that usually bites during the day (early in the morning or late in the afternoon) and reproduces in places where there is standing water. There are four different serotypes of this virus (DENV-1, 2, 3 and 4) and the infection generates permanent immunity, but it is a specific serotype immunity. That is, it is possible to be infected by the four serotypes, regardless of age. People with chronic diseases, such as diabetes, hypertension, pregnant women, children up to 2 years of age, and people over 65 years of age have a higher risk of developing complications from the disease (Fiocruz, 2013).

The first symptoms of dengue are high fever, body aches and pains behind the eyes, redness of the skin and fatigue. At this stage, the disease is classified as classic dengue or dengue without warning signs. In severe dengue, the one that is most worrisome, there is a greater systemic inflammatory reaction, which alters blood clotting and leads to fluid loss. The consequence can be heavy bleeding and a sudden drop in blood pressure, responsible for the shock associated with dengue, the main cause of death (SES, 2021).

Chikungunya is an acute febrile disease, caused by the chikungunya virus (CHIKV), transmitted by the *Aedes aegypti* mosquito. CHIKV is an RNA virus that belongs to the genus *Alphavirus* of the *Togaviridae* family. Its transmission occurs through the bite of infected female mosquitoes. The mosquito acquires the virus by biting an infected person, during the period in which the virus circulates in the blood. There is no transmission between people. The virus can affect people of any age or gender, but the signs and symptoms tend to be more intense in children and the elderly. In addition, people with chronic diseases are more likely to develop severe forms of the disease. (Fiocruz, 2013).

Leptospirosis is an infectious disease caused by a bacterium called *Leptospira* present in the urine of rats and other animals, transmitted to humans mainly in floods. Cattle, pigs and dogs can also get sick and transmit leptospirosis to humans. The most frequent symptoms are similar to those of other diseases, such as flu and dengue fever, and there may be difficulty in diagnosis due to the symptomatological similarity. The main ones are: fever, headache, body aches, especially in the calves (gastrocnemius, soleus and plantar muscles), and vomiting, diarrhea and cough may also occur. In the most severe forms, jaundice (yellowish color of the skin and eyes) usually appears and there is a need for special care in the context of hospitalization. The patient may also have hemorrhages, meningitis, kidney, liver and respiratory failure, which can lead to death. The main form of transmission is by coming into contact with contaminated water. In situations of floods and floods, the urine of rats, present in sewers and storm drains, mixes with the runoff and mud from the



floods. Anyone who has contact with contaminated rainwater or mud can become infected. The *leptospira* present in water penetrates the human body through the skin, being in contact with the mucosa, especially if there is a scratch or wound. Contact with sewage water or mud, contaminated ponds or rivers, and vacant lots with the presence of rats can also facilitate the transmission of leptospirosis (Fiocruz, 2013).

Acute Diarrheal Diseases (ADD) correspond to a group of gastrointestinal infectious diseases characterized by a syndrome, in which there is a decrease in the consistency of the stool, an increase in the number of bowel movements (minimum of 3 episodes in 24 hours) and, in some cases, there is the presence of mucus and blood (dysentery). They are self-limiting, lasting up to 14 days. The clinical picture may progress to mild to severe dehydration. When treated incorrectly or not treated, they can lead to severe dehydration and hydroelectrolyte disturbance, and death can occur (SES, 2019). Infections can be caused by bacteria and their toxins, viruses, opportunistic intestinal parasites and natural toxins, examples are: *E. coli*, *Salmonella*, *Rotavirus*, *Giardia*, *Entamoeba*. Individuals of all ages can develop Acute Diarrheal Disease of infectious origin. However, children, the elderly and immunocompromised are more likely to develop dehydration. Newborns usually have a milder or asymptomatic infection, probably due to breastfeeding and antibodies transferred by the mother. ADD outbreaks, due to the many possible etiologies and sources of transmission, are also called Waterborne and Foodborne Illness (DTHA) outbreaks, mainly related to flooding and flooding.

The increase in the incidence of diarrhea is one of the impacts identified in studies carried out in affected areas (KONDO et al; 2002; WADE et al., 2004).

The impacts of a flood on the health of the affected population can be immediate (those that result in physical trauma and deaths) or long-term, when there is an increase in the incidence and prevalence of infectious diseases, a negative influence on mental health, worsening of pre-existing conditions and losses associated with malnutrition (AHERN et al., 2005). In this adverse context, the mental health of the population becomes an easy target, requiring psychosocial care workers to develop actions to deal with this condition. Nevertheless

[...] the number of people trained in the subject is not always proportional to the needs presented, because for each person with physical injury, there are at least two hundred who need assistance (not treatment) in the area of mental health (BENIAKAR, et al., 2009).

The great potential impact of disasters on the population reveals the importance of action, in all spheres, based on knowledge in mental health to provide the population and the professionals themselves with activities that promote prevention, mitigation and treatment in mental health. In this way, seeking to understand people's subjective experiences in disaster contexts and post-disaster recovery denotes how those affected understand their social world after the experience of trauma, and allows them to be heard, legitimizing the suffering that emerges from these life situations,



providing opportunities to understand the suffering that is often marginalized and invisible over time (BENIAKAR et al., 2009).

Rodrigues (2019) highlights that hydrological disasters have among their primary causes the action of natural processes, which involve excess water in the affected system, these are usually related to extremes of precipitation and flooding, with deficiency in the urban drainage system, mainly affecting the population that occupies areas sensitive to drainage and with restrictions on use and occupation, such as flooded surfaces. Floods are caused by the increase in the water level in the river, causing the water to overflow and invade streets, homes and commercial enterprises, as well as causing financial losses to the local economy and generating a strong threat to public health by causing the spread of dirt, diseases and disorders to the health of residents (BARRA; TEIXEIRA, 2015). This has developed numerous challenges that involve the relationship of the human being and its influence on the environment in which he lives.

However, the difference in the phenomena stands out, being

Flood or flood: It is the temporary increase in the water level, reaching its maximum quota, but without overflow (MinC, IPT, 2007).

Flooding: Refers to the overflow of water, reaching marginal areas and causing flooding in regions close to rivers (MinC, IPT, 2007).

Flooding: Occurs in urban perimeters, as a result of drainage problems, leading to the accumulation of water in inhabited areas (MinC, IPT, 2007).

According to Pires (2006), the ideal to seek to solve the characteristic problem of floods would be to promote the conservation of natural resources, such as green areas such as rivers, lagoons and forests without the presence of human action, in all cities, regardless of their size, in this way the environment would be able to maintain the process of development of ecosystems in a natural way.

When rainwater drainage in urban areas is insufficient, flooding and flooding phenomena occur. Due to the absence of proper drainage, stagnant water accumulates, resulting in pollution problems, increased spread of disease, and economic losses (BEZERRA et al. 2016).

## JUSTIFICATION

On February 21, 2024, the municipality of Paracambi suffered, along with other municipalities in the Baixada Fluminense of the state of Rio de Janeiro, one of the largest episodes of flooding in recent years, reverberating in the different spheres of life of the residents of the region. The increase in rainfall evidenced in the period from January to February 2024, added to the precarious infrastructure for containing rivers and dams, in addition to pollution and inefficient public prevention measures, were the main catalysts for the problem that affected a large part of the



families in Paracambi (people born and living in the city of Paracambi), both in terms of housing and public health. In this scenario, there was flooding with enough water to reach 2 meters in height in several neighborhoods, many houses were destroyed and furniture and personal belongings were lost, leading residents to have to rebuild their homes practically from scratch, which mainly influenced the intensification of health problems due to stress and psychological disorders related to the experience of such a catastrophe, such as an increase in cases of anxiety, sleep disorders and panic syndrome. In addition, disease outbreaks, which were already occurring in the region, were intensified with the episodes of flooding. The increase in the number of cases of Dengue, Chikungunya Fever, Acute Diarrheal Disease, Leptospirosis has further aggravated the problem in question, extrapolating the individual sphere to a very serious public health case, with hospitals and medical clinics crowded due to intensified outbreaks in several neighborhoods of the municipality. In this scenario, it is essential to understand the short and long-term consequences that such a calamity generated for the residents of the municipality of Paracambi, in addition to debating the measures that were taken to circumvent such impacts by the public authorities in the region.

Thus, it is important to emphasize that the effects of floods in Paracambi-RJ have the possibility of worsening due to the precarious situation of the environmental sanitation system, especially for population groups excluded from sanitation infrastructure that do not have access to sanitary infrastructure. Regarding infectious diseases, the fact that Paracambi is already facing outbreaks of vector-borne diseases even before the floods raises doubts about the effectiveness of public health policies. In addition, such flood events represent a threat to the advances achieved by the country in recent decades, especially with regard to the reduction of infant mortality, life expectancy and quality of life. It is essential to emphasize that dealing with these impacts is not the exclusive responsibility of the public health sector, but rather of the whole society, which needs to engage in the promotion of healthy and sustainable environments, as well as in the reduction of social disparities. In this context, the importance of the United Nations global strategy on the Sustainable Development Goals (SDGs) is highlighted, which aims to commit, mobilize and propose effective means to achieve sustainable development for all. Among the 17 goals established, SDG 3: "Ensure a healthy life and promote well-being for all, at all ages"; SDG 6: "Ensure the availability and sustainable management of water and sanitation for all", and SDG 11: "Make cities and human settlements inclusive, safe, resilient and sustainable" are fundamental for reducing the impacts of natural disasters on human health. In addition, it is also worth mentioning the importance of the role of the National Council for the Environment (CONAMA), which aims to advise, study and propose to the Brazilian Government Council and other environmental agencies guidelines and government policies for the environment and to deliberate, within the scope of its competences, on norms and standards for the environment.



Among all catastrophic natural phenomena, floods stand out for being the most common and for causing a large number of problems in both southern and northern nations, sometimes with devastating consequences, such as the events recorded in China in 1959 and in Bangladesh in 19743. In 2017 in Texas, flooding resulting from Hurricane Harvey impacted millions of people and caused significant financial losses. Concomitantly, severe flooding in India, Nepal and Bangladesh affected more than 10 million individuals (WHO, 2013). The effects of flooding on the health of the affected population are both immediate and long-lasting, resulting from displacement and deteriorating living conditions.

## OBJECTIVES

The main objective of this book chapter is to analyze how the city of Paracambi-RJ is dealing with floods, floods and floods that occurred on 02/21/2024, investigating the causes and consequences of these events in the municipality. The performance of local political management will be examined, analyzing the measures adopted and planned to prevent and combat these avoidable natural phenomena. In addition, an exploratory literature review will be carried out to understand the current state of global scientific research on floods and public health, seeking to identify trends and patterns of approach in the articles. The study will map unprecedented information, obtained through the perception of residents of the affected areas and the global panorama of scientific research, in order to contribute to the public debate and assist managers and society in improving the planning and formulation of public policies. A cross-analysis will be carried out in the Brazilian Health and Information Platform (DATASUS) between the data of notifications of diseases such as Dengue, Chikungunya Fever, Leptospirosis and Acute Diarrheal Disease (ADD) and the microbiological parameters of the water, in order to assess whether there is a correlation between the notifications of disease and water quality.

## GENERAL OBJECTIVE

To analyze how the Municipal Health, Environment and Civil Defense Managers and the Academy (scientific production) have been dealing with the problem in the post-flood scenario in Paracambi and how the responses to the adversities that occurred (public policies, planning, disease prevention programs, clinical care, epidemiology, health surveillance, combat and mitigation) have been developed at the municipal level.

## SPECIFIC OBJECTIVES

1. To analyze, through a bibliographic review, the state of scientific productions that deal with the relationship between floods and public health, having as an axis of analysis the

causes, consequences and responses adopted to the problems of floods as well as on the concepts/conceptions about key words that permeate the universe of natural disasters avoidable or caused by human action.

2. Investigate the impact of flooding and flooding, on the health of residents and the notification of cases of Leptospirosis, Dengue and Acute Diarrheal Disease (ADD), after avoidable floods in the municipality of Paracambi in February 2024. And evaluation of the microbiological parameters of the water collected at the time of flooding in a local residence.
3. To carry out a survey of the environmental and anthropogenic changes introduced in the microbasin of the Rio dos Macacos, in the Municipality of Paracambi (RJ), which led to the flood, causing great economic and social damage. It was sought to emphasize the dynamics of floods in this municipality, from the perspective of the physical and ecological characteristics of the Rio dos Macacos Sub-Basin.

## THEORETICAL FRAMEWORK

### THE IMPACT OF FLOODS, FLOODS AND FLOODS ON THE HEALTH OF AFFECTED POPULATIONS

Among natural disasters, floods are the most common and result in the highest number of deaths, affecting countries in both the northern and southern hemispheres. Floods have immediate and long-term impacts on the health of affected populations, due to displacement and deteriorating living conditions. According to Paterson et al. (2018), the health risks arising from floods can be categorized according to time, as shown in Chart 1.

Table 1: Health risks of floods after their occurrence.

Tempo após o evento	Risco
Imediatos	Afogamento Trauma Hipotermia Eletrocussão Intoxicação aguda por monóxido de carbono
< 10 dias depois do evento	Infecção cutânea Pneumonias Infecções respiratórias virais Gastrenterites
> 10 dias depois do evento	Leptospiroses Doenças associadas a mosquitos Infecções cutâneas de organismos atípicos (fungos, microbactérias) Hepatite A ou E Problemas mentais e/ou emocionais, incluindo estresse pós-traumático e depressão Outras doenças crônicas

Fonte: Adapted from PATERSON et al., 2018.





## MORBIDITY MORTALITY ASSOCIATED WITH FLOODS

Flood-related mortality has become so worrisome that it has been the subject of study in a large number of countries, regardless of income and level of development. Most deaths are associated with drowning, being more frequent in rapid floods, when large volumes of water invade communities with high speed and power (MALILAY, 2000). Some studies also indicate deaths from physical and emotional stress, which increase the likelihood of heart attacks or cardiorespiratory arrests in people with preexisting conditions.

Prevention of chronic non-infectious diseases, social and psychological support, and improved access to health services reduce long-term post-flood mortality.

## INJURIES AND EXPOSURES TO TOXIC PRODUCTS

Injuries can occur at all stages of flooding, but there is little documentation available on these incidents (WHO, 2013). Often, these injuries occur when people strive to rescue their belongings, save themselves, family members, or pets from currents or drowning. Floods, especially unexpected ones, have the ability to sweep away vehicles, trees, furniture, and utensils, as well as cause ruptures in pipes and tanks that store hazardous chemicals.

Fractures, twists and cuts by contaminated objects are also common after returning to homes or businesses and during cleaning. Bites from snakes and insects displaced by the water are also a risk.

Depending on the characteristics of the flood (nature of the flood, land use and associated infrastructure), the chemicals can be diluted in the water, reducing its toxicity; they can react with water to form toxic clouds; they can disperse over extensive areas, contaminating soils, streets, homes and agricultural areas, as is the case with fossil fuels that are not very soluble in water; or they can contaminate water supply systems. Flammable chemicals released during floods also present a risk of fires and explosions, causing immediate damage to people's lives and health (WHO, 2018).

## LONG-TERM MENTAL HEALTH AFTER EXPERIENCING DISASTERS

Psychological stress is a consequence of calamitous events is quite common, such as floods. Symptoms such as discouragement, depression, distress, exacerbated anxiety, hyperactivity, and difficulty sleeping, among other physical and emotional signs, are frequently observed in affected individuals (HEALTH PROTECTION AGENCY, 2010). Although these symptoms are generally considered normal after trauma, if they persist for more than a month or affect people's quality of life, it is necessary to seek specific precautions and treatments (WHO, 2013).

Epidemiological studies on mental health after floods have significant methodological limitations, making evaluation difficult. Several resources have been used, but they are not directly



comparable, and the lack of studies prior to the disaster on the incidence and prevalence of symptoms makes it difficult to estimate the specific consequences of the occurrence of floods. Despite these limitations, it is widely recognized that disasters, especially floods, have a significant impact on the mental health and well-being of the affected population. They conducted a case-control study with residents of households directly and indirectly affected by flooding and found that 75% of these people experienced mental health effects, the most severe of which were observed among the elderly (GREEN et al., 1985).

In general, the magnitude of the damage caused by the flood, the duration and intensity of the disruption to people's daily lives, and the extent of loss and damage and the resources available in the community to cope with the event, are critical determinants of health impacts over subsequent years.

### FREQUENT DISEASES DUE TO FLOODS

Respiratory diseases, mainly due to the temporary stay in accommodations and shelters, with a large number of people living in the same space, are part of this group, with this we can cite as examples: influenza, meningitis, diphtheria, pertussis, chickenpox, tuberculosis, covid-19 and/or others. And, also, Waterborne and Foodborne Diseases (DTHA), due to the contamination of water in the public supply networks, as the consumption of (contaminated) water can occur, which is a basic need, often the population ends up using contaminated water, exposing themselves to the risk of diarrhea, cholera, typhoid, meningitis by enterovirus and hepatitis A and E.

The transmission of infectious and foodborne diseases represents a significant challenge to global public health, characterized by the spread of pathogens through the consumption of contaminated food. These diseases, often caused by bacteria, viruses, parasites, or toxins present in poorly handled or prepared foods, manifest with a wide range of symptoms ranging from mild gastroenteritis to more severe conditions such as acute intestinal infections. Vulnerable groups, such as children, the elderly, and immunocompromised individuals, are particularly susceptible to these diseases, which can result in significant impacts on health and well-being.

Water-related diseases, especially those that depend on access to water and are transmitted by water, are influenced by environmental conditions. Therefore, it is possible that variations occur in the seasonality, frequency, and even virulence and adaptability of waterborne microorganisms. Chart 2 exemplifies some pathogens associated with water.

Table 2: Examples of pathogens from the different classifications of water-related diseases.

Classificação	Potenciais causas	Exemplos de micro-organismos
Transmissão hídrica	Contaminação de águas de abastecimento público	<i>Cryptosporidium</i> spp., <i>Giardia</i> spp., <i>Vibrio cholerae</i>
	Contaminação de águas recreacionais (doces e costeiras)	Adenovírus, <i>Cryptosporidium</i> spp.
	Inundação	<i>Leptospira</i> spp.
	Formação de biofilmes em redes de abastecimento de água	<i>Mycobacterium</i> não-tuberculose
	Contaminação de águas para irrigação agrícola	<i>Salmonella</i> spp.
Privação hídrica	Higiene precária decorrente de secas	<i>Chlamydia trachomatis</i>
Criação hídrica	Criadouros de mosquitos	Vírus da dengue
Base hídrica	Criação de novos ambientes	<i>Schistosoma mansoni</i> , <i>Legionella</i> spp.

Fonte: LAU et al., 2010; FLAHAUT et al., 2016; LEVY et al., 2016; NICHOLS et al., 2018.

Heavy rainfall and subsequent surface runoff are considered crucial elements in the transport of pathogenic microorganisms to water sources, both surface and groundwater, intended for public supply and primary contact recreation (LAU et al., 2010; LEVY et al., 2016; ANDRADE et al., 2018).

It is crucial to note that climate change contributes to favorable conditions for the emergence of new diseases and the resurgence of others caused by emerging and reemerging pathogens, such as known arboviruses (WHO, 2003; WOOLHOUSE, 2006).

## HOW UNDERREPORTING OF DISEASES IMPACTS THE HEALTH OF AFFECTED RESIDENTS

It is observed that the poorer the area, the greater its underreporting may be, and due to the number of patients this number is very high, that is, the number of patients is not equal to the number of notifications made, that is. Sometimes there is a difference between the information in the system and the information recorded in the patient's medical record. Therefore, it significantly alters the number of cases and alters the goals of eradication of the disease. With this underreporting, the quality of information is unreliable and therefore national policies aimed at improving the quality of life are not satisfactory and the desired effect is not achieved.

This study shows a strong underreporting in the system, which can cause serious damage because underreported diseases threaten public health. Knowledge of them and their problems is essential to promote control measures.

For any disease or health problem, the notification follows a dynamic process (e.g., mentioning the uniqueness of the subject) and thus increases the possibilities of responding to the needs of the disease reporting community and ensures that the majority of cases are; reported and that we know the reality of the place. Health information is important because it helps us make



decisions about public policies and improve the quality of life of the population. Information on the profile of morbidity and mortality, common risk factors and factors that influence them, demographic characteristics, and health services are essential for the planning, implementation, monitoring, and evaluation of health interventions and services.

## **MATERIALS AND METHODS**

(1.1) To carry out an observational case-control study with fieldwork in the neighborhoods affected by the floods, the action of the Municipal Health, Environment and Civil Defense Managers regarding health negligence, underreporting of diseases, absence of socio-environmental intervention, and the performance of municipal management through the response of the population, investigating the notifications of diseases and resolution of the problem that devastated the city.

(1.2) 1000mL of water was collected from inside a residence affected by the flood and sent to the Chemistry Laboratory of the University of the State of Amazonas for microbiological analysis. Clinical and epidemiological data were collected in loco in the neighborhoods affected by the floods and environmental assessment of the Rio dos Macacos Sub-Basin where there was no drainage and cleaning in the last 7 years. The DATASUS platform was used in this period to cross-reference data on cases of Leptospirosis, Dengue, Chikungunya Fever and ADD.

(1.3) A Literature Review addressing the relationship between Floods, Public Health, Mental Health, Infectious Diseases and Environmental Interventions. A literature review was carried out on articles available in PubMed, SciELO, and Scopus until the year 2024, as they are more comprehensive bibliographic databases and at the same time specific to public health. As it is a bibliographic database in English, the following terms "floods" and "public health" were chosen as general descriptors. The objective was to capture the largest number of articles that addressed the topic of floods, and at the same time restrict those that established a more direct link between these events and public health, understood here as a response of the state to health needs. A total of 114 articles were identified, which were submitted to two groups of inclusion criteria. The first group was to be in a language that could be read by the authors, namely: English, Portuguese or Spanish. From this criterion, 9 articles were not included (5 in Chinese, 2 in French, 1 in Norwegian and 1 in Russian). The second group was the article that addresses in the abstract at least one of the items selected for analysis, which were: (1) causes; (2) consequences; (3) responses and actions: forwarding proposals and solutions for the prevention and/or mitigation of flood risks and impacts. 74 articles were selected and another 28 were excluded, which addressed very specific topics of investigations of flood-related diseases. In the end, there are 48 articles left for analysis, the first published in 1985 and the last in 2024.

Three local residents were interviewed respecting the legality and conduct of the Informed Consent Form (ICF) of the National Health Council, Resolution 466/12 and 510/16.

## RESULTS AND DISCUSSION

According to Brasil (2018), the effects of floods on health can be direct or indirect, short, medium and long term, and affect the individual and the community as a whole, being considered a public health problem. The abrupt or linear nature of the occurrences also has repercussions on the behavior and volume of damage, with greater emphasis on fatalities by drowning or trauma, communicable diseases (water and food), electric shocks, accidents with venomous animals, and psychosocial issues, among others. other. The most susceptible groups are children, the elderly and people with disabilities or limited movement, as well as pregnant women.

It is known that through drainage systems, excess water in the soil is directed to strategic locations, such as rainwater galleries and wells, for example. This, in turn, prevents flooding, flooding, landslides, low agricultural productivity, deaths, among other problems. However, the municipality of Paracambi-RJ had the city's main river drained in 2017, and even after the catastrophe the Rio dos Macacos remains undrained.

Figure 3: Last Drainage of the Rio dos Macacos Sub-Basin in December 2017.



Source: Paracambi City Hall, 2017.

Figure 4: Rio dos Macacos Sub-Basin in 2024.



Source: Author, 2024.

The Barcelos study; Sabrozza (2001) highlights the strong link between high rainfall, the occurrence of flooding and the increased incidence of leptospirosis in urban spaces, especially during periods of seasonal rainfall.

Genovez (2009) believes that the occurrence of leptospirosis is closely related to environmental factors. The most common way to contract the disease is during floods and floods, when rat urine in sewers and drains mixes with runoff and mud from floods. Therefore, flooding is a major risk factor for disease outbreaks in urban areas, especially during the rainy season. Despite being a common disease in these cases, the flooding of Paracambi -RJ did not notify any cases during this period of the disaster.

The magnitude of these impacts is directly related to the conditions of vulnerability that exist in the affected areas and the ability of the agents involved in emergency response to take timely action. In the health sector, discussions about the need to expand the capacity for timely action in emergencies and disasters are not new and have grown after the release of a report by the Intergovernmental Panel on Climate Change, which observed that extreme weather events will occur more and more frequently and will be increasingly recurrent, according to a study by Caruso (2017).

Ahern et al., (2020) elucidates that studies on epidemiological evidence on the effects of floods on health have produced a series of results, the most obvious being the occurrence of death (drowning, electric shock or trauma); injuries (bruises, lacerations or fractures); communicable diseases (fecal-oral and vectors), deaths in high-income areas are related to car drownings and when recorded in homes, most are elderly.

According to Freitas; Ximenes (2012) contact with contaminated water can cause a variety of diseases, especially diseases of fecal-oral origin (diarrhea, rotavirus, hepatitis, gastroenteritis). In this study, a microbiological analysis of water collected inside a residence affected by the flood in Paracambi-RJ was carried out, with laboratory results presented in the figure and table below:

Figure 5: Material collected for analysis at the UEA Chemical Analysis Laboratory



Source: Author (2024)



Table 1: Microbiological analysis (performed in duplicate) of 1000mL of water collected inside a residence affected by the flood in Paracambi-RJ. Carried out at the Chemical Analysis Laboratory of the University of the State of Amazonas, respecting the parameters of CONAMA.

Local	Collection Date	Totais coliforms	E.Coli
01 Residence affected by the flood	21/02/2024	Present	Present

Source: Author, 2024.

The occurrence of diarrheal diseases involves a series of factors related to an individual's health status, as well as social, economic, cultural, and environmental determinants. During floods, drinking water networks can be affected, damaging the supply systems of families and health services, leading to a lack of drinking water, or even the contamination of water reserves with infectious agents, according to Davies et al., (2015).

According to Paz et al., (2012) outbreaks of diarrhea associated with extreme weather phenomena have occurred all over the world, particularly after floods and floods, which corroborates the results of this study in which all the individuals studied presented ADD (acute diarrheal disease) in the flooding of Paracambi -RJ.

According to Marcondes; Ximenes (2016) the *Aedes aegypti* mosquito is the main vector of arboviruses (dengue, Zika and Chikungunya), this mosquito adapts easily to urban environments due to the higher population density and the greater number of artificial breeding sites. The link between *Aedes aegypti* and the quality of life of the urban population is strong and is based on the planning conditions surrounding urban areas, the presence of basic sanitation, efficient garbage disposal and hygienic behavior. As a result, it is necessary to understand the urbanization process, the association between the process and health to try to prevent the associated problems.

Dengue and Chikungunya are caused by the same vector, the *Aedes aegypti* mosquito. Although Chikungunya and dengue have similar symptoms, including fever, headaches, joint pain, nausea and rash (red spots on the body), there are significant differences in the symptoms that differentiate them. The main clinical sign of Chikungunya, such as severe joint pain, arthralgia, is usually accompanied by fever. This condition can occur in any joint, but it is especially common in the feet and hands, such as the fingers, ankles, and wrists. In Chikungunya, these symptoms are caused by inflammatory reactions in the joints, these symptoms can also involve edema and stiffness.

According to the Department of Information and Informatics of the Unified Health System of the Ministry of Health of Brazil (DATASUS), in 2024 to date, 265 cases of Dengue have been reported in the municipality of Paracambi-RJ. During the months of February to May, 8 cases of Chikungunya Fever were registered.

This type of pain can also occur in dengue, but experts say that the difference is in the intensity of the pain. Patients with dengue may experience mild to moderate pain, while those



infected with Chikungunya experience high levels of pain, leading to reduced work productivity and quality of life. In the subacute or chronic phases of the disease, it can persist for months or even years, especially in older patients.

According to Few et al., (2004) mental health can also be affected by flooding, including incidents of post-traumatic stress syndrome, irritability, anxiety, aggression, depression, insomnia, and suicide. However, establishing the relationship between floods and disease occurrence is complicated because data are underestimated and records are scarce. The immediate risks of trauma and death are often obvious, but the long-term effects, especially on mental health, are detrimental and have led to an increase in the dispensation of prescription drugs.

Diseases and syndromes resulting from emotional factors, such as sleep disorders, are identified. Most of these consequences manifest themselves after floods and especially during the rainy season, but they are also associated with the breakdown of domestic and social routines and during reconstruction (cleaning, repairs, insurance activation, indemnities). According to Mendonça et al (2009), these mental and emotional consequences can persist for months or years after a flood, reappearing whenever heavy rains or other floods have occurred again.

## CONCLUSION

It became possible to understand that the floods, floods and floods that occurred in the municipality of Paracambi-RJ on 02/21/2024, are social, political, environmental and public health issues, that is, if there was a regularity of drainage of the Rio dos Macacos Sub-Basin, especially due to the considerable volume of material damage and in particular, of countless lives that were physically impacted, intellectually and spiritually and material losses as a result of poor planning and even the absence of any planning in numerous risk areas in the municipality, since 18,299 inhabitants comprise the population without water, 14,713 without sewage, 1,000 without garbage collection, 7,023 households, are subject to flooding and there is no alert system for hydrological risks in the city.

Despite the prominent position occupied by these phenomena that directly affected the community, they tend to be repeated as long as there are causes that contribute to their occurrence, thus listing the need for corrective and/or preventive measures, avoiding that new events may occur every year. It is emphasized, in such a way, that it is essential to carry out urban planning and at the same time to carry out infrastructure works that enable the drainage of rainwater, with several areas of knowledge and a multidisciplinary team as fundamental in conducting this process, enabling necessary activities and processes that contribute to the balance between man and nature. This does not exclude the possibility that, mainly due to the inability to develop prevention and mitigation strategies, events with a large number of infectious diseases may occur, as in explicit cases. An





example of this is Bill No. 3350/2024 proposed in the Legislative Assembly of Rio de Janeiro (ALERJ) by the State Deputy of Rio de Janeiro, Andrezinho Ceciliano, which provides for: "the adoption of sustainable rainwater management mechanisms for the purpose of controlling floods and flooding, applying the concept of Sponge City in the State of Rio de Janeiro."

The current trends of population growth and concentration in urban areas, without adequate infrastructure, and with environmental degradation and social inequalities already point to the growth of exposed populations and economic losses related to floods, even without considering that the intensification of climate change will represent an increase in the frequency and severity of events like these. In this scenario, it is expected that the most vulnerable and least prepared populations will increasingly suffer the consequences.

The drainage density correlates the total length of the outflow channels with the area of the watershed, however, a study carried out in 2009 by LEMOS et al., found that the Rio dos Macacos Sub-basin has low values (0.08 m), which is indicative of a greater tendency to flood occurrences. The local evaluation showed constant modifications of the physical environment of the Rio dos Macacos Sub-basin due to anthropogenic influence. Allied to this and other factors, the omission of the public power, underreporting of diseases, worsens the environmental and health care situation and becomes explicit in the lack of an efficient management system and environmental planning mechanisms.

It is up to the Management of the Municipality of Paracambi, and all the competent bodies, in reinforcement of the Municipal Epidemiological Surveillance, Municipal Health Secretariat, Social Assistance Secretariat, Zoonoses Surveillance Unit, the constant evaluation of health indicators and determinants. Such a circumstance could have a different impact if there was drainage of the Rio dos Macacos Sub-Basin. In view of the results exposed, it is imperative to implement drainage measures in the Rio dos Macacos, scientific updating and training for health professionals and local political authorities, health education and control of zoonoses for the population and environmental intervention. It is possible to offer essential contributions to the prevention of floods and floods, because the municipality of Paracambi-RJ continues to be a potential for future catastrophes, but since 2009 there have been scientific reports of the need for prophylaxis and care for the population, but there was a lack of scientific preparation on the part of the municipal management, in the face of an unexpected catastrophe, but with potential scientifically described. Furthermore, the reduction of waterborne and foodborne diseases, health surveillance, social assistance, professional training and environmental intervention, must be done frequently, all support must happen perennially, and in cases of events like this, all management must have control. In the observational study, it was found that before the floods and floods, the inhabitants of Paracambi felt helpless and without resources on the part of the municipality and the current management. The city must be increasingly prepared to



reduce current and future risks. Thus, taking as a reference the document of the United Nations Secretariat for Rio+20, on Disaster Risk Reduction and Building Resilience, it was considered that the reduction of the causes and consequences of floods in the health sector must involve integrated responses with broad policies for sustainable development, reducing the vulnerability of certain localities and populations. Making the relationship between management and citizens closer to the reality that marks the existence of man in society.



## REFERENCES

1. ALERJ - Assembléia Legislativa do Estado do Rio de Janeiro. (n.d.). Disponível em: <[http://www3.alerj.rj.gov.br/lotus\\_notes/default.asp?id=161&url=L3NjcHJvMjMyNy5uc2YvMThjMWRkNjhmOTZiZTNINzgzMjU2NmVjMDAxOGQ4MzMvNjc4MDc0ZTk3MzFlODMzZjAzMjU4YWVvMDA2NDZINTU/T3BlbkRvY3VtZW50](http://www3.alerj.rj.gov.br/lotus_notes/default.asp?id=161&url=L3NjcHJvMjMyNy5uc2YvMThjMWRkNjhmOTZiZTNINzgzMjU2NmVjMDAxOGQ4MzMvNjc4MDc0ZTk3MzFlODMzZjAzMjU4YWVvMDA2NDZINTU/T3BlbkRvY3VtZW50)>. Acesso em: 15 jul. 2024.
2. Ahern, M., Kovatz, S., Wilkinson, P., Few, R., & Matthies, F. (2005). Global health impact of floods: Epidemiologic evidence. \*Epidemiologic Reviews, 27\*, 36-46. <https://doi.org/10.1093/epirev/mxi004>
3. Ahern, M., Kovats, R. S., Wilkinson, P., Few, R., & Matthies, F. (2005). Global health impacts of floods: Epidemiologic evidence. \*Epidemiologic Reviews, 27\*, 36-46.
4. ANA - Agência Nacional de Águas. (2005). \*Conservação e Reuso da Água em Edificações\*. São Paulo: Prol Editora Gráfica.
5. Andrade, L., et al. (2018). Surface water flooding, groundwater contamination and enteric disease in developed countries: A scoping review of connections and consequences. \*Environmental Pollution, 236\*, 540-549.
6. Barcelos, C., & Sabroza, P. C. (2001). Dengue: um desafio para a saúde pública. \*Cadernos de Saúde Pública, 17\*(1), 77-89.
7. Barcelos, C., & Sabroza, P. C. (2001). The place behind the case: Leptospirosis risks and associated environmental conditions in a flood-related outbreak in Rio de Janeiro. \*Cadernos de Saúde Pública, 17\*(Supl. 1), 59-67.
8. Bezerra, I. M. P., & Sorpreso, I. C. E. (2016). Concepts and movements in health promotion to guide educational practices. \*Journal of Human Growth and Development, 26\*(1), 11.
9. Beniaikar, M., & Collazo, C. (2009). Salud mental em desastres: Problemáticas, paradojas y perspectivas clínicas. In M. Benikar, J. T. Thomé, & I. H. Taralli (Eds.), \*Intervenção em situações limite desestabilizadoras: Crises e traumas\* (pp. 115-135). Rio de Janeiro: ABP.
10. Brasil, Ministério da Saúde. (2018). \*Desastres naturais e saúde: Análise do cenário de eventos hidrológicos no Brasil e seus potenciais impactos sobre o Sistema Único de Saúde\*. Bol Epidemiológico da Secretaria de Vigilância em Saúde.
11. Brasil, Ministério da Saúde. Secretaria de Vigilância em Saúde, Departamento de Vigilância Epidemiológica. (2024). \*Sistema de Informação de Agravos de Notificação - Sinan\*. Brasília: Editora do Ministério da Saúde.
12. Brasil, Ministério do Desenvolvimento Regional. (2021). \*Sistema Nacional de Informações sobre Saneamento (SNIS). Diagnóstico dos Serviços de Água e Esgotos - 2021\*. Brasília: SNIS. Disponível em: <http://www.snis.gov.br/diagnostico-agua-e-esgotos/rj/paracambi>
13. Caruso, G. D. (2017). The legacy of natural disasters: The intergenerational impact of 100 years of disasters in Latin America. \*Journal of Development Economics, 127\*, 209-233.
14. Costa, H., & Wilfried, T. (2001). \*Enchentes no estado do Rio de Janeiro: Uma abordagem geral\*. Projeto Planágua Semads/GTZ. Rio de Janeiro.



15. Davies, G. I., et al. (2015). Water-borne diseases and extreme weather events in Cambodia: Review of impacts and implications of climate change. *\*International Journal of Environmental Research and Public Health*, 12\*(1), 191-213. <https://doi.org/10.3390/ijerph120100191>
16. De Avila-Pires, F. D. (2006). Leptospirose e enchentes: Uma falsa correlação? *\*Revista de Patologia Tropical/Journal of Tropical Pathology*, 35\*(3), 199-201. Disponível em: <https://www.revistas.ufg.br/iptsp/article/view/1880/1793>
17. Distrito Federal, Secretaria Estadual da Saúde. (2023). *\*Doenças diarreicas agudas (DDA) - 2023\**. Distrito Federal: Secretaria Estadual da Saúde. Disponível em: <https://www.saude.df.gov.br/doen%C3%A7as-diarreicas>
18. El Ghassem, A., et al. (2023). Arthropod-borne viruses in Mauritania: A literature review. *\*Pathogens*, 12\*(11), 1370. <https://doi.org/10.3390/pathogens12111370>
19. EM-DAT: The Emergency Events Database – Université Catholique de Louvain (UCL). (n.d.). Disponível em: <https://www.emdat.be/>. Acesso em: 13 dez. 2018.
20. Few, R., Ahern, M., Matthies, F., et al. (2004). Floods, health and climate change: A strategic review.
21. Fiocruz. (n.d.). *\*Glossário de doenças\**. Disponível em: <https://agencia.fiocruz.br/gloss%C3%A1rio-de-doen%C3%A7as>. Acesso em: 12 jul. 2024.
22. Flahault, A., Castaneda, R. R., & Bolon, I. (2016). Climate change and infectious diseases. *\*Public Health Reviews*, 37\*(21).
23. Freitas, C. M., & Ximenes, E. F. (2012). Enchentes e saúde pública: Uma questão na literatura científica recente das causas, consequências e respostas para prevenção e mitigação. *\*Ciência & Saúde Coletiva\**.
24. Genovez, M. E. (2009). Leptospirose: Uma doença de ocorrência além da época das chuvas. *\*Biológico*, 71\*(1), 1-3.
25. Green, C., et al. (1985). The health effects of flooding: Survey at Uphill, Avon. Enfield, Middlesex Polytechnic, Flood Hazard Research Centre.
26. Health Protection Agency. (2010). *\*Microbial risk assessment. Incidence of vector borne diseases in Europe\**. Porton Down, Wiltshire: Emergency Response Department.
27. IBGE – Instituto Brasileiro de Geografia e Estatística. (2022). *\*Cidades e estados\**. Brasília, DF: IBGE.
28. Kondo, H., Seo, N., Yasuda, T., Hasizume, M., Koido, Y., Ninomiya, N., & Yamamoto, Y. (2002). Post-flood epidemics of infectious diseases in Mozambique. *\*Prehospital and Disaster Medicine*, 17\*(3), 126-133.
29. Lau, C. L., et al. (2010). Climate change, flooding, urbanization and leptospirosis: Fuelling the fire? *\*Transactions of the Royal Society of Tropical Medicine and Hygiene*, 104\*, 631-638.
30. Lemos, R. M. A. (n.d.). *\*Dinâmica de enchentes na bacia hidrográfica do Rio dos Macacos, RJ, Brasil\**. Disponível em: [https://www.seb-ecologia.org.br/revistas/indexar/anais/2009/resumos\\_ixceb/1929.pdf](https://www.seb-ecologia.org.br/revistas/indexar/anais/2009/resumos_ixceb/1929.pdf). Acesso em: 15 jul. 2024.




31. Levy, K., et al. (2016). Untangling the impacts of climate change on waterborne diseases: A systematic review of relationships between diarrheal and temperature, rainfall, flooding, and drought. \*Environmental Science & Technology, 50\*(10), 4905-4922. <https://doi.org/10.1021/acs.est.5b06186>
32. Malilay, J. (2000). Inundaciones. In E. K. Noji (Ed.), \*Impacto de los desastres en la salud pública\* (pp. 21-34). Bogotá, Colombia: Organización Panamericana de la Salud.
33. Marcondes, C. B., & Ximenes, M. F. F. M. (2016). Zika virus in Brazil and the danger of infestation by Aedes (Stegomyia) mosquitoes. \*Revista da Sociedade Brasileira de Medicina Tropical, 49\*(1), 4-10. <https://doi.org/10.1590/0037-8682-0121-2016>
34. Mendonça, F. A., Veiga, S., Souza, A., & Dutra, D. A. (2009). Saúde pública, urbanização e dengue no Brasil. \*Sociedade & Natureza, 21\*(3), 257-269. <https://doi.org/10.1590/S1413-81232009000300007>
35. Ministério das Cidades/Instituto de Pesquisas Tecnológicas. (2007). \*Mapeamento de riscos em encostas e margens de rios\*. Brasília: Ministério das Cidades. Disponível em: <http://www.capacidades.gov.br/biblioteca>
36. Morais, V. d. S., et al. (2023). Detecção de coinfeção com Eritroparvovírus 1 e arbovírus primatas (DENV, CHIKV e ZIKV) em indivíduos com doença febril aguda no estado do Rio Grande do Norte em 2016. \*PLoS Neglected Tropical Diseases, 17\*(11), e0011701. <https://doi.org/10.1371/journal.pntd.0011701>
37. Nichols, G., Lake, I., & Haevicide, C. (2018). Climate change and water-related infectious diseases. \*Atmosphere, 9\*(1), 1-60. <https://doi.org/10.3390/atmos9010001>
38. Paz, M. G. A., Almeida, M. F., & Gunther, W. M. R. (2012). Prevalência de diarreia em crianças e condições de saneamento e moradia em áreas periurbanas de Guarulhos, SP. \*Revista Brasileira de Epidemiologia, 15\*(1), 188-197. <https://doi.org/10.1590/S1415-790X2012000100016>
39. Paterson, D. L., Wright, H., & Harris, P. N. A. (2018). Health risk of flood disasters. \*Clinical Infectious Diseases, 67\*(10), 1450-1454. <https://doi.org/10.1093/cid/ciy496>
40. Rodrigues, T. A. (2019). Impactos ambientais hidrológicos ocasionados pelo desflorestamento metropolitano, Rio de Janeiro. \*Sustinere\*, 8-9. Disponível em: <https://www.publicacoes.uerj.br/index.php/sustinere/article/view/188327/12845>
41. São Paulo, Secretaria Estadual da Saúde. (2021). \*Relatório anual de saúde - 2021\*. São Paulo: Secretaria Estadual da Saúde. Disponível em: <http://www.saude.sp.gov.br/coordenadoria-de-controle-de-doencas/noticias/22032024-conheca-os-sintomas-da-dengue-as-fases-da-doenca-e-os-sinais-de-alerta>
42. Silva, E. (2015). Modernização, sanitarismo e cotidiano (Jacobina - BA 1955-1959). \*Campina Grande – PB\*, 17-18. Disponível em: <http://dspace.sti.ufcg.edu.br:8080/jspui/bitstream/riufcg/1172/1/EDSON%20SILVA%20%e2%80%93%20DISSERTA%20c3%87%20c3%83O%20%28PPGH%29%202015.pdf>
43. World Health Organization. (2018). \*Chemical releases caused by natural hazards events and disasters – Information for public health authorities\*. Geneva: World Health Organization.



44. World Health Organization. (2013). \*Floods in the WHO European Region: Health effects and their prevention\*. The Regional Office for Europe of the World Health Organization. Copenhagen, Denmark.
45. Woolhouse, M. E. J. (2006). Where do emerging pathogens come from? \*Microbe, 1\*(11), 511-515. <https://doi.org/10.1128/microbe.1.11.511-515.1>
46. Young, P. R. (2018). Arboviruses: A family on the move. In R. Hilgenfeld & S. Vasudevan (Eds.), \*Dengue and Zika: Control and antiviral treatment strategies\* (Vol. 1062, pp. 1-11). Springer. [https://doi.org/10.1007/978-981-10-8727-1\\_1](https://doi.org/10.1007/978-981-10-8727-1_1)

## "What has been studied about Technostress?": A Systematic Review of Literature under scientific production from 2001 to 2022

 <https://doi.org/10.56238/sevened2024.016-015>

Marjori Gonçalves Lencina<sup>1</sup>, Kathiane Benedetti Course<sup>2</sup> and Paulo Cassanego Jr<sup>3</sup>

### ABSTRACT

This study aims to analyze the state of the art of scientific production on Technostress, according to the Web of Science and Scopus platforms. Based on the principles of the Systematic Review of the Literature (RSL), the available textual corpus on "Technostress" was explored. After searching the database, 296 articles were found through the application of selection filters, after using the exclusion criteria, a textual corpus of 130 articles was reached. Subsequently, a more specific analysis of the most cited articles was carried out, as well as the most current ones. To compile the data, the HistCiteTM and VOSviewer software were used. Regarding the results, it was possible to identify that from 2019 onwards a growing movement in studies on technostress began, and that the author Tarafdar is one of the most influential researchers among the 390 authors and co-authors. Currently, the context of the pandemic and Technostress are in evidence, since there has been an expansion in the use of information and communication technology for the development of professional and educational activities, being then one of the most explored contexts - the educational environment - since before the pandemic scenario.

**Keywords:** Systematic Review of the Literature, Technostress.

---

<sup>1</sup> Master's student in Business Administration  
Federal University of Pampa

E-mail: marjorilencina@gmail.com

<sup>2</sup> Doctor in Business Administration  
Federal University of Pampa

E-mail: kathianecorso@unipampa.edu.br

<sup>3</sup> Doctor in Business Administration  
Federal University of Pampa

E-mail: paulo.cass@gmail.com



## INTRODUCTION

The transition from an industrial to a knowledge society occurred rapidly, in the context of the knowledge society, before users adapted to an even more advanced technology (CREDE & MANSELL, 1998; SALMI, 2003).

According to the studies of Weil and Rosen (1997), this conjuncture can generate two beliefs, routinely associated by individuals with technological development: (1) Computers will dominate the world and (2) computers are indispensable for humanity.

However, the accelerated advancement of technologies can outpace their usefulness, thus causing anxiety and hopelessness (Shu *et al.*, 2011) and promote the appearance of *Technostress*, a term first addressed by Craig Brod, a psychiatrist in 1984, who highlighted it as a disease of modern adaptation. Shortly thereafter, Champion (1998) defined it as a consequence of the use of technologies.

Therefore, in this context and seeking to understand what surrounds *Technostress*, the following question arises: What is the state of the art of *Technostress studies*?

To achieve the questioning, the general objective is: To analyze the state of the art of scientific production on *Technostress*, according to the Web of Science and Scopus platforms. In order to achieve the established general objective, it is intended to carry out a systematic literature review – RSL.

Nevertheless, the present study proposes to expand the study by Beltrame and Bobsin (2020) who searched for the term "*Technostress*" in the Web Of Science database in the period (2000-2020) and highlighted that the topic of *Technostress* is emerging, grows annually, despite being a topic that is still little researched, especially in Brazil. In addition, As a suggestion for future studies, the authors highlight that other researchers carry out systematic reviews in order to cover any gaps, as well as carry out research after the year 2020. An example of a study that expanded the theme after 2022 was by SCHOLZ *et al.*, (2022) who proposed to carry out a bibliometrics where results showed that there are few authors who publish on the subject, highlighting the author Monideepa Tarafdar. In addition, the predominance of North American publications on the subject was evidenced and there was a significant growth in publications, reaching its peak in 2019.

To this end, this systematic literature review proposes to carry out searches on the topic of *Technostress* in the two largest databases – Web Of Science and Scopus – in order to broaden the view on the theme and observe the changes in the scenario from the turn of the millennium to the post-pandemic period in 2022.

This article is structured in five sections, initially presented in the first section to the introduction with the problem, justification and objectives of the proposed theme. In the second section, the literature review addresses the central theme of the study: *Technostress*. Next, the third



section presents the methodology used, the fourth section observes the results and later the fifth section highlights the conclusions of the study, limitations and suggestions for future studies.

## THEORETICAL FRAMEWORK

### TECHNOSTRESS

The term *Technostress* was first addressed by psychiatrist Craig Brod (1984), for which the author described it as being – a disease of modern adaptation – which refers to a kind of disorder caused by the inability to deal with technology.

Other researchers also contributed to the advancement of the term, such as: Champion (1998) defined it as a consequence of technology, Weil and Rosen (1997) highlighted that it is a negative impact directly or indirectly provided by technology, Arnetz and Wiholm (1997) proposed that it is a kind of psychophysiological state.

Currently, La Torre *et al* (2019) corroborate by highlighting that *Technostress* is a disease that presents physical, psychological, cognitive and behavioral symptoms.

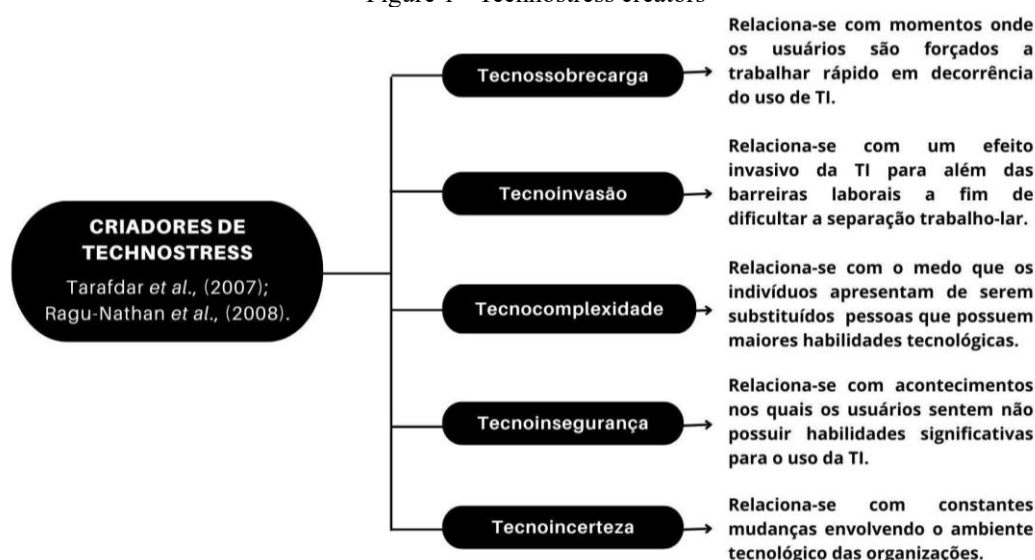
Melo and Nascimento (2009, p. 332) point out that:

Technostress manifests itself in three basic stages. In the initial stage, the person is usually stimulated by the possibilities of technology and solves a simple problem, such as printing a report, and feels fulfilled in front of the solution. In the intermediate stage, with the impossibility of using technology, anger attacks become more and more frequent and symptoms such as headaches and muscle tension begin to appear. In the final stage, health is seriously compromised and technostress becomes chronic.

In this sense, these 3 stages can evolve gradually. In the literature there are the creators of *Technostress* who describe the motivations that lead individuals to present *Technostress*.

To this end, the creators of *Technostress* – figure 1 – show that *Technostress* can manifest itself by increased overload, exhaustion, exhaustion and decreased job satisfaction (TARAFDAR *et al.*, 2007; RAGU-NATHAN *et al.*, (2008).

Figure 1 - Technostress creators



Source: Prepared by the authors based on Tarafdar et al., (2007) and Ragu-Nathan et al., (2008).

Tarafdar et al., (2007) in their study entitled "*The impact of technostress on role stress and productivity*" was one of the first empirical studies on *Technostress* and identified that it has a negative impact on individual productivity. In a subsequent study, Ragu-Nathan et al., (2008) in "*The consequences of technostress for end users in organizations: Conceptual development and empirical validation*" elaborated a conceptual model that lists the 5 elements of Figure 1 as "factors that create *Technostress*" and suggested that *Technostress* corroborates the decrease in job satisfaction.

Based on these studies, the factors that create *Technostress* can be measured by means of an instrument developed by Tarafdar et al., (2007) and Ragu-Nathan et al., (2008), which enabled other researchers to look at the theme from different areas of knowledge and points of view.

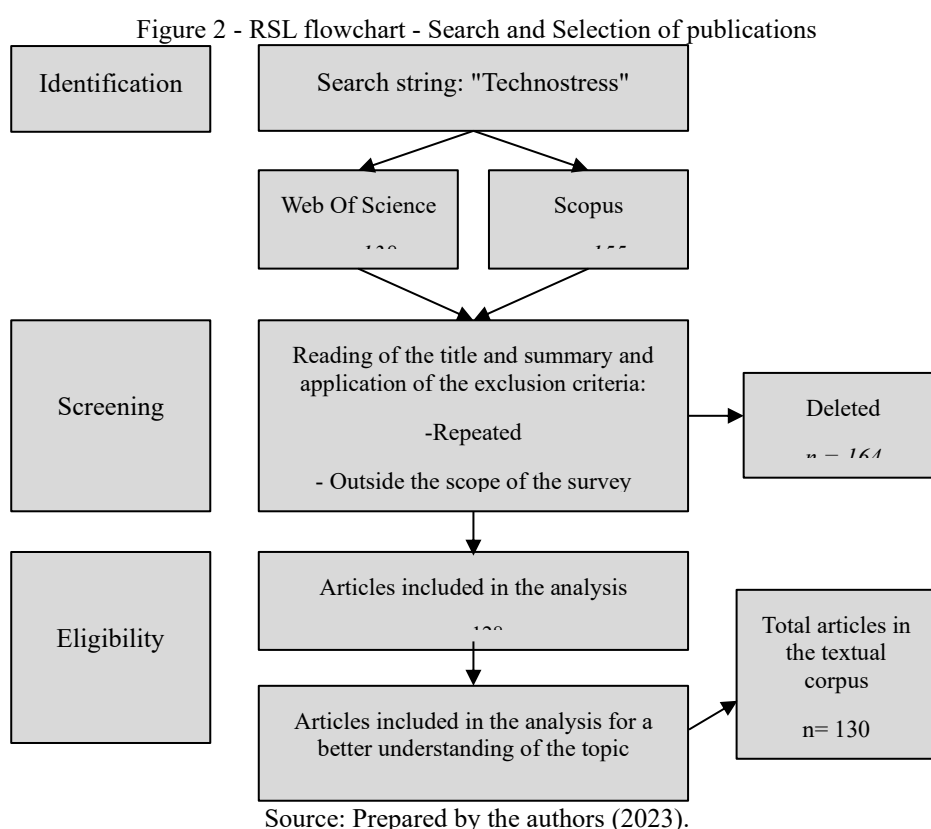
The next chapter aims to report the methodological path followed in this study, which provided support for the subsequent analysis of the results.

## METHODOLOGICAL PROCEDURES

In this section, issues related to the methodological path were addressed, thus, in order to meet the general objective of the study, which is to analyze the state of the art of scientific production on *Technostress*, it is intended to seek evidence in the scientific literature in order to carry out a Systematic Review of Literature (RSL). To this end, it was decided to carry out a systematic review of the literature, since this type of study corroborates the identification and analysis of the most relevant studies (TRANFIELD; DENYER; SMART, 2003).

In addition, the assumptions of the RSL were followed according to Tranfield et al., (2003), which is divided into three phases: 1) Review Planning - it was decided which protocol would be followed in the study, that is, research question, inclusion and exclusion criteria; 2) Conduction - the search for the string was carried out within the Web Of Science and Scopus databases, later, the

studies were analyzed based on the research question and following the criteria for removal of duplicate articles and exclusion; 3) Dissemination of Knowledge - detailing of the data of each of the articles that make up the textual corpus - annual distribution of the research corpus; analysis of the composition of the authorship of the articles; relationship between the authors of the articles; statistics of the number of citations received by the authors; most relevant words of the articles - subsequently, the interpretative analysis of the data was performed. Nevertheless, viewing the list of most cited articles, the need to include Tarafdar *et al.*, (2007) and Ragu-Nathan *et al.*, (2008) for a better understanding of the theoretical advance, since these articles are embryonic of the theme, thus, figure 1, can be seen the steps for the construction of the textual corpus of the article.



Consequently, section 4 presents the results of the present study.

## ANALYSIS OF THE RESULTS

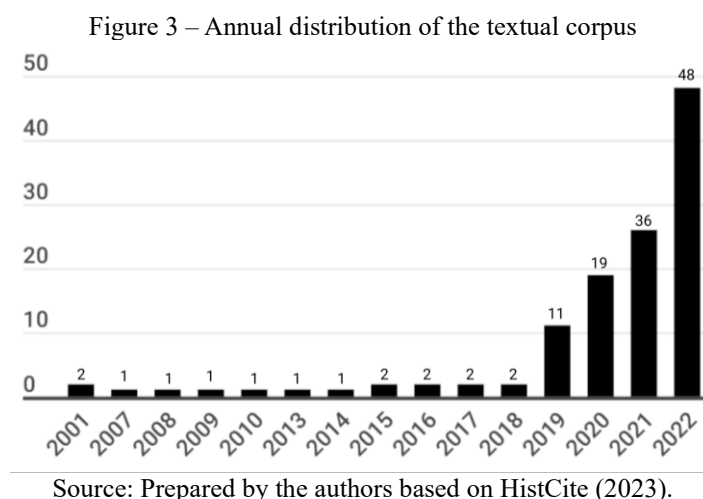
From the studies carried out and the construction of the textual corpus, it becomes possible to discuss the analysis of the evolution of the theme of *Technostress*.

## ANNUAL DISTRIBUTION OF THE RESEARCH CORPUS

The theme of *Technostress* is included in several researches around the world, for this, the articles that make up the sample textual corpus of this research total 128 studies, cover 86 different

journals and approximately 390 authors and co-authors, registered in the Web of Science and Scopus databases. Figure 02 shows the distribution of these articles over the years, in terms of annual quantity.

It can be seen that in the last year of the first decade (2001-2019) a growing movement of publications begins, since, in the years prior to 2019, 1 or 2 articles were presented per year, followed by a growing and significant increase from 2020 onwards, when the process of social distancing occurs in order to contain the advance of the Covid-19 pandemic.



Among these, the article published in 2007 deserves to be highlighted, which obtained the highest number of citations of the entire time series, presenting 458 global citations in the Web of Science and Scopus databases, the work developed by Tarafdar, M., Tu, Q., Ragu-Nathan, B. S., & Ragu-Nathan, T. S. (2007), entitled *The impact of technostress on role stress and productivity*. *Journal of management information systems*, v. 24, n. 1, p. 301-328, 2007. It is worth mentioning that Tarafdar is also leading the *ranking* of authors with the most studies in the present textual corpus, followed by Pirkkalainen and Salo, respectively.

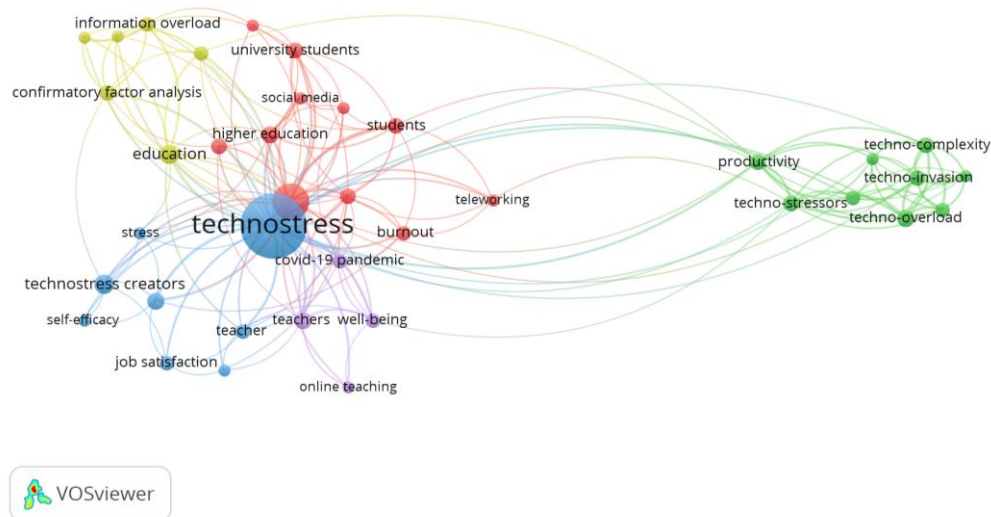
In the next topic we find the general thematic mapping of the studies involving all the years that make up the textual corpus.

## THEMATIC MAPPING

For the analysis of the main themes addressed in function of the textual corpus of this article, the VOSviewer software was used. To this end, a thematic mapping was created in order to enable the identification, frequency and intensity of the most addressed themes (nodes) and their relationships (edges), as can be seen in figure 3.

Through the mapping it was possible to see beyond the visible occurrences, that is, it was also possible to verify the connections between the terms, as well as the clusters of themes that were formed – represented by the colors yellow, blue, green, red and purple.

Figure 4 – Thematic mapping of the textual corpus



Source: Prepared by the authors based on the textual corpus (2023).

It is noted that the graphic grouping corroborates the identification of the lexical content, as well as the term that stands out in the textual corpus, where the term *Technostress* stands out, which is the basic concept of this study.

To create the map of the most addressed themes in the textual corpus, abstracts and keywords were used, for this, the software selection criterion was followed, and thus, only the terms with at least 3 occurrences were selected, obtaining a total of 39 terms, represented by the nodes in the network. In this sense, the words: *Technostress* (90 occurrences), *Covid-19* (25 occurrences) and *Education* (7 occurrences) stood out, evidenced in figure 2 – graph – by the size of the circle, the higher it is, the greater its importance within the networks, connecting *distinct clusters* – in this case 5 – and establishing this interconnection (FREEMAN, 1979).

It is noteworthy that the grouping between the graphs – *Technostress* and *covid-19* – occurs as a result of the significant increase in the growth of scientific production from 2019 onwards, when social distancing began as a way to contain the advance of the Covid-19 pandemic, and the use of technology intensified.

In this sense, the clusters that were formed show 5 groups, namely:

a) *Blue Cluster* - refers to the beginning of research on the theme, as the term is found with a larger circle, highlighting its importance within the network. In addition, in this respective cluster are the terms *Technostress creators*, *job satisfaction*, *teacher*, *self-efficacy* and *stress*, and the creators of *Technostress* and relationships that can be searched together can be highlighted.

(b) *Yellow Cluster* - This is the progress of the studies and concerns the scenario of well-being and confirmation of questionnaires that later serve to corroborate with the other clusters.

c) *Red Cluster* - highlights the ramifications of research that emerged during the pandemic and relates more directly to universities and students' mental health issues.

d) *Purple Cluster* - Portrays the studies that also took place during the pandemic period, however, in this cluster the studies are more directed to teachers.

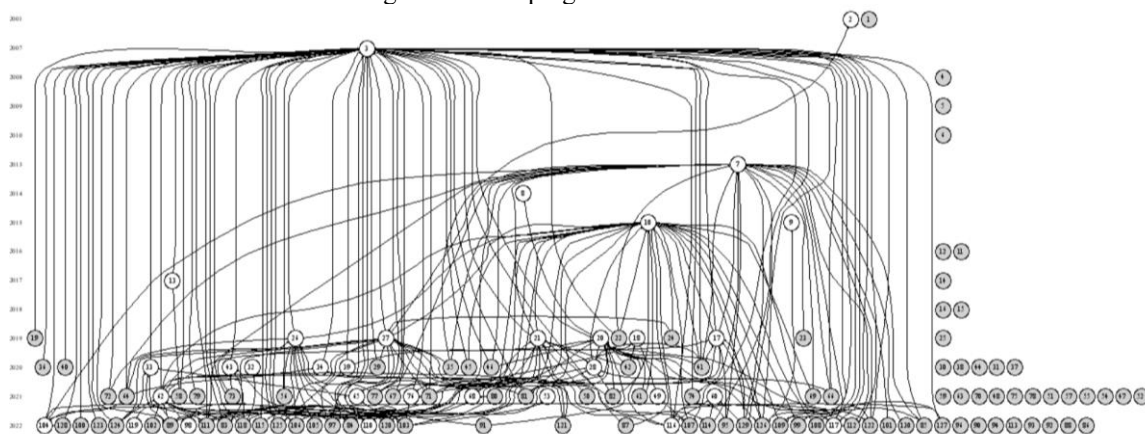
e) *Green Cluster* - addresses the dimensions of *Technostress* and/or techno-stressors where the terms – *techno-complexity*, *techno-overload*, *techno-invasion* and related to *productivity* are included.

To this end, it is evident that of the 5 clusters studied, 4 of them have some term related to the educational environment - teachers, students, online teaching and education - which highlights that this context is on the rise and the remaining *cluster* refers to the dimensions studied in the Technostress research.

## ADVANCEMENT OF THE THEME OF TECHNOSTRESS OVER THE YEARS

The first studies of *Technostress* based on the textual corpus began with Tarafdar *et al.*, (2007), respectively with Salanova *et al.*, (2013). These authors, as shown in figure 4, present themselves as a theoretical basis for other generations of researchers on the subject, which ends up gaining strength in 2019, where 5 influential studies are evidenced.

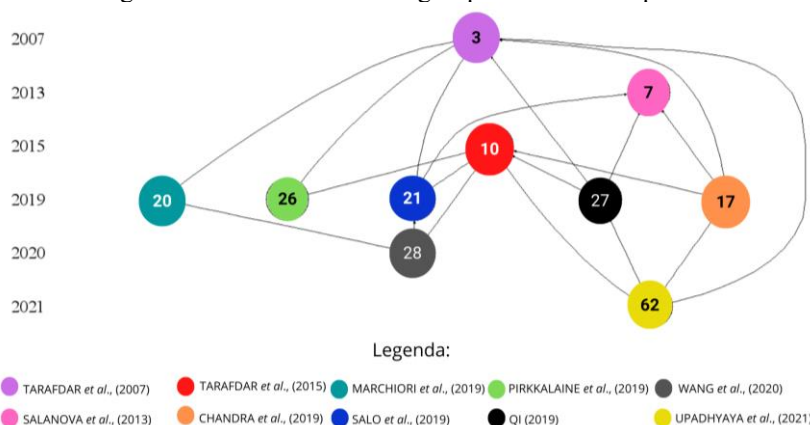
Figure 5 - Grouping of most cited authors



Source: Prepared by the authors based on HistCite (2023).

In order to understand the connections between the studies, the network of influence between the authors was highlighted, taking into account the 10 studies that stand out the most in order to have a better understanding, as shown in figure 5.

Figure 6 – Distribution of the group of authors - expanded



Source: Prepared by the authors based on HistCite (2023).

According to figure 5, the authors who present themselves as a basis for the other researchers in the network are Tarafdar *et al.*, (2007) and Salanova *et al.*, (2013), according to the number of citations – 458 – Tarafdar is one of the largest references for the textual corpus. To this end, chart 1 points out these articles, that is, the studies with the highest number of citations, demonstrating through the textual corpus that there is a variety of themes.

Chart 1 - General information of the most cited articles in the textual corpus

Code	Title	Year	Quotes	Authors	Source Title
3	The impact of technostress on role stress and productivity.	2007	458	Tarafdar, M., Tu, K., Ragu-Nathan, B. C., & Ragu-Nathan, T. C	Journal of management information systems
7	The dark side of technologies: Technostress among users of information and communication technologies	2013	177	LET'S GO, MARISA; LLORENS, Susana; CIFRE, Eva.	International journal of psychology
10	Technostress: negative effect on performance and possible mitigations	2015	246	Tarafdar, Manideepa; Pullins, Ellen Bollman; Ragu-Nathan, T. S.	Information Systems Journal
17	Does technostress inhibit employee innovation? Examining the linear and curvilinear influence of technostress creators.	2019	21	CHANDRA, Shalini; SHIRISH, Anuragini; SRIVASTAVA, Shirish C	Communications of the Association for Information Systems
20	Do individual characteristics influence the types of technostress reported by workers?	2019	48	MARCHIORI, Danilo Magno; MAINARDES, Emerson Wagner; RODRIGUES,	International Journal of Human-Computer Interaction

				Ricardo Gouveia.	
21	Technostress and social networking services: Explaining users' concentration, sleep, identity, and social relation problems.	2019	57	SALO, Markus; PIRKKALAINEN, Henri; KOSKELAINEN, Tiina	Information Systems Journal
26	Deliberate or instinctive? Proactive and reactive coping for technostress	2019	58	PIRKKALAINEN, Henri; SALO, Markus; TARAFDAR, Monideepa; MAKKONEN, Markus.	Journal of Management Information Systems
27	A double-edged sword? Exploring the impact of students' academic usage of mobile devices on technostress and academic performance	2019	60	QI, Gong	Behaviour & Information Technology
28	Measuring university students' technostress in technology-enhanced learning: Scale development and validation	2020	14	WANG, Xinghua; TAN, Seng Chee; LI, Lu	Australasian Journal of Educational Technology
62	Impact of technostress on academic productivity of university students	2021	30	Upadhyaya, Pallavi; Vrinda.	Education and Information Technologies

Source: Prepared by the authors based on HistCite (2023).

According to chart 1, with regard to the context of the most cited articles, the authors sought to carry out their research in different scenarios: intensive and non-intensive users of information and communication technology, institutional sales professionals, professionals from public institutions, users of websites and social networking services, users of organizational IT, executives/knowledge workers, employees who use IT in their workplace and students at public and private universities, that is, corroborating so that the theme of *Technostress* will be studied in various environments.

Regarding the most cited article, this is the study by Tarafdar *et al.*, (2007) where the authors sought to study the effects of stress created by the use of ICTs in relation to paper stress and individual productivity, concluding that technostress inversely affects productivity and that the validation of the relationship between technostress and paper stress creates a new thread for literature, It analyzes the relationship between: a) technology, b) organizational roles and c) structure.

Therefore, in chart 2 the articles analyzed in chart 1 can be visualized, now specifically analyzing the objective, context and main results/contributions.



Chart 2 - Article contextualizing the most cited articles of the textual corpus

Code	Objective	Context	Results/Contributions
3	Explore the effects of stress created by information and communication technology (ICT) – i.e. "technostress" – on paper stress and individual productivity.	ICT users in 223 organizations.	<p>Or <i>technostress</i> inversely afeta</p> <p>In other words, it is reinforced that failure to manage the effects of stress-induced ICT can compensate for the expected increases in productivity.</p> <p>Furthermore, the validation of the relationship between <i>technostress</i> and paper stress adds a new conceptual thread to the literature analyzing the relationship between technology and organizational roles and structure. In the practical domain, the article proposes a diagnostic tool to evaluate</p> <p>The extent to which <i>technostress</i> is present in an organization suggests that the adverse effects of technostress can be partially countered by strategies that reduce the role of conflict and role overload.</p>
7	To test the structure and predictors of two specific technostress experiences ( <i>technostrain</i> and <i>technoaddiction</i> ) in the workplace.	1072 ICT users, of which 675 (52% women) were non-intensive ICT users and 397 were intensive ICT users (62% were women).	<p>Non-intensive ICT users experience significantly more anxiety, scepticism and ineffectiveness than intensive ICT users.</p> <p>It is concluded that <i>techno-strain</i> and <i>techno-addiction</i> are two different but interrelated experiences of <i>technostress</i> in intensive ICT users.</p>
10	They examine the impact of <i>technostress</i> creators (TSC) on innovation and sales professional performance.	237 institutional sales professionals.	Negative association between <i>technostress</i> and performance creators.
17	Examine the influence technostress creators have on employees innovation.	164 senior managers.	The results offer a nuanced understanding about the nature of <i>individual technostress</i> creators and their relationships to ICT-enabled employee innovation.
20	To detect whether personal characteristics related to gender, age, educational level, and professional experience influence the way in which they are impacted by <i>technostress</i> , through the analysis of technostress-creating factors.	927 questionnaires applied in 14 different Brazilian public institutions that were distributed in all regions of the country and that were heavily dependent on IT for their main business processes.	Demographic characteristics were related in a different and specific way to the various forms of technostress manifestation, i.e., older workers or those with greater professional experience reported greater difficulties with the increase in technological complexity for the execution of tasks (techno-complexity). Women reported being subject to higher levels of techno-complexity and techno-uncertainty, while men indicated feeling greater effects of techno-overload and techno-invasion.
21	Examine the various wellbeing-related stresses	32 users of websites and social networking services	They reveal four types of well-being-related stresses (concentration

	these stressors can create, nor the underlying SNS.	(SNS) who experienced SNS stress.	problems, sleep problems, identity problems, and social relationship problems), as well as two different patterns with distinct sets of NHS stressors and NHS characteristics that generate these stresses.
26	Examine how proactive and reactive coping behaviors, individually and in tandem, enable organizational IT users to cope with <i>technostress</i> .	846 organizational IT users.	Theoretical contribution by identifying ways in which organizational IT users can deal with <i>technostress</i> .
27	To investigate the double-edged effect of the academic use of mobile devices.	208 university students.	Academic use of mobile devices does not lead to <i>technostress</i> ; however, it does help improve academic performance. In addition, individual student differences, e.g. the self-efficacy of mobile technology and the extent of use significantly influence <i>technostress</i> .
28	Develop a psychometric scale to measure <i>technostress levels</i> of college students in technology-enhanced learning.	620 students from two public universities in China.	The development of scale based on the theory of Person-Environment fit and <i>technostress</i> . Upon completion, he arrived at a scale with robust psychometric properties, step important in detecting maladaptive students and maintaining their psychological well-being, better exploiting the benefits associated with technology, and increasing students' constructive and active participation in technology-enhanced learning.
62	Investigate the impact of <i>technostress</i> on students' academic productivity.	673 Indian private university students.	The <i>technostress instrument</i> is valid for use in the academic context, and students experienced moderate levels of <i>technostress</i> . It was also found that <i>technostress</i> had a negative impact on students' academic productivity.

Source: Prepared by the authors based on HistCite (2023).

Since, in chart 2, the context where *Technostress* was researched can be seen in a broader way, it is clear that the academic community is a well-explored scenario, as they addressed contexts such as: productivity versus effects of *Technostress*, development of a scale to measure the possible levels of *Technostress* in students, investigate the effects of academic use of mobile devices and *Technostress*element. Table 3 shows the articles with the most recent publications on the subject of *Technostress*.

Table 3 - Latest articles on Technostress

Title	Year	Quotes	Authors	Source Title
The Role of Mindfulness in Mitigating the Negative Consequences of Technostress	2022	7	Iono, at that; LYCETT, Mark; MARSHAN, Alaa.	Information Systems Frontiers
Factors Influencing Teacher's Technostress Experienced in Using Emerging Technology: A Qualitative Study	2022	7	KHLAIF, Zuheir N; Shanmugam, Maheswaran; JOMA, Amjad; ODEH, Ahmad; BARHAM, Kefah.	Technology, Knowledge and Learning
An examination of remote e-working and flow experience: The role of technostress and loneliness	2022	12	TASER, Didem; AYDIN, Esra; TORGALÖZ, Alev Özer; ROFCANIN, Yasin	Computers in Human Behavior
Technostress in a hostile world: older internet users before and during the COVID-19 pandemic	2022	21	Nimrad, abused.	Aging & Mental Health
Teleworking and technostress: early consequences of a COVID-19 lockdown	2022	8	CAMACHO, Sonia; BARRIOS, Andrés.	Cognition, Technology & Work
The relationship between Technostress levels and job satisfaction of Teachers within the COVID-19 period	2022	7	AKTAN, Osman; TORAMAN, Cetin	Education and Information Technologies

Source: Prepared by the authors based on HistCite (2023).

Regarding chart 3, it can be inferred that the work by Nimrod (2022), published in 2022, being the most cited, brings a discussion about the fact that older adults are ignored in *Technostress studies*. To this end, in order to fill this gap, we sought to explore the individual and contextual antecedents for *Technostress* among older information and communication technology users. The study by Nimrod (2022) highlights that the factors that predict *Technostress* are not having good health, fewer years of use, fewer hours of use per week and smaller repertoire of use, it also highlights that individual antecedents hardly vary in the presence of significant contextual antecedents.

Other themes, in recent studies, address emerging perspectives, such as: the role of mindfulness to corroborate the consequences of *Technostress*, *Technostress* and loneliness, teleworking and *Technostress* in the Covid-19 scenario, the relationship between job satisfaction and *Technostress* in teachers during the Covid-19 pandemic.

## FINAL CONSIDERATIONS

The present research aimed to analyze the state of the art of scientific production on *Technostress*, and thus it was decided to carry out a systematic literature review in order to map and



treat the most relevant academic productions about "*Technostress*" in the organizational literature in two important scientific journals – Web Of Science and Scopus.

As can be seen in the discussion of the results, there was an annual growth, as a result of the increase in publications within the platforms, especially when isolation begins to contain the advances of the Covid-19 pandemic. To this end, this movement gave rise to other research relationships such as the role of mindfulness to corroborate the consequences of *Technostress*, *Technostress* and loneliness, teleworking and *Technostress* in the Covid-19 scenario. But studies in the educational area were also highlighted, one of the most explored when it comes to the theme of *Technostress*.

In addition, as for the descriptive analysis of the research corpus (130 articles), it revealed 390 authors and co-authors, in a production that covers the years 2001 to 2022, highlighting a growing movement that begins to occur in 2019 and especially in the following years – 2020, 2021 and 2022 – with about 103 articles published.

With regard to thematic mapping, the words that stand out the most are *Technostress* (90 occurrences), Covid-19 (25 occurrences) and *Education* (7 occurrences), which highlights that the theme has been widely studied, especially during the Covid-19 pandemic, reinforcing the movement of expanded scientific production from 2019 onwards. This movement is due to the fact that during the pandemic several sectors began to develop their activities remotely, which ended up increasing the number of individuals who used information and communication technologies (ICTs) to carry out their respective jobs and in education it was no different, as students and teachers went into the home making classes continue through Emergency Remote Teaching, which also expanded the time of these individuals with ICTs.

One of the most important authors in the studies is Tarafdar, being the most cited author and one of the main ones in the network of influence for research in *Technostress*, in general the studies sought several scenarios: intensive and non-intensive users of information and communication technology, institutional sales professionals, professionals from public institutions, users of websites and social network services, users of organizational IT, executives/knowledge workers, employees who use IT in their workplace and students from public and private universities, that is, corroborating so that the theme of *Technostress* will be studied in various environments.

Therefore, the most current research on the subject sought other relationships between productivity and the effects of *Technostress*, development of a scale to measure the possible levels of *Technostress* in students, investigate the effects of academic use of mobile devices and *Technostress*.

To this end, through this study it aims to contribute to research on the theme of *Technostress*, contributing with other researchers on the international scientific production of this theme. In addition, the main authors were identified and what new associations of the theme have been



emerging, which can serve as a basis to expand the scenarios of observation of the phenomenon. As limitations, searches are carried out on platforms with different *strings*, *since in this article this process was carried out with only one, as suggestions for future research, it is suggested the elaboration of a research agenda on the theme of Technostress.*



## REFERENCES

1. Arnetz, B. B., & Wiholm, C. (1997). Technological stress: Psychophysiological symptoms in modern offices. *Journal of Psychosomatic Research*, 43\*(1), 35-42. [https://doi.org/10.1016/S0022-3999\(97\)00007-8](https://doi.org/10.1016/S0022-3999(97)00007-8)
2. Champion, S. (1988). Technostress: Technology's toll. *School Library Journal*, 35\*(3), 48-51.
3. Credé, A., & Mansell, R. E. (1998). *Knowledge societies—in a nutshell: Information technology for sustainable development\**. Ottawa: International Development Research Centre.
4. Beltrame, G., & Bobsin, D. (2021). Uma análise da produção acadêmica sobre o technostress (2000-2020). *REAd. Revista Eletrônica de Administração (Porto Alegre)*, 27\*, 285-312. <https://doi.org/10.1590/1679-395120220015>
5. Brod, C. (1984). *Technostress: The human cost of the computer revolution\**. Reading, Mass.: Addison-Wesley.
6. Freeman, L. C. (1978). Centrality in social networks: Conceptual clarification. *Social Networks*, 1\*(3), 215-239. [https://doi.org/10.1016/0378-8733\(78\)90021-7](https://doi.org/10.1016/0378-8733(78)90021-7)
7. La Torre, G., Esposito, A., Sciarra, I., & Chiappetta, M. (2019). Definition, symptoms and risk of techno-stress: A systematic review. *International Archives of Occupational and Environmental Health*, 92\*(1), 13-35. <https://doi.org/10.1007/s00420-018-1343-3>
8. Melo, J. N. de, & Nascimento, M. T. M. (2009). Tecnoestresse: Tecnologia. *Revista IGT na Rede*, 6\*(11), 329-333.
9. Ragu-Nathan, T. S., Tarafdar, M., Ragu-Nathan, B. S., & Tu, Q. (2008). The consequences of technostress for end users in organizations. *Information Systems Research*, 19\*(4), 417-433. <https://doi.org/10.1287/isre.1070.0165>
10. Scholz, R. E. dos S., da Silva, L. F. M., & Ferraz, R. C. (2022). Análise bibliométrica e proposição de uma agenda de pesquisa sobre o technostress na área de sistemas de informação. *Revista ADM. MADE*, 26\*(1), 35-52. <https://doi.org/10.5935/2176-7545.20220003>
11. Salmi, J. (2003). Constructing knowledge societies: New challenges for tertiary education. *Higher Education in Europe*, 28\*(1), 65-69. <https://doi.org/10.1080/0379772032000070105>
12. Shu, Q., Tu, Q., & Wang, K. (2011). The impact of computer self-efficacy and technology dependence on computer-related technostress: A social cognitive theory perspective. *International Journal of Human-Computer Interaction*, 27\*(10), 923-939. <https://doi.org/10.1080/10447318.2011.555829>
13. Tarafdar, M., Tu, Q., Ragu-Nathan, B. S., & Ragu-Nathan, T. S. (2007). The impact of technostress on role stress and productivity. *Journal of Management Information Systems*, 24\*(1), 301-328. <https://doi.org/10.2753/MIS0742-1222240109>
14. Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14\*(3), 207-222. <https://doi.org/10.1111/1467-8551.00375>



15. Weil, M., & Rosen, L. D. (1997). \*Technostress: Coping with technology @work @home @play\*. New York: J. Wiley.



## APPENDIX A - TOTAL ARTICLES IN THE TEXTUAL CORPUS

Code	Title	Anus	Authors	Source Title
1	Overcoming technostress in reference services to adult learners	2001	QUINN, Brian	The Reference Librarian
2	Technological change in the workplace: A statewide survey of community college library and learning resources personnel.	2001	Poole, C. E., Denny, E.	College & Research Libraries
3	The impact of technostress on role stress and productivity	2007	Tarafdar, M., Tu, K., Ragu-Nathan, B. C., Ragu-Nathan, T. C.	Journal of management information systems
4	The consequences of technostress for end users in organizations: Conceptual development and empirical validation	2008	Ragu-Nathan, T. C., Tarfdar, M., Ragu-Nathan, B. C., Tu, K.	Information systems research
5	Social networking users' views on technology and the determination of technostress levels.	2010	Sahin, Y. L., Çoklar, A. N.	Procedia-Social and Behavioral Sciences
6	Translation, adaptation and exploration of psychometric properties of technostress scale (RED/TIC)	2013	Carlotto, M.S; Câmara, S.G.	Psychology in Study
7	The dark side of technologies: Technostress among users of information and communication technologies	2014	Salanova, M., Llorens, S., Cifre, E.	International journal of psychology
8	Moderating effect of technostress inhibitors on the relationship between technostress creators and organisational commitment.	2015	Ahmad, U. N. U., Amin, S. M., Ismail, W. K. W.	Sains Humanika
9	Conceptual framework: AIS technostress and its effect on professionals' job outcomes	2015	Saganuwan, M. U., Ismail, W. K. W., Ahmad, U. N. U	Asian Social Scienc
10	Technostress: negative effect on performance and possible mitigations.	2015	Tarafdar, M., Pullins, E. B., Ragu-Nathan, T. S	Information Systems Journal
11	The impacts of smartphone addiction and technostress on customer satisfaction and loyalty.	2016	Kim, D., Shin, J.	International Journal of Security and Its Applications
12	Exploring technostress: Results of a large sample factor analysis	2016	Jonušauskas, S., Raišienė, A. G.	Journal of Information and Organizational Sciences
13	Technostress, career commitment, satisfaction with life, and work-family interaction among workers in information and communication technologie	2017	Carlotto, M. S., Welter Wendt, G., Jones, A. P.	News in Psychology



14	An investigation on exhaustion of SAP ERP users: Influence of pace of change and technostress.	2017	Roy, P. K., Mahmud, I., Jahan, N., Sadia, F.	Annals of Emerging Technologies in Computing (AETiC)
15	Understanding User Characteristics as Antecedents of Technostress towards HRMIS: A Mixed-Method Study	2018	Ibrahim, H., Shamsudin, F. M., Zin, M. L. M., Subramaniam, C.	Journal of Management
16	The Facebook sabbatical as a cycle: Describing the gendered experience of young adults as they navigate disconnection and reconnection.	2018	Franks, J., Chenhall, R., Keogh, L.	Social Media+ Society
17	Does technostress inhibit employee innovation? Examining the linear and curvilinear influence of technostress creators	2019	Chandra, S., Shirish, A., Srivastava, S. C.	Communications of the Association for Information Systems
18	Teachers' Technostress Levels as an Indicator of Their Psychological Capital Levels	2019	Efiliti, E., Çoklar, A. N.	Universal Journal of Educational Research
19	The effects of leadership styles and internet addiction on technostress.	2019	Souza, R. L. D., Cappellozza, A.	Administration in Dialogue Journal
20	Do individual characteristics influence the types of technostress reported by workers?	2019	Marchiori, D. M., Mainardes, E. W., Rodrigues, R. G.	International Journal of Human-Computer Interaction
21	Technostress and social networking services: Explaining users' concentration, sleep, identity, and social relation problems	2019	Salo, M., Pirkkalainen, H., Koskelainen, T.	Information Systems Journal
22	The mediating role of coping behavior on the age-technostress relationship: A longitudinal multilevel mediation model.	2019	Hauk, N., Göritz, A. S., Krumm, S.	PloS one
23	Work Techno-resources and its impact on Technostress. A case study	2019	Ruiz Dominguez, V. E., Rios, M., Sánchez-Fernández, M. D.	International Journal of Innovation
24	Technostress among university teachers in higher education: A study using multidimensional person-environment misfit theory.	2019	Wang, X., Li, B.	Frontiers in Psychology
25	Predictors of Technostress in distance education teachers	2019	Goebel, D. K., Carlotto, M. S.	Technology and Society Journal
26	Deliberate or instinctive? Proactive and reactive coping for technostress	2019	Pirkkalainen, H., Salo, M., Tarafdar, M., Makkonen, M.	Journal of Management Information Systems,
27	A double-edged sword? Exploring the impact of students' academic usage of mobile devices on technostress and academic performance.	2019	Qi, C.	Behaviour & Information Technology
28	Measuring university students' technostress in technology-enhanced	2020	Wang, X., Tan, S. C., Li, L.	Australasian Journal of Educational



	learning: Scale development and validation.			Technology
29	Exploring the effects of excessive texting through mobile applications on students' technostress and academic writing skills in the Arabic language	2020	Al-Abdullatif, A. M., Alsubaie, M. A., Aldoughan, E. A	IEEE Access
30	Technostress mitigation: An experimental study of social support during a computer freeze	2020	Weinert, C., Maier, C., Laumer, S., Weitzel, T.	Journal of Business Economics
31	A novel construct to measure employees' technology-related experiences of well-being: Empirical validation of the Techno-Work Engagement Scale (TechnoWES)	2020	Mäkiniemi, J. P., Ahola, S., Joensuu, J.	Scandinavian Journal Of Work And Organizational Psychology
32	When mobile technologies simultaneously influence well-being and stress at work.	2020	Loup, P., Maurice, J., Rodhain, F.	Information Systems and Management
33	Explaining the link between technostress and technology addiction for social networking sites: A study of distraction as a coping behavior.	2020	Tarafdar, M., Maier, C., Laumer, S., Weitzel, T.	<i>Information Systems Journal</i>
34	Technology addictions and Technostress: An examination of the US and China.	2020	Brooks, S., Wang, X., Schneider, C.	Journal of Organizational and End User Computing (JOEUC)
35	Teacher technostress in the Chilean school system.	2020	Estrada-Muñoz, C., Castillo, D., Vega-Muñoz, A., Boada-Grau, J.	International Journal of Environmental Research and Public Health
36	Wellbeing costs of technology use during Covid-19 remote working: An investigation using the Italian translation of the technostress creators scale.	2020	Molino, M., Ingusci, E., Signore, F., Manuti, A., Giancaspro, M.L., Russo, V., Cortese, C. G.	Sustainability
37	Examining the effect of overload on the mHealth application resistance behavior of elderly users: an SOR perspective	2020	Cao, Y., Li, J., Qin, X., Hu, B.	International Journal of Environmental Research and Public Health
38	Healthcare managers' experiences of technostress and the actions they take to handle it—a critical incident analysis	2020	Stadin, M., Nordin, M., Fransson, E. I., Broström, A.	<i>BMC medical informatics and decision making</i> ,
39	A relationship between technostress, satisfaction at work, organizational commitment and demography: evidence from the Brazilian Public Sector.	2020	Marchiori, D. M., Felix, A. C. S., Popadiuk, S., Mainardes, E. W., Rodrigues, R. G.	<i>Management &amp; Technology Magazine</i>
40	Elaboration of social media performance measures: from the perspective of social media discontinuance behavior.	2020	Kang, I., Zhang, Y., Yoo, S.	Sustainability



41	Technostress in Spanish university students: validation of a measurement scale.	2020	Penado Abilleira, M., Rodicio-García, M. L., Rios-de-Deus, M. P., Mosquera-González, M. J.	Frontiers in psychology
42	Motivation and continuance intention towards online instruction among teachers during the COVID-19 pandemic: The mediating effect of burnout and technostress.	2020	© 2018 Panisoara, A.S. All right. All right.	International Journal of Environmental Research and Public Health,
43	Taking on the “dark side”—Coping with technostress.	2020	Tarafdar, M., Pirkkalainen, H., Salo, M., Makkonen, M.	IT professional
44	Reliability and validity of a stress scale in public employees from Murcia (Spain).	2020	Rodríguez-González-Moro, M. T., Gallego-Gómez, J. I., Rodríguez-González-Moro, J. M., Cano, M. C. C., Rivera-Caravaca, J. M., Simonelli-Muñoz, A. J.	International Journal of Environmental Research and Public Health
45	Technostress: how does it affect the productivity and life of an individual? Results of an observational study.	2020	La Torre, G., De Leonardis, V., Chiappetta, M.	<i>Public Health</i>
46	Workaholism and technostress during the COVID-19 emergency: The crucial role of the leaders on remote working.	2020	Spagnoli, P., Molino, M., Molinaro, D., Giancaspro, M. L., Manuti, A., Ghislieri, C.	Frontiers in psychology
47	The impact of Technostress on student satisfaction and performance expectancy	2021	Abd Aziz, N. N., Kader, M. A. R. A., Ab Halim, R.	Asian Journal of University Education
48	Perceived technostress while learning a new mobile technology: Do individual differences and the way technology is presented matter?	2021	Jurek, P., Olech, M., Brycz, H.	Human Technology
49	Technostress, work performance, job satisfaction, and career commitment of teachers amid COVID-19 crisis in the Philippines.	2021	Cahapay, M. B., Bangoc II, N. F.	IJERI: International Journal of Educational Research and Innovation,
50	The dark side of mobile learning via social media: how bad can it get?.	2021	Loh, X. K., Lee, V. H., Loh, X. M., Tan, G. W. H., Ooi, K. B., Dwivedi, Y. K.	Information Systems Frontiers
51	Examining individual demographic and school support factors regarding teachers’ intention to use technology: A hierarchical regression analysis.	2021	Huang, M., Li, X., Zhang, J.	International Journal of Emerging Technologies in Learning (Online)
52	Consequences of COVID-19 confinement for teachers: Family-work	2021	Solís García, P., Lago Urbano, R., Real	International Journal of Environmental



	interactions, technostress, and perceived organizational support.		Castelao, S.	Research and Public Health
53	Gamification in E-Learning: The Mitigation Role in Technostress.	2021	Fajri, F. A., Haribowo P, R. Y., Amalia, N., Natasari, D.	<i>International Journal of Evaluation and Research in Education,</i>
54	The mediating effects of ego resilience on the relationship between professionalism perception and technostress of early childhood teachers.	2021	Lee, J. Y., Kim, S. Y.	International Journal of Learning, Teaching and Educational Research
55	Correlation technostress creators with empoyess' Work-Life Balance in the context of Journalists' Use of information and communication technology at work: moderating role of self-efficacy	2021	Mohammed, I. A., Nizam, O. M., Lawal, G. A., Thi, V. P.	International Journal of Media and Information Literacy
56	Innovations in human resources management of higher education institutions: technostress factors.	2021	Bencsik, A. Csinger B.	Marketing And Management Of Innovations
57	The mediating role of work-family conflict in the relationship between supervisor support and job satisfaction.	2021	Ngah, N., Ahmad, A., Hamid, T. A. T. A., Ismail, A.	The International Journal of Interdisciplinary Social Sciences
58	Technostress in students of a public university in the Peruvian Amazon during the COVID-19 pandemic	2021	Araoz, E.G.E., Ramos, N.A.G., Loayza, K.H.H, Valverde, Y.P., Herrera, R.Q.	Brazilian Journal Of Rural Education
59	Investigating the impact of technostress on productivity and overall life satisfaction of managers working at a South African ferrochrome smelting company.	2021	Le Roux, D. J. Botha, P. A.	SA Journal of Human Resource Management
60	The impact of self-esteem, conscientiousness and pseudo-personality on technostress.	2021	Korzynski, P., Rook, C., Florent Treacy, E., Kets de Vries, M.	Internet Research
61	Technostress in Spanish university teachers during the COVID-19 pandemic.	2021	Penado Abilleira, M., Rodicio-García, M. L., Rios-de Deus, M. P., Mosquera-González, M. J.	Frontiers in psychology
62	Impact of technostress on academic productivity of university students.	2021	Upadhyaya, P.	Education and Information Technologies
63	Does the end justify the means? The role of organizational communication among work-from-home employees during the COVID-19 pandemic.	2021	Zito, M., Ingusci, E., Cortese, C. G., Giancaspro, M. L., Manuti, A., Molino, M., Russo, V.	International Journal of Environmental Research and Public Health
64	Overwhelmed by technostress? Sensitive archetypes and effects in times of forced	2021	González-López, Ó. R., Buenadicha-	International Journal of Environmental

	digitalization.		Mateos, M., Sánchez-Hernández, M. I.	Research and Public Health
65	How adolescents cope with technostress: A mixed-methods approach.	2021	Schmidt, M., Frank, L., Gimpel, H.	International Journal of Electronic Commerce
66	Technostress of Chilean Teachers in the Context of the COVID-19 Pandemic and Teleworking.	2021	Estrada-Muñoz, C., Vega-Muñoz, A., Castillo, D., Müller- Pérez, S., Boada- Grau, J.	International journal of environmental research and public health
67	Impacts of digital technostress and digital technology self-efficacy on Fintech usage intention of Chinese Gen Z consumers.	2021	Lee, Y. K.	Sustainability
68	Technostress among health professionals—a multilevel model and group comparisons between settings and professions.	2021	Golz, C., Peter, K. A., Zwakhalen, S. M., Hahn, S.	Informatics for Health and Social Care
69	Can leaders prevent technology from backfiring? Empowering leadership as a double-edged sword for technostress in care.	2021	Bauwens, R., Denissen, M., Van Beurden, J., Coun, M	Frontiers in Psychology
70	Late-night use of social media and cognitive engagement of female entrepreneurs: a stressor–strain–outcome perspective.	2021	Shahzad, F., Abbas, A., Fateh, A., Kasim, R. S. R., Akram, K., Ashraf, S. F.	SAGE Open
71	Influence of technostress on academic performance of university medicine students in Peru during the COVID-19 pandemic.	2021	Alvarez-Risco, A., Del-Aguila- Arcentales, S., Yáñez, J. A., Rosen, M. A., Mejia, C. R.	Sustainability
72	Investigating the impact of technostress on productivity and overall life satisfaction of managers working at a South African ferrochrome smelting company.	2021	le Roux, D. J., Botha, P. A.	SA Journal of Human Resource Management
73	COVID-19 crisis and digital stressors at work: A longitudinal study on the Finnish working population.	2021	Oksanen, A., Oksa, R., Savela, N., Mantere, E., Savolainen, I., Kaakinen, M.	Computers in Human Behavior
74	Healthcare personnels' technostress and individual innovativeness levels: Digital hospital example Technostress, individual innovativeness.	2021	Ozer, Z., Ozcelik, S. K., Bahcecik, A. N., Ucar, S. E.	Annals of Clinical and Analytical Medicine
75	Technoagism and Technical Behavior of Elderly Citizens: Results of Russian and Belarusian Research.	2021	Karapetan, R. V., Lebedev, A. V., Titarenko, L. G.	Advances in Gerontology
76	Effects of remote virtual work environment during COVID-19	2021	Gabr, H. M., Soliman, S. S.,	Environmental Science and Pollution

	pandemic on technostress among Menoufia University Staff, Egypt: A cross-sectional study.		Allam, H. K., Raouf, S. Y. A.	Research
77	Technostress and employee performance nexus during COVID-19: training and creative self-efficacy as moderators.	2021	Saleem, F., Malik, M. I., Qureshi, S. S., Farid, M. F., Qamar, S.	Frontiers in Psychology
78	Consequences of COVID-19 confinement for teachers: Family-work interactions, technostress, and perceived organizational support.	2021	Solís García, P., Lago Urbano, R., Real Castelao, S.	International Journal of Environmental Research and Public Health
79	Technostress Analysis in Educational Institutions during the COVID-19 Confinement.	2021	Urbano, O. F. A., Chanchi, G. G. E., Campo, M. W. Y.	Tem Journal-Technology Education Management Informatics
80	Technostress and digital competence among health professionals in Swiss psychiatric hospitals: cross-sectional study.	2021	Golz, C., Peter, K. A., Müller, T. J., Mutschler, J., Zwakhalen, S. M., Hahn, S.	JMIR mental health
81	Technology-induced stress, sociodemographic factors, and association with academic achievement and productivity in Ghanaian higher education during the COVID-19 pandemic.	2021	Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., Johnson, E. E., Ebeheakey, A. K.	Information
82	The Achilles heel of technology: how does technostress affect university students' wellbeing and technology-enhanced learning.	2021	Wang, X., Li, Z., Ouyang, Z., Xu, Y.	International Journal of Environmental Research and Public Health
83	Technostress from smartphone use and its impact on university students' sleep quality and academic performance.	2022	Yao, N., Wang, Q.	The Asia-Pacific Education Researcher
84	Exploring early adolescents' stressful IT use experiences.	2022	Mehtälä, S., Salo, M., Tikka, S., Pirkkalainen, H.	Behaviour & Information Technology
85	The Role of Gender, TPACK, School Support and Job Satisfaction in Predicting the Technostress Levels of Social Studies Teachers.	2022	Edğan, E., & Akbaba, B.	Education & Science
86	Technostress Creators and Outcomes Among Egyptian Medical Staff and Students: A Multicenter Cross-Sectional Study of Remote Working Environment During COVID-19 Pandemic.	2022	Kasemy, Z. A., Sharif, A. F., Barakat, A. M., Abdelmohsen, S. R., Hassan, N. H., Hegazy, N. N., Abdelwanees, S.	Frontiers in Public Health
87	The role of mindfulness in mitigating the negative consequences of technostress.	2022	Ioannou, A., Lycett, M., Marshan, A.	Information Systems Frontiers
88	A Study of Technostress Levels of Secondary School Teachers in Malaysia	2022	Now Wahab, N. Y., Muhat, H., Razzali,	International Journal of Learning, Teaching



	During the COVID-19 Pandemic.		M.M., Baharudin, N.H.	and Educational Research
89	Technology-Enhanced Learning and Well-being: a Contribution to the Validation of a Measure to Assess University Students' Technostress in the Italian Context.	2022	Schettino, G., Marino, L., Capone, V.	International Journal of Mental Health and Addiction
90	Technostress Creators in Higher Education During the Covid-19 Pandemic: A Comparison of Faculty Perceptions and Experiences.	2022	Boyer-Davis, S., Berry, K.	Journal of Higher Education Theory & Practice
91	Psychometric properties of the Polish adaptation of Technostress Creators and Technostress Inhibitors Scale.	2022	Kot, P.	Occupational medicine
92	Mobile instant messaging technostressors: Measurement, dimensionality, and relationships with type of usage.	2022	Ardèvol-Abreu, A., Rodríguez-Wangüemert, C., Delponti, P.	Information Professional
93	Caught Unprepared: Consequences of Getting Full Online During a Pandemic.	2022	Arslan, A., Yener, S., KORKMAZ, F., Alola, U.	Journal of Research and Social Intervention
94	Technostress and its effect on productivity in university students in times of COVID-19.	2022	Salazar-Concha, C., Encina Ramírez, C., Rojas Ramírez, G., Araya-Guzmán, S.	Venezuelan Journal of Management
95	The Influence of Technostress, Learning Goal Orientation, and Perceived Team Learning Climate on Intra-Team Knowledge Sharing and Innovative Practices Among ICT-Enabled Team Members.	2022	Song, L., Ma, Z., Sun, J.	Scientometrics
96	Teachers' Work-Related Well-Being in Times of COVID-19: The Effects of Technostress and Online Teaching.	2022	Pace, F., Sciotto, G., Randazzo, N. A., Macaluso, V.	Social Sciences
97	Factors influencing teacher's technostress experienced in using emerging technology: A qualitative study.	2022	Khlaif, Z. N., Sanmugam, M., Joma, A. I., Odeh, A., Barham, K.	Technology, Knowledge and Learning
98	The Effect of Technostress on Online Learning Behaviour among Undergraduates.	2022	Kader, M. A. R. A., Abd Aziz, N. N., Zaki, S. M., Ishak, M., Hazudin, S. F.	Malaysian Journal of Learning and Instruction
99	Investigating e-retailers' intentions to adopt cryptocurrency considering the mediation of technostress and technology involvement	2022	Wu, R., Ishfaq, K., Hussain, S., Asmi, F., Siddiquei, A. N., Anwar, M. A.	Sustainability
100	The moderating effects of technostress inhibitors on techno-stressors and employee's well-being.	2022	Hang, Y., Hussain, G., Amin, A., Abdullah, M. I.	Frontiers in Psychology
101	An examination of remote e-working	2022	Taser, D., Aydin, E.,	Computers in Human

### Collection of International Topics in Health Sciences V.2

"What has been studied about Technostress?": A Systematic Review of Literature under scientific production from 2001 to 2022



	and flow experience: The role of technostress and loneliness.		Torgaloz, A. O., Rofcanin, Y	Behavior
102	Analysis of the Emotional Exhaustion Derived From Techno-Stress in the Next Generation of Qualified Employees.	2022	Buenadicha-Mateos, M., Sánchez-Hernández, M. I., González-López, Ó. R.	Frontiers in Psychology
103	Overcoming the “Dark Side” of Technology—A scoping review on preventing and coping with work-related technostress.	2022	Rohwer, E., Flöther, J. C., Harth, V., Mache, S. (	International journal of environmental research and public health
104	Technostress in a hostile world: Older internet users before and during the COVID-19 pandemic.	2022	Nimrod, G.	Aging & Mental Health
105	Employee mindfulness and proactive coping for technostress in the COVID-19 outbreak: The roles of regulatory foci, technostress, and job insecurity.	2022	Tuan, L. T.	Computers in Human Behavior
106	Examining the impact of algorithmic control on Uber drivers’ technostress.	2022	Cram, W. A., Wiener, M., Tarafdar, M., Benlian, A	Journal of Management Information Systems
107	Impact of Techno-Creators and Techno-Inhibitors on Techno-Stress Manifestations in Chilean Kindergarten Directors in the Context of the COVID-19 Pandemic and Teleworking.	2022	Estrada-Muñoz, C., Vega-Muñoz, A., Boada-Grau, J., Castillo, D., Müller-Pérez, S., Contreras-Barraza, N.	Frontiers in Psychology
108	Does Technostress Increase R&D Employees' Knowledge Hiding in the Digital Era?.	2022	Zhang, Z., Ye, B., Qiu, Z., Zhang, H., Yu, C.	Frontiers in Psychology
109	Technostress Creators and Job outcomes Performance among Frontliners: Theorizing the Moderating Role of Self-Efficacy.	2022	Saeedi, J., Guarantee, Z., Sadaka, R	Frontiers in Psychology
110	Technostressors—a boon or bane? Toward an integrative conceptual model.	2022	Ramesh, R., Ananthram, S., Vijayalakshmi, V., Sharma, P.	Journal of Indian Business Research
111	The phenomenon of technostress during the COVID-19 pandemic due to work from home in Indonesia.	2022	Farmania, A., Elsyah, R. D., Fortunisa, A.	Sustainability
112	Occupational risk of technostress related to the use of ICT among teachers in Spain.	2022	Rey-Merchán, M. D. C., López-Arquillos, A.	Sustainability
113	Attentional and Behavioral Disengagement as Coping Responses to Technostress and Financial Stress: An Experiment Based on Psychophysiological, Perceptual, and Behavioral Data.	2022	Korosec-Serfaty, M., Riedl, R., Sénécal, S., Léger, P. M.	Frontiers in Neuroscience




114	The influence of technostress, work–family conflict, and perceived organisational support on workplace flourishing amidst COVID-19.	2022	Harunavamwe, M., Ward, C.	Frontiers in Psychology
115	Encouraging positive emotions to cope with technostress’s adverse effects: insights into the broaden-and-build theory.	2022	Sriwidharmanely, S., Sumiyana, S., Mustakini, J. H., Nahartyo, E.	Behaviour & Information Technology
116	Teleworking and technostress: early consequences of a COVID-19 lockdown.	2022	Camacho, S., Barrios, A.	Cognition, Technology & Work
117	The relationship between Technostress levels and job satisfaction of Teachers within the COVID-19 period.	2022	Aktan, O., Toraman, C.	Education and Information Technologies
118	Effects of Instant Messaging Related Technostress on Work Performance and Well-Being.	2022	Hurbean, L., Dospinescu, O., Munteanu, V., Danaiaata, D.	Electronics
119	Technostress, coping, and anxious and depressive symptomatology in university students during the COVID-19 pandemic.	2022	Galvin, J., Evans, M. S., Nelson, K., Richards, G., Mavrtsaki, E., Giovazolias, T., Vallone, F.	Europe's Journal of Psychology
120	Examining the Moderating Role of Technostress and Compatibility in EFL Learners’ Mobile Learning Adoption: A Perspective from the Theory of Planned Behaviour (TPB).	2022	Wang, Q., Zhao, G., Cheng, Z.	Frontiers in Psychology
121	Problematic social media use and associated consequences on academic performance decrement during Covid-19.	2022	Homaid, A. A.	Addictive Behaviors
122	The impact of technostress on teacher educators’ work–family conflict and life satisfaction while working remotely during COVID-19 in Pakistan.	2022	Shaukat, S., Bendixen, L. D., Ayub, N.	Education Science
123	Digitalisation in Craft Enterprises: Perceived Technostress, Readiness for Prevention and Countermeasures—A Qualitative Study.	2022	Scheepers, L., Angerer, P., & Dragano, N.	International Journal of Environmental Research and Public Health
124	The Influence of Technostress on Cyberslacking of College Students in Technology-Enhanced Learning: Mediating Effects of Deficient Self-Control and Burnout	2022	Li, X., Liu, D.	International Journal of Environmental Research and Public Health
125	Parental involvement in distance K-12 learning and the effect of technostress: Sustaining post-pandemic distance education in Saudi Arabia.	2022	Al-Abdullatif, A. M., Aladsani, H. K.	Sustainability,
126	Validation of the Spanish version of the Technostress Creators Scale in Chilean	2022	Salazar-Concha, C., Ficapal-Cusi, P.,	Annals of Psychology



	Workers.		Peñarroja, V., Enache-Zegheru, M.	
127	Teachers' Work-Related Well-Being in Times of COVID-19: The Effects of Technostress and Online Teaching.	2022	Pace, F., Sciotto, G., Randazzo, N. A., Macaluso, V	Social Sciences
128	Technostress causes cognitive overload in high-stress people: Eye tracking analysis in a virtual kiosk test.	2022	Kim, S. Y., Park, H., Kim, H., Kim, J., Seo, K.	Information Processing & Management
129	Enforced remote working: The impact of digital platform-induced stress and remote working experience on technology exhaustion and subjective wellbeing.	2022	Singh, P., Bala, H., Dey, B. L., Filieri, R.	Journal of Business Research
130	Lecturers' technostress at a South African university in the context of coronavirus (COVID-19).	2022	Govender, R., Mpungose, C.	Cogent Education

Source: Prepared by the authors based on the textual corpus (2023).

## Acute Coronary Syndrome: Approach and impacts

 <https://doi.org/10.56238/sevened2024.016-016>

Luana Tavares Neves<sup>1</sup>, Luiz Osvaldo Becker Geraldí<sup>2</sup>, Alissa Paglioco Correia<sup>3</sup>, Ana Clara Haluch Maoski Kleiner<sup>4</sup>, Gabriela Alves Miranda Damaceno<sup>5</sup>, Thomaz Nassif George Bassi<sup>6</sup>, Luiz Henrique Gonçalves dos Santos<sup>7</sup>, Lucas Mendonça Silva de Ávila<sup>8</sup>, Anderson Kretschmer<sup>9</sup>, Walter Rocha Passos Nieto<sup>10</sup>, Julia Pina Vieira dos Santos<sup>11</sup> and Larissa Guerra Fernandes<sup>12</sup>

### ABSTRACT

Chest pain is one of the most frequent reasons for seeking emergency care. Among the causes of this pain, acute coronary syndrome comprises one of the main pathologies. Such a syndrome is serious, and must be correctly diagnosed, in order to carry out the correct management of the patient, avoiding irreducible consequences. The objective of this study is to provide the necessary support for the understanding of this syndrome as a whole. For this, a narrative literature review was carried out, with the delimitation of articles published in the last 5 years, from 2019 to 2024, in the Index Scielo and Pubmed bibliographic databases. Articles that did not meet the criteria established in the methodology were discarded, resulting in a total of 25 selected articles. After careful analysis, the information collected served as a basis for the construction of the

<sup>1</sup> Graduation in progress. UNICESUMAR University, Maringá-PR.

E-mail: luanataneves@gmail.com

ORCID: <https://orcid.org/0009-0003-2925-6149>

<sup>2</sup> Graduation in progress. UNICESUMAR University, Maringá-PR.

E-mail: luiz.becker@icloud.com

ORCID: <https://orcid.org/0009-0005-5473-2519>

<sup>3</sup> Graduation in progress. UNICESUMAR University, Maringá-PR.

E-mail: alissa\_paglioco@hotmail.com

ORCID: <https://orcid.org/0009-0001-0692-2167>

<sup>4</sup> Graduation in progress. UNICESUMAR University, Maringá-PR.

E-mail: anaclarakleiner@hotmail.com

ORCID: <https://orcid.org/0009-0006-5996-5765>

<sup>5</sup> Medical. Graduated from the University of Western São Paulo (UNOESTE), Pres. Prudente-SP

E-mail: gabiammiranda@gmail.com

ORCID: <https://orcid.org/0009-0003-8730-0785>

<sup>6</sup> Graduation in progress. Centro Universitário Municipal de Franca (UNI-FACEF), Franca-SP

E-mail: thomazbassi09@gmail.com

ORCID: <https://orcid.org/0009-0004-4800-3611>

<sup>7</sup> Graduation in progress. Universidade Brasil, Fernandópolis-SP

E-mail: enfermeiro-luiz@hotmail.com

ORCID: <https://orcid.org/0009-0007-5815-6576>

<sup>8</sup> Graduation in progress. University Center of Goiatuba, Goiatuba-GO

E-mail: lucasmsavila17@alunos.unicerrado.edu.br

ORCID: <https://orcid.org/0009-0002-3657-4607>

<sup>9</sup> Doctor. Graduated from the Federal University of São Paulo (UNIFESP), São Paulo-SP

E-mail: andersonkrets@hotmail.com

ORCID: <https://orcid.org/0009-0005-8675-1554>

<sup>10</sup> Doctor. Graduated from the Polytechnic and Artistic University of Paraguay. Ciudad del Este-PY.

E-mail: walterfelli@yahoo.com.br

ORCID: <https://orcid.org/0009-0006-4244-7806>

<sup>11</sup> Medical. Graduated from the Evangelical University of Goiás, Anápolis-GO

E-mail: juliapinavs@gmail.com

ORCID: <https://orcid.org/0009-0005-5016-6927>

<sup>12</sup> Medical. Graduated from the Evangelical University of Goiás, Anápolis-GO

E-mail: Larissa.guerrafernandes@gmail.com

ORCID: <https://orcid.org/0009-0003-5181-0441>



review. It was observed that the syndrome is extremely important, especially in the scenario of emergency medicine and emergency care. Thus, it is necessary that physicians be properly trained on the subject, in order to avoid unfavorable outcomes for patients, and iatrogenesis.

**Keywords:** Acute Coronary Syndrome, Infarction, Clinical Management, Case Administration.



## INTRODUCTION

Cardiovascular diseases are, in the current scenario, still very responsible for global morbidity and mortality. Among them, acute coronary syndrome occupies a place of extreme importance, and is responsible for a considerable portion of hospitalizations, which progressively increases over time (Carvalho et al., 2022). With the lack of knowledge about the approach and management of the subject, countless cases are misdiagnosed or simply treated incorrectly, and the consequences of such actions are not long in coming. All of this leads to excessive expenses for the health system, which could be better managed and even avoided with the correct approach to the condition in question, by health professionals.

When we talk about acute coronary syndrome, the symptom reported by patients is, essentially, chest pain, which is one of the most frequent causes of emergency room visits. Despite this, not all patients with chest pain actually have an ACS and estimates indicate that about 25% of patients actually have a diagnosis of acute coronary syndrome, which again raises the issue of the correct management of this pain in the context of medical care (Brazilian Society of Cardiology, 2021).

Acute coronary syndrome encompasses a spectrum of clinical and laboratory manifestations resulting from the imbalance between oxygen supply and demand in cardiac tissues, resulting in acute myocardial ischemia. This complex of acute syndromes is classified according to its representation on the electrocardiogram (ECG), and thus, there are three main types: unstable angina (UA), non-ST-elevation acute myocardial infarction (NSTEMI), and ST-elevation acute myocardial infarction (STEMI) (Bassan; Bassan, 2006; Carvalho et al., 2022).

Despite being divided into three clinical forms, essentially the pathophysiology of ACS is the same for all of them, and is mainly due to the development and instability of atherosclerotic plaques, formed from cholesterol deposits (Bassan; Bassan, 2006). This process can occur suddenly, or occur gradually throughout life. The problem with plaque stability is commonly associated with plaque rupture, or coagulation problems, which course with the subsequent development of thrombi, which cause myocardial ischemia (Carvalho et al., 2022).

The lack of oxygenation of cardiac tissues can lead to clinical manifestations, especially in the change of the "st" segment of the ECG. However, such a change is not a rule, and therefore the syndrome also includes infarctions that course without alterations in the exam (Carvalho et al., 2022). Therefore, taking into account the severity of the disease and the fact that an incorrect diagnosis can be fatal for the patient, it was established that the ECG should be performed and interpreted within the first ten minutes of medical contact with the patient who has chest pain suspected of ACS (Brazilian Society of Cardiology, 2021).



The risk factors for diseases in general are divided into modifiable and non-modifiable. For ACS, the relationship between modifiable factors and individuals' lifestyle habits is notorious. Such habits can be important contributors to the development of the pathology. As an example, we can mention smoking, high-fat diets, sedentary lifestyle, among others. Previous evidence indicates that ACS tends to be more influenced by these factors, which provides ways to avoid or delay the onset of the syndrome, with a simple change in lifestyle (Carvalho et al., 2022; Saints; Axe; Menezes, 2018). There are also non-modifiable factors, which include advanced age, male gender and family history. In this second group, it is not so easy to change the course of the disease, but knowledge of such fundamentals can be useful in guiding patients during continued care (Santos; Axe; Menezes, 2018).

The syndrome complex also has particularities of clinical presentation and outcome, according to the group of affected individuals. Regarding the disparity between the sexes, it was demonstrated that women with acute myocardial infarction (AMI) are less likely to need reperfusion techniques and clinical treatment, while men have higher reperfusion rates. In addition, it was also observed that there is a lower awareness of the risks among women. As a result of hormonal influences, and the postmenopausal period, it was also observed that when present in women, ACS is associated with older age, and also with the accumulation of other comorbidities and risk factors (Soeiro et al., 2018).

All this knowledge is important when we discuss acute coronary syndrome, and with this it is imperative to highlight that this group of pathologies is complex and requires a lot of study, since professionals are faced daily with cases indicative of one of the three syndromes, and the diagnosis must be made as soon as possible, to avoid irreversible consequences resulting from cardiac hypoperfusion.

In view of the importance of the theme for the health scenario of the population as a whole, and knowing that encouraging the adoption of healthy practices by individuals can contribute significantly to mitigating the impacts of coronary syndrome, we intend with this review to provide the necessary subsidies for the practical understanding of acute coronary syndrome in general, in such a way that we will address its main points, and especially the management of the sick. Therefore, it is also expected that the review will contribute to the implementation of new public policies, and also health promotion actions aimed at this theme, since awareness can help avoid unnecessary expenses and overloads on the health system.

## **MATERIALS AND METHODS**

The present study is a qualitative analysis of a descriptive character, of the narrative review of the literature type. Such methodology is broad and aims to describe and discuss data found on a given subject, based on the analysis of previous literary evidence, from a theoretical and contextual point of



view (Rother, 2007). Added to this is the importance of narrative reviews for continuing education and as a way to provide a basis for future research on the subject. This methodology was chosen in view of the breadth and importance of the theme, and as a way to explore the maximum number of characteristics that describe, in general, the group of syndromes that make up ACS.

The main theme was searched in the Pubmed and Index Scielo (Scientific Electronic Library Online) literary databases using the denominator "Acute coronary syndrome". In order to address current knowledge, the period from 2019 to 2024 (last 5 years) was delimited. In addition, the articles could be written in English, Portuguese and Spanish, and only texts available in full were screened.

At the first moment of screening, the results were selected based on the denominator being present in the title, keywords or abstract of the publications. From this, the second screening took place, made more carefully from the reading of the abstract. Thus, the texts that applied to the theme and match the objectives to be studied in the review were selected. The excluded articles did not meet the established criteria, and were therefore discarded during the screening period.

Subsequently, all the articles included in the review were read and analyzed in a careful manner, in order to extract the necessary information for the construction of the literature review. Finally, as a way to organize the findings and facilitate understanding, the theme was subdivided into the main topics that should be understood about ACS: epidemiology and risk factors, pathophysiology, clinical picture, diagnosis, approach, and management. The development of the discussion took place based on this division.

## RESULTS AND DISCUSSION

The research strategy resulted in 1,026 publications, 781 of which were from Pubmed and the other 245 from Scielo. Of these, 64 were selected after the first screening, and finally, 25 articles satisfactorily met the objectives and criteria. Of the articles that made up the review, 03 were written in Portuguese and the other 22 in English.

From what was found in the literature, it is evident the importance of understanding the mechanisms behind the syndrome, in order to consequently elucidate gaps in its approach and management in patient care. Thus, the subcategories related to the understanding of the syndrome were divided in order to facilitate understanding and organize the findings in the reviewed evidence.

## EPIDEMIOLOGY AND RISK FACTORS

Despite scientific advances, which contribute to the treatment and development of prevention measures, acute coronary syndrome still remains one of the leading causes of death globally (Abukhalil et al., 2024). Corroborating this, WHO data show that in 2016, ischemic heart disease was responsible for more than 9 million deaths worldwide (Soares, 2020; World Health Organization,

2018). It is believed that much of this is related to the prevalence of risk factors, and therefore the importance of clarifying them (Magalhães; CADE, 2019).

Among the factors reported in the literature are: male gender, smoking, advanced age, hypertension, hyperlipidemia, diabetes mellitus, unhealthy diet, physical inactivity, obesity, previous history of coronary artery disease (CAD), and family history of premature CAD. Their relationship with the development of the disease is clear when relating them to the pathophysiology. Thus, taking into account that the main etiology is atherosclerosis, everything that contributes to the formation of plaques consequently becomes a risk factor for ACS (Abukhalil et al., 2024; Ali et al., 2024).

With regard to smoking, it alone is already related to a greater propensity to develop numerous diseases. Cardiovascular diseases are added to the list, precisely because of its association with atherosclerosis and strokes (Abukhalil et al., 2024). The pathophysiology behind this lies in increased fibrinogen levels, endothelial cell damage, higher levels of platelet aggregation, and vasospasm, all of which are the results of smoking. Smoking is more frequently present in men, and in addition, it can reduce the expected age for the development of cardiovascular events resulting from this risk factor by 10 years. (Shrateh et al., 2024).

The comorbidities hypertension and diabetes are related to ACS due to their association with the cardiovascular system. The two conditions involve endothelial alterations, vascular inflammation, and arterial remodeling in their history of evolution, mechanisms that can result in ischemia of cardiac tissue (Abukhalil et al., 2024). In addition, hypercholesterolemia and high-density lipoprotein, as well as hypertriglyceridemia, obesity, and insulin resistance are factors that may increase the risk of ACS at a young age (Shrateh et al., 2024).

In addition, evidence indicates that the hormone estrogen, in women, works as a protective factor, and prevents the formation of atherosclerosis. Therefore, the lower the chances of developing atherosclerosis, the lower the chances of having an eventual ischemic event resulting in ACS. Therefore, the highest prevalence is in males (Abukhalil et al., 2024; Shrateh et al., 2024).

In the study by Abukhalil et al., 2024, the reported data demonstrate in practice the presentation of these factors. In this cohort, of the 255 patients included, most were men, aged 60 years. The most evidenced comorbidities were hypertension and type 2 diabetes mellitus (Abukhalil et al., 2024). Another study by Shamaki et al., 2024 evaluated the presentation of ACS in younger patients, and observed that young people who do not have such traditional cardiovascular risk factors have worse hospital outcomes, such a result is controversial and requires more research addressing the topic (Shamaki et al., 2024).

Thus, with the recognition of the risk factors most associated with ACS in scientific evidence, it is possible to affirm that personalized interventions aimed at mitigating modifiable risk factors are essential to reduce the occurrence of coronary syndrome cases in the current population.





## PATHOPHYSIOLOGY

The mechanism that is most strongly related to ACS, based on the literature and evidence, is atherosclerosis. In addition to ACS, chronic arterial diseases are also related to atherosclerosis, which shows its potential to damage the vessels, causing damage to the cardiovascular system (Rocha; Aguiar, 2020). Succinctly, what occurs, as a rule, is partial or complete occlusion of the coronary artery, causing myocardial ischemia and a potential infarction, and the degree of obstruction is what will determine the severity of the disease (Abukhalil et al., 2024; Cui; Guo; Li, 2024). In agreement, previous research states that nearly half of all sudden cardiac arrests are related to acute plaque complications (Juntunen et al., 2024).

Going deeper into the details of the pathophysiology, the process of plaque formation has been described as a result of the gradual accumulation of cholesterol. In particular, what occurs is receptor-mediated uptake that sequesters the modified low-density lipoprotein, causing it to accumulate in the subendothelial intima layer of the vessel. With the increase in uptake and a greater amount of cholesterol concentrated at the site, plaque increases so much, leading to progressive stenosis, and reducing blood flow (Rocha; Aguiar, 2020; Yu et al., 2024).

As a systemic process, inflammation plays a role in the pathogenesis of the syndrome by promoting extracellular traps of immune cells in the growing plaque. Neutrophil infiltration is critical to regulate inflammation, causing elevated levels of pro-inflammatory cytokines such as IL-1 $\beta$ , IL-6, and tumor necrosis factor. Leukocytes enter the endothelial cells, and cause the formation of microvasculature, causing instability and increasing the chances of plaque rupture. Thus, the atheromatous (atherosclerotic plaque) is the result of a dynamic process, and comprises a living center of inflammatory reactions. In addition, the inflammatory process and subsequent reactions contribute to the evolution of plaque, thrombogenesis, and can even cause activation of the catabolic activities of metabolism, leading to excessive energy expenditure (Yuxiu et al., 2024; Rock; Aguiar, 2020; Yu et al., 2024; Simon et al., 2024; Jercalau et al., 2024).

It is notorious that the growth of plaque itself can already be a factor in occlusion of the artery, but in addition, it is important to note that the rupture of plaque is also one of the causes of such obliteration. When plaque ruptures, the exposed collagen residue generates a cascade of thrombotic events, leading to platelet adhesion and thrombi formation that prevent oxygenation of the heart (Cui; Guo; Li, 2024; Rock; Aguiar, 2020). A partially blocked coronary artery is responsible for unstable angina, whereas coronary arteries with more advanced, complete or almost complete blocks, accompanied by early automatic thrombolysis in the body, will be responsible for AMI, which can be with or without ST unevenness (Cui; Guo; Li, 2024).



## CLINICAL PICTURE

Knowing the clinical picture is essential for health professionals, in order to confirm the diagnosis accurately. In addition, it is vital that not only the doctor understands the symptoms, but also that the patient interprets that the perceived symptoms are alarming, so that he or she seeks care as early as possible. What makes such a relationship difficult is the absence of several concomitant symptoms, and also the presence of atypical symptoms (Ninomiya et al., 2024). The presence of thoracic symptoms leads to initial suspicion mainly concentrated in acute coronary syndrome or heart failure (Seo; Lee, 2024).

With regard to ACS, the disease develops abruptly, and this represents an alarming sign of threat to the patient's life. In the initial period, patients may experience digestive tract symptoms. Subsequently, with the progression in the development of the disease, other symptoms appear, such as chest pain, arrhythmias, anxiety, irritability, depression, tension and anger. In addition, as associated symptoms, patients may report sweating, nausea, vomiting, palpitations, and even dyspnea (Cui; Guo; Li, 2024).

Despite this wide variety of symptoms, chest pain (angina) remains the main one, and is accompanied by attributes that can help in the diagnosis. Angina can also be classified as typical and atypical, according to the attributes. The typical quality of angina includes: chest pain, compressive pain, irradiation to the left upper limb or neck, severe intensity reported by the patient, discomfort felt in previous days, presence of vagal symptoms and, finally, improvement of symptoms with the use of sublingual medication. In the atypical characteristics, there are changes in the pain pattern according to the following events: change in position, local palpation, arm movement, and breathing (Filgueiras et al., 2021).

The presence of atypical symptoms may occur in approximately one third of patients admitted to emergency units with a future diagnosis of SAC, and this may make it difficult to delay diagnosis, contributing to the worsening of the condition. It is believed that among these patients, specific populations are concentrated, such as the elderly, women, and individuals with already established heart failure, but this relationship remains controversial among the results of various studies. Therefore, as a way to avoid diagnostic errors, some evidence suggests that the interpretation of symptoms regardless of age would be recommended (Singh et al., 2024; Filgueiras et al., 2021).

Despite the symptoms mentioned, coronary syndrome can manifest in a variety of ways, and the order of the symptoms presented can confuse the diagnostic hypotheses. In a case report by Hashimoto and Nagasaki, 2024, a myocardial infarction was masked by the symptoms of gastroenteritis. The patient presented abdominal pain, followed by nausea, vomiting, and diarrhea, symptoms that do not clearly indicate an episode of infarction. This case reveals the importance of



symptom analysis and complementary tests as a way to aid in diagnosis, in addition to revealing that the variety of symptoms can mimic abdominal diseases (Hashimoto; Nagasaki, 2024).

In view of this, it is important to take note of the main symptoms associated with infarction, as well as to point out that there are atypical symptoms and characteristics that cannot lead to the discarding of ACS from the diagnostic hypotheses. Complementary tests can serve as a strong aid in cases of atypical symptoms, so that AMI does not go unnoticed in the consultations.

## APPROACH AND MANAGEMENT

When faced with a patient suspected of ACS, the first measure to be taken is to perform a 12-lead electrocardiogram (ECG), which must be done and interpreted within 10 minutes after the patient's admission (Piccioni et al., 2024; Malentin et al., 2024). An elevation in the "st" segment in the ECG leads already directs the diagnosis, early on, to STEMI, a subtype of ACS. For those who do not have an "st" elevation, it is necessary to delve even deeper into the investigations, in order to identify whether or not it is an ACS, and if so, which of the other two subtypes in question (Ali et al., 2024).

As a way of differentiating the other two subtypes, AI and NSTEMI, the main test to be performed indicates the levels of cardiac troponin (cTn). High levels speak in favor of NSTEMI, while stable levels are more indicative of AI. The cTn protein is present in the contractile apparatus of cardiomyocytes, and is released into the blood after myocardial injury. Although very specific for cardiac tissue, elevated troponin is not pathognomonic of ACS, as it may be present in other pathologies, such as congestive heart failure, kidney disease, and pulmonary embolism. However, when cTn elevation is caused by cardiac ischemia, mortality and reinfarction rates are high, and appropriate therapy should be initiated as soon as possible (Ali et al., 2024).

With the development of high-sensitivity troponin, it has become the gold standard for the diagnosis of NSTEMI. However, it is important to point out that there are divergences in the literature regarding the proportionality of the increase in troponin levels with the degree of coronary artery obliteration. Some authors state that the higher the percentage, the higher the percentage of obstruction, while others counter that the extent of stenosis is not associated with the level of the biomarker (Bravo et al., 2024; Piccioni et al., 2024). Another relevant point in the use of troponin is the need to know the other pathologies that course with troponin elevation, in order to avoid unnecessary treatments, and the overload of the health system. Misdiagnosis of ACS based on protein levels can lead to unnecessary antithrombotic therapy, which may be inappropriate for the patient and, therefore, the need for an accurate diagnosis (Ali et al., 2024).

Studies indicate that the process of carrying out complementary exams and narrowing the hypotheses should be done in approximately one hour. The 0/1 hour protocol is important to prevent



the discharge decision from being unwise. Patients who do not have myocardial infarction (MI) ruled out within 1 hour of admission will have a lower chance of safe discharge (Miller et al., 2024). In addition, patient stratification through scores such as HEART, GRACE, PURSUIT and TIMI is an appropriate tool to assess prognosis, as well as to indicate the need for more diagnostic tests in patients who, even without initial evidence, are populations at risk for cardiovascular events (Piccioni et al., 2024; Abdelmegid et al., 2024; Soares, 2020; Magellan; CADE, 2019; Jercalau et al., 2024; Jobs; Collet; Thiele, 2023).

After a proper diagnosis, treatment should be initiated in order to avoid further tissue damage to the myocardium. Increasingly, researchers have sought to elucidate effective and problem-solving strategies. In addition, the personalized and individual approach for each patient has been put on the agenda, as a promise to adapt the right treatment to the right patient and at the right time (Magalhães; CADE, 2019; Montone et al., 2024). Such an approach combines all the findings in the patient's history and examinations, so that they can be analyzed and taken into account when making decisions about what to do next (Montone et al., 2024).

With regard to the already strongly established treatment for the condition, there are two modalities: invasive or non-invasive. The choice of approach depends on the patient's presentation and clinical evaluation, as well as the classification of ACS, the outcome of cardiac biomarkers, and the availability of equipment in the hospital in question. In addition, many factors can affect responses to treatment modalities, and these are mainly related to the infrastructure of the place where the treatment is performed, and availability of the necessary resources (Abukhalil et al., 2024).

The modality chosen for the treatment has already proven to be very important in the patient's final outcome, and therefore the importance of carrying out a conscious and safe approach. In the cohort study by Abukhalil et al., 2024, the results indicated that patients treated with early invasive strategies had a probability of recurrence within one year in the range of 40.5%, while those who received ischemia-guided therapy had a much lower percentage, around 27.1% (Abukhalil et al., 2024).

Among the invasive approaches, we have cardiac catheterization that aims to clean the narrow or occluded lumen, improving blood flow, and also the surgical option that consists of revascularization of the region. The most widely used interventional therapy for blood vessel dilation is percutaneous coronary intervention (PCI), which consists of implanting stents in coronary arteries narrowed by atherosclerosis. An ally to PCI is thrombolytic therapy, which reduces thromboembolism as well as restores blood flow and myocardial perfusion. PCI can also be performed together with coronary angiography, facilitating and accelerating the management flow. With regard to the surgical technique of revascularization, it comprises a procedure capable of



opening blocked arteries, allowing the passage of blood flow in the coronary arteries (Abukhalil et al., 2024; Cui; Guo; Li, 2024).

In addition, pharmacological measures are also important, and here it is worth highlighting drugs for antiplatelet therapy, to promote blood circulation and to remove blood stasis. Antiplatelet therapy may include aspirin and clopidogrel, which have proven efficacy in reducing the risk of ischemic events. In addition, it is vital to control the other factors involved in the pathophysiology of the disease, such as diabetes, hypertension and hyperlipidemia. Statins play a crucial role in lowering cholesterol levels, preventing the progression of atherosclerotic plaque, and helping to manage lipids. After the interventions, patients tend to maintain the administration of statins for a relatively long period of time to stabilize and control blood lipid levels. Medications to control blood pressure and blood glucose should also be used, when necessary (Abukhalil et al., 2024; Cui; Guo; Li, 2024).

In addition to everything already covered, guidance on lifestyle changes is essential, and should be explained to all patients, since this can reduce recurrence rates and improve long-term treatment outcomes. So, the diet to be followed should be low in fat and salt, and high in fiber. Weight monitoring should be continuously carried out, and physical exercise practices should be introduced. Exercise has the potential to improve cardiovascular health, reduce blood pressure and cholesterol levels, and dramatically decrease the chances of ACS recurrence (Cui; Guo; Li, 2024).

From this perspective, it is clear that management is a powerful dictator of the patient's prognosis, and the speed with which measures are taken and applied can avoid unfavorable outcomes, recurrences, and greater damage.

## CONCLUSION

Based on what has been analyzed, acute coronary syndrome is a very prevalent disease, and has a high impact on the health system. Both overdiagnosis and underdiagnosis of such pathology cause damage, the first by overloading expenses with unnecessary treatments, and the second by delaying the diagnosis and can even lead to the death of patients. Knowledge of risk factors is a critical point with major repercussions on the patient's life. From the identification of the factors, it is possible to outline strategies that aim to mitigate the chances of a future occurrence of ACS. In turn, the clinical picture is a major divider, but it can also confuse and hinder diagnosis. There are tests and biomarkers that must be performed and analyzed quickly, and these are increasingly being studied to expand the options. The treatment is effective when implemented not many hours after admission, and the measures can be invasive or not, with PCI being the most applied. Finally, the patient must continue with the use of medications according to the comorbidities presented.

With this article, it is concluded that the investigation of acute coronary syndrome is broad and encompasses multiple factors. It is believed that the review was effective in providing the



necessary support for a general understanding of the syndrome, and in order to assist future studies that address this theme. In addition, it is expected that new actions aimed at preventing this syndrome will be applied, aiming to promote the health of the population.



## REFERENCES

1. Abdelmegid, M. A. K., et al. (2024). Coronary artery disease severity and risk stratification of patients with non-ST-elevation acute coronary syndrome using CHA2DS2-VASc-HSF score. \*BMC Cardiovascular Disorders, 24\*(1), 263. <https://doi.org/10.1186/s12872-024-03929-5>
2. Abukhalil, A. D., et al. (2024). Acute coronary syndrome: Treatment strategies and outcomes in patients admitted to a tertiary care hospital in Palestine. \*Patient Preference and Adherence, 18\*, 1173-1181. <https://doi.org/10.2147/PPA.S467924>
3. Ali, F., et al. (2024). Elevated troponins and diagnosis of non-ST-elevation myocardial infarction in the emergency department. \*Cureus, 16\*(5), e59910. <https://doi.org/10.7759/cureus.59910>
4. Bassan, F., & Bassan, R. (2006). Abordagem da síndrome coronariana aguda. \*Revista da Sociedade de Cardiologia do Rio Grande do Sul\*, 7.
5. Bravo, C., et al. (2024). Clinical implications of high-sensitivity troponin elevation levels in non-ST-segment elevation myocardial infarction patients: Beyond diagnostics. \*Diagnostics (Basel), 14\*(9), 893. <https://doi.org/10.3390/diagnostics14090893>
6. Carvalho, L. C., et al. (2022). Síndrome coronariana aguda: Uma abordagem sobre seu impacto na cardiologia. \*Research, Society and Development, 11\*(9), e8811931676. <https://doi.org/10.33448/rsd-v11i9.31676>
7. Cui, H., Guo, X., & Li, F. (2024). Analysis of diagnosis and treatment of patients with acute coronary syndrome treated by emergency rescue. \*Alternative Therapies in Health and Medicine\*. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/38904625>
8. Filgueiras, P. H. C., et al. (2020). Idade avançada reduz a tipicidade da apresentação clínica em pacientes com dor torácica aguda relacionada a doença coronária obstrutiva? \*Arquivos Brasileiros de Cardiologia, 116\*(6), 1039-1045. <https://doi.org/10.36660/abc.20190089>
9. Hashimoto, E., & Nagasaki, K. (2024). The masquerade of myocardial infarction as gastroenteritis: A diagnostic challenge. \*Cureus, 16\*(4), e58441. <https://doi.org/10.7759/cureus.58441>
10. Jercalau, C. E., et al. (2024). Lymphocyte-to-red blood cell ratio—the guide star of acute coronary syndrome prognosis. \*Healthcare (Basel), 12\*(12), 1205. <https://doi.org/10.3390/healthcare12121205>
11. Jobs, A., Collet, J. P., & Thiele, H. (2023). Timing of invasive coronary angiography in non-ST-elevation acute coronary syndrome—an updated individual patient data meta-analysis. \*European Heart Journal - Acute Cardiovascular Care, 12\*(6), 374-375. <https://doi.org/10.1093/ehjacc/zuad034>
12. Juntunen, S., et al. (2024). The burden of sudden cardiac arrest in the setting of acute coronary syndrome. \*Resuscitation\*. <https://doi.org/10.1016/j.resuscitation.2024.110297>
13. Magalhães, M. A., & Cade, J. R. (2019). Appropriate use criteria for coronary angiography at two hospitals in southern Brazil: "Doing the right things and doing things right". \*Arquivos Brasileiros de Cardiologia, 112\*(5), 532-533. <https://doi.org/10.5935/abc.20190084>
14. Maletin, S., et al. (2024). The role of QRS complex and ST-segment in major adverse cardiovascular events prediction in patients with ST-elevated myocardial infarction: A 6-year


- follow-up study. \*Diagnostics (Basel), 14\*(10), 1042.  
<https://doi.org/10.3390/diagnostics14101042>
15. Miller, J., et al. (2024). Rapid acute coronary syndrome evaluation over one hour with high-sensitivity cardiac troponin I: A United States-based stepped-wedge, randomized trial. \*Annals of Emergency Medicine\*. <https://doi.org/10.1016/j.annemergmed.2024.04.024>
16. Montone, R. A., et al. (2024). Stratified medicine for acute and chronic coronary syndromes: A patient-tailored approach. \*Progress in Cardiovascular Diseases\*. <https://doi.org/10.1016/j.pcad.2024.06.003>
17. Ninomiya, R., et al. (2024). Effect of patient's symptom interpretation on in-hospital mortality in acute coronary syndrome. \*Circulation Journal\*. <https://doi.org/10.1253/circj.CJ-24-0113>
18. Organização Mundial da Saúde. (2018). \*Global health estimates 2016: Disease burden by cause, age, sex, by country and by region, 2000-2016\*. Geneva: World Health Organization.
19. Piccioni, A., et al. (2024). Multi-marker approach in patients with acute chest pain in the emergency department. \*Journal of Personalized Medicine, 14\*(6), 564.  
<https://doi.org/10.3390/jpm14060564>
20. Rocha, B., & Aguiar, C. (2020). Síndrome coronariana aguda em mulheres idosas: A inflamação ataca novamente. \*Arquivos Brasileiros de Cardiologia, 114\*(3), 515-517.  
<https://doi.org/10.36660/abc.20200092>
21. Rother, E. T. (2007). Revisão sistemática x revisão narrativa. \*Acta Paulista de Enfermagem, 20\*(2), 5-6. <https://doi.org/10.1590/S0103-21002007000200001>
22. Santos, A. F., Machado, R. R., & Menezes, M. G. V. (2018). Fatores de risco predominantes na população com síndrome coronariana aguda. \*Revista Saúde.Com, 14\*(2), 1146-1152.  
<http://dx.doi.org/10.22481/rsc.v14i2.553>
23. Seo, M. J., & Lee, J. H. (2024). Low D-dimer in acute coronary syndrome and heart failure: Screening for large vessel diseases in patients with chest symptoms. \*Heliyon, 10\*(10), e31210.  
<https://doi.org/10.1016/j.heliyon.2024.e31210>
24. Shamaki, G. R., et al. (2024). Prevalence, predictors, and in-hospital outcomes of ST-elevation myocardial infarction among young adults without traditional cardiovascular risk factors in the United States. \*American Heart Journal Plus, 43\*, 10008.  
<https://doi.org/10.1016/j.ahjo.2024.100408>
25. Shrateh, O. N., et al. (2024). Acute coronary syndrome in young ( $\leq 45$  years) patients: A multi-centre observational study. \*Annals of Medicine and Surgery (London), 86\*(6), 3303-3309.  
<https://doi.org/10.1097/MS9.0000000000002125>
26. Simon, J., et al. (2024). Evaluating cardiovascular risks: The platelet lymphocyte ratio and the neutrophil lymphocyte ratio as high-risk heart score predictors in non-ST elevation myocardial infarction (NSTEMI) and unstable angina patients. \*Cureus, 16\*(5), e61279.  
<https://doi.org/10.7759/cureus.61279>
27. Singh, N., et al. (2024). Navigating diagnostic challenges in acute coronary syndrome: A case of Bezold-Jarisch reflex and Wellens pattern. \*Cureus, 16\*(5), e60323.  
<https://doi.org/10.7759/cureus.60323>





28. Soares, G. (2020). Comparação dos escores HEART, TIMI, GRACE para predição de eventos cardiovasculares adversos maiores na era de troponina I de alta sensibilidade. \*Arquivos Brasileiros de Cardiologia, 114\*(5), 803-804. <https://doi.org/10.36660/abc.20200314>
29. Sociedade Brasileira de Cardiologia. (2021). \*Diretrizes da Sociedade Brasileira de Cardiologia sobre angina instável e infarto agudo do miocárdio sem supradesnível do segmento ST – 2021\*. Departamento de Cardiologia Clínica (DCC) da Sociedade Brasileira de Cardiologia (SBC). Disponível em: [https://abccardiol.org/wp-content/uploads/articles\\_xml/0066-782X-abc-117-01-0181/0066-782X-abc-117-01-0181.x47225.pdf](https://abccardiol.org/wp-content/uploads/articles_xml/0066-782X-abc-117-01-0181/0066-782X-abc-117-01-0181.x47225.pdf). Acesso em: 10 Jul. 2024.
30. Soeiro, A. M., et al. (2018). Diferenças prognósticas entre homens e mulheres com síndrome coronariana aguda. Dados de um registro brasileiro. \*Arquivos Brasileiros de Cardiologia, 111\*(5), 648-653. <http://dx.doi.org/10.5935/abc.20180166>
31. Yuxiu, Y., et al. (2024). Combined effect of inflammation and malnutrition for long-term prognosis in patients with acute coronary syndrome undergoing percutaneous coronary intervention: A cohort study. \*BMC Cardiovascular Disorders, 24\*(1), 306. <https://doi.org/10.1186/s12872-024-03951-7>

## Description of human skull with AATM and secondary comorbidities in university collection

 <https://doi.org/10.56238/sevened2024.016-017>

Priscila Lini<sup>1</sup>, André Luis Ramos Soares<sup>2</sup> and Maria da Gloria Tavares Demamann<sup>3</sup>

### ABSTRACT

This article proposes a case study of analysis in forensic anthropology and bone pathology in a human skull deposited at the Dental Sculpture Laboratory, human anatomy sector of the Institute of Biosciences, Federal University of Mato Grosso do Sul, and possible interpretations for these alterations. In addition to diagnostic hypotheses, we intend to present possible comorbidities, as well as estimates of biological sex, approximation of age and other elements that can be determined through human identification criteria in forensic anthropology. The methodology used consisted of qualitative analysis of completely skeletonized bone material, in three criteria – sex, age and ancestral affinity – as well as a survey of the possible bone pathology, its etiology and consequences on the individual's health while still alive. The results point to the presence of a debilitating disease of inflammatory origin and several secondary problems resulting from this condition.

**Keywords:** Temporomandibular ankylosis, Osteology, Pathology, Forensic anthropology.

---

<sup>1</sup> Prof. Dr.

Federal University of Mato Grosso do Sul (UFMS) - Laboratory of Forensic Anthropology (LABFOR)

E-mail: priscila.lini@ufms.br

<sup>2</sup> Prof. Dr.

Federal University of Santa Maria - Laboratory of Archaeology, Societies and Cultures of the Americas (LASCA)

E-mail: andre.soares@ufsm.br

<sup>3</sup> Ma.

University of the Extreme South of Santa Catarina (UNESC)

PhD student at the Graduate Program in Environmental Sciences (PPGCA/CAPES) – Pedro Ignácio Schmitz Archaeology Laboratory (LAPIS)

E-mail: gloriamd@unesc.net



## INTRODUCTION

Ankylosis is the Greek word for "rigid joint." The term "ankylosis of the temporomandibular joint" (TMAA) refers to the bony or fibrous adhesion of the anatomical components of the joint and their consequent loss of function. Adhesion can occur between the condylar head of the mandible and the glenoid fossa of the temporal bone, or between any component of mandible tissue (hard and soft) and the maxilla, zygoma, or skull base (Bello *et al.*, 2011). TMHA has different forms of manifestation in different degrees of restriction to mandibular movements (Manganello-Souza, Mariani, 2003), and extreme cases can be recorded, such as ankylosis of the temporal-mandibular joint (TMA), of a permanent nature with complete paralysis of the mandibular joint.

Ankylosis is a disabling condition that has stressful consequences such as speech disorders, chewing difficulty, facial disfigurement, impairs breathing and psychological stress (Kumar *et al.*, 2014; Ko *et al.*, 2005).

## CASE REPORT AND ETIOLOGY

TMJ ankylosis is classified according to the combination of site (intra- or extra-articular), type of tissue involved (bone, fibrous or fibro-bone) and the extent of fusion (complete or incomplete) (Chidzonga, 1999; Erdem and Alkan, 2001). It can be caused by malformation or trauma, or both associated. Classifying TMJ ankylosis in children, Sawhney (1986) identified four different types: In type 1 there is minimal fusion, but extensive fibrous adhesions around the joint; type 2 has more bone fusion, especially at the outer edge of the articular surface, but no fusion on the most medial surface of the joint area; in type 3 there is a bone bridge between the mandible and the temporal bone; and in type 4 the joint is replaced by a mass of bone. TMAA is a pathological fusion of the mandible with the skull base, and the fusion can be partial or complete, and its connection can be fibrous, fibro-osseous, or completely bony. TMJ ankylosis can be acquired in conditions resulting from condylar trauma at birth or childhood, septic arthritis, systemic infections such as tuberculosis, syphilis, or smallpox (Chouinard *et al.*, 2018). The pathology can also be associated with trauma, local or systemic infections, systemic diseases, such as ankylosing spondylitis, rheumatoid arthritis, psoriasis, untreated or inadequately treated condylar fractures (Rodrigues, 2011).

Figure 1 – Bone fusion in the temporal-mandibular joint.

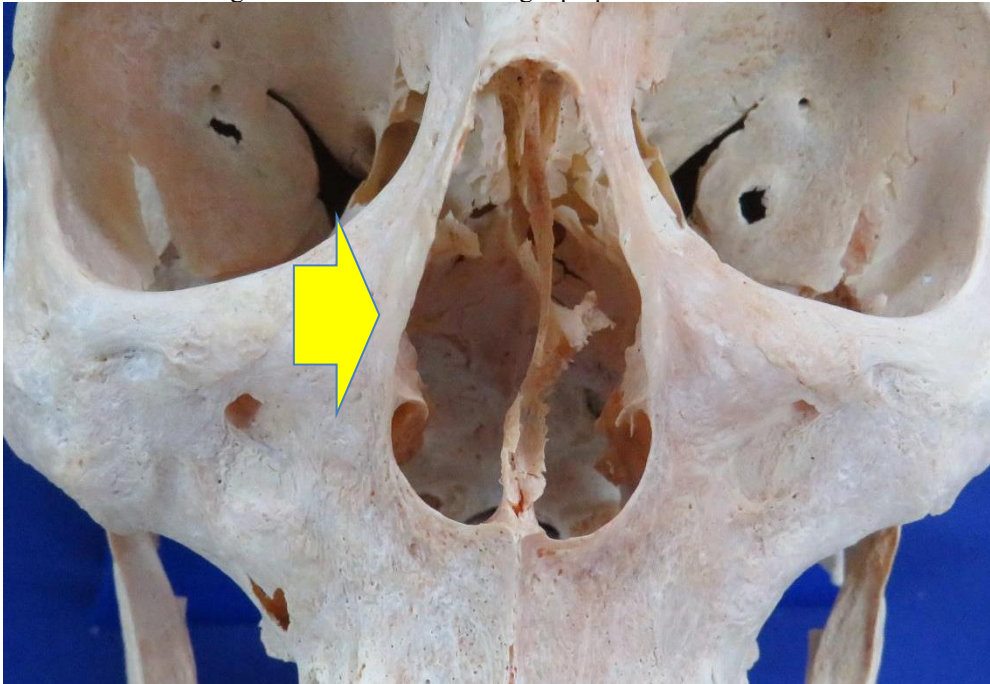


Source: Lini and Soares, 2024

On examination of the condylar adjacencies, no scarring processes resulting from fractures were observed, so that, apparently, the condition does not originate from condylar trauma, thus suggesting that the process resulted from an inflammatory or acquired systemic condition. The stage of complete immobility of the joint indicates that the individual no longer had the ability to chew (Figure 1). It should be noted that the skull under examination is completely edentulous, with the alveolar portion closed and signs of significant bone resorption.

From the analysis of the orbital foramina, the presence of *cribra orbitalia* is verified. This was classified by Knip in 1971, according to its morphology and extension, dividing it into four groups. In *hyperostotic osteoporosis*, at the cranial level, the diploe is thickened at the expense of the external surface, which is very thin. This alteration usually predominates in the frontal bone and in the anterior portion of both parietals, its appearance is usually granular or microareolar, giving rise to a very characteristic "bristle" spicular radiographic image (Isidro and Malgosa, 2003). They occur initially in the anterior third of the orbital roof, and may extend throughout the orbital cavity, as well as in the lower part of the frontal bone scale, in addition to other areas of the external skull table, in the parietal, occipital, temporalis and sphenoids (Mello and Alvim, Uchoa and Gomes, 1991). They are associated with nutritional deficiencies, such as anemia, vitaminosis C, A and complex B. Hengen (1971), establishes a strong association between iron deficiency anemia and parasitic infections, specifically worms, in European populations of tropical and subtropical areas.

Figure 2 – Deviation in the right perpendicular lamina.

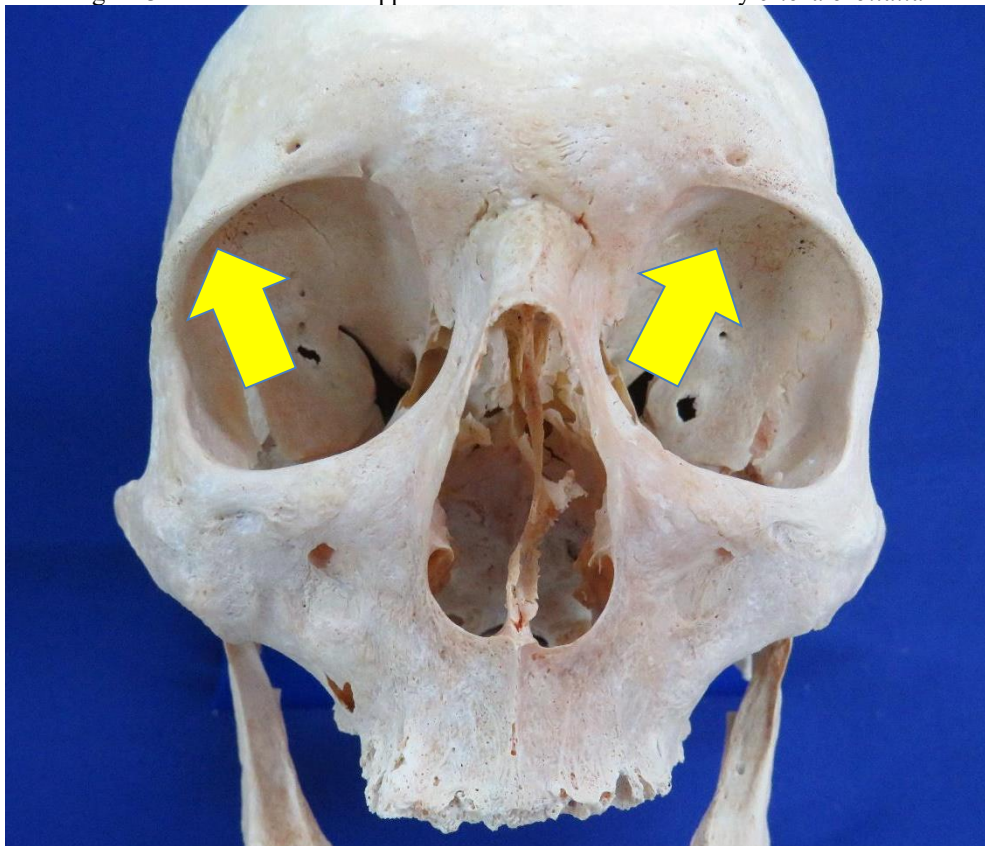


Source: Lini and Soares, 2024

Considering that the skull under analysis is associated with an older individual, the vitamin deficiencies mentioned result in hypochromia, and, in this age group, types of anemia are more commonly found as anemia of chronic disease and iron deficiency. Most elderly people have normocytic and normochromic anemia, which is suggestive of anemia due to chronic disease. In 50% of cases of anemia of the chronic disease, hematimetric alterations are found hypochromia (Buffon *et al.*, 2015).

From the analysis of the nasal foramen, a significant deviation in the perpendicular lamina in the right direction can be perceived, apparently due to a cumulative injurious process (Figure 2). The use of a nasogastric tube is one of the options for the maintenance of patients affected by trauma or processes that prevent full chewing and swallowing (Peixoto *et al.*, 2019), as in the case of AATM. Considering the position, the condition of joint immobility presented, it is suggested that the deviation, although not exclusively, has been aggravated by the presence of a medical apparatus for life support, in this case, a cannula for the administration of enteral diet.

Figure 3 – Porosities in the upper wall of the orbital foramen by *cribra orbitalia*.



Source: Lini and Soares, 2024

The analyzed material comes from a collection deposited in the collection of the Dental Sculpture Laboratory, Human Anatomy sector, of the Federal University of Mato Grosso do Sul, in the city of Campo Grande, state of Mato Grosso do Sul, Brazil. This material is used for practical classes in dentistry and dental sculpture, and in the case of the specimen under study, it consists of a male individual, over 45 years of age, of predominantly Caucasian ancestral affinity, who presents, in addition to TMAA, signs of tooth loss in adulthood, possibly caused by vitamin C vitaminosis (scurvy). as well as signs of *Cribra Orbitalia* in both eye sockets, however, in the left orbit, in addition to the porous aspect, which indicates active injury, healing points are observed. These points may suggest a normalization or reversal of the health conditions of the individual affected by the injury (Figure 3). The individual under analysis was incorporated into the Laboratory's collection in the 1990s, and probably comes from an unclaimed burial by relatives, in the city's municipal public cemetery.

## METHODOLOGY

Analysis of the human bone sample through the existing osteological collection in the Laboratory, in comparison with the case study. Results and conclusions: Through comparison with existing samples, the presence of Bilateral Mandibular Ankylosis as well as other diseases caused by



it was detected. We conclude that studies on dry bone materials are relevant for the diagnosis of arthrosis at different stages.

## DISCUSSION

The absence of evidence of trauma to the maxilla/mandible complex points to the formation of TMAA in adulthood, with probable formation of type 4 calcification due to autoimmune disease. Traumas such as bruises, dislocation, or fracture are not noticeable on either side of the jaw. TMAA caused significant loss in the patient's quality of life, with regard to food, speech and most likely self-esteem. The possibility of using a nasogastric tube reflects concern regarding the maintenance of existence, but the origin of the skull also refers to socioeconomic conditions of low stratum, in addition to the other comorbidities detected, such as scurvy and *cribra orbitalia*.

## CONCLUSIONS

The study of collections is an important means for characterizing pathologies at different stages. The observation of pathological processes can help in the identification of individuals, as well as to ascertain *antemortem* and *perimortem* processes, even in isolated case studies. The care, ethics and good preservation of the materials present in collections of this nature are of great importance for the study not only of anatomy, but also for the critical analysis by academics and researchers about the living conditions and health problems suffered by a large portion of the population. Thinking about the etiological factors of the pathologies present in bone remnants in the custody of research centers is a way to democratize knowledge in forensic anthropology, but also in the anthropology of human health and corporality.




## REFERENCES

1. Bello, S. A., et al. (2011). Aetiology and presentation of ankylosis of the temporomandibular joint: Report of 23 cases from Abuja, Nigeria. Disponível em: <<https://doi.org/10.1016/j.bjoms.2010.12.006>>. Acesso em: 11 jul. 2024.
2. Buffon, P. L. D., et al. (2015). Prevalência e caracterização da anemia em idosos atendidos pela Estratégia Saúde da Família. \*Revista Brasileira de Geriatria e Gerontologia, 18\*(2), 373-384.
3. Chouinard, A.-F., Kaban, L., & Peacock, Z. (2018). Acquired abnormalities of the temporomandibular joint. \*Oral Maxillofacial Surg Clin N Am, 30\*, 83–96. Disponível em: <<http://dx.doi.org/10.1016/j.coms.2017.08.005>>. Acesso em: 11 jul. 2024.
4. Chidzonga, M. M. (1999). Temporomandibular joint ankylosis: Review of thirty-two cases. \*Br J Oral Maxillofac Surg, 37\*, 123-6.
5. Erdem, E., & Alkan, A. (2001). The use of acrylic marbles for interposition arthroplasty in the treatment of temporomandibular joint ankylosis: Follow up of 47 cases. \*Int J Oral Maxillofac Surg, 30\*, 32-6.
6. Hengen, O. P. (1971). ‘Criba orbitalia’: Pathogenesis and probable etiology. \*Homo, Stuttgart, 22\*, 57-75.
7. Isidro, A., & Malgosa, A. (2003). \*Paleopatologia: La enfermedad no escrita\*. Barcelona: Masson.
8. Ko, E. W. C., Huang, C. H., Chen, Y. R., & Figueroa, A. A. (2005). Cephalometric craniofacial characteristics in patients with temporomandibular joint ankylosis. \*Chang Gung Med J, 28\*, 456-466.
9. Kumar, D., Rajan, G., Raman, U., & Varghese, J. (2014). Autogenous reconstructive modalities of TMJ ankylosis: A retrospective analysis of 45 cases. \*J. Maxillofac. Oral Surg., 13\*(4), 359–365. DOI: 10.1007/s12663-013-0504-9.
10. Manganello-Souza, L. C., & Mariani, P. B. (2003). Temporomandibular joint ankylosis: Report of 14 cases. \*Int J Oral Maxillofac Surg, 32\*, 24-9.
11. Mello E Alvim, M. C. De, Uchoa, D. P., & Gomes, J. C. O. (1991). Criba orbitalia e lesões cranianas congêneres em populações pré-históricas do Brasil. \*Revista do Museu de Arqueologia e Etnologia, São Paulo, 1\*, 21-53.
12. Peixoto, V. O. N., et al. (2019). Reconstruções mandibulares com enxerto livre: Relato de casos. In: Jornada Internacional de Implantologia e Cirurgia Bucomaxilofacial da Alacibu/Sobracibu e VIII Encontro de Residentes da Alacibu, João Pessoa. \*Anais... João Pessoa: UPE, 2019\*.
13. Rodrigues, D. C. (2011). Anquilose da articulação têmpero-mandibular. Monografia de especialização. Universidade Federal de Minas Gerais.
14. Sawhney, C. P. (1986). Bony ankylosis of the temporomandibular joint: Follow-up of 70 patients treated with arthroplasty and acrylic spacer interposition. \*Plast Reconstr Surg, 77\*(1), 29–40.



## Root resorption in endodontically treated teeth that have been subjected to orthodontic forces

 <https://doi.org/10.56238/sevned2024.016-018>

Roberto César Bossi Pimenta<sup>1</sup>, Warley Silva de Oliveira<sup>2</sup>, Maria Cláudia Nunes Araújo Teodoro<sup>3</sup>, Renata Afonso da Silva Pereira<sup>4</sup>, Juliana de Carvalho Carmelo Paiva<sup>5</sup>, Luciano Henrique Figueira<sup>6</sup>, Renata Pereira Georjutti<sup>7</sup>, Eduardo Zancín Teruel<sup>8</sup>, Akel Fares Akel Neto<sup>9</sup> and Debora Souto-Souza<sup>10</sup>

### ABSTRACT

Root resorption, also known as external apical resorption or induced apical resorption, expressed as apical rounding, is one of the most recurrent findings in orthodontic practice. This pathology, when it occurs due to orthodontic movement, is a consequence of the mechanical and physiological reactions that occur at the cellular level. These reactions are part of the apical remodeling process, and are therefore inevitable in most cases, and acceptable in orthodontic practice. The search for orthodontic treatment by adult patients is growing more and more, which leads to an increase in the number of pulped teeth subjected to orthodontic forces. In view of this fact, studies comparing the consequences of these mechanotherapies in pulped teeth in relation to vital teeth in the context of root resorption are pertinent. This study aims to evaluate root resorptions induced by orthodontic movements in teeth previously treated endodontically. Research on root resorption comparing vital teeth and pulped teeth uses animal studies, radiographic analyses, histological studies and clinical cases. Studies have shown that it cannot be confirmed that endodontically treated teeth have greater resorption, showing that they move just like vital teeth when submitted to orthodontic treatment and that root resorption is a multifactorial phenomenon. Therefore, it is recommended to wait for the success of the endodontic treatment to be proven, as well as the elimination of all inflammatory exudate, so that orthodontic treatment can begin.

**Keywords:** Root Resorption, Endodontics, Orthodontic Movement.

<sup>1</sup> Highest Education Degree: Orthodontic Specialist

Academic institution: Faculdade Integração Tietê "FIT"

<sup>2</sup> Highest training degree: Doctor of Clinical and Experimental Dentistry

Academic institution: Federal University of Juiz de Fora- UFJF

<sup>3</sup> Highest Education Degree: Specialist in Pediatric Dentistry

Academic institution: Universidade Paulista Júlio de Mesquita Filho - Unesp and Centro Universitário do Triângulo- Unitri

<sup>4</sup> Highest Education Degree: Doctor of Dentistry

Academic institution: Federal University of Uberlândia - UFU and University Center of the Triangle - Unitri

<sup>5</sup> Highest degree of education: Master of Dentistry

Academic institution: Pontifical Catholic University of Minas Gerais - PUC Minas and University Center of the Triangle - Unitri

<sup>6</sup> Highest Education Degree: Doctor of Orthodontics

Academic institution: São Leopoldo Mandic Dental Research Center - SLMANDIC and Triângulo University Center - Unitri

<sup>7</sup> Highest education degree: Doctorate in Dentistry/Dental Clinic

Academic institution: Federal University of Uberlândia-UFU and University Center of Triângulo-UNITRI (Coordinator of the Dentistry course at Unitri).

<sup>8</sup> Highest Education Degree: Orthodontic Specialist

Academic institution: Faculdade Integração Tietê "FIT"

<sup>9</sup> Highest Education Degree: Master of Dentistry/Surgery

Academic institution: University of São Paulo-USP

<sup>10</sup> Highest Degree of Education: Doctorate in Dentistry/Pediatric Dentistry

Academic institution: Federal University of the Jequitinhonha and Mucuri Valleys-UFVJM and University Center of the Triangle-UNITRI.



## INTRODUCTION

With the advances in modern orthodontics, the contingent of adult patients who seek a more harmonious, functional and visually pleasing smile through orthodontic treatment has grown in recent years. In contrast to the past, in which it was believed that orthodontic treatment was restricted only to children and adolescents who had perfect teeth, absent endodontic treatment (Banzatto et al. 2005)

Adult patients have oral conditions that are different from those of other age groups. Some conditions may be unfavorable to orthodontic mechanics, such as periodontal diseases, endodontically treated teeth, severe wear due to parafunctional habits, and tooth loss.

Orthodontic treatments affect the pulp and periodontal ligament, which can result in root resorption or loss of vitality. Root resorption is the result of a complex combination of factors inherent to each patient and the mechanical forces employed. It can occur in 39% to 99% of orthodontic patients. (Reukers, et al. 1998; Brezniak, Wasserstein, 1993)

Orthodontic tooth movement can cause degeneration and/or inflammatory responses in the dental pulp of teeth with complete apical formation. The impact of tooth movement on the pulp is primarily focused on the neurovascular system, where the release of specific neurotransmitters (neuropeptides) can influence blood flow and cellular metabolism. Responses induced in the pulp may have an impact on the initiation and perpetuation of apical root remodeling or resorption during tooth movement. The severity of these changes may be influenced by previous or ongoing insults to the dental pulp, such as the incidence of trauma or caries.

Considered one of the most common findings in orthodontic clinical practice, root resorption is considered a "side effect". Several studies have addressed the relationship between root resorption and orthodontic movement in vital teeth (Santos, et al. 2007; Younis et al.2008; Camargo, et al. 2008;). Despite this, the cause or prognosis of resorption has not yet been concretely elucidated, and this also applies to pulped teeth that have undergone orthodontic treatment. There is no evidence that the frequency or extent of root resorption is higher or lower in previously endodontically treated teeth (Goldner et al., 2002).

Generally, this pathology does not present symptoms, and can only be detected through radiographic examinations. Thus, it is of great importance that radiographic examinations are performed frequently so that resorption is diagnosed early, for the most favorable treatment and prognosis (Westphalen, 2002).

Wickwire (1974) reports that endodontically treated teeth are more susceptible to fractures, ankyloses and root resorption when they are subjected to orthodontic forces. However, when compared to root resorption, some claim that these teeth behave in the same way as vital teeth (Spurrier et al., 1990). Others show that endodontically treated teeth are more susceptible to root



resorption (Wickwire et al., 1974; Komorowski 1997) and yet there are studies that state that vital teeth are more sensitive to resorption than pulped teeth (Spurrier et al., 1990; Lee, 2016).

Thus, in view of the lack of concrete answers about the interrelationship between endodontics and orthodontics, the present study aims to investigate, through a literature review, whether teeth previously treated endodontically are more susceptible to root resorption, when moved orthodontically.

## **METHODOLOGY**

The aim of this study was to perform a literature search to evaluate the relationship of external root resorption in orthodontic movement when the tooth is already endodontically treated.

The search tools were online databases, such as PubMed ([www.pubmed.org](http://www.pubmed.org)) and Scielo (<https://scielo.org>). The search strategy included the following keywords: "orthodontic treatment" AND "root resorption" and was conducted in February 2024. The most relevant articles for the topic in question published in the last ten years were selected for bibliographic survey, as well as classic articles that the authors considered pertinent.

When the complete study was not available in the databases, the search was used using the Portal de Periódico/CAPES ([www.periodicos.capes.gov.br](http://www.periodicos.capes.gov.br)) platform. A descriptive analysis of the articles was performed. After a broad reading of the articles of choice, the main information was selected in order to organize the references for the complete development of the objective proposed to the present work.

## **LITERATURE REVIEW**

Root resorption is one of the most frequent complications associated with orthodontic treatment (Goultchin et al., 1982; Copeland et al., 1986 ; Spurrier et al., 1990; Brenzniak et al., 1993; Blake et al., 1995; Goldner et al., 2002). Root resorption associated with orthodontic treatment is classified as inflammatory resorption (Consolaro, 2002). It occurs during induced tooth movement due to compression of the microvessels of the periodontal ligament, leading to necrosis of the cementoblasts. After cementoblast necrosis, the root surface will be unprotected, allowing osteoclasts, originating from the neighboring bone, to migrate to this region and organize themselves into osteoremodeling units, thus initiating the resorption of exposed dentin, resulting in root resorption linked to orthodontic movement.

The predisposition to tooth resorption is directly associated with root morphology (shape, length, thickness, and crown and root angle), bone morphology (height, thickness, and shape of the alveolar crest), individual susceptibility, genetic influence, sex, age, endocrine changes, hormonal

imbalance, parafunctional habits, previous trauma (Consolaro, 2002; Samesshima and Sinclair, 2001; Al-Qawasmi et al., 2003).

In most cases, the resorption resulting from orthodontic movement is minimal and of no clinical significance, reaching mean values of 0.5 to 3 mm of root shortening. These resorptions affect the majority (90.5%) of the vital teeth treated orthodontically, especially incisors, which are always repaired by cellular cementum. Therefore, orthodontics coexists peacefully with root resorption during treatment (Brezniak, Wasserstein, 1993a, Brezniak, Wasserstein, 1993b; Harris, 2000; Henry, Weinmann, 1951; Spurrier et al., 1990).

According to Malmgren et al. (1982), apical tooth resorption can be associated with orthodontic movement, on a progressive scale according to its magnitude, where: Grade 0 represents no root resorption, Grade 1 or minimal resorption only irregular apical contour; Grade 2 resorption or moderate resorption, resorption presents with less than 2mm reduction in root length; Grade 3 or severe resorption, where the apical region has resorption greater than 2 mm to a third reduction from the original length; Grade 4 or extreme resorption when the reduction is greater than one-third of the original root length.

According to Remington et al. (1989), teeth that had previously undergone endodontic treatment would have a slower response to the absorptive capacity of root resorptions, since endodontic treatment increases dentin density.

According to the morphology of the tooth structure and the existence of previous root resorption, individuals predisposed to root resorption can be identified. Lavander, Malmgren and Eliasson (1994) presented a study in which they evaluated radiographs of the dental roots taken prior to orthodontic treatment, after 6 to 9 months after treatment and after its completion. It was found that the degree of resorption was significantly higher in teeth that already had a small resorption or irregular apex prior to treatment than in teeth without resorption.

Mirabella and Artun (1995) evaluated the prevalence and severity of root resorption of maxillary anterior teeth in a sample of 343 adult patients. It was hypothesized that teeth that were treated endodontically had less apical resorption, to make this evaluation, periapical radiographs were taken before and after orthodontic treatment. It was concluded that the endodontically treated teeth showed a lower degree of resorption than the vital teeth.

In 1997, Bender et al. reported two cases, the first of which was a 7-year-old and 2-month-old female patient, who suffered a trauma to the left upper central incisor. The patient underwent an apicification treatment using calcium hydroxide and she was referred to an orthodontist in order to correct her class II malocclusion with horizontal overjet. After about 9 months, the left maxillary central incisor was filled. After 4 years, periapical radiographs for control were taken, where root resorption could be observed in the right maxillary central incisor and in the maxillary lateral incisors

on both sides. The pulped tooth did not show any sign of resorption at its root. When the patient turned 14 years old, the orthodontic apparatus was removed and new radiographs were taken, where a greater resorption in the vital tooth and a slight resorption in the pulped tooth were found. After 6 years, control radiographs revealed a distinct resorption process in the vital teeth, with rounding of the resorbed roots. A resorption process was also evidenced in the endodontically treated tooth, which revealed a rounding of the apex and an increase in bone density. The second case presents a 15-year-old individual, who at the age of 7 years suffered a trauma to the maxillary central incisor, in which endodontic treatment was performed, where a radiolucent region was maintained due to the non-closure of the apex, due to the interruption of root development. So the apicification treatment was chosen with the objective of inducing the formation of a calcified barrier. Orthodontic treatment was initiated after the first dressing change, and two more were performed later. Apical maturation occurred after 10 months of treatment, thus showing that orthodontic treatment does not interfere in the process of apical maturation of the central incisors submitted to endodontic treatment. At the 4- and 8-year follow-up visits, periapical radiography showed root resorption in the homologous central incisor. Thus, the authors suggested that endodontically treated teeth create an alkaline environment that leads to bounded apical resorption after being exposed to orthodontic mechanics. They concluded that previous endodontic treatment should be performed when orthodontic treatment is anticipated, as the occurrence of apical resorption as a side effect is predictable.

In 2005, Banzatto et al. conducted a study with 20 Brazilian male and female individuals treated orthodontically. The criterion for sample selection was the presence of an upper incisor with endodontic treatment prior to orthodontic treatment and its vital counterpart. The samples were divided into group 1, composed of endodontically treated teeth, and group 2, their vital counterparts, for control and subsequent comparison. Initial periapical radiographs were taken, these prior to orthodontic treatment, and final periapical radiographs. Both radiographs were compared in a negatoscope. After comparisons of the samples evaluated, it was observed that endodontically treated teeth had a lower degree of resorption than their vital counterparts, but the difference between the two groups was not statistically significant.

Sampaio et al. (2006) evaluated incisor and premolar roots of 2 adult crossbred dogs in order to histomorphologically evaluate the consequences of orthodontic movement on the healing process of chronic periapical lesions. The lesion was formed in an induced manner, through coronary opening and pulpectomy up to the cementodentin junction with exposure of the canals for six months. After this period, these teeth were X-rayed and filled in two sessions. The control group was composed of five mandibular premolars, which were also submitted to the same process. In the first session, two mandibular central incisors were extracted to make it possible to perform orthodontic movement, which was performed for 5 months and 15 days, following a protocol of changing elastics

every 21 days. At the end of this period, the device was removed and the samples were prepared for histological analysis. The results revealed that the roots of the control group presented several areas of apical resorption, of diversified extensions and depths. In the group that was subjected to orthodontic forces, seven treated teeth showed biological closure at the apical foramen level. In the group exempt from orthodontic movement, seven teeth presented closure of the foramen through newly formed cementum. In half of the cases, a well-organized periodontal ligament could be found. A mild inflammatory reaction can be seen in four cases. This experiment concluded that the healing of chronic periapical lesions was more efficient in the group that did not undergo orthodontic movement. However, the authors of the experiment call attention to the fact that orthodontic movement of teeth with chronic periapical lesions, after endodontic treatment with calcium hydroxide, delays but does not prevent the healing process.

La Fuente Chavéz (2009) evaluated external root resorption in endodontically treated teeth after undergoing orthodontic mechanics. The analyses were performed by means of final digitized panoramic, conventional periapical digitized and direct digital radiography, as well as comparing the radiographic methods that were used. After evaluating orthodontic documentation, 20 teeth were selected from patients with complete orthodontic documentation, good health conditions, aged between 25 and 50 years of both sexes and who had central and lateral incisors, treated endodontically prior to the beginning of orthodontic treatment. From the orthodontic documentation, the initial and final panoramic radiographs were selected, and current periapical radiographs were also taken, one through the conventional technique and the other direct digital. The radiographs were evaluated by 3 specialists (endodontist, orthodontist and radiologist). The specialists had the function of evaluating whether or not external apical root resorption was present in the endodontically treated teeth that were submitted to orthodontic treatment, as well as comparing the methods applied and verifying their reliability. The following parameters were taken into account: periapical lesion, pericentary space, and endodontic treatment limit. According to statistical analyses, the authors concluded that most orthodontists do not use periapical radiographs to evaluate teeth treated endodontically before the beginning of orthodontic treatment, which can compromise the progress and final result of the treatment, since the resorption in the treatment has a symptomatological character in its diagnosis. Regarding external root resorption, the examiners pointed out that there was an increase in this, mostly of the mild and localized type located in the apical region. The most efficient technique for determining this diagnosis by the examiners was direct digital radiography.

In 2012, Llamas Carreras conducted a study with the aim of evaluating external root resorption in endodontically treated teeth and their vital counterparts. A sample of 38 individuals, 14 men and 24 women, previously selected according to the selection criteria, having an upper incisor treated endodontically before the placement of orthodontic bands, having the vital homologous



incisor, evaluated with thermal test, orthodontic therapy with active treatment for more than 1 year. To avoid bias, two radiology assistants were in charge of digital panoramic radiographic shots before and after orthodontic treatment. In these, the measurements were standardized by estimating the greatest distance from the amelodentin junction in each patient. In order to allow intra-patient normalization, a proportion of the resorption of pulped teeth and vital teeth was calculated. In view of the analyses, the authors found that vital teeth had a higher mean resorption, but without statistical relevance when compared to pulped teeth. In addition, 68.4% of the patients had greater resorption of the incisor treated endodontically when compared to the control group. Therefore, the authors state in their study that there is no significant difference in the amount or magnitude of external apical root resorption during orthodontic treatment between endodontically treated incisors and their vital counterparts.

Walker et al. (2013) through a systematic literature review, in order to verify whether pulped teeth are more susceptible to external apical root resorption after orthodontic movement, than their vital counterparts, determined the inclusion criteria such as: study design, sample size, population characteristics, type of radiographic image used for analysis, method of measurement of external root resorption and the results of the study. The selected articles were published between 1990 and 2010. As a result of this review, it was found that the sample sizes ranged from 16 to 77, with a mean population of 13.9 to 32.7 years and a mean orthodontic treatment time of more than 20 months. In all studies, external apical root resorption was measured by periapical radiographs before and after, with the exception of one study that used panoramic radiographs and another that was not evaluated by radiographs. It was found through the study that pulped teeth had a lower resorption after orthodontic treatment when compared to their vital counterparts. The authors concluded that endodontically treated teeth do not have a higher risk for root resorption during orthodontic treatment, when compared to vital teeth. Thus, the authors were able to conclude that there is a low number of studies and all with different methodologies, so it is necessary to carry out more clinical trials with methodologies that are standardized, so that the analysis of such comparison becomes better.

## DISCUSSION

The periodontal ligament is the only one involved in orthodontic movement and a consequence of the force that this movement exerts on the supporting tissues is root resorption (Capelli Junior, 2004). This resorption is considered clinically acceptable in orthodontic practice, since it is part of the apical remodeling process (Reitan, 1985; Consolaro, 2005).

The endodontically treated tooth can be subject to different types of forces, a functional or parafunctional overload can cause an inflammatory process and lead to external root resorption



(Weiland, 2006). Artun et al (2005) stated that if any tooth in active treatment in the first 6 months presents any degree of root resorption, it will be more likely to suffer more resorption in the next 6 months.

With respect to endodontically treated teeth and orthodontics-induced external resorption, published studies have reported controversial results. Some researchers argue that the tooth treated endodontically presents more external root resorption compared to the tooth with vital pulp when involved in orthodontic movement (Wickwire et al, 1974; Iglesias et al, 2013), other researchers report less resorption in endodontically treated teeth (Mirabella, 1995; Lee, 2016) and others show that there are no significant differences in external root resorption in teeth with vital pulp and endodontically treated teeth (Esteves et al. 2007; Castro et al 2015) (Banzatto et al., 2005, Walker et al., 2013).

Agreeing with this, Llamas-Carreras et al., (2012) analyzed 38 individuals who underwent orthodontic treatment, these were divided into 3 groups: traumatized teeth, teeth with endodontic treatment and control group. It was observed that there was no significant difference in the severity of external root resorption between the groups. Although the prognosis of traumatized teeth is unfavorable, endodontic treatment should be performed (Tanaka et al., 2013) with care in measuring the forces correctly. Due to the chance of early root resorption occurring in these teeth, it is important to perform periapical radiographs every 3 months (Consolaro and Consolaro 2013).

Consolaro and Consolaro (2013) argue that one should wait 15 to 30 days to start orthodontic movement of teeth that have undergone endodontic treatment, so that the inflammatory infiltrate migrates from the site and the exudate is reabsorbed. From a biological point of view, movement does not interfere with the repair of periapical lesions as long as endodontic treatment has been performed satisfactorily.

A meta-analysis published by Alhadainy et al (2019) evaluated 7 studies and its result had moderate statistical strength, which proved that endodontic treatment does not increase external root resorption in orthodontic movement; However, the authors point out the need to conduct further studies with a larger sample to verify this relationship. Walker et al. (2013) state that more studies with standardized methodologies are needed, since the findings are scarce and each one follows a different methodology, making it difficult to compare in some studies.

Steadman (1942) stated in his study that the root of endodontically treated teeth acts as a foreign body causing chronic irritation and consequently resorption, it can also suffer the process of ankylosis, which can prevent orthodontic tooth movement. Another study by Huettner and Young (1955), when evaluating the root structure of monkeys, teeth with vital pulp and endodontically treated, observed that after orthodontic movement, root resorption was similar in both conditions. However, the authors argue that the monitoring of orthodontic forces, an aseptic endodontic





treatment and an intact periodontal membrane were preponderant factors for the result found (Huettner, Young, 1955).

In another study conducted by Esteves et al (2007), when analyzing 2500 treatment records, they selected 16 patients with endodontic treatment in the maxillary central incisor before orthodontic intervention, when analyzing the periapical radiographs performed before and after orthodontic treatment, they came to the conclusion that there was no significant difference in apical root resorption of endodontically treated teeth and vital teeth (Esteves et al. 2007).

## CONCLUSIONS

The scarcity of studies on the subject associated with the fact that they do not have standardized methodologies showed that the relationship of greater root resorption in teeth that underwent endodontic treatments when undergoing orthodontic movement is not conclusive. It is necessary that more studies be carried out and that they have standardized methodologies so that they allow comparative analyses with greater significance.

It is important to wait 15 to 30 days, after the end of endodontic treatment, to start orthodontic treatment so that all the resorption of the inflammatory exudate and the migration of the inflammatory infiltrate from the site can first occur. For satisfactory results, it is necessary that the endodontic treatment is well filled and with a good prognosis.



## REFERENCES

1. Alhadainy, H. A., Flores-Mir, C., Abdel-Karim, A. H., Crossman, J., & El-Bialy, T. (2019). Orthodontically Induced External Root Resorption in Endodontically Treated Teeth: A Meta-analysis. *\*Journal of Endodontics\**. doi: 10.1016/j.joen.2019.02.001
2. Al-Qawasmi, R. A., et al. (2003). Genetic predisposition to external apical root resorption. *\*American Journal of Orthodontics and Dentofacial Orthopedics\**, 123, 242–252.
3. Artun, J., Smale, I., Behbehani, F., et al. (2005). Apical root resorption six and 12 months after initiation of fixed orthodontic appliance therapy. *\*Angle Orthodontist\**, 75, 919–926.
4. Blake, M., Woodside, D. G., & Pharoah, M. J. (1995). A radiographic comparison of apical root resorption after orthodontic treatment with the edgewise and Speed appliances. *\*American Journal of Orthodontics\**, 108, 76-84.
5. Brezniak, N., & Wasserstein, A. (1993). Root resorption after orthodontic treatment: Part 1. Literature review. *\*American Journal of Orthodontics and Dentofacial Orthopedics\**, 103(1), 62-66.
6. Camargo, S. E. A., Moraes, M. E. L., Moraes, L. C., & Camargo, C. H. R. (2008). Principais características clínicas e radiográficas das reabsorções radiculares internas e externas. *\*Revista de Odontologia da Universidade Cidade de São Paulo\**, 20(2), 195-203.
7. Capelli Junior, J. (2004). Inter-relação Endodontia-Ortodontia. In Lopes, H. P., & Siqueira Jr, J. F. (Eds.), *\*Endodontia Biologia e Técnica\** (2ª ed., pp. 871-885). Guanabara/Medsi.
8. Castro, I., Valladares-Neto, J., & Estrela, C. (2015). Contribution of cone beam computed tomography to the detection of apical root resorption after orthodontic treatment in root-filled and vital teeth. *\*Angle Orthodontist\**, 85, 771–776.
9. Consolaro, A. (2002). *\*Reabsorções dentárias nas especialidades clínicas\**. Maringá: Dental Press.
10. Consolaro, A. (2005). *\*Reabsorções dentárias nas especialidades clínicas\**. Maringá: Dental Press.
11. Consolaro, A. (2013). [Incomplete reference].
12. Copeland, S., & Green, L. J. (1986). Root resorption in maxillary central incisors following active orthodontic treatment. *\*American Journal of Orthodontics\**, 89(1), 51-55.
13. Steadman, S. R. (1942). Resume of the literature on root resorption. *\*Angle Orthodontist\**, 12, 283-286.
14. Da Cruz, O. T., Yaya, M., & Lopez, A. M. (2002). Tratamiento ortodóncico em piezas com endodoncia. *\*Ver Estômato Hered\**, 11(1/2), 52-56.
15. Esteves, T., Ramos, A. L., Pereira, C. M., & Hidalgo, M. M. (2007). Orthodontic root resorption of endodontically treated teeth. *\*Journal of Endodontics\**, 33, 119–122.
16. López-Frías, F. J. (2012). External apical root resorption in maxillary root-filled incisors after orthodontic treatment: A split-mouth design study. *\*Medicina Oral, Patología Oral y Cirugía Bucal\**, 17(3), e523-527.




17. Goldner, M. T. A., Capelli, J. R. J., Carlini, M. G., & Silva, A. C. P. (2002). Avaliação da reabsorção radicular em dentes com tratamento endodôntico e submetidos a movimentação ortodôntica. *\*Revista SOB\**, 4(1), 14-19.
18. Goultschin, J., Nitzan, D., & Azaz, B. (1982). Root resorption. *\*Oral Surgery\**, 54(5), 586-590.
19. Harris, E. F. (2000). Root resorption during orthodontic therapy. *\*Seminars in Orthodontics\**, 6(3), 183-194.
20. Henry, J. L., & Weinmann, J. P. (1951). The pattern of resorption and repair of human cementum. *\*Journal of the American Dental Association\**, 42(3), 270-290.
21. Huettner, R. J., & Young, R. W. (1955). The movability of vital and devitalized teeth in the macaca rhesus monkey. *\*Oral Surgery, Oral Medicine, Oral Pathology\**, 8, 189-197.
22. Iglesias-Linares, A., Yanez-Vico, R. M., Ballesta-Mudarra, S., et al. (2013). Interleukin 1 receptor antagonist (IL1RN) genetic variations condition post-orthodontic external root resorption in endodontically-treated teeth. *\*Histology and Histopathology\**, 28, 767-773.
23. López-Frías, F. J., Castellanos-Cosaño, L., Martín-González, J., Amarilla, A., Sánchez-Domínguez, B., Espinar-Escalona, E., & López-Frías, F. J. (2012). External apical root resorption in maxillary root-filled incisors after orthodontic treatment: A split-mouth design study. *\*Medicina Oral, Patología Oral y Cirugía Bucal\**, 17(3), e523-527.
24. Komorowski, R. (1997). Orthodontic forced eruption and endodontic treatment. *\*Ontario Dentist\**, 74, 20-21.
25. Kreia, T. B., Camargo, E. S., Westphalen, V. P. D., Tanaka, O., Lara, F., & Maruo, H. (2005). Avaliação da reabsorção radicular após a movimentação ortodôntica em dentes tratados endodônticamente. *\*Revista Odonto Ciência – Faculdade de Odontologia/PUCRS\**, 20(47), 1-9.
26. La Fuente, J. E. R. C. (2009). Avaliação da reabsorção radicular externa em dentes tratados endodônticamente após tratamento endodôntico por meio de análise comparativa de métodos radiográficos [Dissertação de Doutorado, Universidade de São Paulo].
27. Lee, Y. J., & Lee, T. Y. (2016). External root resorption during orthodontic treatment in root-filled teeth and contralateral teeth with vital pulp: A clinical study of contributing factors. *\*American Journal of Orthodontics and Dentofacial Orthopedics\**, 149, 84-91.
28. Levander, E., Bajka, R., & Malmgren, O. (1998). Early radiographic diagnosis of apical root resorption during orthodontic treatment: A study of maxillary incisors. *\*American Journal of Orthodontics\**, 20(1), 57-63.
29. Malmgren, O., Goldson, L., Hill, C., Orwin, A., & Lundberg, M. (1982). Root resorption after orthodontic treatment of traumatized teeth. *\*American Journal of Orthodontics\**, 81(esp.), 487-491.
30. Mirabella, A. D., & Artun, J. (1995). Prevalence and severity of apical root resorption of maxillary anterior teeth in adult orthodontic patients. *\*European Journal of Orthodontics\**, 17, 93-99.



31. Tanaka, O. M., Leão Filho, J. C. B., Vitral, R. W. F., & Bósio, J. A. (2013). Orthodontic treatment in an endodontically treated maxillary incisors. *\*European Journal of General Dentistry\**, 2(1), 39-44.
32. Reitan, K. (1985). Biomechanical principles and reactions. In T. M. Graber & B. F. Swain (Eds.), *\*Orthodontics: Current principles and techniques\** (pp. 101-192). St. Louis: CV Mosby.
33. Reukers, E., Sanderink, G., Kuijpers-Jagtman, A. M., & Van't Hof, M. (1998). Assessment of apical root resorption using digital reconstruction. *\*Dentomaxillofacial Radiology\**, 27(1), 25-29.
34. Sampaio de Souza, R., Gandini Jr, L. G., Souza, V., Holland, R., & Dezan Jr, E. (2006). Influence of orthodontic dental movement on the healing process of teeth with periapical lesions. *\*Journal of Endodontics\**, 32(2), 122-126.
35. Santos, E. C. A., Iara, T. S., Arantes, F. M., Coclete, G. A., & Silva, R. S. (2007). Análise radiográfica computadorizada da reabsorção radicular apical após a utilização de duas mecânicas ortodônticas. *\*Dental Press Journal of Orthodontics\**, 12(1), 48-55.
36. Sameshima, G. T., & Sinclair, P. M. (2001). Predicting and preventing root resorption: Part I. Diagnostic factors. *\*American Journal of Orthodontics and Dentofacial Orthopedics\**, 119(5), 505-510.
37. Spurrier, S. W., Hall, S. H., Joondeph, D. R., Shapiro, P. A., & Riedel, R. A. (1990). A comparison of apical root resorption during orthodontic treatment in endodontically treated and vital teeth. *\*American Journal of Orthodontics and Dentofacial Orthopedics\**, 97(2), 130-134.
38. Steadman, S. R. (1942). Resume of the literature on root resorption. *\*Angle Orthodontist\**, 12, 283-286.
39. Walker, S. L., Tieu, L. D., & Flores-Mir, C. (2013). Radiographic comparison of the extent of orthodontically induced external apical root resorption in vital and root-filled teeth: A systematic review. *\*European Journal of Orthodontics\**, 35(6), 796-802.
40. Westphalen, V. P. D. (2002). Comparação da eficácia dos métodos radiográficos convencional e digital no diagnóstico de reabsorções radiculares externas simuladas, em função de examinadores e tamanhos de cavidades [Tese de Doutorado, Faculdade de Odontologia de Bauru, Universidade de São Paulo].
41. Weiland, F. (2006). External root resorptions and orthodontic forces: Correlations and clinical consequences. *\*Progress in Orthodontics\**, 7, 156-163.
42. Wickwire, N. A., McNeil, M. H., Norton, L. A., & Duell, R. C. (1974). The effects of tooth movement upon endodontically treated teeth. *\*Angle Orthodontist\**, 44(3), 235-242.
43. Younis, M., Irala, L. E. D., Soares, R. G., & Salles, A. A. (2008). Ortodontia frente às reabsorções apicais e periapicais prévias ou posteriores ao tratamento. *\*Revista de Endodontia Pesquisa e Ensino On Line\**, 4(8), 30-35.

## "The cell phone is free!": A study of the student's propensity to Smartphone Dependence and the teacher's perception in the classroom

 <https://doi.org/10.56238/sevened2024.016-019>

Rafael Machado Amorim<sup>1</sup>, Kathiane Benedetti Corso<sup>2</sup>, Sebastião Ailton da Rosa Cerqueira Adão<sup>3</sup>, João Roberto de Lima Gaffrée<sup>4</sup> and Cristiane Ferreira de Souza Araujo<sup>5</sup>

### ABSTRACT

The pedagogical practices of 30 years ago are incompatible with the current reality. The innovations provided using ICTs significantly reduce this time window. In view of this scenario, through a descriptive study, using the sequential mixed method, with quantitative and qualitative data collection, it was sought to meet the objective of the research, which is to analyze what are the effects of the use of the smartphone in the classroom on the student-teacher relationship in the Administration course of the Federal University of Pampa. From the application of the smartphone addiction test – SPAI-BR, the results indicate that about 43% of students can be considered smartphone dependent. With the qualitative stage of interviews with teachers, it was found that this group sometimes presents feelings of uselessness and lack of motivation in the teaching practice. However, they evaluate it as a good teaching tool, although little used in the classroom. Participant observation also showed that students commonly spend more time in the classroom attentive to what happens on social networks than in academic activity, collaborating even more to demotivate the teacher in pedagogical practice. The present work also brings as a contribution an analysis of the difficulties faced by teachers in the development of their activity and also presents the dichotomous reality between teachers and students' smartphones.

**Keywords:** Higher education, Teaching challenges, Smartphone addiction.

---

<sup>1</sup> Federal University of Pampa - UNIPAMPA

E-mail: amorim@rafaelamorim.com.br

<sup>2</sup> Graduate Program in Business Administration - PPGA

Federal University of Pampa - UNIPAMPA

E-mail: kathi.corso@gmail.com

<sup>3</sup> Graduate Program in Business Administration - PPGA

Federal University of Pampa - UNIPAMPA

E-mail: sebastiaocerqueira@unipampa.edu.br

<sup>4</sup> University Center of Campanha - URCAMP

E-mail: joaorobertogaffree@urcamp.edu.br

<sup>5</sup> Federal University of Pampa - UNIPAMPA

E-mail: cris.fsaraujo88@gmail.com



## INTRODUCTION

Education is a process that is constantly evolving. The pedagogical practices of 30 years ago do not apply to today's reality, in the same way that 30 years from now the most modern practices of today will be incredibly obsolete. In this sense, the innovations provided by the use of information and communication technologies (ICT) reduce this time window, so that the teaching of 10 years ago is already very different from the one that exists today. And certainly in 10 years the current practices will be outdated. Cetic (2011) states that several countries, from all continents, have invested in the use of ICTs in the innovation of pedagogical processes in schools.

According to data from UNESCO (2010), investments and the use of ICTs in initial teacher training should be in accordance with the fact that the use of such technologies is already a practice used by most young people in the world. The agency also states that many students have become digital citizens while the training of educators and practices in classrooms, at all educational levels, remain in the twentieth century.

In formal education, these technological devices, especially cell phones, receive some criticism from teachers, in relation to the problems they cause, such as distraction and deviation of the students' focus from the subjects covered in the classroom. Dealing specifically with the use of cell phones, Machado (2012) argues that it is necessary to carefully analyze the issue. According to the author, it may be necessary to establish restrictions on the use of these devices in schools, to allow a better progress of pedagogical actions and to "disconnect" students a little from the frenetic pace of today's life, or it is possible to make this equipment a work element for the development of various educational projects.

Research such as those by Lee (2013), Campenella et al. (2015), Choi et al. (2015), Kim et al. (2015), Haug et al. (2015) and Skarupová; Oláfsson; Blinka (2015) point to studies on the influence or impact of the use of technologies on personal behavior and social relationships. However, it is necessary to propose an advance in the depth of these influences, in the context of the classroom. In view of this scenario, this article aims to discuss the use of cell phones in the educational context, based on the following research problem: **What are the effects of the use of smartphones in the classroom on the student-teacher relationship in the Administration course at the Federal University of Pampa?**

Supporting this discussion, the following general objective is obtained: To analyze what are the effects of the use of smartphones in the classroom on the student-teacher relationship in the Administration course at the Federal University of Pampa. And specific: a) To investigate the degree of smartphone dependence of students of the Administration course at the Federal University of Pampa; and b) To analyze the vision and practices of the professors of the Administration course at



the Federal University of Pampa in relation to the use of smartphones by students in the educational context;

The interest in conducting a study on this subject is justified by the fact that the use of smartphones and the resulting dependence on the internet has become a globally recognized public health issue (WORLD HEALTH ORGANIZATION, 1996; AMERICAN PSYCHIATRIC ASSOCIATION, 2014), and the topic has been addressed in different ways in several studies, as shown by the studies by Ming et. al.(2006), Takao et al.(2009), Yen et al., (2009), Binning (2010), Turel and Serenko, (2010); Walsh et al.(2011), Oliveira et. al. (2017). The Federal Government, through the Reconnect program, aims to develop policies to combat the immoderate use of technology, which negatively affects family relationships (BRASIL, 2019).

The insertion of ICTs in education can be an important tool for improving the teaching-learning process. These technologies can generate positive or negative results, depending on how they are used. However, every new technique is only used with ease and naturalness at the end of a long process of appropriation. In the case of ICTs, this process clearly involves two facets: the technological and the pedagogical (Ponte, 2000).

Technology alone is incapable of transforming the educational environment (FERNANDES, MEDEIROS; 2012). For the inclusion of these technologies in education, in a positive way, several factors are necessary, such as those pointed out by Cetic (2011): a) the teacher's mastery of existing technologies and their use in practice; b) that the school be equipped with a good physical and material structure; c) that governments invest in training the teaching staff; d) that the teacher remains motivated to learn and innovate in his pedagogical practice and; e) that school curricula can integrate the use of new technologies.

Next, the theoretical framework will address in a more specific way the concepts related to the challenges of teaching in higher education in the use of technologies and also on the theme of smartphone addiction.

## **THEORETICAL FRAMEWORK**

### **OS CHALLENGES OF TEACHING IN HIGHER EDUCATION IN THE USE OF TECHNOLOGIES**

According to Masetto (2008), the structure in which higher education is organized in Brazil, since its inception, privileges the mastery of knowledge and professional experience, as sufficient requirements to teach in university courses. However, there is a growing awareness that the role of teaching in higher education needs to change, because, as in any other professional activity, teachers need their own specific training, which "is not restricted to having a bachelor's degree, or even a master's or doctor's degree, or even just the exercise of a profession" (MASETTO, 2003, p. 13).



According to Masetto (2003), the main focus of change is found in the teacher's own action, which must cease to be the center of the process and move to a learning scenario in which the learner occupies the centrality. It is necessary that teacher and student become partners and co-participants in the same process (SILVA and CILENTO, 2014).

However, it is expected that, in the digital culture, the teacher knows how to operate with information in hypertext and explore communication networks in interactivity. It is also expected that they know how to develop a pedagogy that contemplates the hypertextual and interactive dynamics of the web, making these communicational dispositions favorable to dialogical and collaborative educational practice, demanding new teaching knowledge that can be developed in the continuing education of teachers in tune with the socio-technical changes that emerge with digital culture (SILVA, 2005, 2014).

The popularization of cell phones and the technological development associated with them have highlighted these devices in actions related to *m-learning* (Schmiedl et al., 2010, Robles et al., 2011, Xie et al., 2011), so that these devices have the potential to make learning more accessible, collaborative and relevant (Unesco, 2012). However, despite the potential that cell phones have in educational terms, the school, in general, does not use them, often choosing only to prohibit their use in the classroom (Seabra, 2013). Seabra (2013) and Machado (2012) analyze problems and possibilities of using cell phones in the school environment, stating that this equipment can collaborate in pedagogical actions, as a research and production tool, overcoming its negative effects.

Despite its limitations, m-learning cannot be defined as *restricted e-learning*, confined to a smaller device. Nor is it a hardware platform. It is a new concept related to learning, characterized by ease of access, mobility and permanent connectivity, possible anytime and anywhere (Caudill, 2007; Traxler, 2007; Parsons et al., 2007). *M-learning* should be studied not only with regard to technology, but also with regard to broad and sustainable development, considering all the transformations involved, such as social and educational transformations based on access to information and knowledge at any time and in any place where the learner, when carrying it with him, permanently, it enhances the opportunities for its use, increasing the chances of learning.

According to Traxler (2007), the first definitions of m-learning were initially centered on technology, basically relating m-learning to learning with the use of mobile technologies. However, more than the simple use of mobile and wireless technologies for learning, it is important to characterize m-learning by what differentiates it from other practices or modalities of teaching-learning. In this regard, a current of literature (Sharples et al., 2007; Traxler, 2007; Winters, 2007; Kukulska-Hulme et al., 2011) points out that m-learning can be characterized by helping to provide: greater control and autonomy over one's own learning - individual-centered learning; learning in context, that is, at the place, time and under the conditions that the learner deems most appropriate;





continuity and connectivity between contexts, such as the possibility of the learner accessing the cell phone to obtain information while moving in a certain area or throughout an event; spontaneity and opportunism, which means bringing the possibility for the learner to take advantage of times, spaces and any opportunities to learn spontaneously, according to their interests and needs

## SMARTPHONE ADDICTION

Dependence, according to Orto (2017), is a condition where the individual has an uncontrollable need for a behavior or substance, and the lack of this behavior or substance can cause a state of malaise, anxiety, nausea and tachycardia. The diagnostic manuals for diseases DSM-IV (AMERICAN PSYCHIATRIC ASSOCIATION, 2014) and ICD-10 (WORLD HEALTH ORGANIZATION, 1996) recognize the existence of two groups of dependencies. Substance use dependencies and behavioral dependencies. The World Health Organization (WHO) defines substance use addictions when the individual uses, solely or continuously, substances that are harmful to the body, presenting disorders and disorders in the absence of their use (WORLD HEALTH ORGANIZATION, 1996). When the individual repeats a certain behavior and it generates a reward reaction, behavioral dependence occurs. Games (there may be some type of betting, digital or physical), work, sex, physical exercise, shopping and technology are some of the types of behavioral dependence, according to the World Health Organization (1996) and Oliveira (2012). Griffiths (1996a) and Caplan (2007) defend the idea that technological dependence is a type of behavioral dependence, while Kuss and Griffiths (2012a; 2012b) and Davis (2001) associate it with something beyond behavioral dependence, such as attention-deficit/hyperactivity disorder, depression, and social phobia (PICON, et al., 2015).

New services, technologies and also problems have emerged with the growing number of internet users where, in Brazil, 181 million users were registered by the IBGE (2018) in 2017. The most relevant of the technological dependencies is internet dependence. According to research, this represents a growing problem in health care, providing the individual with essentially emotional complications, such as stress, depression and suicidal tendencies, anger and anxiety (YOUNG and ABREU, 2011; ORTO, 2017; BŁACHNIO et al, 2019).

Internet addiction has been studied in academia since 1995, with the seminal works of Griffiths (1995) and Young (1996). Fortim and Araujo (2013) also state that internet addicts resort to this medium to escape from reality, distract themselves, obtain pleasure or even some kind of emotional support, temporarily relieving their problems. By understanding that, according to Lee et al. (2013) smartphones are an essential part of people's lives, some present, due to not being able to disconnect from their smartphones, problems concentrating on their daily activities. For Picon et al. (2015), the fact that "it is always close to the body and within reach of the hand wherever the



individual is", the various forms of communication that the smartphone allows people also makes room for the smartphone to negatively interfere with individuals (PICON, et al., 2015), so that it is used almost everywhere, such as in bed, bathroom, work, restaurants, etc. (CHOI, 2015).

Consequently, these people become dependent on the use of the smartphone.

In this sense, Lin et. al (2014) consider smartphone dependence as a form of technological dependence. Won-jun (2013) states that it is a condition "where the individual feels enslaved by their smartphone and related services". Kwon et. al (2013a), Salehan and Negahban (2013), Mok et al. (2014) directly link smartphone addiction to internet addiction, as they understand the intrinsic nature of the latter. King et al. (2010) state that smartphone addiction can also be called nomophobia, a term created in the United Kingdom whose meaning refers to the expression "*no mobile phobia*" or phobia of remaining without a cell phone, in our translation.

Current studies on Smartphone Addiction have been initiated in order to investigate the impact of cell phone use on students and university students. The studies of Lee et al (2015) point out that the greater the degree of smartphone addiction, the lower the self-learning capacity in South Korean students. In this sense, Lepp, Barkley and Karpinski (2015) point out that American students who use smartphones a lot have lower academic performance, compared to students considered not dependent on smartphones.

## STUDY METHOD

The present study is characterized as descriptive, as it seeks to describe and analyze the effects of smartphone use in the classroom on the student-teacher relationship. According to Gil (2010), research of this type has as its primary objective the description of the characteristics of a given population or phenomenon or the simple identification of the existence of relationships between variables and intends to determine the nature of this relationship. Regarding the approach, this research is classified as a qualitative and quantitative study. The qualitative approach was based on an interview with the faculty of the Administration course at the Federal University of Pampa – UNIPAMPA and participant observation in the classroom. Regarding the quantitative approach, it is reported that a questionnaire was applied to the student body of the Administration course of the same University. Silva (1998) defends the use of the two approaches together. For the author, the relationship between the quantitative and the qualitative is complementary, that is, the quantitative is concerned with orders, quantities and their relations, and the qualitative formulates a framework of interpretations for measurements or understanding for what is not quantifiable.

In view of the research approach, it was decided to use the sequential mixed method, starting the collection of quantitative data and in a second stage, qualitative data. According to Tashakkori and Creswell (2007), mixed-methods research is defined as one in which the investigator collects and



analyzes data, integrates findings, and draws inferences using qualitative and quantitative approaches or methods in a single study or research program" (TASHAKKORI AND CRESWELL, 2007, p. 4). In the mixed method, the researcher bases the investigation on the assumption that the collection of different types of data ensures a better understanding of the researched problem (CRESWELL, 2007).

Regarding data collection, three diversified techniques were selected: questionnaire application, face-to-face interview and participant observation. Questionnaires are defined by Gil (2012) as an investigation technique, based on a set of questions, which are applied to people in order to collect information about knowledge, values, beliefs, interests, expectations, present or past behavior, etc. The questionnaire used in this study is the *Smartphone Addition Inventory* (SPAI-BR), developed and validated in Taiwan by Lin et al. (2014). The SPAI scale is based on the CIAS scale, which was developed by Kim et al. (2006). Prepared in English, it consists of 26 questions with answers on the Likert scale, where each alternative is equivalent to a score ranging from 1 to 4, as follows: 1 - strongly disagrees; 2 - moderately disagrees; 3 - moderately agrees and; 4 - strongly agree.

The translation and cultural adaptation to the Brazilian Portuguese language was carried out by Khoury et al. (2017). In this process, the SPAI-BR scale ceased to be of the Likert type and became dichotomous, with answers of the type "Yes" and "No". Its application was non-probabilistic for convenience, considering a population of 351 students, obtaining a return of 104 online questionnaires (via Google forms) and printed questionnaires (collected in the classroom).

Regarding the interview conducted individually with university professors, it can be stated that the interview is a meeting between two people, so that one of them obtains information about a certain subject (LAKATOS; MARCONI, 2007). Lakatos and Marconi (2007) point out that the structured interview, also known as standardized interview, has as its main characteristic the use of a previously organized script. The interview script was prepared by the authors based on the theoretical framework, with the following questions: 1) Teaching time; 2) Sex; 3) Age; 4) Research Area/Focus; 5) How do you feel about the use of smartphones by students in the classroom at times not scheduled by the teacher? 6) Do you think there is a use of the smartphone when used in a guided way by the teacher? 7) Do you think that the excessive use of smartphones in the classroom harms the teaching-learning process? If so, how much does it harm? 8) Do you think that the excessive use of smartphones in the classroom helps in the teaching-learning process? If so, how much does it help? 9) Do you use the smartphone as a teaching tool in the classroom? If so, how often? 10) And how do you use it, give examples?

From a total of 20 effective professors of the Administration course at the Federal University of Pampa, 04 interviews were conducted, and these were recorded and later transcribed for analysis



in the IRAMUTEQ software. From this group, substitute professors and those who are not performing academic activities were excluded

Regarding participant observation, it is clarified that the authors carried out during the teaching internship period of the graduate course, each in their respective classes and class professors, sought to observe the behavior of students in relation to the use of smartphones in the classroom. For Gil (2012, p. 103) "participant observation is the technique by which one arrives at knowledge of the life of a group from within itself".

Interpretative analysis was used to triangulate the data, which according to Severino (2007, p. 59) is "to interpret in a restricted sense, to take one's own position regarding the ideas enunciated, to overcome the strict message of the text, to read between the lines [...], to explore all the fruitfulness of the ideas exposed". The analysis carried out in this research was based on the joint analysis of the collected data.

## ANALYSIS OF THE RESULTS

In the analysis of the quantitative stage of the work, the students who responded to the survey represent approximately 29% of the total of 351 students of the Administration course, in the day and night shifts. Table 1 presents the quantitative of the responses collected.

Table 1 - Responses to the *Smartphone Addition Inventory* (SPAI-BR) questionnaire

Alternative	YES	NO
<b>1. I've been told more than once that I spend too much time on my smartphone.</b>	56	48
<b>2. I feel uncomfortable/anxious/restless when I don't use a smartphone for a certain period of time.</b>	45	59
<b>3. I think I've been staying more and more time connected to the smartphone.</b>	70	34
<b>4. I feel restless and irritable when I don't have access to my smartphone.</b>	38	66
<b>5. I feel willing to use the smartphone even when I feel tired.</b>	59	45
<b>6. I use a smartphone for longer and/or spend more money on it than I initially intended.</b>	31	73
<b>7. Although smartphone use has had negative effects on my interpersonal relationships, the amount of time I spend on it remains the same.</b>	38	66
<b>8. On more than one occasion, I slept less than four hours because I was using the smartphone.</b>	33	71
<b>9. I have considerably increased the time spent using the</b>	30	74



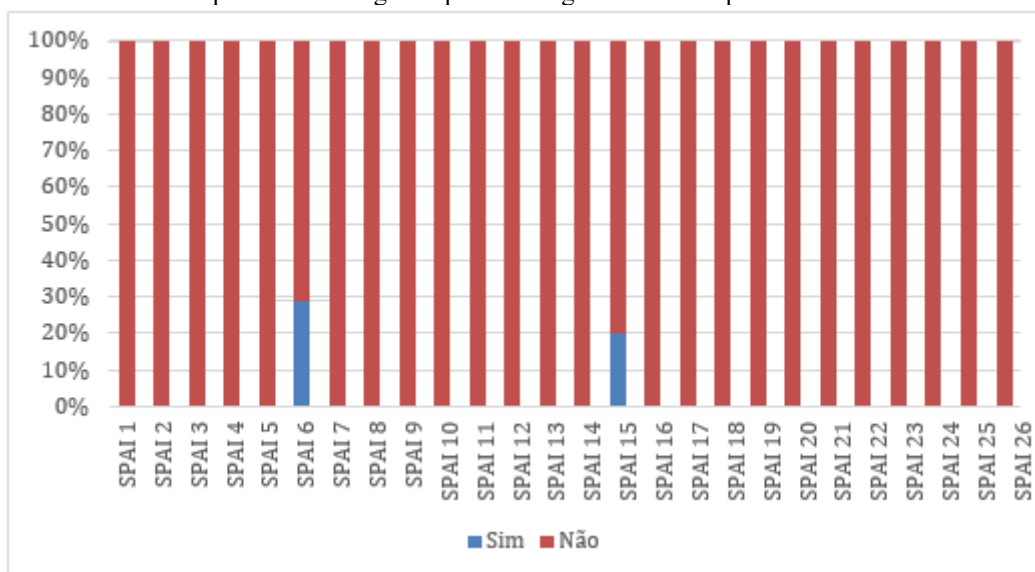
<b>smartphone in the last 3 months.</b>		
<b>10. I feel bothered or down when I stop using the smartphone for a certain period of time.</b>	23	81
<b>11. I can't control the impulse to use the smartphone.</b>	33	71
<b>12. I feel more satisfied using my smartphone than spending time with my friends.</b>	7	97
<b>13. I feel pain or discomfort in my back, or discomfort in my eyes, due to excessive use of the smartphone.</b>	40	64
<b>14. The idea of using the smartphone comes as the first thought in my head when I wake up in the morning.</b>	47	57
<b>15. Smartphone use has had negative effects on my performance at school or work.</b>	21	83
<b>16. I feel anxious or irritable when my smartphone is not available and I miss something when I stop using the smartphone for a certain period of time.</b>	32	72
<b>17. My interaction with my family members decreased because of my smartphone use.</b>	30	74
<b>18. My leisure activities have decreased because of smartphone use.</b>	22	82
<b>19. I feel a great urge to use the smartphone again right after I stop using it.</b>	35	69
<b>20. My life would be boring if I didn't have the smartphone.</b>	31	73
<b>21. Browsing on my smartphone has caused damage to my physical health. For example, I use my smartphone when I cross the street, or while driving or waiting for something, and that use may have put me in danger.</b>	29	75
<b>22. I've been trying to spend less time using my smartphone, but I haven't been able to.</b>	27	77
<b>23. I made smartphone use a habit and my quality and total sleep time decreased.</b>	31	73
<b>24. I need to spend more and more time on the smartphone to achieve the same satisfaction as before.</b>	11	93
<b>25. I can't have a meal without using my smartphone.</b>	16	88
<b>26. I feel tired during the day due to late-night/late-night smartphone use.</b>	16	88

Source: The authors

According to the criteria established by Khoury et al. (2017), of the total number of respondents, 59 participants (56.73%) cannot be considered smartphone dependent, as they marked less than nine "Yes" answers, out of a total of 26 statements. The other 45 respondents (43.27%) can be classified as smartphone dependent, as they marked "Yes" in their answers to nine items or more. The averages found were 8.18 for the "Yes" answer and 17.81 for the "No" answer. The standard deviation found was 5.12, both for "Yes" and "No".

The statements with the highest number of "Yes" signed, with 70, 59 and 56 statements, respectively, were number 3 ("I think I've been staying connected to the smartphone more and more"), number 5 ("I feel willing to use the smartphone even when I feel tired") and number 1 ("I've been told more than once that I spend too much time on the smartphone"). The statements that received the most "No" answers are number 12 ("I feel more satisfied using the smartphone than spending time with my friends"), 24 ("I need to spend more and more time on the smartphone to achieve the same satisfaction as before") and 26 ("I feel tired during the day due to using the smartphone late at night/early in the morning"). These statements obtained 97, 93 and 88 negative responses, respectively. Graph 1 shows the percentages of yes and no answers that each statement obtained.

Graph 1 - Percentages of positive/negative answers per affirmative



Source: The authors

The percentage of smartphone dependents found in this stage of the research, 43.27%, is higher than the 35.66% of smartphone dependents found by Khoury et.al (2017).

For the textual analysis of the 4 (four) interviews conducted with effective professors of the Administration Course at the Federal University of Pampa, the free software "*IRAMUTEQ*" (*Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*) was used,



which allows statistical analysis on textual corpus and tables of words/individuals, in addition to having an open data source (CAMARGO and JUSTO, 2013).

The semi-structured interview for the teachers was composed of 10 (ten) questions, and the first 4 (four) (teaching time; gender; age; research area/focus) indicate that the majority of respondents are female (3 people), with ages ranging from 27 to 38 years (mean of 32.75, with standard deviation of 5.12) and average time in teaching activity of 6.75 years (SD: 5.05). The respondents' areas of research/focus, in alphabetical order, are: production management, public administration, inter-organizational relations and information systems and technologies.

Teachers are divided on their sentiment regarding students' smartphone use at unscheduled times. Some describe feelings of worthlessness and demotivation, especially when students talk to each other while the content is being explained. Others do not feel bad or have already adapted to this reality, looking for ways to compete with the attractiveness of the internet when preparing classes.

Regarding the use of the smartphone when used in a teacher-guided way, the respondents state that, although this can be a good tool, there is a lack of knowledge of how to extract the full potential. Currently, the smartphone is most used to access the institution's virtual learning environment (Moodle).

The next question seeks to know from teachers if they think that the excessive use of smartphones in the classroom helps the teaching-learning process. The respondents believe that it can be useful, as long as it is under guidance, and that it should be something different from what currently bothers them.

The smartphone is a didactic tool partially used by teachers. When used, the answers point to infrequency of use every two weeks, and this use is used to send communications to students via WhatsApp, search for information about companies to solve exercises or even to carry out directed reading.

These six questions are also examined through the aforementioned software, in search of patterns in the answers collected. The analyses performed on the textual corpus in the "IRAMUTEQ" software were: 1) Classical textual statistics 2) Analysis of similarity of words present in the text and; 3) Word cloud.

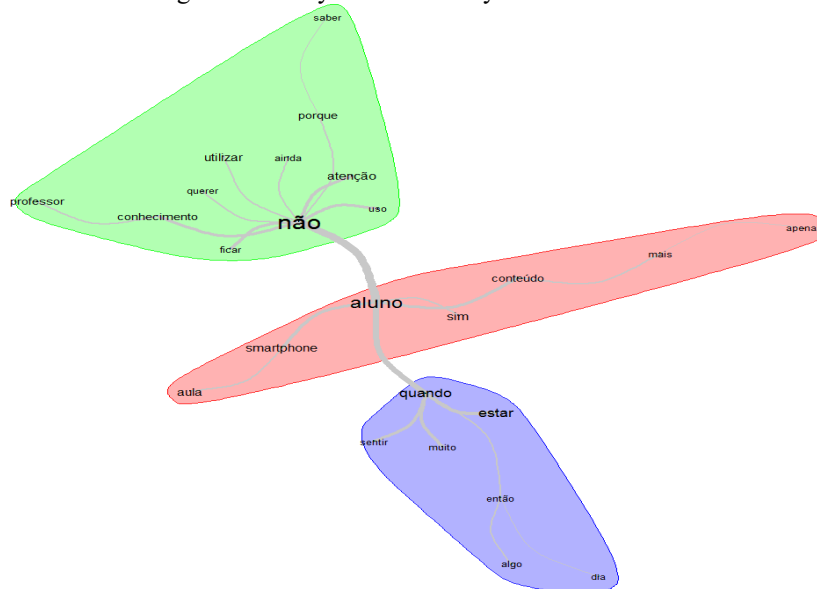
The textual statistical analysis of the corpus presented the following results:

- Number of texts analyzed: 4
- Number of occurrences: 602
- Number of different word forms: 249
- Number of hapax: 164 (27.24% of occurrences and 65.86% of different forms of words)
- Average occurrences per text: 150.50

According to the authors Camargo and Justo (2013), the results identify the textual parts of the interviews, showing the number of words, the frequency and the words that only appear in the text once, called *hapax*, as well as the different forms of words and the average number of words per text analyzed.

Figure 1 shows the analysis of the similarity of the words by interviews.

Figure 1 - Analysis of similarity of the interviews

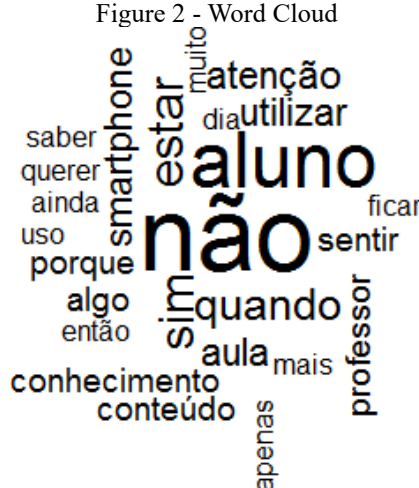


Source: Data obtained by the authors, through the IRAMUTEQ software (2019).

*Figure 1 - Analysis of the similarity of the interviews* Figure 1 (graph) points out that the occurrences and similarity between the words and their consequences indicate a connection between them, thus facilitating the identification of the structure of the representation (CAMARGO and JUSTO, 2013). Each color represents a different cluster, from which three large groups can be noted in the texts, being classified and pointed out 4 words of greater frequency in the interviews, It is noticed that the words most used in their discourses were the words "no" and "student", and the word "no" is linked to the terms know, use, attention to use, knowledge, want and teacher and the word "student" is linked to content, Yes, smartphone and class, demonstrating the thought that teachers have of denying the use or use of smartphones and the reticence they have when associating the class with the smartphone, preferring to develop content. Figure 2 shows the word cloud.



Figure 2 - Word Cloud



Source: Data obtained by the authors, through the IRAMUTEQ software (2019).

The same authors also explain that the word cloud obtained, expresses and joins all the words, organizing them graphically according to their occurrence in the text, and the greater its size and density, the more visibility it will have in the word cloud. The word cloud consists of a simple lexical analysis (in relation to vocabulary), and Figure 2 shows the words with the greatest inference in the text, in the order of their relevance: no; pupil; be; when; yes; smartphone; among other words.

Regarding participant observation, it was found that students are extremely connected to their devices. They often use their smartphones in activities unrelated to class, mainly accessing social networks, such as Facebook and Instagram, completely distracting themselves from academic activity. Other students, usually in the evening period, although outside their working hours, "disconnect from class" because they are still solving work issues, through email or communication applications, such as Messenger and WhatsApp. It is also recorded that the teachers observed rarely used the smartphone and, when they did, it was to send material to the students themselves or to consult the watch, a habit also observed among the students.

## FINAL CONSIDERATIONS

In view of the results previously analyzed, it can be concluded that the present research achieved the proposed objective of analyzing the effects of smartphone use in the classroom on the student-teacher relationship in the Administration course at the Federal University of Pampa.

It was possible to investigate the degree of smartphone dependence of the students, by collecting responses from 104 of the 351 students of the Administration course (representing approximately 29% of students of the course). Of these, 59 participants (56.73%) cannot be considered smartphone dependent, as they marked less than nine "Yes" answers in their questionnaires, according to the criteria established by Khoury et al (2017), and the other 45 respondents (43.27%) were classified as smartphone dependent, when they marked "Yes" in their



answers to nine items or more. For comparison, Khoury et al. (2017) found 35.66% of smartphone addicts in their studies in 2016.

Regarding the analysis of the teachers' vision and practices, in relation to the use of smartphones by students in the educational context, the interviews took place with 4 of the 20 effective teachers, representing 20% of this group, and show that there is a division in the answers. They recognize the importance of using technology in the classroom on the one hand, and on the other hand, they do not know how to exploit this tool to transform the class and thus "win the battle". Feelings of demotivation and/or worthlessness show that at certain times, the battle for the smartphone is lost.

The students observed are often more concerned with what happens outside the classroom than with the knowledge that the teacher is trying, sometimes in vain, to transmit to him. And for that, screens are the bridge to the outside world. Such practice, at the same time, demotivates and challenges the teacher in the search for solutions to hold the attention of the former, and thus allow the latter to develop their disciplines with quality and objectivity.

As limitations to this study, it is highlighted that the results obtained show the only reality of this portion of the academic community, where those studied are from the large area of applied social sciences. Another limitation found was the low adherence of the faculty to participate in the interviews. At this point, it is believed that one of the factors for low adherence is the period at the end of the semester in which the interviews were conducted.

As suggestions for future studies, it is recommended to carry out this research with other students and professors from other major areas of knowledge. Such research could give a broader overview of the effects of smartphone use in the classroom on the student-teacher relationship. Another suggestion is that, with data from this type of study, new pedagogical practices and new teaching tools can be developed, to hold the student's attention in front of this small Pandora's box.



## REFERENCES

1. American Psychiatric Association. (2014). \*Manual diagnóstico e estatístico de transtornos mentais: DSM-5\* (5ª ed.). Porto Alegre: Artmed.
2. Aoki, K., & Downs, E. J. (2003). An analysis of young people's use of and attitudes toward cell phones. \*Telematics and Informatics\*, 20(4), 349-364.
3. Batista, S. C. F. M. (2011). \*M-LearnMat: Modelo Pedagógico para Atividades de M-learning em Matemática\* (Tese de doutorado, Universidade Federal do Rio Grande do Sul).
4. Binning, E. (2010). How texting can be a pain in the neck. \*New Zealand Herald\*. Disponível em: <[https://www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=10688597](https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10688597)>. Acesso em: 02 mar. 2019.
5. Błachnio, A., Przepiórka, A., Gorbaniuk, O., Benvenuti, M., Ciobanu, A. M., Senol-Durak, E., ... & Ben-Ezra, M. (2019). Cultural correlates of internet addiction. \*Cyberpsychology, Behavior, and Social Networking\*, 22(4).
6. Borges, A. P., & Joia, L. A. (2013). Executivos e smartphones: uma relação ambígua e paradoxal. \*O & S\*, 20(67), 585-602. Disponível em <<http://www.portalseer.ufba.br/index.php/revistaoes/article/view/9127/6572>>. Acesso em: 10 jul. 2018.
7. Brasil. Ministério da Mulher, da Família e dos Direitos Humanos. (2019). O que é o Reconecte. Brasília. Disponível em <<https://www.mdh.gov.br/navegue-por-temas/reconecte/o-que-e-o-reconecte>>. Acesso em: 27 ago. 2019.
8. Camargo, B. V., & Justo, A. M. (2013). Tutorial para uso do software de análise textual IRAMUTEQ. Laboratório de Psicologia Social da Comunicação e Cognição, LACCOS. Universidade Federal de Santa Catarina, Brasil.
9. Campanella, M. et al. (2015). Prevalence of internet addiction: A pilot study in a group of Italian high-school students. \*Clinical Neuropsychiatry\*, 12(4), 90-93.
10. Caudill, J. G. (2007). The growth of m-learning and the growth of mobile computing: Parallel developments. \*International Review of Research in Open and Distance Learning\*, 8(2).
11. Centro de Estudos Sobre Tecnologias da Informação e Comunicação. (2011). TIC educação 2010: Pesquisa sobre o uso das tecnologias da informação e comunicação nas escolas brasileiras. São Paulo.
12. Choi, S-W. et al. (2015). Comparison of risk and protective factors associated with smartphone addiction and internet addiction. \*Journal of Behavioral Addictions\*, 4(4), 308-314.
13. Chotpitayasunondh, V., & Douglas, K. M. (2018). The effects of “phubbing” on social interaction. \*Journal of Applied Social Psychology\*, 48(6), 304-316.
14. Churchill, D., & Churchill, D. (2008). Educational affordances of PDAs: A study of a teacher's exploration of this technology. \*Computers & Education\*, 50(4), 1439-1450.



15. Csikszentmihalyi, M. (1988). The flow experience and its significance for human psychology. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *\*Optimal experience: Psychological studies of flow in consciousness\** (pp. 15-35). Cambridge University Press.
16. Dal Cin, I. C. T. P., & Melo, M. C. O. L. (2013). Dependência de Internet: Um estudo com profissionais e estudantes da área de TI em Belo Horizonte. *\*XXXVII Encontro da ANPAD – EnANPAD\**, Rio de Janeiro/RJ, set.
17. Duchesne, S. P. et al. (2008). Trajectories of anxiety during elementary school years and the prediction of high school noncompletion. *\*Journal of Youth and Adolescence\**, 37, 1134-1146.
18. EDUCAUSE. (2010). *\*7 things you should know about mobile apps for learning\**. Disponível em: <http://net.educause.edu/ir/library/pdf/ELI7060.pdf>. Acesso em: 02 jan. 2013.
19. Fernandes, E., & Medeiros, J. (2012). TIC nas aulas: onde estamos? *\*Nova Escola\**, ed. 42, jul.
20. Haug, S. et al. (2015). Smartphone use and smartphone addiction among young people in Switzerland. *\*Journal of Behavioral Addictions\**, 4(4), 299-307.
21. Instituto Brasileiro de Geografia e Estatística (IBGE). (2017). *\*Pesquisa Nacional de Amostragem e Domicílios-PNAD contínua - Acesso à Internet e à televisão e posse de telefone móvel celular para uso pessoal\**. Disponível em: [https://biblioteca.ibge.gov.br/visualizacao/livros/liv101631\\_informativo.pdf](https://biblioteca.ibge.gov.br/visualizacao/livros/liv101631_informativo.pdf). Acesso em: 27 ago. 2019.
22. Khan, M. J., Altaf, S., & Kausar, H. (2013). Effect of perceived academic stress on students' performance. *\*FWU Journal of Social Sciences\**, 7, 146.
23. Khoury, J. M. et al. (2017). Assessment of the accuracy of a new tool for the screening of smartphone addiction. *\*PLOS ONE\**, 12(5).
24. Kim, M. et al. (2015). Smartphone addiction: (Focused depression, aggression and impulsivity) among college students. *\*Indian Journal of Science and Technology\**, 8(25), IPL0428.
25. Kukulska-Hulme, A., Sharples, M., Milrad, M. A. S., Anchez, A., Arnedillo-Sanchez, I., & Vavoula, G. (2011). The genesis and development of mobile learning in Europe. In D. Parsons (Ed.), *\*Combining e-learning and mobile learning: New applications of blended educational resources\** (pp. 151-177). Hershey, PA: IGI Global.
26. Kwon, M. et al. (2013). The Smartphone Addiction Scale: Development and validation of a short version for adolescents. *\*PLOS ONE\**, 8(12).
27. Lee, W-J. (2013). An exploratory study on addictive use of smartphone: Developing SAUS (Smartphone Addictive Use Scale). *\*Journal of Convergence Information Technology (JCIT)\**, 8(12), 403-408.
28. Lee, J., Cho, B., Kim, Y., & Noh, J. (2015). Smartphone addiction in university students and its implication for learning. In G. Chen et al. (Eds.), *\*Emerging issues in smart learning\** (pp. 297-305). Berlin, Heidelberg: Springer.
29. Lepp, A., Barkley, J. E., & Karpinski, A. C. (2015). The relationship between cell phone use and academic performance in a sample of U.S. college students. *\*SAGE Open\**, 5(1).



30. Machado, J. L. A. (2012). Celular na escola: O que fazer? Disponível em: <<http://cmais.com.br/educacao/celular-na-escola-o-que-fazer>>. Acesso em: 10 jan. 2019.
31. Meyer, D., & Turner, J. (2006). Re-conceptualizing emotion and motivation to learn in classroom contexts. *Educational Psychology Review*, 18(4), 377-390.
32. Masetto, M. T. (2003). *Competência pedagógica do professor universitário*. São Paulo: Summus.
33. Masetto, M. T. (2008). *Docência na universidade*. Campinas, SP: Papirus.
34. Ming, Z., Pietikainen, S., & Hänninen, O. (2006). Excessive texting in pathophysiology of first carpometacarpal joint arthritis. *Pathophysiology*, 13(4), 269-270.
35. Moldasheva, G., & Mahmood, M. (2014). Personality, learning strategies, and academic performance: Evidence from post-Soviet Kazakhstan. *Education + Training*, 56(4), 343-359.
36. Nofle, E. E., & Robins, R. W. (2007). Personality predictors of academic outcomes: Big five correlates of GPA and SAT scores. *Journal of Personality and Social Psychology*, 93(1), 116-130.
37. Oliveira, T. S. et al. (2017). Cadê meu celular? Uma análise da nomofobia no ambiente organizacional. *Revista de Administração de Empresas*, 57(6), 634-635.
38. Organização Mundial da Saúde. (1996). *Classificação estatística internacional de doenças e problemas relacionados à saúde: CID-10 Décima revisão* (3. ed., v. 2). São Paulo: EDUSP.
39. Pachler, N., Bachmair, B., & Cook, J. (2010). *Mobile learning: Structures, agency, practices*. New York, USA: Springer.
40. Parsons, D., Ryu, H., & Cranshaw, M. (2007). A design requirements framework for mobile learning environments. *Journal of Computers*, 2(4), 1-8.
41. Ponte, J. P. da. (2000). Tecnologias de informação e comunicação na formação de professores: Que desafios? *Revista Iberoamericana de Educación*, 24, 63-90. Disponível em: <<http://www.rieoei.org/rie24a03.htm>>. Acesso em: 22 abr. 2019.
42. Quinn, C. N. (2011). *Mobile learning: Landscape and trends*. Disponível em: <<https://commons.lbl.gov/download/attachments/77828943/mobile2011report-f2.pdf>>. Acesso em: 12 abr. 2019.
43. Ranie, L., & Zickuhr, K. (2015). *Americans' views on mobile etiquette*. Washington, DC: Pew Research Center. Disponível em: <<http://www.pewinternet.org/2015/08/26/americans-views-on-mobile-etiquette/>>. Acesso em: 25 abr. 2019.
44. Robles, G., González-Barahona, J. M., & Fernández-González, J. (2011). Implementing gymkhanas with Android smartphones: A multimedia m-learning game. In *IEEE Global Engineering Education Conference (EDUCON)* (pp. 1-6). Amman, Jordan.
45. Schmiedl, G., Grechenig, T., & Schmiedl, B. (2010). Mobile enabling of virtual teams in school: An observational study on smartphone application in secondary education. In *International Conference on Education Technology and Computer* (Vol. 2, pp. 74-79). Shanghai, China: IEEE Xplore Digital Library.




46. Seabra, C. (2013). O celular na sala de aula. Disponível em: <<http://cseabra.wordpress.com/2013/03/03/o-celular-na-sala-de-aula/>>. Acesso em: 20 abr. 2019.
47. Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews & C. Haythornthwaite (Eds.), *\*The Sage Handbook of E-learning Research\** (pp. 221-247). London: Sage.
48. Sharupová, K., Ólafsson, K., & Blinka, L. (2016). The effect of smartphone use on trends in European adolescents' excessive Internet use. *\*Behaviour & Information Technology\**, 35(1), 68-74.
49. Silva, M. (2005). *\*Educación interactiva: enseñanza y aprendizaje presencial y online\**. Barcelona: Gedisa.
50. Silva, M. (2014). *\*Sala de aula interativa\** (7. ed.). São Paulo: Loyola.
51. Silva, M., & Cilento, S. A. (2014). Formação de professores para docência online: Considerações sobre um estudo de caso. *\*Revista da FAEEBA-Educação e Contemporaneidade\**, 23(42).
52. Takao, M., Takahashi, S., & Kitamura, M. (2009). Addictive personality and problematic mobile phone use. *\*Cyberpsychology & Behavior\**, 12(5), 501-507.
53. Traxler, J. (2007). Defining, discussing, and evaluating mobile learning. *\*International Review of Research in Open and Distance Learning\**, 8(2).
54. Turel, O., & Serenko, A. (2010). Is mobile email addiction overlooked? *\*Communications of the ACM\**, 53(5), 41-43.
55. Turkle, S. (2012). *\*Alone together: Why we expect more from technology and less from each other\**. New York, NY: Basic Books.
56. UNESCO. (2010). Convite oficial e contexto da Conferência Internacional O Impacto das TICs na Educação. Disponível em: <<http://www.unesco.org/new/pt/brasil/communication-and-information/ict-in-education/international-conference-ict-in-education/official-announcement-and-background/#c154939>>. Acesso em: 14 abr. 2019.
57. UNESCO. (2012). *\*Turning on mobile learning in Latin America: Illustrative initiatives and policy implications\**. Working Paper Series on Mobile Learning. Paris, France. Disponível em: <<http://unesdoc.unesco.org/images/0021/002160/216080e.pdf>>. Acesso em: 28 jun. 2012.
58. Walsh, T. J. et al. (2008). Treatment of aspergillosis: Clinical practice guidelines of the Infectious Diseases Society of America. *\*Clinical Infectious Diseases\**, 46(3), 327-360.
59. Walsh, S. P., White, K. M., & Young, R. M. (2010). Needing to connect: The effect of self and others on young people's involvement with their mobile phones. *\*Australian Journal of Psychology\**, 62, 194-203.
60. Winters, N. (2007). What is mobile learning. In M. Sharples (Ed.), *\*Big issues in mobile learning: Report\** (pp. 1-10). University of Nottingham. Disponível em: <[http://www.lsri.nottingham.ac.uk/Publications\\_PDFs/BIG\\_ISSUES\\_REPORT\\_PUBLISHED.pdf](http://www.lsri.nottingham.ac.uk/Publications_PDFs/BIG_ISSUES_REPORT_PUBLISHED.pdf)>. Acesso em: 15 abr. 2019.



61. Xie, A., Zhu, Q., & Xia, H. (2011). Investigating college major differences in the need of mobile phone learning. In *\*International Conference on Multimedia Technology (ICMT)\** (pp. 1-5). Hangzhou, China: IEEE Xplore Digital Library.
62. Yen, C.-F., Ko, C.-H., Yen, J.-Y., & Cheng, C.-P. (2009). Symptoms of problematic cellular phone use, functional impairment and its association with depression among adolescents in Southern Taiwan. *\*Journal of Adolescence\**, 32(4), 863-873.

## Contextualizing Forensic Nursing

 <https://doi.org/10.56238/sevened2024.016-020>

Jhuliano Silva Ramos de Souza<sup>1</sup>, Zélia Marilda Rodrigues Resck<sup>2</sup> and Sueli de Carvalho Vilela<sup>3</sup>

### ABSTRACT

Forensic Nursing is a specialty that combines knowledge of health, law, and criminology, focusing on the application of nursing in legal contexts. It involves gathering evidence, assisting victims of crime, and accurate documentation for court proceedings. Forensic Nurses work at the interface between health and justice, using their technical and ethical expertise. It is essential that these professionals understand the ethical, legal, and political implications of their work, respecting confidentiality, ensuring informed consent, and reporting incidents accurately. The specialty is also concerned with meeting the emotional needs of victims, considering the trauma they face. Training in this area is crucial, as nurses must have a solid understanding of healthcare practices and legislation. The integration between theory and practice is necessary to deal with complex cases and collaborate with other disciplines in the justice system, making forensic nursing a fundamental area for the protection of victims' rights and the promotion of social justice.

**Keywords:** Forensic Nursing, Regulation of Forensic Nursing, Development of forensic practice, Legal responsibility, Health legislation and justice.

---

<sup>1</sup> Highest degree of education: Doctor candidate in Nursing.

Academic institution: Federal University of Alfenas

E-mail: [jhuliano.souza@sou.unifal-mg.edu.br](mailto:jhuliano.souza@sou.unifal-mg.edu.br)

ORCID: <https://orcid.org/0000-0002-4338-4433>

<sup>2</sup> Highest degree of education: Post-Doctorate in Nursing.

Academic institution: Federal University of Alfenas

E-mail: [zelia.resk@unifal-mg.edu.br](mailto:zelia.resk@unifal-mg.edu.br)

ORCID: <https://orcid.org/0000-0002-3752-8381>

<sup>3</sup> Highest degree: Doctor of Science.

Academic institution: Federal University of Alfenas

E-mail: [sueli.vilela@unifal-mg.edu.br](mailto:sueli.vilela@unifal-mg.edu.br)

ORCID: <http://orcid.org/0000-0003-3034-3904>





## INTRODUCTION

### HISTORICAL, POLITICAL AND LEGAL ASPECTS OF FORENSIC NURSING

Forensic Nursing is a professional specialization in Nursing recognized by the Federal Council of Nursing in 2011 (COFEN, 2011). The object of action of the Forensic Nurse is the person who is the victim of violence, as well as the perpetrators. However, the condition of care for victims and perpetrators is a field of Nurses that is not restricted only to specialists, but is present in Primary Health Care, especially in Family Health Strategies and Basic Health Units.

A victim is understood to be any person who suffers physical, emotional, or property damage as a result of a crime, violation of the law, public calamity, natural calamity, or serious violation of human rights (BRASIL, 2021).

Victims can be direct, indirect, vulnerable, special and collective. The direct victim is the one who is directly harmed by the action or omission of an agent. The indirect one, on the other hand, is the person who maintains an affective or kinship relationship, up to the third degree, as long as they live together, are in their care or if their dependence, in cases of crime, delinquency with death, disappearance or calamity (BRASIL, 2021).

In the case of victims of special vulnerability, this arises from the fact that they have age, sex, health status or disability, and the type, degree and duration of victimization, causing damage with serious consequences for their psychological balance or for their condition of social integration. Finally, collective refers to any social group, community, or organization affected by a crime, unlawful act, or public calamity, which violates collective legal assets, such as public health, among others (BRASIL, 2021).

As for perpetrators, they are those who commit crimes or offenses, known as aggressors (COFEN, 2017). The profile of male aggressors is that of young people, mainly intimate partners, spouses or ex-spouses (MELO et al., 2021). The crime occurs mainly at the victim's residence, on weekends, at night, when the perpetrator uses physical force and is under the influence of alcohol and other drugs (Santos; Carmo, 2023).

Violence occurs all over the world and affects people of all ages, gender, race, religion, nationality, education, sexual orientation or social status. However, violence tends to occur among vulnerable groups due to poor living conditions. It exists in everyone's life, whether as a victim or as an aggressor, and it is repeated in the structure and subjectivity of different spaces, such as home, school, community, work, and institution. Therefore, it is a socially constructed phenomenon, but it must be deconstructed based on intersectoral and multidimensional actions (BRASIL, 2009).

Thus, the situation of violence is understood as a multifaceted problem, with a high incidence of violent deaths throughout the federative regions of Brazil, affecting various groups, among which is the population of lesbians, gays, bisexuals, trans and transvestites, queers, intersex, asexuals and



other existing genders and sexualities, people with disabilities, indigenous people, youth, women and blacks (Cerqueira *et al.*, 2021; BRAZIL, 2016).

## HISTORICAL ASPECT

The term forensics is derived from the Latin word "*forensis*," which relates to the application of scientific knowledge to legal problems. Forensic science, an ancient interdisciplinary field in the world, encompasses all disciplines and applies scientific techniques for legal purposes. Initially, all techniques were borrowed from various disciplines such as chemistry, medicine, biology and dentistry (Amar; Sekula, 2015; Hammer; Moynihan; Pagliar, 2013).

Until the last decade, forensic science has been the domain of investigators, technicians, police officers and prosecutors, creating a medico-legal link that traditionally excluded health care in general and medical care in particular. Although not consciously discouraged by the forensic and criminal justice communities, the involvement of nursing was neither considered necessary nor desired by physicians (Pyrek, 2006).

Forensic Nursing evolved from forensic medicine, which was designed to provide medical care to living patients and was exclusively a medical expertise on several continents such as Europe, Asia, Australia, among others, for more than two consecutive centuries (Mclay, 1990). However, with the emergence of the role of health care as a medical specialty in the United States, it was not until the 1980s that the need for a forensic case specialist became necessary, as much evidence was lost due to lack of intervention. Therefore, it was clear that all nurses working in the health system, and especially in emergency settings, should have a basic understanding of patient assessment, evidence preservation, and interaction with justice (Love; Sekula, 2015).

## POLITICAL ASPECT

In the United States of America (USA), in the mid-1970s, a group of nurse activists in favor of the rights of women victims of rape fought for humanized care for this population. These professionals had perceived a certain limitation in their work, as there were no protocols and training in urgent and emergency services that carried out examinations of victims of violence, which could compromise the quality and legal admissibility of the evidence when collected (Morse, 2019; Hammer; Moynihan; Pagliar, 2013).

In response, these nurses sought to standardize the performance of the examination and professionalize the role of forensic expertise, which included medical documentation of bodily injury, collection of biological materials (e.g., blood, semen, saliva), and physical debris that could link the victim to the suspect and/or the crime scene (Morse, 2019).



After all this struggle by these activist nurses, 72 of them specialized in performing forensic examinations of victims of sexual abuse and rape, they founded the *International Association of Forensic Nurses* (IAFN) and created the *Sexual Assault Nurse Examiner* (SANE) certification in the 1990s (IAFN, 2023; Morse, 2019). After this advance in the professional field in this decade, Forensic Nursing was legally recognized in 1991 by the *American Academy of Forensic Sciences* and, in 1995, by the *American Association of Nurses* (ANA) in the USA as a specialty.

In 1997, the guidelines that guided advanced practice were developed in partnership with IAFN and ANA (Amar; Sekula, 2015; Barder; Gabriel, 2010). In addition, one of the pioneers in the field of Forensic Nursing worldwide was Virginia Lynch, the first nurse to become a member of the American Academy of Forensic Sciences, the first president of the IAFN and the precursor of the specialty, which defines it with a focus on the care of victims and perpetrators of violence based on ethical-legal aspects in clinical nursing practice (Amar; Sekula, 2015; Lynch, 2011; Barder; Gabriel, 2010).

In North America, Virginia Lynch played a role in education and care, developing the specialty in the late 1980s and offering it in the Texas School of Nursing's master's program on Nursing in the Investigation of Death, in which she developed the first scientific articles in the forensic area of that decade. In addition, she had a very comprehensive view of the areas of Nursing and their performance in different scenarios, in which many of them already played their role in forensic practice, but without training (Hammer; Moynihan; Pagliar, 2013).

Forensic Nurses have an in-depth knowledge of the collection and preservation of forensic evidence, treatment practices for sexual violence, domestic violence, abuse among children and the elderly, human trafficking, judicial proceedings, legal expert opinions, inquiry, forensic psychiatric nursing and corrective action in the link between justice and nursing care for people in situations of violence (Hammer; Moynihan; Pagliar, 2013).

According to the IAFN, Forensic Nursing, in addition to providing assistance directly to people in situations of violence, provides advice and testimony in civil and criminal proceedings related to the practice of Nursing. The specialty works in several areas, including aggression, domestic violence, child abuse and neglect, elder abuse, death investigation, mass disasters, among others (IAFN, 2023).

In the areas of expertise of North American Forensic Nursing are: sexual assault examiners, educators/consultants, coroners, death investigators, legal consultants, lawyers, pediatricians, correctionals, geriatricians, psychiatrists, clinicians, emergency physicians and intensivists (Barder; Gabriel, 2010).

U.S. forensic nurses work independently according to clinical protocols, maintain chain of custody, are active members of investigative teams, advocate for victims, provide interventions



related to combating violent crime, assist in investigations with the medical examiner on the cause of death, assess injuries, collect and preserve traces, participate as witnesses for justice, and implement safety plans in relation to violence in the community (Barder; Gabriel, 2010).

In addition, they will be able to assist in the development of evidence-based policies and procedures related to the identification, collection, preservation and photographic documentation. They may also act as consultants in risk management administration and review medical records as legal advisors. In a school environment they are able to identify children at risk of abuse or neglect. In the home environment, they are able to assess living conditions for safety; evaluate the patient for evidence of exploitation, abuse, or neglect; they also provide referral to the primary health care service (Barder; Gabriel, 2010).

## LEGAL ASPECT

Regarding the practice of Forensic Nursing, the *American Nurse Association* (ANA) is the professional association that represents all registered nurses in the United States. In 1995, Forensic Nursing received the status of specialty in approval of the scope and standards of its performance by the Nursing Congress promoted by ANA. The scope and standards of practice of the specialty were published by the ANA in conjunction with *International Forensic Nursing* (IAFN) in 1997. Since then, the standards for Forensic Nursing care practices, as identified by the IAFN, are interconnected with the Nursing Process, based on care, evaluation, outcome, identification, planning, diagnosis, implementation and evaluation (Barder; Gabriel, 2010).

Advances in the science of Forensic Nursing have revolutionized medico-legal care for forensic patients and reduced the risk of liability for violating their legal rights to clinical and community facilities in the USA (HAMMER; MOYNIHAN; PAGLIAR, 2013). Its expansion has been gaining ground in several countries, such as Japan, Canada, Australia, England, Peru, Kenya, Korea, India, Jamaica, Sweden and Italy (Cachoeira; Evangelist; Souza, 2020; Silva; Silva, 2009).

In Brazil, its emergence occurred in the mid-2000s, by two nurses Karen Beatriz and Rita de Cássia, bringing the theme to the scientific community and to professionals about their work in the USA, which contributed to society, as it is the specialty to be recognized by the competent councils and associations (Silva; Silva, 2009).

After this advance, the Federal Council of Nursing (COFEN) recognized Forensic Nursing as a specialty by Resolution No. 389, of October 2011 (COFEN, 2011), with several implementations in the country during this decade. It was updated by Resolution No. 581/2018 (COFEN, 2018).

The Brazilian Association of Forensic Nursing (ABEFORENSE) was founded in 2014 (ABEFORENSE, 2015a), which contributes to the development of technical skills in Forensic



Nursing. In 2015, ABEFORENSE was presented to COFEN for its consolidation (ABEFORENSE, 2015b; ABEFORENSE, 2015c).

In 2015, the Forensic Nurse Examiner (FNE) *was held for the first time in Brazil*, with courses taught by Virginia Lynch, Albino Gomes and Jamie Ferrel, with the participation and support of the Federal Police, the Regional Nursing Council of Sergipe and the Federal Nursing Council, among other institutions, which have the purpose of implementing the specialty in the country (ABEFORENSE, 2015a).

In 2017, COFEN published Resolution 0556/2017, which regulates the country's operations, bringing eight areas or competencies, namely, Sexual Violence, Prison System, Psychiatric, Expertise, Technical Assistance and Consulting, Collection, Collection and Preservation of Traces, Post-Death, Mass Disaster, Humanitarian Missions and Catastrophes, Mistreatment, Trauma and Other Forms of Violence (COFEN, 2017a; COFEN, 2017b). That same year, the Brazilian Society of Forensic Nursing (SOBEF) was founded in the city of São Paulo (ABEN, 2017). After two years, the National Commission for Forensic Nursing was created by COFEN in 2019 (COFEN, 2019).

In Brazil, the Sexual Assault Examining Nursing course was held for the first time on May 6 and 8, 2019 as a high-performance training program for nurses who care for victims of sexual violence. The objectives set out in the course are in line with the guidelines for comprehensive care for victims of violence proposed by Brazilian legislation, such as the involvement of health professionals in the preservation and collection of forensic traces and the applicability of the chain of custody of guarantee in health services (Silva *et al.*, 2021).

Resolution 0556/2017 was updated to Resolution No. 700 of June 2022, which regulated the collection of data and traces to help solve crimes, especially sexual and domestic violence (COFEN, 2022b). That same year, the specialty was included in the Brazilian Occupation Code, demonstrating its relevance in criminal situations (COFEN, 2022a).

The conceptual framework of the specialty was born from the need to reduce and prevent interpersonal violence and criminal behavior in society. The benefits of clinical forensic intervention, the collection and preservation of forensic evidence, the effective investigation of sexual crimes, the recognition and reporting of abuse, the investigation of suspicious death, court-ordered mental health assessments, and qualified forensic testimony are clearly recognized (Hammer; Moynihan; Pagliar, 2013).

Therefore, the trajectory of Forensic Nursing has demonstrated its contribution both in the criminal and civil spheres, which points to a new need for implementation and recognition of this practice in the context of forensic investigation in Brazil. Although research in this area is just beginning, the literature already reveals several options for science- and humanitarian-based action



that are essential to help clarify crimes and support and care for victims, aggressors, and their families (Furtado *et al.*, 2021).

## ACTIVITY

In this chapter, he addressed the foundations of forensic science and the influence of this science on cases related to Nursing. As nursing professionals, it is important to reflect on how this area can interfere in our practice. When analyzing the following case study, it is considered how this discussion may impact professional performance?

## CASE STUDY: FAMILY HEALTH STRATEGY (FHS) NURSE

"A woman, Maria, 30 years old, married, mother of three children, one three years old and two others five and six. She sought the service to perform the preventive colposcopic pathological exam. When you saw Maria and started the nursing consultation, you noticed that her arms and legs had bruises and possible scratches on her neck. When approached about what those signs were, Maria informed her that she had hit her arm and legs at home and that the scratches were from her pet cat. She seemed to be a little embarrassed and scared."

## QUESTIONS FOR REFLECTION

*In their daily professional routine, many nurses are often faced with situations that reverberate aspects similar to those described in discussions about forensic science in nursing. These situations, which can involve everything from gathering evidence in cases of abuse to documenting incidents in detail, reinforce the importance of being prepared to act rigorously and ethically. This reality leads them to reflect on the relevance of the guidelines and protocols that govern nursing practice, ensuring that interventions are not only technical, but also aligned with ethical and legal principles.*

*In relation to the ethical, political and legal dimension, it is crucial that nursing professionals conduct their work with a strong sense of responsibility. When facing complex circumstances, nurses must always seek the best approach, which considers not only the rights of patients, but also the need to follow ethical and legal standards. Often, these situations require careful analysis of confidentiality, informed consent, and the ability to make decisions in contexts of vulnerability. Thus, the conduct of these situations must be done with a clear awareness of the implications that each action can have not only for the patient, but for society as a whole.*

*Finally, when elaborating a critical analysis that articulates theoretical contextualization with practice, it is evident that the scientific basis and continuing education are fundamental. Theory provides the necessary framework for professionals to understand the nuances of the situations they experience on a daily basis. However, practice calls for the need for adaptation and reflection. It is at the intersection between theory and practice that nurses can develop critical skills to face ethical,*



*political and legal challenges, thus promoting a more conscious and grounded professional practice. This articulation not only improves the capacity to respond to emergency situations, but also strengthens the profession and ensures the protection of patients' rights. In this way, continuous reflection becomes an indispensable tool for professional development and the quality of the service provided.*



## REFERENCES

1. Amar, A., & Sekula, L. K. (2015). \*A practical guide to forensic nursing: Incorporating forensic principles into nursing practice\*. Sigma Theta Tau. <https://doi.org/10.7748/nm.23.8.17s25>. Acesso em 26 fev. 2023.
2. Associação Brasileira de Enfermagem (ABEN). (2017). \*SOBEF - Sociedade Brasileira de Enfermagem Forense\*. Brasília. <http://www.abennacional.org.br/site/sobef-sociedade-brasileira-de-enfermagem-forense/>. Acesso em 26 fev. 2023.
3. Associação Brasileira de Enfermagem Forense (ABEFORENSE). (2015a). \*Nossa história\*. Aracaju. <http://www.abeforense.org.br/nossa-historia/>. Acesso em 26 fev. 2023.
4. Associação Brasileira de Enfermagem Forense (ABEFORENSE). (2015b). \*Parecer sobre campo de atuação da enfermagem forense brasileira protocolado no COFEN\*. Aracaju. <http://www.abeforense.org.br/wp-content/uploads/2016/06/Compet%C3%AAs-Ancias-Tecnicas-da-Enfermagem-Forense.pdf>. Acesso em 26 fev. 2023.
5. Associação Brasileira de Enfermagem Forense (ABEFORENSE). (2015c). \*Regulamento das competências técnicas da enfermagem forense\*. Aracaju. <https://www.abeforense.org.br/parecer-sobre-campo-de-atuacao-da-enfermagem-forense-brasileira-protocolado-no-cofen/>. Acesso em 26 fev. 2023.
6. Barder, D. M. G., & Gabriel, S. (2010). \*Forensic nursing: A concise manual\* (1st ed.). Taylor & Francis Group. <https://books.google.com/books?id=dEoDZ3q62uIC&lpg=PP1&hl=pt-PT&pg=PP1#v=onepag&q&f=false>. Acesso em 26 fev. 2023.
7. Berbel, N. N. (n.d.). “Problematization” and problem-based learning: Different words or different concepts? \*[No additional publication information provided]\*.
8. Brasil, Conselho Nacional do Ministério Público. (2021). \*Resolução nº 243, de 18 de outubro de 2021\*. Dispõe sobre a política institucional de proteção integral e de promoção de direitos e apoio às vítimas. Brasília, DF. <https://www.cnmp.mp.br/portal/images/Resolucoes/2021/Resoluo-n-243-2021.pdf>. Acesso em 26 abril. 2023.
9. Brasil, Secretaria de Estado de Saúde do Distrito Federal. (2009). \*Manual para atendimento às vítimas de violência na rede de saúde pública do distrito federal\* (Laurez Ferreira Vilela, coord.). Brasília: Secretaria de Estado de Saúde do Distrito Federal.
10. Brasil, Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Vigilância de Doenças e Agravos Não Transmissíveis e Promoção da Saúde. (2016). \*Viva: Instrutiva notificação de violência interpessoal e autoprovocada\* (2ª ed.). Brasília, DF. [https://bvsm.s.saude.gov.br/bvs/publicacoes/viva\\_instrutivo\\_violencia\\_interpessoal\\_autoprovocada\\_2ed.pdf](https://bvsm.s.saude.gov.br/bvs/publicacoes/viva_instrutivo_violencia_interpessoal_autoprovocada_2ed.pdf). Acesso em 03 mar. 2023.
11. Cachoeira, D. B. C., Evagelista, H. R. F., & Souza, W. de L. (2020). \*Enfermagem forense: Contexto histórico, atuação do enfermeiro, contribuições para saúde e segurança pública\* (pp. 1-20). Grupo Tiradentes. <https://openrit.grupotiradentes.com/xmlui/bitstream/handle/set/3223/Enfermagem%20Forense%20atualizado%20%2005.12.18%20wbiratan%20PDF.pdf?sequence=1&isAllowed=y>. Acesso em 26 fev. 2023.






12. Cerqueira, D. et al. (2021). \*Atlas da violência\*. Instituto de Pesquisa Econômica Aplicada (Ipea). <https://www.ipea.gov.br/atlasviolencia/arquivos/artigos/5141-atlasdaviolencia2021completo.pdf>. Acesso em 07 mar. 2021.
13. Conselho Federal de Enfermagem (COFEN). (2018). \*Anexo da Resolução nº 581/2018: Especialidades do enfermeiro por área de abrangência\*. Brasília, DF.
14. Conselho Federal de Enfermagem (COFEN). (2022a). \*COFEN cria protocolo de Enfermagem Forense para vítimas de violência\*. Brasília, DF. [http://www.cofen.gov.br/cofen-cria-protocolo-de-enfermagem-forense-para-vitimas-de-violencia\\_100170.html](http://www.cofen.gov.br/cofen-cria-protocolo-de-enfermagem-forense-para-vitimas-de-violencia_100170.html). Acesso em 26 fev. 2023.
15. Conselho Federal de Enfermagem (COFEN). (2019). \*Decisão COFEN nº 0040/2019. Criação da Comissão Nacional de Enfermagem Forense do Conselho Federal de Enfermagem\*. Brasília, DF. [http://www.cofen.gov.br/decisao-cofen-no-0040-2019\\_69332.html](http://www.cofen.gov.br/decisao-cofen-no-0040-2019_69332.html). Acesso em 26 fev. 2023.
16. Conselho Federal de Enfermagem (COFEN). (2022b). \*Enfermagem Forense é incluída no rol das ocupações do Ministério do Trabalho\*. Brasília, DF. [http://www.cofen.gov.br/enfermagem-forense-e-incluida-no-rol-das-ocupacoes-do-ministerio-do-trabalho\\_100615.html](http://www.cofen.gov.br/enfermagem-forense-e-incluida-no-rol-das-ocupacoes-do-ministerio-do-trabalho_100615.html). Acesso em 26 fev. 2023.
17. Conselho Federal de Enfermagem (COFEN). (2011). \*Resolução nº 389, 18 de outubro de 2011. Conselho Federal de Enfermagem: Procedimentos de título de pós-graduação lato e stricto sensu concedido a enfermeiros e lista as especialidades\*. Diário Oficial da União, Brasília. [https://www.cofen.gov.br/resolucao-cofen-no-581-2018\\_64383.html](https://www.cofen.gov.br/resolucao-cofen-no-581-2018_64383.html). Acesso em 26 fev. 2023.
18. Conselho Federal de Enfermagem (COFEN). (2017a). \*Resolução nº 556, 14 de agosto de 2017a. Alterada pela Resolução COFEN nº 700/2022a\*. Diário Oficial da União, Brasília, DF. [http://www.cofen.gov.br/resolucao-cofen-no-05562017\\_54582.html](http://www.cofen.gov.br/resolucao-cofen-no-05562017_54582.html). Acesso em 26 fev. 2023.
19. Conselho Federal de Enfermagem (COFEN). (2017b). \*Resolução nº 556, 14 de agosto de 2017b. Conselho Federal de Enfermagem: Das áreas de atuação do enfermeiro forense (ANEXO)\*. Diário Oficial da União, Brasília, DF. <http://www.cofen.gov.br/wp-content/uploads/2017/08/ANEXORESOLU%C3%87%C3%83O-556-2017.pdf>. Acesso em 26 fev. 2023.
20. Furtado, B. M. A. S. M., et al. (2021). Investigation in forensic nursing: Trajectories and possibilities of action. \*Revista da Escola de Enfermagem da USP\*, 55, e20200586. <http://dx.doi.org/10.1590/1980-220X-REEUSP-2020-0586>. Acesso em 10 abr. 2023.
21. Hammer, R. M., Moynihan, B., & Pagliaro, E. M. (2013). \*Forensic nursing: A handbook for practice\* (2nd ed.). Jones & Bartlett Learning. <https://books.google.com.br/books?id=APgVX1WcuYcC&printsec=frontcover&dq=forensic+nursing&hl=pt-BR&sa=X&ved=0ahUKEwjguciyxezjAhVHH7kGHTN0BhQQ6AEIRTAD#v=onepage&q=forensic%20nursing&f=false>. Acesso em 06 abr. 2023.
22. International Association of Forensic Nurses (IAFN). (2023). \*Forensic nursing\*. Silver Spring, Maryland. <https://www.forensicnurses.org/page/WhatisFN/>. Acesso em 24 fev. 2023.
23. Lynch, V., & Duval, J. (2011). Evolution of forensic nursing science. In \*Forensic nursing science\* (2nd ed.). Elsevier Mosby. <https://books.google.com.br/books?id=nD6VAFvKGC0C&printsec=frontcover&dq=forensic+nursing&hl=pt-BR>



BR&sa=X&ved=0ahUKEwjguciyxezjAhVHH7kGHTN0BhQQ6AEISzAE#v=onepage&q=forensic%20nursing&f=false. Acesso em 26 fev. 2023.

24. McLay, W. D. S. (1990). *\*Clinical forensic medicine\**. Pinter.
25. Melo, C. A. de, & Santos, S. et al. (2021). Perfil do agressor e fatores associados à violência contra mulheres no Município de Marabá – PA. *\*Research, Society and Development\**, 10(11), e334101119572.
26. Morse, J. (2019). Legal mobilization in medicine: Nurses, rape kits, and the emergence of forensic nursing in the United States since the 1970s. *\*Social Science & Medicine\**, 222, 323-334.
27. Pyrek, K. M. (2006). *\*Forensic nursing\**. Taylor & Francis Group. <https://doi.org/10.1201/EBK0849335402>. Acesso em 06 abr. 2023.
28. Santos, J. D., & Carmo, C. N. D. (2023). Características da violência por parceiro íntimo em Mato Grosso do Sul, 2009-2018. *\*Epidemiologia e Serviços de Saúde\**, 32(1), e2022307.
29. Silva, R. C., & Silva, K. B. (2009). Enfermagem forense: Uma especialidade a conhecer. *\*Cogitare Enfermagem\**, 14(3), 564-568. <https://revistas.ufpr.br/cogitare/article/viewFile/16191/10709>. Acesso em 26 fev. 2023.
30. Silva, J. O. M., et al. (2021). Planning and implementation of the Sexual Assault Nurse Examiner course to assist victims of sexual violence: An experience report. *\*Revista da Escola de Enfermagem da USP\**, 55, e03739. <https://doi.org/10.1590/S1980-220X2020029803739>. Acesso em 10 abr. 2023.

## Endodontic retreatment, fiberglass pin installation and composite resin prosthetic rehabilitation: Case report

 <https://doi.org/10.56238/sevned2024.016-021>

Nattaska Nyckolly Rodrigues Maciel<sup>1</sup>, Clarissa Lopes Drumond<sup>2</sup>, Raulison Vieira de Sousa<sup>3</sup>, José Klidemberg de Oliveira Júnior<sup>4</sup> and Marcos Alexandre Casimiro de Oliveira<sup>5</sup>

### ABSTRACT

**Introduction:** Endodontic treatment aims to keep the tooth in proper shape and function, but it may fail, requiring retreatment. This involves the complete removal of the contents of the root canal for disinfection and refilling. The aesthetics and function of the endodontically treated tooth depend on the choice of restorative material, with fiberglass pins being an option that offers superior aesthetics and mechanical properties similar to dentin, providing greater retention and stability of the restoration. **Case report:** A female patient came to the clinic complaining of loss of restoration of the maxillary canine (13). Radiographic examination revealed an inadequate filling, exposed to the oral environment for a long period. Endodontic retreatment was performed in three sessions, with removal of the previous filling, disinfection of the root canal, and new filling with resin cement. Subsequently, a fiberglass pin was installed, followed by composite resin restoration. The steps included anamnesis, clinical and radiographic examinations, absolute isolation, use of files and solvents to remove the old filling, and application of intracanal medication. After the final filling, the canal was prepared to receive the fiberglass post, followed by the coronary restoration with composite resin. **Conclusion:** Endodontic retreatment is essential to eliminate bacteria from the root canal, especially in cases of previous failure. The choice of the fiberglass post, due to its biomechanical and aesthetic properties, in combination with the composite resin, proved to be effective in the rehabilitation of teeth with compromised coronary structure, resulting in a functional and aesthetically satisfactory restoration.

**Keywords:** Endodontics, Retreatment, Retainer.

<sup>1</sup> Dental Surgeon, Cajazeiras City Hall, Cajazeiras, Paraíba, Brazil

<sup>2</sup> Professor of the Undergraduate Course in Dentistry at Centro Universitário Santa Maria - UNIFSM, Cajazeiras, Paraíba, Brazil.

<sup>3</sup> Professor of the Undergraduate Course in Dentistry at Centro Universitário Santa Maria - UNIFSM, Cajazeiras, Paraíba, Brazil.

<sup>4</sup> Professor of the Undergraduate Course in Dentistry at Centro Universitário Santa Maria - UNIFSM, Cajazeiras, Paraíba, Brazil.

<sup>5</sup> Professor of the Undergraduate Course in Dentistry at Centro Universitário Santa Maria - UNIFSM, Cajazeiras, Paraíba, Brazil.



## INTRODUCTION

The main goal of endodontic treatment is to keep the tooth in proper shape and function. But occasionally, endodontic treatment fails. In these cases, retreatment is indicated, which involves the complete removal of the contents of the root canal to perform complete disinfection of the apical foramen for subsequent refilling and aesthetic and functional rehabilitation (MOLLO *et al.*, 2012).

The complete removal of the root canal filling material is a procedure of great importance in endodontic retreatment because, through mechanical instrumentation and the use of irrigating solutions, which constitute an effective measure against debris and root and periapical microorganisms (MARQUES *et al.*, 2012; RIOS *et al.*, 2014).

The restoration of endodontically treated teeth has evolved from a fully empirical approach to the application of biomechanical concepts based on scientific evidence to clinical decision-making (PEDREIRA; KOREN, 2013).

The aesthetics of dental rehabilitation depends on the material chosen to accurately copy the appearance of a natural tooth (CHU *et al.*, 2004). All-ceramic systems are stable and biocompatible in the oral environment because they do not undergo changes. In this way, they constitute an alternative for better aesthetics without losing strength and durability. It became one of the best indications for making anterior tooth crowns (HONDRUM, 1992).

On the other hand, traditional feldspar dental ceramics, when associated with metal, clinically provide resistance and durability, which is highly satisfactory (NAPANKANGAS, 2008), however, among the disadvantages of this type of ceramic are associated with the lack of translucency, marginal darkening of the gums due to metal oxidation, which compromise the aesthetics of the treatment (ZAWTA, 2001).

It should be noted that for the aesthetic and functional rehabilitation of most dental elements with extensive coronary destruction, it is also necessary to use intraradicular retainers to provide better instability to the coronary restoration (ALBUQUERQUE; DUTRA; VASCONCELLOS, 1998). However, the main objective of the indication of these retainers is not to reinforce the remaining tooth structure, but to obtain better retention and stabilization of the restorative material (FERNANDES; DESSAI, 2001).

The clinical success of endodontically treated dental elements will depend, in addition to the degree of coronary destruction, on the tooth involved and its position in the arch, the bone support, the type of prosthesis and the forces to which these teeth will be submitted, since the preparation of the tooth to receive the intraradicular post follows protocols for removing the tooth structure so that it provides adequate installation (MEZZOMO, 2002).

Thus, the correct choice of pin will be decisive for the success of the restorative procedure. Among the different types of retainers, such as: the cast metal core, the metal prefabricated pin and

the non-metallic fiberglass (MANKAR *et al.*, 2012), the latter stands out for having a greater bond to the dentin through adhesive systems, modulus of elasticity and rigidity similar to that of dentin, better aesthetics, and absence of corrosion. In addition to sufficient resistance to withstand masticatory forces (LIDEN; NORBERG, 2005).

Given the variety of options for intraradicular retainers, it is essential to know about the fiberglass post, so that it can be properly indicated in cases of rehabilitation of elements with extensive coronary destruction. It is worth noting the fact that the canine is a key occlusion tooth that receives lateral forces, requiring the placement of a material compatible with this load. Therefore, the objective of this study will be to report a clinical case of endodontic retreatment of an upper canine with the aid of an intraradicular fiberglass retainer and composite resin restoration.

## OBJECTIVES

### GENERAL OBJECTIVE

- To report a clinical case of endodontic retreatment of an upper canine (13), installation of a fiberglass pin, and prosthetic rehabilitation in composite resin.

### SPECIFIC OBJECTIVES

- Describe the stages of endodontic retreatment;
- Describe the importance of effective coronary sealing after endodontic treatment and its correct indication;
- Demonstrating the use of the prefabricated fiberglass pin provides greater aesthetics and less wear during dental rehabilitation.
- List the steps from preparing space for fiberglass pins until final tooth restoration.

## THEORETICAL FRAMEWORK

### ENDODONTIC RETREATMENT

Endodontic retreatment is indicated after proof of failure of primary endodontic therapy. Creating adequate clinical and biological conditions for periradicular tissue repair (SOARES; GOLDBERG, 2011).

According to Lopes and Siqueira (2015), endodontic retreatment consists of a new therapy due to previous failure or inadequate treatment. Basically, endodontic retreatment consists of removing the filling material, reinstrumenting and refilling the conduit.

The most used technique in cases of endodontic retreatment has been manual, using Kerr and Hedstroem files associated with the use of solvents such as eucalyptol, xylo, chloroform and orange oil-based solvents (SOMMA *et al.*, 2008).



Complete removal of the contents of the canal and access to the apical foramen in a retreatment approach are mandatory for proper cleaning and refilling (SALEBRABI; ROSTSTEIN, 2010). The concern with the removal of the filling material is extremely important, as the presence of remnants of it inside the root canal can harbor microorganisms, making complete disinfection difficult (KALED *et al.*, 2011). The use of intracanal medication enhances the antimicrobial effect achieved in the root canal preparation phase (KUMAR *et al.*, 2015).

Thus, chemical-mechanical preparation plays a fundamental role in endodontic retreatments in order to promote complete cleaning, disinfection and modeling of the root canal (SIQUEIRA *et al.*, 2013).

## REHABILITATION OF ENDODONTICALLY TREATED TEETH

Dentistry has presented significant advances in restorative techniques and materials and this advance is due to the recognition of the importance of preserving the tooth structure, since worn dentin, whether in the coronary portion or inside the root canal, implies less tooth resistance (MUNIZ *et al.*, 2005).

The evolution of this treatment led to the perception that, in addition to restoring the aesthetic function, Restorative Dentistry also needs to be concerned with the protection of the remainder against fractures, and should be planned, because the tooth submitted to endodontics is subject to considerable loss of intracoronary and intraradicular dentin, in addition to other losses and is more susceptible, also, to the impairment of dental reinforcement structures, such as marginal ridges, enamel bridges, and pulp chamber roof (MENDONÇA *et al.*, 2017).

The restoration of endodontically treated teeth has always been a challenge for clinicians and researchers, as the coronary structure has a significant part compromised (PRADO *et al.*, 2014). In this way, the survival rate of these teeth depends on several factors such as; location in the arch, proximal contacts, amount of tooth tissue loss, previously performed endodontic restorations or accesses, periodontal and apical condition, occlusal contacts, among others (IQBAL *et al.*, 2002).

As the loss of pulp vitality and the execution of endodontic treatment occur, dental tissues undergo structural and biochemical changes, which can generate changes in the aesthetics and biomechanics of the teeth (MUNIZ *et al.*, 2011). Therefore, for the planning and execution of a restorative treatment of these dental elements, the dentist needs to be aware of these changes for the best management of the clinical case (GONZAGA *et al.*, 2011).

The aesthetic and functional rehabilitation of these teeth, with extensive destruction due to carious lesions, fractures, defective endodontic access, replacement of restorations or internal resorptions, most of the time requires the use of intraradicular pins as an additional way to stabilize and retain the restorative material (FERRARI *et al.*, 2000).



Due to the large insufficient coronary structure, in most cases, it is not possible to achieve sufficient anchorage for a restoration in the remaining dentin, therefore, it is necessary to place an intraradicular retainer to provide adequate retention to the stump and the final restoration (PHARK *et al.*, 2012; HEYDECKE *et al.*, 2002).

However, it is of fundamental importance to understand the biomechanical factors that affect the ability of the post to support a restoration and protect the remaining tooth structure for its long-term success (SCHWARTZ *et al.*, 2004).

When a pin is placed in a root canal of a structurally compromised tooth, significant changes occur in biomechanical behavior (TORBJORNER *et al.*, 2004), since stress is directly proportional to deformation (PHARK *et al.*, 2012).

### INTRARADICULAR RETENTORS

In the expectation of reducing the number of consultations and eliminating the laboratory stage, in the 1960s prefabricated metal pins were introduced to the market (AKKAYAN; GULMEZ, 2004). For decades, molten metal cores have been used as a technical solution for the reconstruction of endodontically treated teeth, however characteristics such as preparation far from being conservative, stiffness much higher than that of dentin, the need for the laboratory phase, probability of corrosion and impaired retention due to the lack of adhesion to the remaining tooth, led to studies that developed other retainers (SCOTTI; FERRARI, 2003) and at the end of the 80s, prefabricated ceramic pins and different types of fibers, including carbon, quartz and glass (AKKAYAN; GULMEZ, 2002).

Metal pin materials are found on the market in three types: stainless steel (nickel-chromium); titanium alloy (titanium, vanadium, and aluminum), and pure titanium. The most used are made of titanium alloy or pure titanium, as it tries to restrict the use of nickel-chromium, due to allergic reactions (CHRISTENSEN, 2004).

However, the use of metal pins can impair the aesthetic appearance, especially in the anterior teeth, in addition to the absence of chemical bond between the metal pins and the resinous materials. In addition, the act of fitting the metal pin into the dentin promotes stress that can generate restoration fractures, dental fissures, pulp hypersensitivity, pulp or periodontal perforation (FENNIS, 2013).

Zhou and Wang (2013), in *in vitro* studies, observed the high modulus of elasticity, metal pins concentrate pressure on the root and promote a higher incidence of root fractures compared to fiber pins. The rigidity of metal pins transfers forces along their vertical axis, creating a wedge effect on the tooth structure, acting similar to a metal wedge on a piece of wood, thus causing unfavorable fractures.



The composition of the materials used in intraradicular seals has changed over the years, from materials with a high modulus of elasticity such as gold, stainless steel and zirconia dioxide to materials that have mechanical properties more similar to dentin, such as composite resin and carbon fiber (AKGUNGOR; AKKAYAN, 2006). Adjacent to this fact came the evolution of Aesthetic Dentistry, with the emergence of new pins in the market, such as those made of quartz fibers, carbon fibers coated with quartz and glass fibers (VICHI, 2002).

Several types of intraradicular reinforcements have been described and used to promote restorations retention in addition to metal pins, such as fiberglass pins (OLIVEIRA *et al.*, 2010; MOTISUKI; SANTOS-PINTO; GIRO, 2005), pin made of orthodontic wire in the shape of the Greek letter alpha, short composite resin pins (PERRELA; SAGRETTI; GUEDES-PINTO, 1995; JUDD *et al.*, 1990) and, biological pins from extracted tooth roots (SACONO *et al.*, 2007; GALINDO *et al.*, 2000).

Fiber pins have an anisotropic behavior, that is, they have different modulus of elasticity depending on the direction of the applied load. This characteristic is quite interesting since, when mechanically requested (oblique forces), the modulus of elasticity of the fiber spikes approaches the modulus of elasticity of the dentin, reducing the possibility of fracture. However, due to their elasticity, adhesive interfaces are more stressed, increasing the risk of unstripping, but decreasing the risk of fracture and when these occur in most cases they are repairable (UDDANWADIKER *et al.*, 2007).

The type of pin (fiber, quartz, zirconia, gold, stainless steel, or titanium) determines the stress distribution and has a significant effect on the stress concentration (AUSIELLO *et al.*, 2011).

Considering these aesthetic aspects, disadvantages and technical complications, other materials have been proposed as a way to replace metal pins by reinforcing composite resin restorations, such as the fiberglass post (MELO NETO, 2018).

In a study of teeth restored with fiberglass pins, they showed the highest resistance values in laboratory tests. Another characteristic recommended by the tests is that these pins have a low modulus of elasticity, so when a load is placed on the root structure, the stress is minimized and there is also a better absorption of the tensions between pin and root. Clarifying the absence of fractured roots and pins in the tests (MACCARI; CONCEIÇÃO; NUNES, 2003).

## GLASS FIBRE PINES

During the rehabilitation procedure of extensive coronary destruction, intraradicular reinforcement is often necessary to increase the adhesion area and offer more resistance to the reconstructed tooth. In addition, oblique, horizontal and shear forces occur on the anterior teeth, and



the use of pins favors the dissipation of these forces along the coronary remnant and the root, preventing the occurrence of fractures (WANDELEY *et al.*, 2015).

Fiberglass pins have proven to be a very viable alternative, as they have characteristics such as a modulus of elasticity similar to that of dentin, are biocompatible, distribute masticatory force better, are highly durable, resist corrosion, eliminate the laboratory phase and are aesthetically superior, as they have optical properties that provide greater translucency to the dental core (DURKAN *et al.*, 2008; BALBOSH; KERN, 2006).

Chronologically, fiberglass pins represented the last proposed solution for the reconstruction of teeth with endodontic treatment. They were introduced to the market as a replacement option for metal pins, due to their aesthetic and mechanical properties. They can better absorb masticatory loads, due to their resilience, similar to that of dentin. This favors the distribution of forces on the root, reducing the stress transmitted to the tooth and minimizing the risk of root fracture, since the functional loads through the prostheses are transmitted and absorbed in a similar way to what occurs in the intact tooth (SÁ *et al.*, 2010).

Fiberglass pins were introduced in the market with the purpose of replacing metal pins, favoring aesthetics due to their color similar to that of the dental structure and less wear of intraradicular dentin, dispensing with the laboratory phase (SOUZA *et al.*, 2011) and have stood out among the options for intracanal reinforcement. These pins offer several facilities and advantages, such as the choice of diameter, both for deciduous and permanent teeth, high retentivity, due to its outer layer being surrounded by a BIS-GMA film, eliminating the existence of additional retentions, low risk of fracture, modulus of elasticity very close to that of the tooth and excellent aesthetics, dispensing with the use of opacifiers or aesthetic masking resources (WANDERLEY *et al.*, 2015).

According to Dietschi *et al.* (2008) by Naumann *et al.* (2006), the main disadvantages of these pins are: higher cost, the sensitivity of the clinical cementation technique and the absence of radiopacity of some pins. Thus, there is a need to adapt the pins to the cement, so that the tooth structure is preserved with minimal wear. For this reason, the pin cannot be larger than 1/3 of the width of the root, or else it will be susceptible to fracture or loosening (MINGUINI *et al.*, 2014).

However, for Marques *et al.* (2016) The technique for using the fiberglass retainer is simple, as long as it is carried out carefully, without neglecting any of the clinical steps, namely, selection of the diameter, length and shape of the pin to be used. There must also be a minimum remaining of 4.0 mm of filling material and the surface treatment of the pin and root canal. The cementation and preparation of the coronary part is performed with composite resin based on the characteristics of the crown to be used.

The indication of uses of this type of pin, in general, is for teeth whose half of the remainder still exists, but which need retention. In wide channels, it is necessary to use composite resin to

reanatomize the pin. These pins are composed of longitudinal glass fibers, combined with a composite resin matrix. Most of them are oriented parallel along the axis in order to reduce stresses for the matrix. Its volume changes according to the manufacturer, but the greater the amount of fibers, the greater the resistance and rigidity (MARTINHO *et al.*, 2015).

Thus, the longevity of endodontically treated teeth is directly related to both the remaining structure and the efficiency of restorative procedures, hence the importance of choosing this procedure correctly (AMIZIC; BARABA, 2016).

The technique for using the fiberglass retainer is easy to manipulate, but it must be performed without neglecting any of the clinical steps. The length of the pin is directly related to retention and must meet both functional and biological requirements, with the following rules (1) at least 3 to 4 mm of endodontic filling material must remain in the apical region; (2) a 1:1 ratio between crown height and pin root length; (3) the pin must extend at least half the length of the root supported by bone tissue; (4) the walls surrounding the canal (dentin) should be worn as little as possible for the placement of the pin, so as not to further weaken the tooth (BARATIERI, 2011).

Thus, cementation with dual or chemically active systems is preferentially indicated due to the difficulty of access to light from the light-curing device in the apical region (PERREIRA; FRANCISCONE; PORTO, 2005) and ceramics have been considered the ideal material for indirect restorations due to their physical, biological and optical characteristics (LORENZONE *et al.*, 2012).

These properties allow durability in the color of the restoration, as well as resistance to abrasion, in addition to enabling great stability in the oral environment, high biocompatibility, and natural appearance in terms of translucency, luminosity, and fluorescence (SHIBAYAMA, 2016).

## CASE REPORT

A female patient came to the School Clinic of Faculdade Santa Maria complaining of loss of the restoration of the maxillary canine (13) (Figure 1) previously treated endodontically, in the radiographic examination it was observed that the filling was far below the length of the tooth. Due to the long time in which the filling was exposed in the oral environment and the filling below the length of the tooth, endodontic retreatment was chosen.

The research complied with all the norms and guidelines proposed by resolution 466/12 of the National Health Council, with the approval of the Ethics and Research Committee of Faculdade Santa Maria with CAAE 38488420.6.0000.5180 and Opinion No. 4.351.837 (Appendix A) and was carried out after signing the Free and Informed Consent Form (Appendix A)

## ENDODONTIC RETREATMENT

Endodontic Retreatment was performed in three sessions. In the first session: Anamnesis, extraoral and intraoral clinical examinations, initial X-ray (Figure 2), antisepsis, micromotor prophylaxis (NSK®, Japan), Robinson brush and pumice stone (Maquira®, Maringá – PR, Brazil) were performed; 2% lidocaine anesthesia with vasoconstrictor epinephrine (DFL Indústria e Comércio S.A., Rio de Janeiro – RJ, Brazil), coronary opening with diamond tip No. 1014 (KG Sorensen®, Barueri, Brazil), absolute isolation with rubber dam, Young's arch (Maquira®, Maringá – PR, Brazil), Ainsworth perforator (Golgran®, São Paulo, Brazil), clamp holder forceps (Golgran®, São Paulo, Brazil), dental floss, clamp No. 211 (Golgran®, Sao Paulo, Brazil), scissors (Golgran®, Sao Paulo, Brazil).

This was followed by the deblinding of the canal using the Gates-Glidden Reamers (Maillefer®, Ballaigues, Switzerland), using the Crown-Apex technique (CROWN – DOWN) preparing 2/3, the cervical and middle third with the reamers in sequence 4, 3, 2 and 1 working on the CAD (26mm) - 4mm = 22mm; irrigation with 2.5% NaClO. Kerr and Hedström files (Maillefer®, Ballaigues, Switzerland) and eucalyptol solvent (Biodinâmica®, Ibiporã – PR, Brazil) were associated with the dissolution of the Guta-Percha, facilitating its removal, then the total cleaning of the ducts was carried out, irrigating copiously with 2.5% NaClO using the Navitip® system (Ultradent Products Inc., South Jordan, USA).

Because it is a very atretic channel, the desired limit was not reached in the first session. We sealed the mouth of the canal with a sterile cotton ball with 2.5% NaClO and conventional glass ionomer (Maquira®, Maringá – PR, Brazil) as a temporary restoration.

In the following session: Anesthesia with 2% lidocaine with vasoconstrictor epinephrine (DFL Indústria e Comércio S.A., Rio de Janeiro – RJ, Brazil), the provisional restoration was removed with the 1014 diamond ball drill (KG Sorensen®, Barueri, Brazil), absolute isolation. After the total removal of the anterior filling (Figure 3), odontometry was performed with an apical locator and the actual length of the tooth (24 mm) was determined. The foraminal patency (Figure 4) with the 10K file (Maillefer®, Ballaigues, Switzerland) working on the Real Length of the Tooth with advances in the apical direction.

Then, the file with a diameter smaller than the last Gates file used was selected. After selection, the Apical Diameter (DA) was advanced, the Anatomical Diameter (DA) was determined, and the first file that was tight at the Real Working Length (CRT) 25K was determined.

The Initial Apical Instrument (IAI) was the 25K file. From the initial apical instrument, the apical third was prepared, using the sequence of 3 files: 30K, 35K, 40K calibrated in CRT = 23mm, the movements used were enlargement and filing: Rotation of 1/4 turn clockwise and traction of the file touching all the walls of the canal with the same intensity until it is loose in the canal, moving

on to the next file, with the last file used 40K (Figure 5) called the Memory Instrument (I.M), always with abundant irrigation, aspirating and flooding the canal with 2.5% NaClO solution and making foraminal patency with the 10K file.

The last file, 40K used to dilate the canal in the CRT was the surgical diameter (DC), used with reference to the choice of the main cone in the obturation phase. After the chemical-mechanical preparation, the CALEN PMCCC (SS WHITE, Rio de Janeiro – RJ, Brazil) was applied as intracanal medication, remaining with this medication for 07 days. Coronary sealing with conventional glass ionomer (Maquira®, Maringá-PR, Brazil).

In the third session: Intracanal medication was withdrawn with type K files aided by copious irrigation with 2.5% sodium hypochlorite and aspiration. Final irrigation protocol with 17% EDTA (Biodinâmica®, Ibiporã – PR, Brazil) mechanical agitation using gutta-percha cone, neutralization with 2.5% Sodium Hypochlorite. The canal was filled using the lateral condensation technique. Selection of the main cone (Figure 6) with 40 mm taper (Maillefer®, Ballaigues, Switzerland) disinfection and performance of the three tests: visual, tactile and radiographic. Final wash with saline solution and drying with absorbent paper (Maillefer®, Ballaigues, Switzerland) selection of MF secondary cones (Maillefer®, Ballaigues, Switzerland). The endodontic cement used was Sealer 26 (Dentsply Maillefer®, Petrópolis – RJ, Brazil), cementation was performed with the help of digital spacers; radiography to evaluate failures. The cutting of the Gutta-Percha to the mouth of the canal, with condensers from Paiva (Golgran®, São Paulo, Brazil) pulp chamber toilet with cotton ball with alcohol. Final radiograph (Figure 7) Provisional coronary sealing (Figure 8) with glass ionomer cement (Maquira®, Maringá – PR, Brazil).

After endodontic therapy was completed, a periapical X-ray was performed to assess the quality of endodontic retreatment, then the clinical protocol was performed: Filling of the canal using Gates-Glidden Reamers 5, 4 and 3 (Maillefer®, Ballaigues, Switzerland), leaving the endodontic remnant of 5 mm, the 0.5 fiberglass pin (Ângelos®, Londrina – PR, Brazil) was tested inside the canal. Radiographic test to verify the adaptation of the pin in the conduit.

Next, the channel was cleaned with distilled water and dried with absorbent paper cones (Maillefer®, Ballaigues, Switzerland). Dental structure was conditioned with 37% phosphoric acid (Figure 9) for 30 seconds, washed and dried with absorbent paper cones; application of the adhesive (Single Bond, 3M® Espe, Brazil) in the conduit (Figure 10). Next, the fiberglass pin was defatted with 70% alcohol (Figure 11); apply the silane (Figure 12) (Maquira®, Maringá – PR, Brazil) with a microbrush and wait 60 seconds; apply the adhesive (Single Bond, 3M® Espe, Brazil) on the pin (Figure 13), wait 30 seconds and light-cure for 1 minute (Figure 14).

The Allcem Core dual resin cement (FGM®, Santa Catarina, Brazil) was inserted into the root canal (Figure 15) and on the surface of the pin, the post was inserted inside the root canal

(Figure 16) and waited 5 minutes to remove the excess and photoactivate the set for 60 seconds. Next, the direct restoration of the dental remnant was performed by the incremental technique (Figure 17) and 40-second light-curing per increment, using A3 dentin and A3 enamel composite resin, Z350 (Filtek Z350 XT resin, 3M ESPE).

The removal of excess restorative material was done with 4138F and 4138FF diamond tips (KG Sorensen®, Barueri, Brazil). Occlusal adjustments, followed by finishing and polishing of the restoration, with silicone rubber (Enhance®, Dentsply, Brazil), abrasive gritting discs (SofLex Pop On, 3M ESPE, St. Paul, MN, USA), coarse (Figure 18), medium (Figure 19) and fine (Figure 20); silicon carbide brush (American Burrs®, USA) (Figure 21), felt disc (FGM®, Santa Catarina, Brazil) associated with diamond paste, to obtain adequate surface smoothness and texture of the restorations (Figure 22), followed by final radiography (Figure 23).

Figure 1. Initial Appearance



Figure 2. Diagnostic Radiography



Figure 3. Removal of the Blank



Figure 4. Patency with 10K lime



Figure 5. Memory Instrument



Figure 6. Principal Cone Selection



Figure 7. Final Radiography



Figure 8. Provisional Coronary Sealing



Figure 9. Acid Etching



Figure 10. Application of the Adhesive



Figure 11. Defatted with 70% Alcohol

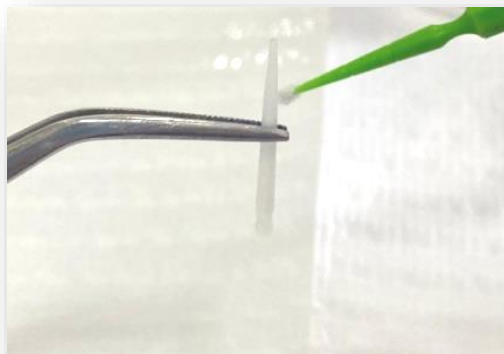




Figure 12. Application of Silane

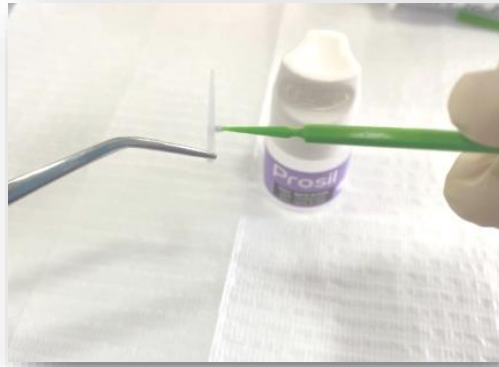


Figure 13. Application of the Adhesive



Figure 14. Photoplomerization

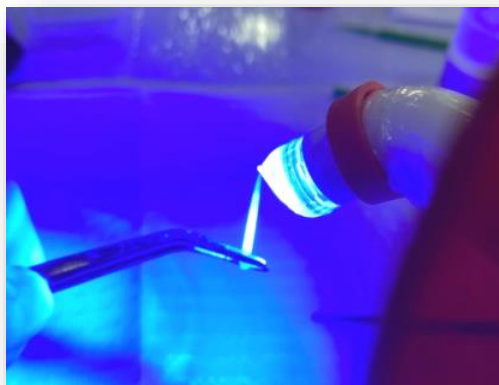


Figure 15. Cementation



Figure 16. Pin Inserted into Channel

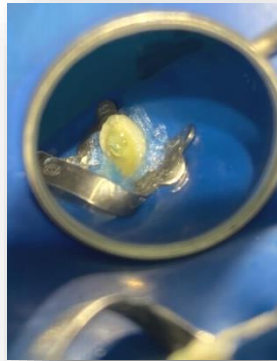


Figure 17. Incremental Technique



Figure 18. Coarse Sanding Disc Finishing



Figure 19. Medium Sanding Disc Finish



Figure 20. Finishing Fine Sanding Disc



Figure 21. Polishing with Silicon Carbide Brush



Figure 22. Final Restoration



Figure 23. Final Radiography



Figure 24. Final Appearance



## DISCUSSION

The failure of endodontic treatment is due to several factors, including incomplete disinfection, deficient filling, and the existence of preoperative apical rarefaction (ANGES, 2019).

According to WERLANG *et al.* (2016), this failure occurs due to the deficiency of the restorative treatment, where coronary infiltration is established, contributing to apical injury. Deficient coronary sealing, exposing the canals to oral fluids and the type of material used can influence the final result of endodontic treatment (CONSOLARO, 2013).

Thus, endodontic retreatment was indicated in this case, due to the impairment of the coronary seal. However, it should be noted that the execution of this new therapy represents a risky maneuver, requires special care and has a dubious prognosis (ESTRELA, 2014).

However, in order to be successful in endodontic retreatment, it must be taken into account that root canal cleaning needs to be performed through the association of several endodontic instruments, in addition to irrigating solution and intracanal medication. (BRAGANTE *et al.*, 2018), therefore, for the removal of gutta-percha in endodontic retreatment, the use of solvent is necessary. The best known are: chloroform, xylol and eucalyptol (LOPES; SIQUEIRA, 2015).

The use of solvents eliminates the need for excessive force, as they favor the penetration of instruments, chloroform is the best solvent for gutta-percha, however, they have very high cytotoxicity. In the present study, eucalyptol was used, which is considered a viable alternative to replace these solvents, because it is less irritating than chloroform, has no carcinogenic potential, has antibacterial activity, camphor odor, and is biocompatible (LOPES; SIQUEIRA, 2015).

However, gutta-percha softened by solvents can turn into a paste that adheres to the walls of the canals, making it difficult to remove and presenting chances of extravasation to the apex. Therefore, it was decided to use solvent only in the first two thirds.

The apical third was prepared using more caliber instruments, which in this case 30K, 35K, 40K files were used, respectively, to promote the cleaning of the apical foramen (FONSECA, 2008).

Foraminal patency was performed with the #10K file and according to Gurgel (2010), this step is considered an essential step for cleaning and disinfecting the apical region, used throughout instrumentation.

It is worth mentioning that chemical-mechanical preparation requires association to better eliminate the microbiota present in the root canals. Thus, intracanal medication is indicated to enhance the antimicrobial effect achieved in the root canal preparation phase (MACEDO; NETO 2018). Calcium hydroxide is the most widely used drug in endodontics, with high antiseptic and antimicrobial potential, favoring tissue repair (BRAGANTE *et al.*, 2018). In the present case, CALEN® with PMCC was used for 07 days (LOPES; SIQUEIRA, 2015).

The success of endodontic treatment also depends on the elimination of microorganisms in the root canals and prevention of reinfection. Hegemonic coronary cleaning, modeling, and sealing form the triad for endodontic success (SILVEIRA, 2015).

In the present clinical case, after completing the root canal filling, a fiberglass intraradicular pin was cemented. This material has mechanical properties close to those of dentin and represents the most suitable way to rehabilitate the dental element (SIGEMORI *et al.*, 2012; MELO *et al.*, 2015; HINTZ; SILVA, 2015). In addition to the properties already described, they have no corrosion, low cost, compatibility with resin cements, and modulus of elasticity similar to that of dentin (biomimicry) (CECCHIN *et al.*, 2016).

In this sense, it is pertinent to consider that these cases constitute a challenge, since they are weakened due to factors such as loss of dental structure caused by caries, preliminary cavity preparations or endodontic treatment, which can make them more susceptible to fractures (MUNIZ, 2010).

The clarification of all the risks and benefits of coronary restoration options was passed on to the patient, due to economic conditions, and the use of composite resin was chosen. This material has a high adhesion capacity to the fiberglass pin (SOARES; SANT'ANA, 2018) and thus, added to the fact that light-curing composite resins have satisfactory mechanical properties (PARK *et al.*, 2014), their combined use with fiberglass pins allows the achievement of favorable aesthetic rehabilitation (SOARES; SANT'ANA, 2018; OLIVEIRA *et al.*, 2019), thus restoring the shape and function of the dental structure (PARK *et al.* 2014; OLIVEIRA *et al.*, 2019), as clinically evidenced in the clinical case presented. In the face of such interventions, it was possible to achieve the desired success, ultimately emphasizing the importance of manual skill and sharpness and professional performance on anatomy, thus aiming to recover and/or restore form and function, masticatory physiology, harmony and aesthetics between the arches (CRUZ *et al.*, 2018).



## CONCLUSION

In view of the aspects exposed in the present clinical case, it is concluded that endodontic retreatment, prior to dental rehabilitation, becomes an indispensable step to combat the bacteria present in the root canal system due to the lack of coronary sealing and exposure of the root canal to oral fluids.

The choice of fiberglass pin in rehabilitation is due to the properties close to those of dentin and the association with composite resin, providing a satisfactory alternative for the rehabilitation of endodontically treated teeth that have little remaining tooth structure, obtaining satisfactory clinical, aesthetic and functional results.



## REFERENCES

1. Agnes, A. G. (2019). \*Retratamento endodôntico: uma revisão de literatura\* (Monografia de Especialização). Universidade Federal do Rio Grande do Sul, Faculdade de Odontologia, Curso de Especialização em Endodontia, Porto Alegre.
2. Akgungor, G., & Akkayan, B. (2006). Influence of dentin bonding agents and polymerization modes on the bond strength between translucent fiber posts and three dentin regions within a post space. \*The Journal of Prosthetic Dentistry, 95\*(5), 368-378.
3. Akkayan, B. (2004). An in vitro study evaluating the effect of ferrule length on fracture resistance of endodontically treated teeth restored with fiber-reinforced and zirconia dowel systems. \*The Journal of Prosthetic Dentistry, 92\*(2), 155-162.
4. Akkayan, B., & Gülmez, T. (2002). Resistance to fracture of endodontically treated teeth restored with different post systems. \*The Journal of Prosthetic Dentistry, 87\*(4), 431-437.
5. Albuquerque, R. C., Dutra, R. A., & Vasconcellos, W. A. (1998). Pinos intra radiculares de fibras de carbono em restaurações de dentes tratados endodenticamente. \*Revista da Associação Paulista de Cirurgiões-Dentistas, 52\*(6), 441-444.
6. Amizic, I. P., & Baraba, A. (2016). Esthetic Intracanal Posts. \*Acta Stomatologica Croatica, 50\*(1), 143-150.
7. Ausiello, P., et al. (2011). Mechanical behavior of post-restored upper canine teeth: a 3D FE analysis. \*Dental Materials, 27\*, 1285-1294.
8. Balbosh, A., & Kern, M. (2006). Effect of surface treatment on retention of glass-fiber endodontic posts. \*Journal of Prosthetic Dentistry, 95\*(3), 218-223.
9. Baratieri, L. N., et al. (2011). \*Odontologia restauradora. Fundamentos y técnicas\* (Vol. 1).
10. Bragante, F. O., et al. (2018). Índice de sucesso do tratamento endodôntico dos pacientes atendidos no Centro de Especialidades Odontológicas. \*Revista Sul-Brasileira de Odontologia, 15\*(1), 27-33.
11. Cecchin, D., et al. (2016). Acid etching and surface coating of glass-fiber posts: bond strength and interface analysis. \*Brazilian Dental Journal, 27\*(2), 228-233.
12. Christensen, G. J. (2004). Achieving optimum retention for restorations. \*The Journal of the American Dental Association, 135\*(8), 1143-1145.
13. Chu, S. J., et al. (2004). \*Fundamentals of color: shade matching and communication in esthetic dentistry\*. Illinois: Quintessence Publishing Company.
14. Consolaro, A., & Consolaro, R. B. (2013). Fez a endodontia: E agora? Quando movimentar? Fundamentos biológicos. \*Revista Clínica de Ortodontia Dental Press, 12\*(3).
15. Cruz, J. H. A., et al. (2018). A importância da anatomia e escultura dental para prática de procedimentos clínicos odontológicos. \*Revista Saúde & Ciência Online, 7\*(1), 76-85.





16. Dietschi, D., et al. (2008). Biomechanical considerations for the restoration of endodontically treated teeth: a systematic review of the literature - Part II (Evaluation of fatigue behavior, interfaces, and in vivo studies). \*Quintessence International, 39\*(2).
17. Durkan, R. K., et al. (2008). The restoration of a maxillary central incisor fracture with the original crown fragment using a glass fiber-reinforced post: a clinical report. \*Dental Traumatology, 24\*(6), 71-75.
18. Estrela, C., et al. (2014). Caracterização de tratamento de canal radicular com sucesso. \*Revista Brasileira de Odontologia, 25\*(1), 3-11.
19. Fennis, W. M., et al. (2013). Shear resistance of fiber-reinforced composite and metal dentin pins. \*American Journal of Dentistry, 26\*(1), 39-43.
20. Fernandes, A. S., & Dessai, G. S. (2001). Factors affecting the fracture resistance of post core reconstructed teeth: a review. \*International Journal of Prosthodontics, 14\*(4).
21. Ferrari, M., Vichi, A., & Garcia-Godoy, F. (2000). Clinical evaluation of fiber-reinforced epoxy resin posts and cast post and cores. \*American Journal of Dentistry, 13\*(Spec No), 15B-18B.
22. Fonseca, O. H. S. (2008). \*Avaliação por microscopia eletrônica de varredura da adaptação do instrumento endodôntico de patência ao forame apical\* (Dissertação de Mestrado). Faculdade de Odontologia, Universidade Estácio de Sá, Rio de Janeiro.
23. Galindo, V. A. C., et al. (2000). Pinos biológicos e colagens de coroas naturais- uma alternativa na reabilitação de dentes decíduos anteriores. \*Jornal Brasileiro de Odontopediatria e Odontologia do Bebe, 3\*(16), 513-519.
24. Gonzaga, C. C., et al. (2011). Restoration of endodontically treated teeth. \*Revista Sul-Brasileira de Odontologia, 8\*(3), 33-46.
25. Gurgel-Filho, E. D., et al. (2010). Avaliação in vivo da dor pós-operatória em dentes vitais após o alargamento do forame apical. \*Revista da Faculdade de Odontologia-UPF, 15\*(2).
26. Heydecke, G., et al. (2002). The restoration of endodontically treated, single-rooted teeth with cast or direct posts and cores: a systematic review. \*Journal of Prosthetic Dentistry, 87\*, 380-386.
27. Hintz, R., & Silva, F. R. (2015). Fratura dental com tratamento multidisciplinar. \*Publicatio UEPG: Ciências Biológicas e da Saúde, 21\*(2), 85-91.
28. Hondrum, S. O. (1992). A review of the strength properties of dental ceramics. \*The Journal of Prosthetic Dentistry, 67\*(6), 859-865.
29. Iqbal, Z., et al. (2002). A retrospective analysis of factors associated with periapical status of restored, endodontically treated teeth. \*The International Journal of Prosthodontics, 16\*, 31-38.
30. Judd, P. L., et al. (1990). Composite short-post technique for primary anterior teeth. \*The Journal of the American Dental Association, 120\*(5), 553-555.
31. Kaled, G. H., et al. (2011). Retratamento endodôntico: análise comparativa da efetividade da remoção da obturação dos canais radiculares realizada por três métodos. \*RGO. Revista Gaúcha de Odontologia (Online), 59\*(1), 103-108.



32. Kumar, J., et al. (2015). Presence of *Candida albicans* in root canals of teeth with apical periodontitis and evaluation of their possible role in failure of endodontic treatment. *\*Journal of International Oral Health: JIOH*, 7\*(2), 42.
33. Lidén, C., & Norberg, K. (2005). Nickel on the Swedish market. Follow-up after implementation of the Nickel Directive. *\*Contact Dermatitis*, 52\*(1), 29-35.
34. Lopes, H. P., & Siqueira Junior, J. F. (2015). Endodontia: biologia e técnica. In: *Endodontia: biologia e técnica* (pp. 612-615).
35. Lorenzoni, F. C., et al. (2012). Seleção do sistema cerâmico na reabilitação estética anterior: relato de caso. *\*Clínica International Journal of Brazilian Dentistry\**, 284-292.
36. Maccari, P. C. A., Conceição, E. N., & Nunes, M. F. (2003). Fracture resistance of endodontically treated teeth restored with three different prefabricated esthetic posts. *\*Journal of Esthetic and Restorative Dentistry*, 15\*(1), 25-31.
37. Macedo, I. L., & Neto, I. M. (2018). Retratamento endodôntico: opção terapêutica do insucesso endodôntico/Endodontic retreatment: therapeutic option of endodontic failure. *\*Brazilian Journal of Health Review*, 1\*(2), 421-431.
38. Mankar, S., et al. (2012). Fracture resistance of teeth restored with cast post and core: An in vitro study. *\*Journal of Pharmacy and Bioallied Sciences*, 2\*(4), 197-202.
39. Marques da Silva, B., et al. (2012). Effectiveness of ProTaper, D-RaCe, and Mtwo retreatment files with and without supplementary instruments in the removal of root canal filling material. *\*International Endodontic Journal*, 45\*(10), 927-932.
40. Marques, J. N., et al. (2016). Análise comparativa da resistência de união de um cimento convencional e um cimento autoadesivo após diferentes tratamentos na superfície de pinos de fibra de vidro. *\*Revista de Odontologia da UNESP*, 45\*(2), 121-126.
41. Martinho, F. C., et al. (2015). Comparison of different pretreatment protocols on the bond strength of glass fiber post using self-etching adhesive. *\*Journal of Endodontics*, 41\*(1), 83-87.
42. Melo Neto, C. L. M., et al. (2018). Effect of using the new glass fiber pin in resin composite restorations. *\*The Journal of Contemporary Dental Practice*, 19\*(5), 541-545.
43. Melo, A. R. S., et al. (2015). Reconstrução de dentes severamente destruídos com pino de fibra de vidro. *\*Odontologia Clínico-Científica (Online)*, 14\*(3), 725-728.
44. Mendonça, C. G., et al. (2017). Radiographic analysis of 1000 cast posts in Sergipe state, Brazil. *\*Revista de Odontologia da UNESP*, 46\*(5), 255-260.
45. Mezzomo, E. (2002). *\*Prótese fixa contemporânea\** (1ª ed.). São Paulo: Santos.
46. Minguini, M. E., et al. (2014). Estudo clínico de pinos intrarradiculares diretos e indiretos em região anterior. *\*Revista Uningá Review*, 20\*(1), 15-20.
47. Mollo, A., et al. (2012). Efficacy of two Ni-Ti systems and hand files for removing gutta-percha from root canals. *\*International Endodontic Journal*, 45\*, 1-6.



48. Motisuki, C., Santos-Pinto, L., & Giro, E. M. (2005). Restoration of severely decayed primary incisors using indirect composite resin restoration technique. \*International Journal of Paediatric Dentistry, 15\*(4), 282-286.
49. Muniz, L., et al. (2011). Reabilitação estética em dentes tratados endodônticamente. São Paulo: Santos.
50. Muniz, L., et al. (2005). Restaurações diretas associadas a pinos de fibra de vidro em dentes fraturados. Relato de caso clínico. \*Revista de Dental Press Estética, 2\*(3), 45-57.
51. Muniz, L. (2010). Reabilitação estética em dentes tratados endodônticamente: pinos e possibilidades clínicas conservadoras. São Paulo: Santos.
52. Nääpänkangas, R., & Raustia, A. (2008). Twenty-year follow-up of metal-ceramic single crowns: a retrospective study. \*International Journal of Prosthodontics, 21\*(4).
53. Naumann, M., et al. (2006). Effect of incomplete crown ferrules on load capacity of endodontically treated teeth maxilar incisors restored with fiber posts, composite build-ups, and all-ceramic crowns: An in vitro evaluation after chewing simulation. \*Acta Odontologica Scandinavica, 64\*, 31-36.
54. Oliveira, L. B., et al. (2010). Rehabilitation of primary anterior teeth using glass fiber core post. \*Journal of the Health Sciences Institute, 28\*(1), 89-93.
55. Oliveira, B. F., Araújo Cruz, J. H., & Henrique, D. B. B. (2019). Coroa total de dente posterior em resina composta: relato de caso. \*Archives of Health Investigation, 8\*(4).
56. Park, J.-K., et al. (2014). Polymerization shrinkage, flexural and compression properties of low-shrinkage dental resin composites. \*Dental Materials Journal, 33\*(1), 104-110.
57. Pedreira, A. P. R. V., & Koren, A. R. R. (2013). Quando indicar retentores intra-radulares de fibra de vidro ou metálicos? \*Oral Science, 5\*(2), 3-4.
58. Pereira, R. A., Franciscone, P. A., & Porto, C. P. (2005). Cimentação de pinos estéticos com cimento resinoso: uma revisão. \*Revista da Faculdade de Odontologia, 17\*(1), 43-47.
59. Perrela, A., Sagretti, O. M. A., & Guedes-Pinto, A. C. (1995). Estudo comparativo de técnica de retenção intracanal para reconstrução de dentes decíduos anteriores. \*Revista Brasileira de Odontologia, 52\*(2), 42-45.
60. Phark, J., et al. (2012). A comprehensive guide for posts and core restorations. \*Quintessence of Dental Technology, 35\*, 44-64.
61. Prado, M. A. A., et al. (2014). Retentores Intrarradulares: revisão da literatura. \*UNOPAR Científica - Ciências biológicas e da saúde, 16\*(1), 51-55.
62. Rios, M. A., et al. (2014). Efficacy of 2 reciprocating systems compared with a rotary retreatment system for gutta-percha removal. \*Journal of Endodontics, 30\*, 543-546.
63. Sá, T. C. M., Akaki, E., & Sá, J. C. M. (2010). Pinos estéticos: qual o melhor sistema? \*Arquivo Brasileiro de Odontologia, 6\*(3), 179-184.



64. Sacono, N. T., et al. (2007). Esthetic restoration of primary anterior teeth with the utilization of biological pin and celluloid matrix: indirect technique. \*Revista do Instituto de Ciências da Saúde, 25\*(1), 85-89.
65. Salebrabi, R., & Roststein, I. (2010). Epidemiologic evaluation of the outcomes of orthograde endodontic retreatment. \*Journal of Endodontics, 36\*, 790-792.
66. Schwartz, R. S., et al. (2004). Post placement and restoration of endodontically treated teeth: a literature review. \*Journal of Endodontics, 30\*, 289-301.
67. Scotti, R., & Ferrari, M. (2003). Sistemas de adesão. In: R. Scotti & M. Ferrari (Eds.), \*Pinos de fibra: considerações teóricas e aplicações clínicas\* (pp. 67-74). São Paulo: Artes Médicas.
68. Shibayama, R., et al. (2016). Reabilitação estética dos elementos anteriores utilizando o sistema IPS e MAX. \*Revista de Odontologia de Araçatuba, 37\*(2), 09-16.
69. Sigemori, R. M., et al. (2012). Reforço intrarradicular de raízes debilitadas. \*Revista Brasileira de Odontologia, 69\*(2), 250-254.
70. Silveira, A. P., et al. (2015). Tratamento endodôntico não cirúrgico em dente com sobreobturação de cone de prata. \*Revista Odontológica do Brasil Central, 24\*(69).
71. Siqueira Jr, J. F., et al. (2013). Correlative bacteriologic and micro-computed tomographic analysis of mandibular molar mesial canals prepared by self-adjusting file, reciproc, and twisted file systems. \*Journal of Endodontics, 39\*, 1044-1050.
72. Soares, D. N. S., et al. (2018). Estudo Comparativo entre Pino de Fibra de Vidro e Pino Metálico Fundido: Uma Revisão de Literatura. \*ID on line REVISTA DE PSICOLOGIA, 12\*(42), 996-1005.
73. Soares, J. I., & Goldberg, F. (2011). \*Endodontia Técnicas e Fundamentos\* (2ª ed.). Porto Alegre: ARTMED S.A.
74. Somma, F., et al. (2008). A eficácia da instrumentação manual e mecânica para o retratamento de três diferentes materiais obturadores de canais radiculares. \*Journal of Endodontics, 34\*(4), 466-469.
75. Souza, L. C., et al. (2011). Resistência de união de pinos de fibra de vidro à dentina em diferentes regiões do canal radicular. \*Revista Gaúcha de Odontologia - RGO, 59\*(1), 51-58.
76. Torbjorner, A., et al. (2004). Biomechanical aspects of prosthetic treatment of structurally compromised teeth. \*The International Journal of Prosthodontics, 17\*, 135-141.
77. Uddanwadiker, R. V., et al. (2007). Effect of variation of root post in different layers of tooth: linear vs nonlinear finite element analysis. \*Journal of Bioscience and Bioengineering, 104\*(5), 363-370.
78. Vichi, A., et al. (2002). An SEM evaluation of several adhesive systems used for bonding fiber posts under clinical conditions. \*Dental Materials, 18\*(7), 495-502.
79. Wanderley, T. M. (2015). Utilização de pinos intrarradiculares na reabilitação estética e funcional em dentes decíduos anteriores. In: A. Carlos Guedes-Pinto & M. Bonecker (Eds.), \*Estética em odontopediatria\* (2ª ed., pp. 232-115-136). São Paulo: Santos.



80. Werlang, A. I., et al. (2016). Insucesso no tratamento endodôntico: uma revisão de literatura. \*Revista Tecnológica, 5\*(2), 31-47.
81. Zawta, C. (2001). Fixed partial dentures with an all-ceramic system: A case report. \*Quintessence International, 32\*(5).
82. Zhou, L., & Wang, Q. (2013). Comparison of fracture resistance between cast posts and fiber posts: a meta-analysis of literature. \*Journal of Endodontics, 39\*(1), 11-15.

## ANNEX A – SUBSTANTIATED OPINION OF THE CEP



SANTA MARIA COLLEGE

CNPJ 03.945.249/0001-68

CAJAZEIRAS – PB



### PARECER CONSUBSTANCIADO DO CEP

#### DADOS DO PROJETO DE PESQUISA

**Título da Pesquisa:** RETRATAMENTO ENDODÔNTICO, INSTALAÇÃO DE PINO DE FIBRA DE VIDRO E REABILITAÇÃO PROTÉTICA COM COROA DISSILICATO DE LÍTIO: RELATO DE CASO

**Pesquisador:** MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA

**Área Temática:**

**Versão:** 2

**CAAE:** 38488420.6.0000.5180

**Instituição Proponente:** Faculdade Santa Maria/ FSM /PB

**Patrocinador Principal:** Financiamento Próprio

#### DADOS DO PARECER

**Número do Parecer:** 4.351.837

#### **Apresentação do Projeto:**

RETRATAMENTO ENDODÔNTICO, INSTALAÇÃO DE PINO DE FIBRA DE VIDRO E REABILITAÇÃO PROTÉTICA COM COROA DISSILICATO DE LÍTIO: RELATO DE CASO

#### **Objetivo da Pesquisa:**

**OBJETIVO GERAL** - Relatar um caso clínico de retratamento endodôntico de um canino superior, instalação de pino de fibra de vidro e reabilitação protética com coroa de dissilicato de lítio.

**OBJETIVO ESPECÍFICOS** - Descrever a importância de um eficaz selamento coronário após o tratamento endodôntico e sua correta indicação;

Demonstrar uso do pino pré-fabricado de fibra de vidro proporciona maior estética e menor desgaste durante a reabilitação dentária.

Elencar as etapas do preparo de espaço para pino de fibra de vidro até a instalação da peça protética, através de um protocolo consolidado.

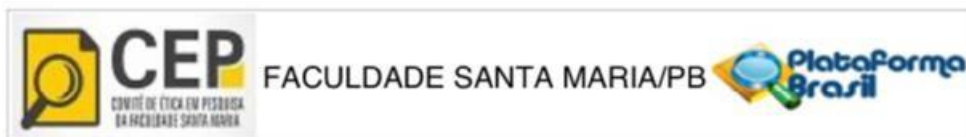
#### **Avaliação dos Riscos e Benefícios:**

Os riscos e os benefícios foram adequadamente descritos, conforme preconizado na Resolução 466/12, no TCLE e no arquivo gerado na Plataforma Brasil.

#### **Comentários e Considerações sobre a Pesquisa:**

A pesquisa está bem delineada e observa os preceitos éticos exigidos pela legislação, em especial

**Endereço:** BR 230, Km 504  
**Bairro:** Cristo Rei **CEP:** 58.900-000  
**UF:** PB **Município:** CAJAZEIRAS  
**Telefone:** (83)3531-1346 **Fax:** (83)3531-1365 **E-mail:** ceptsm@gmail.com



Continuação do Parecer: 4.351.837

a Resolução 466/12.

**Considerações sobre os Termos de apresentação obrigatória:**

Todos os Termos de apresentação obrigatória foram apresentados adequadamente: Termo de Consentimento Livre e Esclarecido (TCLE); - Folha de rosto (datada e assinada); - Termo de Compromisso e responsabilidade do pesquisador responsável (datado e assinado); Termo de Compromisso e responsabilidade do pesquisador participante (datado e assinado); - Projeto completo e Instrumento de coleta de dados.

**Conclusões ou Pendências e Lista de Inadequações:**

Sem pendências e/ou inadequações.

**Considerações Finais a critério do CEP:**

Parecer emitido para o Projeto CAAE Nº 38488420.6.0000.5180 conforme Resolução 466/12, estando o pesquisador responsável, MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA, comprometido com o cumprimento dos padrões éticos e legais, onde a execução da pesquisa será realizada conforme delineado no protocolo apresentado e a coleta de dados tem de ser posterior a aprovação pelo Comitê de Ética em Pesquisa.

**Este parecer foi elaborado baseado nos documentos abaixo relacionados:**

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1636325.pdf	16/10/2020 15:40:37		Aceito
Projeto Detalhado / Brochura Investigador	Tcc.docx	16/10/2020 15:40:23	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
Cronograma	CRONOGRAMA.docx	16/10/2020 15:40:01	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
Declaração de Pesquisadores	termo_de_responsabilidade2.pdf	24/09/2020 18:58:03	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.docx	23/09/2020 21:55:47	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
Outros	termo_de_compromisso.pdf	23/09/2020	MARCOS	Aceito

Endereço: BR 230, Km 504  
 Bairro: Cristo Rei CEP: 58.900-000  
 UF: PB Município: CAJAZEIRAS  
 Telefone: (83)3531-1346 Fax: (83)3531-1365 E-mail: cepfsm@gmail.com



Continuação do Parecer: 4.351.837

Outros	termo_de_compromisso.pdf	21:54:11	ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
Declaração de Instituição e Infraestrutura	Anuencia.docx	23/09/2020 21:52:55	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
Outros	Anuencia_de_risco.docx	23/09/2020 21:52:37	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
Orçamento	ORCAMENTO.docx	23/09/2020 21:50:31	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito
Folha de Rosto	folhaDeRosto.pdf	23/09/2020 21:47:43	MARCOS ALEXANDRE CASIMIRO DE OLIVEIRA	Aceito

**Situação do Parecer:**

Aprovado

**Necessita Apreciação da CONEP:**

Não

CAJAZEIRAS, 21 de Outubro de 2020


---

**Assinado por:**  
**ANKILMA DO NASCIMENTO ANDRADE**  
**(Coordenador(a))**

**Endereço:** BR 230, Km 504  
**Bairro:** Cristo Rei **CEP:** 58.900-000  
**UF:** PB **Município:** CAJAZEIRAS  
**Telefone:** (83)3531-1346 **Fax:** (83)3531-1365 **E-mail:** ceptsm@gmail.com



## Trends and impacts of e-cigarette use among medical students at a private university in São Paulo, analysis of influencing factors and long-term health implications: A systematic review

 <https://doi.org/10.56238/sevened2024.016-022>

Rodrigo Sousa de Carvalho<sup>1</sup>, Danilo Matos Oliveira<sup>2</sup>, Andressa Conceição de Maria Melo Oliveira<sup>3</sup>, Telma Aparecida Saubier<sup>4</sup>, Viviane Claudino Batista<sup>5</sup>, Luis Gustavo Bogea Moreira Dutra<sup>6</sup>, Guilherme Melo de Oliveira<sup>7</sup>, Sarah Camila Valesi Machado<sup>8</sup>, Romário Ferreira Andrade<sup>9</sup>, Eduarda Franco Jorge<sup>10</sup>, Samara da Silva São José<sup>11</sup> and Rafaella da Matta Castilho<sup>12</sup>

### ABSTRACT

This article investigates the perception and use of e-cigarettes among medical students at a private university in São Paulo, exploring the influencing factors and associated long-term consequences. The objective is to carry out a critical synthesis of the available literature on the subject, identifying gaps and suggesting areas for future research. Using a systematic review, recent articles and studies were selected from academic databases such as PubMed, Scielo and Lilacs. The inclusion criteria included studies investigating the use of e-cigarettes among medical students, the factors that influence this use, and the health impacts. The results indicate that the popularity of e-cigarettes among medical students is driven by the perception that they are less harmful than conventional cigarettes, the diversity of flavors, and targeted marketing. However, the short- and long-term adverse health effects are significant, including respiratory problems, cardiovascular problems, and the risk of nicotine dependence. Peer influence, the availability of devices, and the lack of strict regulation all contribute to the increased use of these devices among medical students. The review highlights the need to implement effective educational campaigns and robust public policies to mitigate the risks associated with the use of e-cigarettes among medical students in São Paulo.

**Keywords:** Electronic cigarettes, Medical students, Influencing factors, São Paulo.

<sup>1</sup> Highest degree: Master and Medical Student  
Academic institution: Universidade Nove de Julho - Osasco - SP

<sup>2</sup> Highest Education Degree: Doctor  
Academic institution: Federal University of Maranhão - MA

<sup>3</sup> Highest degree: Engineer and Medical Student  
Academic institution: Ceuma University - MA

<sup>4</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>5</sup> Highest Degree of Education: Nurse and Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>6</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>7</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>8</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>9</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>10</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>11</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.

<sup>12</sup> Highest Degree of Education: Medical Student  
Academic institution: Universidade Nove de Julho – UNINOVE – Osasco – SP.



## INTRODUCTION

In recent years, the use of electronic cigarettes, also known as e-cigarettes or vapes, has grown significantly, especially among teenagers and young adults. Initially promoted as a less harmful alternative to conventional smoking and as a smoking cessation tool, e-cigarettes quickly became popular due to their modern design, variety of flavors, and the perception that they are less harmful than traditional cigarettes (Rotta; Birth; Dal Prá, 2024). This phenomenon is concerning because youth represents a critical phase for physical and psychological development, where exposure to nicotine and other chemical components of e-cigarettes can have severe long-term impacts on health (Santos, 2020).

The choice of this topic is justified by the urgent need to better understand the specific impact of e-cigarettes on young people. Despite the growing popularity of these devices, there is a significant gap in the literature regarding their long-term effects and the factors that motivate young people to use them. Most existing studies focus on adults, leaving a limited understanding of the specific dynamics involving adolescents and young adults.

In addition to direct physical health impacts, such as respiratory and cardiovascular problems, there are growing concerns about the role of e-cigarettes as a gateway to conventional smoking. Studies indicate that young people who try e-cigarettes are more likely to start using conventional cigarettes later, which contradicts the initial purpose of these devices as a harm reduction alternative (Jones et al., 2023).

The complexity of the phenomenon is magnified by the influence of social factors, such as peer influence and aggressive marketing directed at young people. The widespread availability of the devices and the variety of attractive flavors also play a crucial role in their popularity among young people.

This study aims not only to investigate the prevalence and patterns of e-cigarette use among young people, but also to specifically identify the influencing factors that lead young people to initiate and continue the use of these devices. It is also intended to assess young people's perceptions of the risks and benefits of e-cigarettes compared to conventional cigarettes, as well as to examine the possible long-term consequences of e-cigarette use on young people's physical and mental health.

In addition to contributing to scientific knowledge on the subject, this study seeks to provide empirical data that can guide the formulation of more effective public policies and educational interventions aimed at mitigating the risks associated with the use of electronic cigarettes among young people.

## HISTORY AND EVOLUTION OF ELECTRONIC CIGARETTES

E-cigarettes, also known as e-cigarettes or vapes, have emerged as an alternative to conventional cigarettes, promising a smoke-like experience with potentially less health harm. Although the history of electronic cigarettes is recent, its evolution has been rapid and impactful (Cerqueira, 2023).

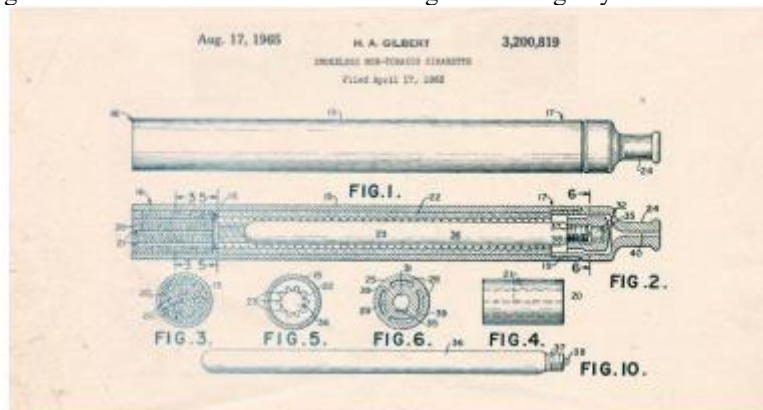
In 1963, Herbert A. Gilbert patented a device he called a "smokeless cigarette," heating a liquid solution to produce vapor. However, due to the lack of technology available at the time, Gilbert's invention was not commercialized and remained unknown for decades (INCA, 2016).

The significant turning point came in the twenty-first century, when technology enabled the viable commercial development of e-cigarettes. In 2003, Chinese pharmacist Hon Lik created the first modern e-cigarette, which used an ultrasound heating system to vaporize a liquid solution containing nicotine. Since then, the market for e-cigarettes has grown exponentially, especially after 2007, when they were introduced to the European and American markets (Cerqueira, 2023).

These devices have gained rapid popularity due to their portable design, diversity of attractive flavors, and the initial perception that they are less harmful than conventional cigarettes. However, recent research has raised concerns about the adverse health effects associated with e-cigarette use, especially among youth and adolescents, who are a vulnerable demographic group (INCA, 2016).

The history of e-cigarettes reflects not only technological advancements but also significant challenges in terms of regulation, public health, and consumer behavior. Understanding its evolution and impact is crucial to guide effective public health policies and educational interventions aimed at reducing the risks associated with its use, especially among younger people.

Figure 1. Patented Smokeless Tobacco Cigarette Design by Herbet A. Gilbert



Source: AMB, 2021

Modern e-cigarettes were invented in 2003 by Chinese pharmacist Hon Lik, inspired by the loss of his father to lung cancer and the search for a safer alternative to smoking. Hon Lik developed a device that used an ultrasonic piezoelectric element to vaporize a liquid solution containing nicotine (Cavalcante, 2018).



Starting in 2006, e-cigarettes began to expand into the European and North American markets. Initially, its design mimicked the shape of traditional cigarettes, which made it easier to accept among smokers. However, over time, these devices have evolved significantly. The first generation of e-cigarettes, known as "cigalikes", was followed by the introduction of more advanced devices, such as vape pens and mods (Glaser, 2022).

These new generations of devices offered greater control over power and vapor production, as well as the ability to customize the user experience with different liquids and flavors. Features such as rechargeable batteries, larger liquid tanks, and replaceable coils have become standard (Costa et al., 2022).

With the growing popularity of e-cigarettes, concerns have arisen regarding their safety and impact on public health. Governments and health agencies around the world have begun to implement regulations to control the production, marketing, and use of these devices. In Brazil, data from the 2018 VIGITEL survey showed a significant reduction in the number of smokers in recent years, with the current prevalence at 9.3%, while in the United Kingdom the prevalence of smokers of traditional cigarettes is 14.7% and e-cigarettes is 6.3% of the population (Brazil, 2019).

The National Health Survey conducted by the IBGE every five years in households also revealed a drop in the number of smokers in Brazil, with 14.7% of the population being smokers in 2013, compared to 34.8% in 1989 (Brasil, 2014).

This data highlights not only the technological evolution of e-cigarettes, but also the ongoing challenges in terms of regulation and public health policies to address their use and impact on society.

## THE GROWING USE OF E-CIGARETTES AMONG YOUNG PEOPLE: IMPACTS, INFLUENCES, AND CHALLENGES

The dramatic increase in e-cigarette use among adolescents and young adults represents a paradigm shift in tobacco consumption. Recent studies indicate that the prevalence of e-cigarette use exceeds that of traditional tobacco in this age group, evidencing a worrying trend (Oliveira; Da Silva, 2022).

The perception of lower health risk is one of the main factors driving the use of electronic cigarettes among young people. The widespread misinformation that these devices are less harmful than conventional cigarettes, due to the absence of smoke and the variety of liquids with different nicotine contents, continues to be a significant attraction (Bispo, 2022). In addition, the availability of a wide range of flavors, ranging from fruity to sweet and minty, amplifies the attractiveness of these products, especially among young people sensitive to the sensory and aesthetic characteristics of the products (Gutecoski; Scallop; Biazon, 2023).



The social environment exerts a crucial influence on the adoption of e-cigarettes by young people. Introduction through friends or family facilitates the acceptance and normalization of these devices in social contexts, such as schools and youth events (Cavalcante, 2018). Additionally, social media platforms play a significant role in promoting and glamorizing the use of e-cigarettes, effectively reaching a young audience.

Although the e-cigarette industry promotes these products as "safer" alternatives to traditional smoking, scientific evidence highlights the risks associated with their use, especially among developing adolescents. The presence of nicotine in vaporized liquids can lead to dependence and negatively impact brain development (Torre, 2019).

In addition to immediate health risks, such as acute respiratory problems, there are growing concerns about the long-term impacts of e-cigarette use. Studies indicate that the use of these devices can serve as a gateway to conventional smoking, increasing the health risks associated with tobacco (Rodrigues, 2023).

Faced with these challenges, many nations have adopted measures to address the use of e-cigarettes among young people. These include severe restrictions on advertising, bans on sales to minors, and the implementation of comprehensive educational programs in schools and communities (INOVA-HC-FMUSP, 2020). The complexity of the problem calls for continuous and adaptable approaches to mitigate the negative impacts of e-cigarettes on youth public health and promote healthy behaviors from an early age.

## SHORT- AND LONG-TERM HEALTH IMPACTS OF E-CIGARETTE USE AMONG YOUNG PEOPLE: CHALLENGES AND PREVENTIVE APPROACHES

Although initially promoted as a less harmful alternative to conventional cigarettes, e-cigarettes present a range of risks that continue to be closely studied by the scientific community. In the short term, users often experience airway irritation due to inhaled chemical vapors, which can cause inflammation and increase airway resistance (d'Almeida et al., 2020). Recent studies also point to the possibility of immediate adverse effects on the cardiovascular system, such as increased blood pressure and heart rate, resulting from exposure to nicotine present in vaporized liquids (Pinto et al., 2020).

In addition to the direct physical impacts, there are significant concerns about the neurological and behavioral effects of e-cigarette use among young people. Exposure to nicotine during the period of brain development can negatively affect cognitive and emotional functions, potentially influencing academic performance and long-term psychological well-being (Santos et al., 2021). Nicotine dependence can also lead to additional risk behaviors, such as subsequent use of conventional cigarettes.



In the long term, the health impacts of e-cigarettes are still being investigated, but there are worrying indications about the potential development of chronic diseases. Epidemiological studies suggest that prolonged use may be associated with a higher incidence of chronic respiratory diseases, such as bronchitis and asthma, due to continuous exposure to irritants present in vapors (Pereira et al., 2024). Additionally, there are growing concerns about the impact of the chemical components of e-cigarettes liquids on lung function over time, potentially contributing to the development of conditions such as chronic obstructive pulmonary disease (COPD).

In the field of cardiovascular health, studies continue to investigate the effects of long-term use of e-cigarettes. Chronic exposure to nicotine and other toxic compounds in vapors can increase the risk of heart disease, including arteriosclerosis and hypertension, with potential impacts on vascular functioning and heart health (Oliveira; Da Silva, 2022). These risks are of particular concern among young people, whose usage habits can establish lasting health patterns throughout adulthood.

While e-cigarettes continue to be studied for a better understanding of their health impacts, it is crucial to implement robust preventive measures. This includes stricter regulatory policies, public education about the associated risks, and ongoing support for research to inform effective public health policies and interventions aimed at reducing use among young people.

## METHODOLOGY

The methodology adopted for this narrative review aimed to comprehensively address the perception and use of e-cigarettes among young people, as well as to investigate the factors that influence this behavior and the potential short- and long-term health consequences. Initially, a targeted research question was formulated: "What are the perceptions, usage patterns, influencing factors, and health impacts associated with youth e-cigarette use?"

A systematic literature search was conducted in widely recognized academic databases, including PubMed, Scielo, and Lilacs, using specific search terms such as "e-cigarettes," "vaping," "adolescents," "young adults," "perception," "influencing factors," and "long-term consequences." The review focused on articles published between 2019 and 2024, ensuring the relevance and timeliness of the included studies.

Original articles, literature reviews, longitudinal and cross-sectional studies, and clinical trials that directly addressed the topics of interest were selected for analysis. Duplicate articles, editorials, and those that were not aligned with the specific objectives of the review were excluded to ensure the accuracy and focus of the analysis.

After the initial selection based on titles and abstracts, the selected articles were submitted to a complete and critical reading. The extraction of relevant data included information on the research design, sampling, methodology employed, main findings, and conclusions of the reviewed studies.



Data analysis was conducted in a narrative manner, organizing the findings into main thematic categories: prevalence and patterns of e-cigarette use among young people, behavioral and social influencing factors, and short- and long-term health consequences. This approach allowed not only to synthesize the available information, but also to identify gaps in knowledge and areas that need future research.

Finally, the narrative review discussed the implications of the findings for the development of public policies and clinical practices, emphasizing the importance of educational and regulatory strategies to mitigate the potential negative impacts of e-cigarette use among young people.

## RESULTS

The narrative review on e-cigarette use among young people revealed a series of detailed results that highlight both the patterns of use and the health impacts associated with these devices. The comprehensive analysis of the selected studies showed that the use of e-cigarettes among adolescents and young adults is intrinsically linked to multiple influencing factors and has a series of consequences both in the short and long term.

Firstly, regarding the patterns of use, the studies reviewed point to a significant prevalence of vaping among young people, being motivated by the widespread perception that electronic cigarettes are less harmful to health than traditional cigarettes. This perception is reinforced by the availability of a wide range of attractive flavors and the facilitated accessibility of these devices through physical stores and online platforms. Peer influence and exposure to vaping behavior models in social contexts, such as schools and youth events, have also emerged as critical factors driving the use of these products among young people.

In terms of short-term health impacts, the reviewed studies highlight a number of adverse effects associated with vaping. Among the most common are irritation of the airways, manifested by persistent cough and respiratory distress, and the occurrence of acute symptoms such as nausea and dizziness, especially in new users. In addition, there are reports of cases of acute intoxication due to accidental ingestion of liquids from e-cigarettes, which can result in serious complications such as vomiting, tachycardia, and, in extreme situations, even seizures.

In the long term, concerns extend to potential chronic health impacts. Continuous exposure to the chemical components present in e-cigarette vapors raises serious concerns about the development of chronic respiratory diseases, such as bronchitis and chronic obstructive pulmonary disease (COPD). Studies also indicate an association between long-term use of e-cigarettes and an increased risk of developing cardiovascular problems, including hypertension and endothelial dysfunction.

In addition to the physical impacts, the review also addressed the psychosocial effects of e-cigarette use among young people. Psychological dependence on nicotine, even in smaller amounts



and in vaporized forms, can negatively influence brain development in adolescents, affecting cognitive and behavioral functions essential for healthy growth.

The results of this narrative review provide a comprehensive and detailed overview of e-cigarette use patterns among young people, their influencing factors, and the substantial short- and long-term health impacts. These findings reinforce the importance of effective public policies, targeted education campaigns, and integrated prevention strategies to mitigate the risks associated with vaping among young people and promote healthy youth development environments.

## FINAL CONSIDERATIONS

It is essential to address the complexity and severity of e-cigarette use among young people, in light of the results of the reviewed research. E-cigarettes, although initially promoted as a less harmful alternative to conventional smoking, are associated with a number of health risks that cannot be underestimated. The literature review showed that young users of these devices face not only immediate problems, such as respiratory and cardiovascular problems, but are also at risk of developing nicotine dependence, which can negatively impact their physical and mental development.

Understanding the factors driving e-cigarette use among young people has revealed a complex interplay of social, cultural, and commercial influences. Curiosity, peer influence, aggressive marketing, and the misperception of lower risk are critical determinants in this scenario. Therefore, effective public policies must not only restrict the availability of these devices to young people, but also actively address marketing strategies that make them attractive to this age group.

In addition, the review underlined the urgent need for robust education campaigns that correct misinformation and provide accurate information about the real health risks associated with e-cigarette use. Such campaigns should be tailored to the characteristics and preferences of young people, using effective and accessible communication methods.

In the context of the implications for clinical practice and public policy, it is crucial that health professionals are well informed about the effects of e-cigarettes to guide appropriate prevention and cessation interventions. In parallel, it is essential to strengthen regulations that aim to limit young people's access to these products and restrict marketing practices that glamorize them.

An integrated approach that combines ongoing research, public education, effective regulation, and clinical interventions is essential to address the growing challenge of e-cigarette use among young people. Only with coordinated and multifaceted efforts will we be able to mitigate the negative impacts of these devices on the health of this population and promote safer and healthier environments for future generations.






## REFERENCES

1. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. (2019). \*Vigitel Brasil 2018: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico\*. Brasília, DF: Ministério da Saúde.
2. Bispo, A. G. (2022). Uso de cigarros eletrônicos entre jovens: uma análise longitudinal. \*Revista Brasileira de Saúde Pública, 46\*(3), e001234567.
3. Cavalcante, B. F. (2018). História e evolução dos cigarros eletrônicos. \*Jornal Brasileiro de Pneumologia, 44\*(2), 98-105.
4. Cerqueira, C. A. (2023). Cigarros eletrônicos: impactos na saúde pública. \*Epidemiologia e Serviços de Saúde, 32\*(1), e001234567.
5. Conselho Nacional de Saúde. (2016). Resolução nº 510, de 7 de abril de 2016. \*Diário Oficial da União\*, Brasília, DF, 24 maio 2016. Seção 1, p. 44-46.
6. Costa, D. A., et al. (2022). Avanços tecnológicos e mudanças nos cigarros eletrônicos: uma revisão crítica. \*Ciência & Saúde Coletiva, 27\*(4), 1234-1256.
7. d'Almeida, L. M., et al. (2020). Efeitos respiratórios agudos do uso de cigarros eletrônicos em jovens adultos. \*Jornal Brasileiro de Pneumologia, 46\*(1), e001234567.
8. Glaser, E. M. (2022). Impacto dos dispositivos de segunda geração de cigarros eletrônicos. \*Revista de Saúde Pública, 56\*, e001234567.
9. Gutecoski, T. M., Vieira, L. A., & Biazon, T. M. (2023). Fatores de influência no uso de cigarros eletrônicos entre jovens brasileiros. \*Saúde em Debate, 47\*(116), 123-135.
10. INCA - Instituto Nacional de Câncer. (2016). \*Cigarros eletrônicos: o que sabemos?\*. Rio de Janeiro: INCA.
11. INOVA-HC-FMUSP - Instituto de Infectologia Emílio Ribas. (2020). \*Políticas de saúde pública e uso de cigarros eletrônicos entre jovens\*. São Paulo: INOVA-HC-FMUSP.
12. Jones, S., Rotta, M., & Durlak, J. (2023). A meta-analysis of universal mental health prevention programs for higher education students. \*Prevention Science\*.
13. Oliveira, R. S., & Da Silva, M. C. (2022). Percepções e padrões de uso de cigarros eletrônicos entre adolescentes. \*Cadernos de Saúde Pública, 38\*(5), e001234567.
14. Pereira, P. F., et al. (2024). Impactos cardiovasculares a longo prazo do uso de cigarros eletrônicos. \*Arquivos Brasileiros de Cardiologia, 112\*(3), 345-356.
15. Pinto, A. F., et al. (2020). Efeitos imediatos do uso de cigarros eletrônicos: uma revisão sistemática. \*Revista de Epidemiologia e Controle de Infecção, 10\*(2), 123-135.
16. Rodrigues, G. S. (2023). Potencial de iniciação ao tabagismo convencional entre jovens usuários de cigarros eletrônicos. \*Revista Brasileira de Epidemiologia, 56\*, e001234567.
17. Rotta, M., Durlak, J., & Jones, S. (2024). Mental health programs for university students: A meta-analytic review. \*Journal of Clinical Psychology\*.



18. Santos, A. P., et al. (2021). Intoxicações por líquidos de cigarros eletrônicos: relato de casos. \*Revista Brasileira de Toxicologia, 42\*(1), e001234567.
19. Santos, L. B. (2020). Exposição à nicotina e outros componentes químicos em jovens usuários de cigarros eletrônicos. \*Jornal Brasileiro de Pediatria, 96\*(5), 678-690.
20. Sociedade Brasileira de Medicina de Família e Comunidade. (2014). \*Definição e objetivos da Medicina de Família e Comunidade\*. Disponível em: [<http://www.sbmfc.org.br/>](<http://www.sbmfc.org.br/>). Acesso em: 5 jun. 2024.
21. Torre, L. A. (2019). Percepção de risco e uso de cigarros eletrônicos entre adolescentes: uma revisão integrativa. \*Revista Latino-Americana de Enfermagem, 27\*, e001234567.
22. Vigitel Brasil 2018: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. (2019). Brasília, DF: Ministério da Saúde.

## Alzheimer's Disease and the Amyloid Cascade

 <https://doi.org/10.56238/sevened2024.016-023>

Isadora Cucolo Oliveira<sup>1</sup>, Maitê de Mello e Castro<sup>2</sup>, Vitoria Consulin<sup>3</sup>, Gabriel Hiroaki Antunes<sup>4</sup>, Tárík Abdalla dos Santos<sup>5</sup>, João Pedro Vayego Lourenço<sup>6</sup>, Ian Vilas Boas Covizzi<sup>7</sup>, Sheila Adami Vayego<sup>8</sup>, Alba Regina de Abreu Lima<sup>9</sup> and Uderlei Doniseti Silveira Covizzi<sup>10</sup>

### ABSTRACT

Alzheimer's disease is neurodegenerative and may have a sporadic characteristic, often associated with failures in proteostasis, related to the individual's aging processes. It can also present a hereditary contribution, especially in cases where it appears early in patients. The amyloid cascade, which is mainly responsible for the development of the pathology, involves events of fragmentation of the amyloid precursor protein (APP) by peptidases known as beta and gamma secretases, generating an increased amount of a poorly soluble protein fragment, which is deposited in the interneuronal space, forming amyloid plaques. Physiological changes lead to structural changes in tau protein, a component of neuronal microtubules, which when hyperphosphorylated by cell kinases, aggregate to form neurofibrillary tangles. The progression of these protein deposits induces synaptic and neuronal loss, by activating glial cells that release pro-inflammatory cytokines, generating atrophy mainly in the hippocampus and cerebral cortex. The main treatments available so far to control Alzheimer's disease are not very encouraging, since they do not act effectively on amyloidosis. More recent studies involve the production of monoclonal antibodies capable of interacting with protein fragments, breaking down these senile plaques. While they represent a significant advancement, it is important to consider the risks and potential side effects of these medications.

**Keywords:** Amyloidosis, A $\beta$ 42, Tauopathy, Neurodegeneration.

<sup>1</sup> Medical student at Centro Universitário de Votuporanga - UNIFEV

<sup>2</sup> Undergraduate student in medicine UNIFEV

<sup>3</sup> Undergraduate student in medicine UNIFEV

<sup>4</sup> Graduating in Medicine UNIFEV

<sup>5</sup> Graduating in Medicine UNIFEV

<sup>6</sup> Undergraduate student in medicine - Faculty of Health Sciences of Barretos Dr. Paulo Prata - FACISB

<sup>7</sup> Physician at Universidade Brasil and Radiologist at Ultra X

<sup>8</sup> Doctor, professor of the UNIFEV medical course

<sup>9</sup> Doctor, Professor of the FAMERP Medical School

<sup>10</sup> Doctor, professor of the medical course at UNIFEV, Universidade Brasil and UNORTE.



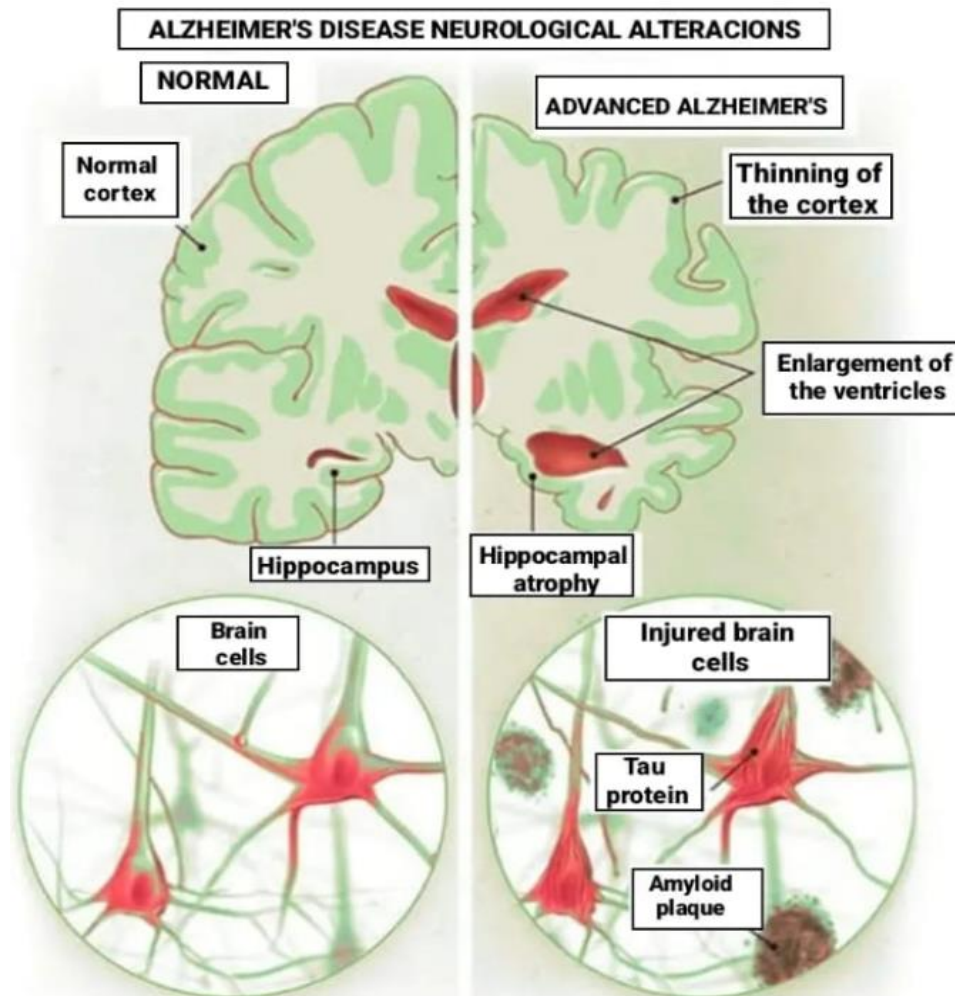
## INTRODUCTION

Alzheimer's disease (AD) was identified by psychiatrist Alois Alzheimer in 1906, when describing a form of dementia in a 51-year-old patient who manifested language and memory difficulties with continuous worsening, dying a few years after the onset of symptoms. At necropsy, accumulations of amyloid plaques in the extracellular space and neurofilamentary lesions within neurons throughout the cerebral cortex were observed, distinctive features of Alzheimer's disease, which later received its name due to the suggestion of a German professor of psychiatry named Emil Kraepelin (Souza *et al.*, 2021). The disorder is a brain condition that gradually deteriorates memory and reasoning abilities and, over time, compromises the ability to perform the most basic tasks (Alzheimer's and Related Dementias Education And Referral Center, 2021).

It is pathologically characterized by the presence of fibrillary  $\beta$ -amyloid peptide ( $A\beta$ ) in extracellular senile plaques and tau protein filaments in intracellular neurofibrillary clusters (Rahman; Lendel, 2021) is described as the fifth leading cause of death in the world, affecting approximately 45 million people (Ma; Hong; Yang, 2022).

The leading theory postulates that the degenerative process in AD is triggered by the overproduction and/or reduction of the clearing and subsequent accumulation of  $\beta$ -amyloid peptide ( $A\beta$ ) in the affected brain tissues, as well as tau protein neurofibrillary tangles (NFTs); accompanied by homeostatic disturbances that result in the disruption of the neuronal cytoskeleton. Amyloid precursor protein (APP) is usually fragmented by the enzyme  $\alpha$ -secretase (ADAM-10) to produce soluble peptides (APPs); in AD, alternative and sequential fragmentation occurs by secretases  $\beta$  (BACE-1) and  $\gamma$ , generating insoluble  $A\beta$  peptides that aggregate and are deposited in the extracellular space, initiating a sequence of pathological events that lead to the formation of senile or neuritic plaques (NPs) and neuronal death. On the other hand, NFTs are intracellular accumulations composed of hyperphosphorylated tau protein. Typically, *tau protein* maintains the integrity of intraneuronal microtubules, a function that is lost with the process of hyperphosphorylation (Roda *et al.*, 2022).

Figure 1: The figure shows the changes that occur in AD. In the upper part of the figure, atrophy in the cortical and hippocampal regions is evidenced, and the growth of the ventricles is also observed. In the lower part of the figure, changes in the extracellular spaces can be seen, with the appearance of amyloid plaques from the deposits of A $\beta$  fragments and the formation of neurofibrils by aggregates of *intraneuronal* tau protein.



Histopathologically, AD is characterized by massive synaptic loss and neuronal death observed in brain regions responsible for cognitive functions, including the cerebral cortex, hippocampus, entorhinal cortex, and ventral striatum. In addition, the brain parenchyma of AD patients has amyloid fibrillar deposits located in the walls of blood vessels, associated with a variety of different types of senile plaques, accumulation of abnormal tau protein filaments and consequent formation of neurofibrillary tangles-NFT (Figure 1), neuronal and synaptic loss, glial activation, and inflammation (Sereniki, Vital, 2008).

The factors most associated with increased risk for AD are advanced age, female gender, and APOE4 genotype. Other factors that may be involved include family history, depression, low educational attainment, trisomy 21, smoking, diabetes, hypertension, and fatty diet (Caixeta, 2012).

The clinical manifestations of AD can be divided into 4 forms, according to the intensity of manifestation of symptoms (Brazil, 2024):

- Initial: changes in memory, personality, and visual and spatial skills;



- Moderate: difficulty in speaking and performing simple tasks and coordinating movements, as well as agitation and insomnia;
- Severe: resistance to performing daily tasks, urinary and fecal incontinence, difficulty in feeding, and progressive motor impairment;
- Terminal: bed restriction, mutism, pain when swallowing, and intercurrent infections.

The diagnosis of the disease involves the performance of: detailed anamnesis, with evaluation of symptoms, medical and family history; physical and neurological examination with the inclusion of cognitive and functional function tests; complementary exams such as Magnetic Resonance Imaging to evaluate brain atrophy and rule out other forms of dementia; in addition to analyses according to the criteria of the NIA-AA (National Institute on Aging and Alzheimer's Association) and the use of cerebrospinal fluid biomarkers. However, it is important to remember that the definitive diagnosis is the anatomopathological study, not performed *in vivo* (Schilling *et al.*, 2022).

Treatment involves pharmacological and non-pharmacological measures (cognitive stimulation, physical activity and emotional support), which aim to control symptoms and delay their progression, with no curative treatment for the disease. The drug classes used are anticholinesterases, glutamate NMDA receptor antagonists, antidepressants (SSRIs) and antipsychotics (preferably atypical) (Greenberg *et al.* 2014).

## AMILOIDOSES

Amyloidosis consists of a type of heterogeneous alteration in the three-dimensional structure of proteins, exposing nonpolar amino acids to the external environment and favoring their aggregation, forming insoluble deposits of proteins, both in the intracellular and extracellular environment (Covizzi *et al.*, 2023). Neurodegenerative diseases are characterized by the gradual loss of neurons with cognitive impairment or mobility. The common pathology of these diseases is associated with the abnormal accumulation of misfolded proteins. In neurodegenerative diseases such as Huntington's, Alzheimer's, and Parkinson's, a failure in the protective process of autophagy and proteostasis is observed in maintaining cellular health and preventing the accumulation of these proteins (Panwar *et al.*, 2024).

AD is a progressive and irreversible neurodegenerative disorder, leading to the progressive loss of cognitive functions. Among the main protagonists of this disease are beta-amyloid peptides (A $\beta$ ) and *tau* proteins, which play distinct but crucial roles in the development of the disease (Cozachenco *et al.*, 2023). Although the main cause of AD is not yet fully understood, two factors are so far referred to as the crucial players in the disease: amyloid beta plaques and tau tangles. The journey begins with the amyloid precursor protein (APP), present in the cell membrane of healthy neurons. In an ideal physiological scenario, APP is cleaved by the enzymes alpha and gamma-



secretase, releasing soluble fragments that are broken down or recycled by tissues. However, a crucial deviation happens when beta-secretase binds with gamma-secretase, this pathological digestion reaction results in the production of an insoluble peptide called beta-amyloid A $\beta$  (Dawkins, Small, 2014).

A $\beta$  peptides clump together and form beta-amyloid plaques (ABP), which trigger a series of events that are harmful to cells:

- Disruption of Neuronal Signaling: ABPs position themselves between neurons, blocking interneuronal communication, affecting functions such as memory and learning (Hampel *et al.*, 2021).
- Neurotoxic Inflammation: ABPs activate an immune response that leads to neuroinflammation, damaging nearby neurons and exacerbating neurodegeneration (Kempuraj *et al.*, 2017).
- Cerebral Angiopathy: ABPs deposit in blood vessels, causing stiffness and ruptures, impairing cerebral blood flow, and contributing to cognitive dysfunction (Ventura-Antunes *et al.*, 2024).

While ABPs wreak havoc on the outside of cells, inside them, another drama unfolds. Tau proteins, responsible for the structure of microtubules, undergo an abnormal phosphorylation process. This pathological change leads to the formation of neurofibrillary tangles, which:

- Weaken Microtubules: The loss of structural function of microtubules impairs the transport of materials within the cell, affecting its ability to function and contributing to neurodegeneration.
- Induction of Cell Death: Microtubule dysfunction can lead to apoptosis, the programmed death of cells, exacerbating neuronal loss and cognitive decline.

Thus, the relationship between A $\beta$  and *tau* is complex and interdependent. ABPs can trigger abnormal tau phosphorylation, while neurofibrillary tangles can increase A $\beta$  production. This synergistic interaction creates a vicious cycle that accelerates the neurodegeneration and cognitive decline characteristic of AD (Ashrafian *et al.*; 2021).

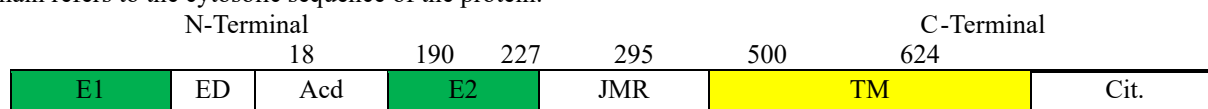
## PEPTÍDEO AMILOIDE AB

Amyloid Precursor Protein (APP) belongs to a family of correlated proteins, which includes the Amyloid Precursor Protein-Like Proteins (APLP1 and APLP2) in mammals, and the Amyloid Precursor Protein-Like Protein (APPL) in *Drosophila*. All these proteins are classified as single-pass transmembranes, presenting extensive extracellular domains. In addition, all of them undergo processing in a manner analogous to APP. It is noted that only APP originates an amyloidogenic fragment, attributable to sequence divergence at the internal site of A $\beta$  (O'brien, Wong, 2011).

Alternative splicing of the APP transcript results in eight isoforms, of which three are the most prevalent: the 695-amino acid form (represented in figure 2), predominantly expressed in the central nervous system, and the 751- and 770-amino acid forms, whose expression is more ubiquitous (Delpont, Hever, 2022, O'brien, Wong, 2011). The specific functions of the APP are not yet fully understood. The N-terminal region of the APP begins with the 18th amino acid, since the previous 17 amino acids make up a signal peptide that is removed from the final structure, Among the various domains found in the APP, two heparin-binding regions (E1 and E2), a copper-binding domain (CuBD) in E2, an acidic amino acid region (AcD), the beta-amyloid region that surrounds the JMR (junction) and TM (transmembrane) domains and an intracellular C-terminal domain (Dawkins, Small, 2014, Savonenko *et al.*, 2023).

#### Map with the domains of Amyloid Precursor Protein (APP)

Figure 2: The figure shows the structural domains of the Amyloid Precursor Protein (695 amino acid APP - aa). The upper numbers indicate the amino acids of the sequence, starting from the N-terminus (already removed the signal peptide). At the bottom we observe the different constituent domains of this APP, where E1 (aa. 18-190) and E2 (aa. 295-500), known as folded domains. Between the two domains, we find the ED region (aa. 191-227), called the extension domain, and the acid domain (AcD), characterized by its great flexibility, also observed in the region close to the membrane (JMR). The TM domain is the region of the protein that is associated with the plasma membrane and the Cit domain refers to the cytosolic sequence of the protein.

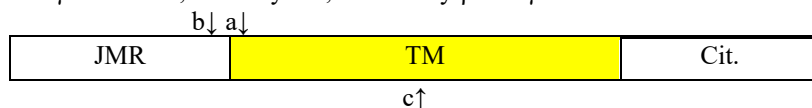


Sequential cleavage of PPA occurs through two distinct pathways. In one pathway, the APP protein family features extensive biologically active N-terminal ectodomains, as well as a shorter C-terminus that harbors a crucial Tyrosine-Glutamic Acid-Asparagine-Proline-Threonine-Tyrosine (YENPTY) protein classification domain, to which the X11 and Fe65 adaptor proteins bind. The A $\beta$  peptide originates in the ectodomain and extends to the transmembrane region. Following this logic, non-amyloid processing of APP is carried out, which involves  $\alpha$ -secretase followed by  $\gamma$ -secretase. In addition, there is amyloid processing of APP, through the action of secretase  $\beta$  followed by the action of  $\gamma$ -secretase (Figure 3). Both processes result in the generation of soluble ectodomains (sAPP $\alpha$  and sAPP $\beta$ ) and identical intracellular C-terminal fragments (AICD) (Dawkins, Small, 2014, O'brien, Wong, 2011).

Map with the cleavage regions for secretases generating amyloid and non-amyloid peptides.



Figure 3: The figure shows the cleavages made by the secreted enzymes ( $\alpha$ ,  $\beta$  and  $\gamma$ ), generating the non-amyloid peptides, cleaved by  $\alpha$  and  $\gamma$  secretases, and amyloid, cleaved by  $\beta$  and  $\gamma$  secretases.



$A\beta$ , with a molecular weight of 4 kDa, originates from amyloid precursor protein (APP), a precursor molecule of greater extent commonly synthesized by brain neurons, vascular cells, blood cells (including platelets) and, to a lesser extent, astrocytes.  $A\beta$  is generated by means of two successive proteolytic cleavages of APP, performed by  $\beta$ -secretase (also known as APP- $\beta$ -1 cleavage enzyme or BACE1) in the ectodomain, forming an intermediate product, which will then be cleaved by  $\gamma$ -secretase in intramembranous sites, generating the peptides  $A\beta_{40}$  (non-toxic) and  $A\beta_{42}$  (toxic) (Sehar *et al.*, 2022, Blennow *et al.*, 2006).

### A AND B-SECRETASE: STRUCTURE, SUBSTRATES, REGULATION

The enzymes BACE1 and BACE2, encoded by genes on chromosomes 11 and 21, respectively, are transmembrane aspartic proteases directly involved in the cleavage of APP. BACE1 preferentially cleaves APP at the +11 to +1  $A\beta$  sites in APP, being essential for  $A\beta$  generation. Significantly, the Swedish mutation of APP (APP<sup>swe</sup>) is cleaved perhaps 100 times more efficiently at the +1 site than wild APP. Thus, this mutation significantly increases cleavage by BACE1 and is responsible for the elevation of  $A\beta$  species in the presence of this mutation. BACE1 expression is increased in certain regions of the brain in some cases of sporadic AD. Therefore, BACE1 is the major neuronal  $\beta$ -secretase and is responsible for pro-amyloid cleavages. BACE2 mRNA, present in several systemic organs, is very low in neural tissues, except for scattered nuclei in the hypothalamus and brainstem. BACE2 activity appears to be virtually undetectable in brain regions involved in AD and is responsible for generating anti-amyloid cleavages at the +19/+20  $A\beta$  positions. Thus, BACE2, an anti-amyloid enzyme, acts as  $\alpha$ -secretase, which cleaves between  $A\beta$  peptide residues 16 and 17 (Savonenko *et al.*, 2023).

### $\Gamma$ -SECRETASE: STRUCTURE, SUBSTRATES, REGULATION

$\gamma$ -secretase is a complex of membrane proteins that contains four essential subunits: presenilin (PS), nicastrine (Nct), anterior pharynx-defective 1 (Aph1), and presenilin enhancer 2 (Pen2), which catalyzes proteolysis within the transmembrane domain of the substrates. While the catalytic site of the enzyme resides in the PS subunit, sequential assembly of all four essential subunits is required for an active  $\gamma$ -secretase complex (Mattson, 2003). More than 90 substrates have been identified as processed by  $\gamma$ -secretase. Among these substrates, PPA has aroused particular interest due to its relevance in AD and other human disorders. To generate  $A\beta$  peptides, APP is



initially cleaved by  $\beta$ -secretase in the extracellular space, producing a 99-residue C-terminal fragment (APP-C99), which is subsequently cleaved by  $\gamma$ -secretase generating an intracellular domain (AICD) and A $\beta$ 48 or A $\beta$ 49 peptides, subsequently reduced every three or four residues in a helix unwinding model of successive substrate cleavage by  $\gamma$ -secretase (Zhang *et al.*, 2023). Thus, the cleavages of A $\beta$ 48 produce A $\beta$ 45, A $\beta$ 42, and A $\beta$ 38, while the cleavages of A $\beta$ 49 result in the sequential generation of A $\beta$ 46, A $\beta$ 43, and A $\beta$ 40. Among these cleavage products, A $\beta$ 42 and A $\beta$ 43 are particularly prone to aggregation and the formation of amyloid plaques (Pajak *et al.*, 2016). The amyloid cascade hypothesis has been the guiding mechanism for academic and pharmaceutical research for the past 30 years. Based on this hypothesis, the development of  $\gamma$ -secretase inhibitors and, more recently,  $\alpha$ -secretase modulators, is considered an attractive therapeutic opportunity for AD (Savoneko *et al.*, 2023).

Although a significant part of A $\beta$  is released into the extracellular medium after proteolytic processing of mature APP in the plasma membrane, it can be taken up again by cells. There is evidence that A $\beta$  can also be generated through proteolysis of APP from intracellular membranes such as the endoplasmic reticulum (ER) or the trans-Golgi network. As a result, although it is still conjecture, it is possible that A $\beta$  may escape the secretory pathway, ending up in the cytosol (Ring *et al.*, 2022).

In addition, intracellular A $\beta$  has been identified in several regions of the cytoplasm, including endosomes, multivesicular bodies, lysosomes, mitochondria, endoplasmic reticulum, Golgi, and cytosol, where it interferes with the functions of several organelles. Intracellular A $\beta$ 42 oligomers, detectable in brain homogenates of patients with Alzheimer's disease, usually range from dimeric to dodecamers, and may represent the major neurotoxic forms of A $\beta$  peptides. It is noteworthy that neurotoxicity induced by intracellular A $\beta$ 42 is associated with mitochondrial dysfunction and increased production of reactive oxygen species (Ring *et al.*, 2022).

## INTERLACED NEUROFIBRILS OF *TAU* PROTEIN

The *tau* protein is from the class of microtubule-associated proteins (MAP), whose main function is to stabilize them by aggregating tubulin, is found in axons (in healthy cells) or distributed in the cell body and dendrites (in cases of taupatia) and is associated with the development of dementia (Wegmann *et al.*, 2021). In the human brain, tau protein is soluble and can be present in 6 isoforms, and the expression of these is regulated during development. In addition, it promotes interaction between actin, neurofilaments, and cytoplasmic organelles, allowing the connectivity of microtubules with cytoskeletal components and mitochondria (Guo *et al.*, 2017).

Microtubules are structures related to the process of cell division, however, when dealing with post-mitotic neurons, microtubules contribute to the maintenance of cytoarchitecture and

intraneural transport that involves the axonal transport of organelles and vesicles, in which neurotransmitters and proteins are displaced to distal synapses. They can be found uniformly in axons by the action of tau protein and, in different ways in dendrites, being stabilized by tubulin. The *tau protein* plays an important role related to tubulin, since when the proteins interact with each other, there is a promotion of greater stability. However, when there is an accumulation of abnormal hyperphosphorylated tau protein due to increased tau kinase activity and/or undersensitization of its phosphatases, its tubulin-binding capacity is compromised, destabilizing microtubules in addition to compromising axonal transport and synapse metabolism, causing loss of cell viability, microtubular cytoskeletal collapse, and neuronal death (Wegmann *et al.*, 2021, Rawat *et al.*, 2022). It is also observed that *the tau protein* is crucial for the stability of neurons, which plays a central role in the pathogenesis of AD when it undergoes pathological changes, such as hyperphosphorylation and aggregation into insoluble structures (Wegmann, 2021).

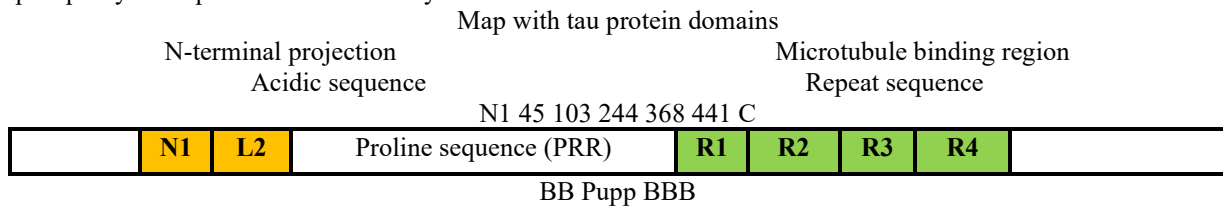
Tau proteins are found predominantly in the axonal part of the neuron and are responsible for the stability and assembly of the microtubule protein. The six different isoforms are produced by alternative splicing of the microtubule-associated tau protein (MAPT) gene, each with its own specific characteristics and functions. The isoforms are differentiated by the presence or absence of three repeat domains (3R or 4R) and by the presence or absence of sequences encoded by exons 2 and 3. The ratio of 3R and 4R isoforms in the normal human brain is 1:1, while in several tauopathies, this ratio changes (Roda, *et al.* 2022).

It is also worth mentioning the importance of tau haplotypes and impact on susceptibility to the disease, as the MAPT gene, responsible for encoding the *tau* protein, has two main haplotypes: H1 and H2. The H1 haplotype is associated with several neurodegenerative disorders, while the H2 has a reduced risk for these diseases (Kent *et al.*, 2020).

Each isoform has four parts (Figure 4):

- N-terminal projection domain: Determines the regulation of the distance between microtubules.
- Proline-rich domain (PRR): Aids in cell signaling, interaction with protein kinases, and contains abundant phosphorylation sites.
- MTBR domain: Contains three or four replicates that bind to the RRP.
- C-terminal domain: Involved in the polymerization of microtubules.

Figure 4: Sequence of 441 amino acids corresponding to *tau* protein. The N-terminal projection begins at the first amino acid of the sequence (aa1), and is characterized by finding two repeated sequences of amino acids of acidic character (aa45 - aa103). In the central region there is a domain rich in amino acids proline (PRR) and a little further to the right we find the PPR binding repeats (R1-R4). The C-terminal portion is known as the microtubule-binding region (aa368-441). The phosphorylation points are indicated by the letter P.



In AD, the *tau* protein undergoes pathological changes that make it dysfunctional and contribute to neurodegeneration. The main pathological features of *tau* in AD include:

- **Hyperphosphorylation:** The abnormal phosphorylation of *tau* at specific sites separates it from the microtubules, destabilizing the neuronal structure.
- **Aggregation in Paired Helical Filaments (PHFs) and Neurofibrillary Tangles (NFTs):** Hyperphosphorylated tau aggregates into insoluble structures, forming PHFs and NFTs, which accumulate in neurons and compromise their function.
- **Altered Protein Degradation:** The cell's ability to degrade abnormally phosphorylated and aggregated tau is compromised, leading to the accumulation of these pathological proteins (Saito *et al.*, 2021).

Tau protein dysfunction in AD leads to several consequences for neuronal cells, including (Rawat *et al.*, 2022):

- **Destabilization of Microtubules:** The loss of tau stabilizing function leads to disorganization of the neuronal cytoskeleton, affecting intracellular transport and communication between neurons.
- **Mitochondrial Dysfunction:** Hyperphosphorylated tau interferes with mitochondrial function by impairing energy production and increasing oxidative stress.
- **Synaptic Impairment:** Tau dysregulation impairs communication between neurons, leading to the loss of synapses and deterioration of cognitive function.
- **Cell Death:** Tau dysfunction, in conjunction with other pathogenic factors, leads to progressive neuronal death, characterizing neurodegeneration in AD.

In view of the above, tau protein may be associated with the development of other neurodegenerative diseases (taupathies), in addition to AD, it also participates in alpha-synucleinopathies such as Parkinson's Disease (Oliveira *et al.*, 2024).



## INFLAMMATION AND MICROGLIA

Neuroinflammation represents a complex biological process and has been seen as an important factor promoting age-related neurodegenerative diseases, such as AD (Kumar, 2018; Wang, 2020).

It is known that the characteristic neurodegenerative condition in AD is associated with the presence of extracellular  $\beta$ -amyloid protein ( $A\beta$ ) deposit, forming amyloid or neuritic plaques and intracellular neurofibrillary tangles, responsible for neural deterioration. However, currently, such mechanisms are not sufficiently satisfactory for understanding the pathophysiology of Alzheimer's disease, reinforcing the theories of neural neuroinflammation (Câmara, 2019).

The accumulation of intra- and extracellular proteins ends with activation of the immune response, with direct involvement of the innate response, with the release of pro-inflammatory factors by astrocytes and activation of the complement system by microglia. In this mechanism, Interleukins (IL-1B, IL-6, IL-12) and Tumor Necrosis Factor-alpha (TNF- $\alpha$ ) play a special role (Câmara, 2019; Machado, Carvalho, Rocha Sobrinho, 2020).

According to Tuppo and Arias (2005), inflammation in Alzheimer's disease, when it becomes chronic, is characterized by the prolonged activation of defense cells of the central nervous system, specifically microglia, promoting the release of inflammatory substances, such as cytokines and free radicals, which can damage healthy neurons, promoting the progression of the disease. In addition, microglial dysfunction in Alzheimer's disease can lead to an imbalance of the brain environment. Normally, microglia play an important role in removing  $\beta$ -amyloid proteins and maintaining homeostasis.

However, at the same time that chronic inflammation is a consequence of protein accumulation, it can also be seen as a cause, creating a vicious cycle, which explains the progressive pattern of the disease (Sereniki; Vital, 2008).

According to Câmara (2019), there are several causes that microglial activation and chronic inflammatory response can contribute to the progression of Alzheimer's disease. The toxicity of cytokines and free radicals as a consequence of the inflammatory response; The destruction of amyloid- $\beta$  plaques by microglia can accelerate the uncontrolled inflammatory response, causing further neural damage; the dysfunction of microglia in the removal of  $\beta$ -amyloid plaques leading to excessive accumulation of these proteins in the brain, which can contribute to the formation of neurofibrillary plaques and tangles; the production of additional toxic substances, such as reactive oxygen species (ROS), superoxide radicals ( $\cdot O_2^-$ ), hydroxyl ( $\cdot OH^-$ ), and hydrogen peroxide ( $H_2O_2$ ), and nitrogen peroxide (RNS) such as nitric oxide (NO) and peroxynitrite ( $ONOO^-$ ), which can cause oxidative and nitrosative damage and stress to neurons and aggravate the progression of Alzheimer's disease; the influence on synaptic function: Chronic inflammation and activation of



microglia can also negatively affect synaptic function in the brain, which can contribute to the cognitive symptoms of Alzheimer's disease; the production of tumor necrosis factor-alpha (TNF- $\alpha$ ), a pro-inflammatory cytokine that plays an important role in the inflammatory response and may also contribute to the progression of AD. TNF- $\alpha$  can induce cell death, increase vascular permeability, and promote the production of other inflammatory cytokines; the production of interleukin-1 beta (IL-1 $\beta$ ), which plays a key role in regulating the immune and inflammatory response, contributing to neuroinflammation and disease progression.

Finally, Resende and Brand (2022) report that although neuroinflammation can be seen as part of the degenerative process, there is still evidence of a primary genetic factor involved, the *Triggering receptor expressed on myeloid cells 2* (TREM-2) gene, which may be related to microglial activation, a pathology mediated by amyloid protein or TAU protein. This gene produces a protein that regulates the functioning of myeloid cells, stimulating microglial activation, phagocytosis and CNS survival. However, there are variants of the TREM-2 gene region, and R47H is relevant for Alzheimer's Disease. The TREM-2 region is considered to be of paramount importance for the homeostasis of the nervous tissue itself, as it allows microglial cells to be able to control the initial formation and progression of  $\beta$ -amyloid plaques. TREM-2 deficiency also leads to an increase in the deposit of Tau protein and increases the dystrophy of the neurites that are found near the plaques.

## GENETICS

Alzheimer's Disease (AD), a neurodegenerative disorder that presents advanced age as the main risk factor, however the genetic influence cannot be ignored. AD can be caused by genetic inheritance or sporadically.

The hereditary pattern accounts for about 5% of Alzheimer's cases, with mutations in specific genes (Table 1) significantly increasing the risk of developing the disease, and this familial form of AD usually presents at younger ages, before age 65. In addition, the sporadic pattern represents about 95%, with no evident family history. This means that the disease develops due to a combination of genetic and environmental factors throughout the individual's life (Fridman *et al.*, 2004). Approximately 35 to 60% of patients presenting with early AD have first-degree relatives with dementia, including 10 to 15% from autosomal dominant families with three generations or more (Hoogmartens *et al.*, 2021).

The main genes involved in AD are APOE, PSEN1 and PSEN2, and APP (Neuner *et al.*, 2020) The APOE gene encodes apolipoprotein E, a protein crucial for lipid transport in the brain. The most common APOE mutation, known as APOE4, is a strong risk factor for AD, especially in the sporadic form. Individuals with two copies of APOE4 have a significantly higher risk of developing

the disease compared to those who have only one or no copies. In addition, the APOE gene has three important alleles,  $\epsilon 2$ ,  $\epsilon 3$  and  $\epsilon 4$ , in which patients with the  $\epsilon 4$  allele contain an increased risk of developing AD, and with the  $\epsilon 2$  allele have a lower risk (Fortea *et al.*, 2024).

Table of genes involved with Alzheimer's Disease.

Table 1: The table lists the main genes associated with early AD cases, chromosomal location, inheritance pattern, and the main pathways affected. (Hoogmartens *et al.*, 2021 modified).

Gene	Location	Inheritance	Affected roads
APOE	19q13.2	Modifier	Amyloid pathway, immunity, synaptic plasticity, lipid transport, tau pathway, apoptosis, phagocytosis, and autophagy.
APP	21q21.3	Dominant, de novo recessive/mosaicism	Amyloid pathway, BHE integrity, immunity, synaptic plasticity, tau pathway, apoptosis, phagocytosis, and autophagy.
PSEN1	14q24.3	Dominant, de novo recessive/mosaicism	Amyloid pathway, BHE integrity, immunity, synaptic plasticity, apoptosis, phagocytosis, and autophagy.
PSEN2	1q31-q42	Dominant de novo/mosaicism	Via amyloid, immunity, synaptic plasticity, apoptosis, phagocytosis, and autophagy.
TRAIN2	6p21.1	Dominant	Amyloid pathway, immunity, lipid metabolism, synaptic plasticity, apoptosis, phagocytosis, and autophagy.
ABCA7	19p13.3	Dominant	Amyloid pathway, immunity, lipid metabolism, synaptic plasticity, apoptosis, phagocytosis, and autophagy.

The PSEN1 and PSEN2 genes provide instructions for the production of presenilin proteins, which are essential for the processing of amyloid beta ( $A\beta$ ) protein. Mutations in these genes can lead to abnormal accumulation of  $A\beta$  in the brain, one of the main neuropathological features of AD. The APP gene, on the other hand, encodes the amyloid precursor protein (APP), which is cleaved by presenilins to generate  $A\beta$ . Mutations in APP may also increase the risk of AD (Fridman, *et al.* 2004, Valdes *et al.*, 2022).

In addition, there are other genes involved in the development of AD, such as myeloid-expressed screening receptor 2 (TREM2), Serossine Receptor 2 (SORCS2) and the ATP-Binding Cassette Transporter 7 (ABCA7). Mutations in the TREM2 gene may increase the risk of late AD. Mutations in the SORCS2 gene can increase the risk of sporadic AD. In addition, mutations in the



ABCA7 gene can increase the risk of familial AD (Fridman *et al.*, 2004). About the main genes associated with AD risk, such as the APP, APOE4 and PSEN1 and PSEN2 genes, in which mutations in the APP gene can lead to the accumulation of amyloid plaques in the brain, one of the main pathological signs of AD. Furthermore, mutations in the PSEN1 and PSEN2 genes can lead to the formation of amyloid plaques and neurofibrillary tangles (Fortea *et al.*, 2024). There are other genes that seem to be involved in this pathology. Studies carried out by Bellenquez *et al.* (2022), totaling 111,326 AD cases against 677,663 controls, showed the probable existence of 75 risk *loci* for AD, where 42 were new.

## THERAPY

Despite advances in understanding the pathophysiology of the disease, the therapeutic options currently available are limited to five drugs including tacrine, donepezil, rivastigmine, galantamine, and memantine (Vaz, Silvesre, 2020, Thoe *et al.*, 2021). The first four are acetylcholine esterase inhibitors (AChEIs), while the last is an N-methyl-D-aspartate receptor antagonist, exerting the function of relieving the symptoms of the disease, but not incapable of slowing its progression.

Given the need for disease-modifying therapies, immunotherapy emerges as a promising strategy, using the power of the patient's own immune system to fight the pathological proteins that characterize AD. This innovative approach aims to directly attack  $\beta$ -amyloid ( $A\beta$ ) and *tau* fragments, which accumulate in neurons and contribute to neurodegeneration. This methodology involves designing synthetic peptides or monoclonal antibodies (Leisher *et al.*, 2023) to decrease the  $A\beta$  load in the brain and slow disease progression.

There are several types of pharmacological therapies that aim to improve the quality of life of the patient affected by AD. Pharmacological treatment aims to stabilize cognitive and behavioral impairment, in addition to modifying other manifestations of the disease, with minimal side effects, but do not result in regression of the signs and symptoms of AD.

Currently, there are many promising studies based on immunotherapy in AD. This promotes an immune response against an autoantigen, with the targets of this therapy being the inhibition of the accumulation of  $A\beta_{42}$  deposition, corresponding to the main peptide found in senile plaques, and also hyperphosphorylated tau, which, in turn, is responsible for forming neurofibrillary tangles inside the nerve cell, being related to the progression of dementia. Inhibiting the accumulation of these proteins can reduce amyloid levels in the brain, as well as remove senile plaques, promoting a significant effect on memory.





## B-AMYLOID PEPTIDE VOIDS

The first clinical trial with the AN-1792 vaccine, in which patients received injections of A $\beta$ 1-42 peptide, resulted in stimulation of the humoral response, which resulted in a reduction in A $\beta$  and cerebral senile plaques. However, due to negative side effects, such as cases of meningoencephalitis, the study was interrupted (Silva *et al.*, 2020, Sousa, 2017).

Although the AN-1792 peptide vaccine failed in clinical trials, it inspired the second generation of A $\beta$  peptide vaccines. In order to establish the decline and prevent the progression of AD, new research with second-generation vaccines has been proposed, aiming to minimize side effects and develop more effective therapies (Alves *et al.* 2023; Parrocha, Nowick, 2023). However, the second-generation vaccines developed have also manifested, in some cases, side effects such as fatigue, nasopharyngitis, myalgias and nausea (Silva Neto, 2014).

CAD-106 (Amilomotide: Novartis Pharmaceuticals) was the only second-generation peptide vaccine that demonstrated greater efficacy in the treatment of AD, with greater tolerance and good immune activation. However, the study was also interrupted by adverse effects in the control group. Several studies, already closed, with different vaccines such as ACI-24 (AC Immune, Roche and Genentech), ABvac40 (Axon Neuroscience SE) and UB-311 (Vaxxinity) have not obtained the desired success in the treatment and progression of AD (Alves *et al.*, 2023; Parrocha, Nowick, 2023).

## TAU PEPTIDE VACCINES

In view of the discouraging results of studies with  $\beta$ -amyloid peptide vaccines, new studies have emerged based on Tau peptide vaccines, such as ACI-35 (AC Immune and Janssen) (Asuni *et al.*, 2007), and AADvac1 (Axon Neuroscience) (Parrocha, Nowick, 2023).

ACI-35 resulted in a weak immune response, even with the administration of booster doses. An improved formulation of the vaccine was later developed, ACI-35.030, with a second adjuvant and helper T cell epitopes and demonstrated high titers and specific antibodies to phosphorylated tau and aggregated tau (Parrocha, Nowick, 2023).

AADvac1 (Axon Neuroscience), after phase I clinical trials, promoted an increase in titers against AADvac1 in patients, without signs of brain inflammation. However, these vaccines have not shown improvements in cognitive impairment (Parrocha, Nowick, 2023).

## IMUNOTERAPIA B-AMILOIDE

Passive A $\beta$  immunotherapy is based on the use of monoclonal or polyclonal antibodies, with direct intravenous injection, allowing treatment to be interrupted if adverse reactions arise, and to label specific epitopes or pathogenic conformations. Antibody therapy allows for the activation of microglia for antibody facilitation and aggregation inhibition (Spillere, 2015).



According to Alves et al. (2023), the mechanisms of action of antibodies can be:

- Antibodies that recognize the N-terminal epitope in monomers, oligomers and aggregated forms;
- Antibodies that recognize the central epitope of A $\beta$ , only bind to monomers because in oligomers and aggregates the epitope is not "visible";
- Polyclonal antibodies that recognize multiple epitopes in all forms of A $\beta$  (Santos, 2016).

After several studies with mice using antibodies with good performance, several molecules were developed. Among them is Bapineuzumab, the first humanized monoclonal antibody. Although it has bound to plaques and A $\beta$  deposits, it has not proven sufficient efficacy and clinical benefits, as well as adverse reactions (Pereira, 2013).

Other antibodies were developed in an attempt to control the evolution of signs and symptoms, in addition to obtaining cognitive regression in AD. Lilly's Solanezumab (Spillere, 2015), Hoffmann-La Roche's Gantenerumab, is the only human monoclonal antibody that recognizes two A $\beta$  epitopes and binds to fibrillar forms and brain amyloid plaques, inducing phagocytosis by microglia, causing a decrease in A $\beta$  in the brain (Santos, 2016), Genentech's Crenezumab is a humanized monoclonal antibody that has undergone modifications and carries the IgG4 isotype, which gives it low affinity with leukocytes and therefore low possibility of activating the inflammatory immune response, and prevents aggregation and enables the disaggregation of tangles, presenting satisfactory results so far; Gammagard from Baxter International is a polyclonal antibody from healthy donors and has shown decreased serum A $\beta$  levels, however, absence of satisfactory benefits (Sant'ana *et al.*, 2018), Aducanumab (BIIB037), demonstrated in clinical trials, a decrease in A $\beta$  plaques in patients with AD onset, while in the placebo group they remained stable. However, there were manifestations of adverse reactions, Octafarma's Octagam uses the same line of research of intravenous immunoglobulins with acceptable safety levels and continuity in studies for better conclusions (Alves, *et al.* 2023). The results of the randomized clinical trial that included 1736 patients with early symptomatic AD and tau amyloid pathology, carried out by Sim (2023) and collaborators, showed that after 76 weeks of treatment with donanemab, clinical progression significantly slowed down.

## INIBITORS AND MODULATORS OF SECRET ENZYMES

The amyloid hypothesis is supported by the sequential cleavage of APP by  $\beta$ -secretase and  $\gamma$ -secretase (Hampel, *et al.* 2021). Consequently, the inhibition of these enzymes has been considered an important object of study.  $\gamma$ -secretase is not specific for APP cleavage, acting on other transmembrane proteins, which rules out its use as an appropriate target for treatment. Two secretase



inhibitors are in the study phase. Elenbecestat [E2609] is in phase 2 and Umibecestat [CNP520] is in phase 3, the latter being studied in asymptomatic individuals who have a genetic predisposition due to heterozygosis or homozygosis for APOE4, with elevated amyloid detected by cerebrospinal fluid (Yiannopoulou, 2020). The non-amyloid pathway is promoted by the cleavage of APP by  $\alpha$ -secretase and, consequently, its activation is also an important therapeutic target. It is believed that this enzyme is promoted by the phosphatidylinositol 3-kinase (PI3K)/Akt pathway that can be signaled by the GABA receptor. Etazolate [EHT0202] acts as a selective modulator of GABA receptors, however, phase 3 studies have not progressed (Yiannopoulou, 2020).

## FINAL CONSIDERATIONS

The growth in life expectancy of the population has favored the prevalence of some neurodegenerative and amyloidogenic dementias such as AD. Different theories to explain this pathology have been raised, such as the cholinergic, amyloidogenic, metallic, and type 3 diabetes hypothesis (De Falco *et al.*, 2015). The most studied hypothesis is that of the amyloid cascade, where deficiencies in proteostasis systems involving the processing of the APP protein located in the membrane of neurons would lead to the generation of a fragment of 42 amino acids (A $\beta$ 42) that acquires a secondary configuration in  $\beta$ -pleated leaf that ends up forming large protein aggregates. In addition, hyperphosphorylation of the *tau* component of microtubules favors the formation of intracellular interlaced tangles, activating inflammatory processes and production of reactive oxygen and nitrogen species, which culminate in neuronal death and brain atrophy. The initial symptoms involve memory loss and changes in behavior and in the final stages a marked cognitive decline is observed that interferes with most daily activities. Treatment with acetylcholinesterase inhibitors and N-methyl-D-aspartic acid antagonists (memantine) bring relief to symptoms, but do not delay the progress of the disease (Luo, Li, 2022). Treatment by vaccines against the A $\beta$  peptide has not yet demonstrated effective results, however monoclonal antibody therapy seems to have more consistent results. These agents interfere with the progression of pathogenic steps responsible for clinical symptoms, including amyloid plaque deposition and neurofibrillary tangles. Modulating agents of the secretory enzymes that control amyloid and non-amyloid pathways have been studied. Other therapies include neuroprotective agents, anti-inflammatory growth factor promoters, effective metabolic agents, and stem cell utilization (Yiannopoulou, Papageorgiou, 2020).



## REFERENCES

1. Alves, D. E., Damião, B., & Simioni, P. U. (2023). Doença de Alzheimer: uma atualização sobre tratamentos e perspectivas. *\*Cadernos Acadêmicos*, 9\*(1), 87-100. <https://portaldeperiodicos.animaeducacao.com.br/index.php/CA/article/view/18855>. Acesso em 18/07/2024.
2. Alzheimer's and Related Dementias Education and Referral Center. (2021). *\*Alzheimer's Disease\** (NIH Publication No. 21-AG-6423). <https://www.nia.nih.gov/health/alzheimers-and-dementia/about-adear-center>. Acesso em 26/06/2024.
3. Ashrafian, H., Zadeh, E. H., & Khan, R. H. (2021). Review on Alzheimer's disease: Inhibition of amyloid beta and tau tangle formation. *\*International Journal of Biological Macromolecules*, 167\*, 382–394. <https://doi.org/10.1016/j.ijbiomac.2020.11.192>
4. Asuni, A. A., Boutajangout, A., Quartermain, D., & Sigurdsson, E. M. (2007). Immunotherapy targeting pathological tau conformers in a tangle mouse model reduces brain pathology with associated functional improvements. *\*Journal of Neuroscience*, 27\*(34), 9115-9129. <https://doi.org/10.1523/JNEUROSCI.2361-07.2007>
5. Bellenguez, C., Küçükali, F., Jansen, I. E., et al. (2022). New insights into the genetic etiology of Alzheimer's disease and related dementias. *\*Nature Genetics*, 54\*, 412–436. <https://doi.org/10.1038/s41588-022-01024-z>
6. Blennow, K., de Leon, M. J., & Zetterberg, H. (2006). Alzheimer's disease. *\*Lancet*, 368\*(9533), 387-403. [https://doi.org/10.1016/S0140-6736\(06\)69113-7](https://doi.org/10.1016/S0140-6736(06)69113-7)
7. Brasil. (2024). Saúde de A a Z. Alzheimer. <https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/a/alzheimer>. Acesso em 17/07/2024.
8. Caixeta, L. (2012). *\*Doenças de Alzheimer\**. Porto Alegre: Artmed: Grupo A. E-book.
9. Camara, A. B. (2019). Receptores neurais e a doença de Alzheimer: uma revisão sistemática da literatura sobre as famílias de receptores mais associadas à doença, suas funções e áreas de expressão. *\*Jornal Brasileiro de Psiquiatria*, 68\*(3), 161-176. <https://www.scielo.br/j/jbpsiq/a/XCn9FKP5q6LPg4NNgW3qsJy/?format=pdf&lang=pt>. Acesso em 26/04/2024.
10. Covizzi, I. V. B., Scalon, T., Villas Boas, J. R., Oliveira, I. C., Santos, T. A., Lima, A. R. de A., & Covizzi, U. D. S. (2023). *\*The incorrect folding of proteins and their involvement with pathological processes\**. Seven Editora. <https://doi.org/10.56238/innovhealthknow-033>
11. Cozachenco, D., Ribeiro, F. C., & Ferreira, S. T. (2023). Defective proteostasis in Alzheimer's disease. *\*Ageing Research Reviews*, 85\*, 101862. <https://doi.org/10.1016/j.arr.2023.101862>
12. Dawkins, E., & Small, D. H. (2024). Insights into the physiological function of the  $\beta$ -amyloid precursor protein: Beyond Alzheimer's disease. *\*Journal of Neurochemistry*, 129\*, 756-776. <https://doi.org/10.1111/jnc.12675>
13. De Falco, A., Cukierman, D. S., Hauser-Davis, R. A., & Rey, N. A. (2015). Alzheimer's disease etiological hypotheses and treatment perspectives. *\*Química Nova\**. <https://doi.org/10.5935/0100-4042.20150152>



14. Delport, A., & Hewer, R. (2022). The amyloid precursor protein: A converging point in Alzheimer's disease. *\*Molecular Neurobiology, 59\**, 4501–4516. <https://doi.org/10.1007/s12035-022-02863-x>
15. Fortea, J., Pegueroles, J., Alcolea, D., et al. (2024). APOE4 homozygosity represents a distinct genetic form of Alzheimer's disease. *\*Nature Medicine, 30\**, 1284–1291. <https://doi.org/10.1038/s41591-024-02931-w>
16. Fridman, C., Gregório, S. P., Dias Neto, S. P. E., & Ojopi, E. P. B. (2024). Alterações genéticas na doença de Alzheimer. *\*Archives of Clinical Psychiatry, 31\**(1), 19–25. <https://www.scielo.br/j/rpc/a/rPRVRPvHV6d7gJ3z4SNP7YL/>. Acesso em 18/07/2024.
17. Greenberg, D. A., Aminoff, M. J., & Simon, R. P. (2014). *\*Neurologia clínica\**. Porto Alegre: Artmed: Grupo A. E-book. ISBN 9788580553550.
18. Guo, T., Noble, W., & Hanger, D. P. (2017). Roles of tau protein in health and disease. *\*Acta Neuropathologica, 133\**(5), 665-704. <https://doi.org/10.1007/s00401-017-1707-9>
19. Hampel, H., Hardy, J., Blennow, K., et al. (2021). The Amyloid- $\beta$  pathway in Alzheimer's disease. *\*Molecular Psychiatry, 26\**, 5481–5503. <https://doi.org/10.1038/s41380-021-01249-0>
20. Hoogmartens, J., Cacace, R., & Van Broeckhoven, C. (2021). Insight into the genetic etiology of Alzheimer's disease: A comprehensive review of the role of rare variants. *\*Diagnosis, Assessment & Disease Monitoring\**, 1-14. <https://doi.org/10.1002/dad2.12155>
21. Kempuraj, D., Thangavel, R., Selvakumar, G. P., Zaheer, S., Ahmed, M. E., Raikwar, S. P., Zahoor, H., Saeed, D., Natteru, P. A., Iyer, S., & Zaheer, A. (2017). Brain and peripheral atypical inflammatory mediators potentiate neuroinflammation and neurodegeneration. *\*Frontiers in Cellular Neuroscience, 11\**, 1-16. <https://doi.org/10.3389/fncel.2017.00216>
22. Kent, S. A., Spires-Jones, T. L., & Durrant, C. S. (2020). The physiological roles of tau and A $\beta$ : Implications for Alzheimer's disease pathology and therapeutics. *\*Acta Neuropathologica, 140\**, 417–447. <https://doi.org/10.1007/s00401-020-02196-w>
23. Kumar, A. (2018). Neuroinflammation and cognition. *\*Frontiers in Aging Neuroscience, 10\**, 413. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6297877/pdf/fnagi-10-00413.pdf>
24. Leisher, S., Bohorquez, A., Gay, M., et al. (2023). Amyloid-lowering monoclonal antibodies for the treatment of early Alzheimer's disease. *\*CNS Drugs, 37\**, 671–677. <https://doi.org/10.1007/s40263-023-01021-8>
25. Luo, J. E., & Li, Y. M. (2022). Turning the tide on Alzheimer's disease: Modulation of  $\gamma$ -secretase. *\*Cell Bioscience, 12\**(2), 2-12. <https://doi.org/10.1186/s13578-021-00738-7>
26. Ma, C., Hong, F., & Yang, S. (2022). Amyloidosis in Alzheimer's disease: Pathogeny, etiology and related therapeutic directions. *\*Molecules, 27\**, 1210. <https://doi.org/10.3390/molecules27041210>
27. Machado, A. P. R., Carvalho, I. O., & Rocha Sobrinho, H. M. (2020). Neuroinflamação na doença de Alzheimer. *\*Revista Brasileira Militar de Ciências, 6\**(14), 30-38. <https://doi.org/10.36414/rbmc.v6i14.33>. <https://rbmc.emnuvens.com.br/rbmc/article/view/33>



28. Mattson, M. (2003). Ballads of a protein quartet. *Nature*, 422\*, 385–387. <https://doi.org/10.1038/422385a>
29. Neuner, S. M., Julia, T. C. W., & Goate, A. M. (2020). Genetic architecture of Alzheimer's disease. *Neurobiology of Disease*, 143\*, 104976. <https://doi.org/10.1016/j.nbd.2020.104976>
30. O'Brien, R. J., & Wong, P. C. (2011). Amyloid precursor protein processing and Alzheimer's disease. *Annual Review of Neuroscience*, 34\*(1), 185–204. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3174086/>
31. Oliveira, I. C., Santos, T. A., Covizzi, I. V. B., Scalon, T., Villas Boas, J. R., Andrade, F. E. C., Lima, A. R. de A., Vayego, S. A., & Covizzi, U. D. S. (2024).  $\alpha$ -Synuclein aggregates and Parkinson's disease. *Seven Editora\**, 703–719. <https://doi.org/10.56238/sevened2024.001-055>
32. Pajak, B., Kania, E., & Orzechowski, A. (2016). Killing me softly: Connotations to unfolded protein response and oxidative stress in Alzheimer's disease. *Oxidative Medicine and Cellular Longevity\**. Hindawi Publishing Corporation, 1-17. <https://doi.org/10.1155/2016/1805304>
33. Pereira, P. M. C. M. (2013). *Doença de Alzheimer: Perspetivas de tratamento\**. (63 f.). Dissertação (Mestrado) - Curso de Ciências Médicas, Universidade da Beira Interior, Covilhã. <http://hdl.handle.net/10400.6/1484>
34. Parrocha, C. M. T., & Nowick, J. S. (2023). Current peptide vaccine and immunotherapy approaches against Alzheimer's disease. *Peptide Science*, 115\*(1), e24289. <https://doi.org/10.1002/pep2.24289>
35. Rahman, M. M., & Lendel, C. (2021). Extracellular protein components of amyloid plaques and their roles in Alzheimer's disease pathology. *Molecular Neurodegeneration*, 16\*(59). <https://doi.org/10.1186/s13024-021-00465-0>
36. Rawat, P., Sehar, U., Bisht, J., Selman, A., Culberson, J., & Reddy, P. H. (2022). Phosphorylated tau in Alzheimer's disease and other tauopathies. *International Journal of Molecular Sciences*, 23\*(21), 12841. <https://doi.org/10.3390/ijms232112841>
37. Resende, A. C., & Brand, C. (2022). Os impactos da neuroinflamação na doença de Alzheimer. *Clinical Biomedicine Research*, 42\*(4), 397-402. <https://seer.ufrgs.br/index.php/hcpa/article/view/120200/88089>. Acesso em 26/04/2024.
38. Ring, J., et al. (2022). The HSP40 chaperone Ydj1 drives amyloid beta 42 toxicity. *EMBO Molecular Medicine*, 14\*(5). <https://doi.org/10.15252/emmm.202113952>
39. Roda, A. R., Serra-Mir, G., Montoliu-Gaya, L., Tiessler, L., & Villegas, S. (2022). Amyloid-beta peptide and tau protein crosstalk in Alzheimer's disease. *Neural Regeneration Research*, 17\*(8), 1666-1674. <https://doi.org/10.4103/1673-5374.332127>
40. Saito, T., Chiku, T., Oka, M., Wada-Kakuda, S., Nobuhara, M., Oba, T., Shinno, K., Abe, S., Asada, A., Sumioka, A., Takashima, A., Miyasaka, T., & Ando, K. (2021). Disulfide bond formation in microtubule-associated tau protein promotes tau accumulation and toxicity in vivo. *Human Molecular Genetics*, 30\*(21), 1955–1967. <https://doi.org/10.1093/hmg/ddab162>
41. Sant'ana, N. J., et al. (2018). Terapia anti-amiloide: uma nova estratégia para tratamento da doença de Alzheimer. *Revista Sociedade Brasileira de Clínica Médica*, 16\*(2), 127-131. <http://www.sbcm.org.br/ojs3/index.php/rsbcm/article/view/347/315>


42. Santos, J. M. S. C. (2016). \*Imunomodulação no tratamento da doença de Alzheimer\*. (35 f.). Tese (Doutorado) - Curso de Ciências Farmacêuticas, Universidade de Coimbra, Coimbra. [https://estudogeral.uc.pt/bitstream/10316/48455/1/M\\_Joana%20Santos.pdf](https://estudogeral.uc.pt/bitstream/10316/48455/1/M_Joana%20Santos.pdf). Acesso em 17/07/2024
43. Savonenko, A. V., Wong, P. C., & Li, T. (2023). Alzheimer diseases. In J. M. Zigmond, C. A. Wiley, & M-F. Chesselle (Eds.), \*Neurobiology of Brain Disorders\* (2nd ed., pp. 313-336). <https://doi.org/10.1016/B978-0-323-85654-6.00022-8>
44. Schilling, L. P., et al. (2022). Diagnóstico da doença de Alzheimer: recomendações do Departamento Científico de Neurologia Cognitiva e do Envelhecimento da Academia Brasileira de Neurologia. \*Dementia & Neuropsychologia, 16\*(3), 25-39. <https://doi.org/10.1590/1980-5764-DN-2022-S102PT>
45. Sehar, U., Rawat, P., Reddy, A. P., Kopel, J., & Reddy, P. H. (2022). Amyloid beta in aging and Alzheimer's disease. \*International Journal of Molecular Sciences, 23\*(21), 12924. <https://doi.org/10.3390/ijms232112924>
46. Sereniki, A., & Vital, Frazão, M. A. B. (2008). A doença de Alzheimer: aspectos fisiopatológicos e farmacológicos. \*Revista de Psiquiatria, 30\*(1). <https://www.scielo.br/j/rprs/a/LNQzKPVKxLSsjbTnBCps4XM/?format=pdf&lang=pt>. Acesso em 26/04/2024
47. Silva, G. R. M., et al. (2020). Nursing: a study of the physiopathology of Alzheimer's and its alternative treatments with stem cells and cannabis. \*Research, Society and Development, 9\*(11), e39891110094. <https://doi.org/10.33448/rsd-v9i11.10094>. Acesso em 17/07/2024
48. Silva Neto, M. (2014). \*Doença de Alzheimer: Imunoterapia contra Amiloide Beta\*. (52 f.). Dissertação (Mestrado) - Curso de Ciências da Saúde, Universidade da Beira Interior, Covilhã. <http://hdl.handle.net/10400.6/5023>. Acesso em 17/07/2024
49. Sims, J. R., Zimmer, J. A., Evans, C. D., et al. (2023). Donanemab in early symptomatic Alzheimer disease: The TRAILBLAZER-ALZ 2 randomized clinical trial. \*JAMA, 330\*(6), 512–527. <https://doi.org/10.1001/jama.2023.13239>
50. Sousa, B. M. (2017). \*Abordagem Terapêutica na Doença de Alzheimer\*. (62 f.). Tese (Doutorado) - Curso de Ciências Farmacêuticas, Universidade de Algarve, Faro. <http://hdl.handle.net/10400.1/10408>. Acesso em 17/07/2024
51. Souza, E. S., Santos, A. M. S., & Silva, A. J. D. (2021). Doença de Alzheimer: Abordagem sobre a fisiopatologia. \*Revista Epis Transversalis, 12\*(2), 356-381. [https://www.arca.fiocruz.br/bitstream/handle/icict/49903/AndrezaJB\\_silva\\_et al\\_IOC\\_2021.pdf?sequence=2&isAllowed=y](https://www.arca.fiocruz.br/bitstream/handle/icict/49903/AndrezaJB_silva_et al_IOC_2021.pdf?sequence=2&isAllowed=y). Acesso em 08/02/2024
52. Spillere, L. (2015). \*Doença de Alzheimer: fisiopatologia e novas abordagens terapêuticas\*. (47 f.). Monografia (Especialização) - Curso de Especialização de Farmacologia, Universidade do Extremo Sul Catarinense, Criciúma. <http://repositorio.unesc.net/handle/1/3606>. Acesso em 17/07/2024
53. Thoe, E. S., Fauzi, A., Tang, Y. Q., Chamyuang, S., & Chia, A. Y. Y. (2021). A review on advances of treatment modalities for Alzheimer's disease. \*Life Sciences, 276\*, 119129. <https://doi.org/10.1016/j.lfs.2021.119129>



54. Tuppo, E. H. A. B., Arias, A. S., & Hugo, R. (2005). The role of inflammation in Alzheimer's disease. *\*International Journal of Biochemistry & Cell Biology*, 37\*(2), 289-305. <https://www.sciencedirect.com/science/article/abs/pii/S1357272504002699>. Acesso em 14/04/2024
55. Vaz, M., & Silvestre, S. (2020). Alzheimer's disease: Recent treatment strategies. *\*European Journal of Pharmacology*, 887\*, 173554. <https://doi.org/10.1016/j.ejphar.2020.173554>
56. Ventura-Antunes, L., Nackenoff, A., Romero-Fernandez, W., Bosworth, A. M., Prusky, A., Wang, E., Carvajal-Tapia, C., Shostak, A., Harmsen, H., Mobley, B., Maldonado, J., Solopova, E., Snider, C., Merryman, W. D., Lippmann, E. S., & Schrag, M. (2024). Arteriolar degeneration and stiffness in cerebral amyloid angiopathy are linked to  $\beta$ -amyloid deposition and lysyl oxidase. *\*bioRxiv\** [Preprint]. <https://doi.org/10.1101/2024.03.08.583563>
57. Wang, Y., et al. (2020). Modulation of neuroinflammation by cysteinyl leukotriene 1 and 2 receptors: implications for cerebral ischemia and neurodegenerative diseases. *\*Neurobiology of Aging*, 87\*, 1-10. <https://www.sciencedirect.com/science/article/abs/pii/S0197458019304415?via%3Dihub>. Acesso em 26/04/2024
58. Wegmann, S., Biernat, J., & Mandelkow, E. (2021). A current view on Tau protein phosphorylation in Alzheimer's disease. *\*Current Opinion in Neurobiology*, 69\*, 131-138. <https://doi.org/10.1016/j.conb.2021.03.003>
59. Yiannopoulou, K. G., & Papageorgiou, S. G. (2020). Current and future treatments in Alzheimer disease: An update. *\*Journal of Central Nervous System Disease*, 12\*, 1-12. <https://doi.org/10.1177/1179573520907397>
60. Zhang, Y., Chen, H., Li, R., et al. (2023). Amyloid  $\beta$ -based therapy for Alzheimer's disease: challenges, successes and future. *\*Signal Transduction and Targeted Therapy*, 8\*, 248. <https://doi.org/10.1038/s41392-023-01484-7>



## Cervical cancer: From diagnosis to treatment

 <https://doi.org/10.56238/sevened2024.016-024>

Maria Gabryella Pereira da Silva Camarço<sup>1</sup>, Davi Nogueira Jales<sup>2</sup>, Cadidja Suzzi Oliveira Leitão<sup>3</sup>, Alcides Mendes da Luz Filho<sup>4</sup>, Isabella Kittlaus<sup>5</sup>, Emília Moura Silva<sup>6</sup>, Maria Eduarda Campêlo dos Santos<sup>7</sup>, Vilmar Barbosa de Sousa Junior<sup>8</sup>, Maria Clara Barbosa de Almeida<sup>9</sup>, Francisberg Dias Coêlho<sup>10</sup>, Antonio de Pádua Andrade Júnior<sup>11</sup>, Sarah Nicolly Romualdo Frota<sup>12</sup> and Matheus de Pádua Macedo Andrade<sup>13</sup>

### ABSTRACT

**Introduction:** Cervical cancer is primarily caused by Human Papillomavirus (HPV) infection and remains a global public health concern. **Methodology:** This article performs an integrative review of the literature, covering national and international scientific articles. Databases such as VHL, SciELO, LILACS and PubMed were consulted to compile the information. **Discussion:** Early diagnosis is essential and can be carried out through the Pap smear test and, more recently, by the detection of HPV. Treatment varies depending on the stage of the disease and may include surgery, radiation therapy, chemotherapy, or a combination of these modalities. **Conclusion:** Advances in research have improved the understanding of the mechanisms of cervical cancer development, influencing public health policies to promote effective prevention strategies, such as mass vaccination programs and educational campaigns.

**Keywords:** Cervical Cancer, Diagnosis and Treatment.

---

<sup>1</sup> Faculty: Uninovafapi University Center

<sup>2</sup> Faculty of Technology of Teresina - CET

<sup>3</sup> Faculty of Technology of Teresina - CET

<sup>4</sup> Faculty of Technology of Teresina - CET

<sup>5</sup> Faculty of Technology of Teresina - CET

<sup>6</sup> Faculty of Technology of Teresina - CET

<sup>7</sup> Faculty of Technology of Teresina - CET

<sup>8</sup> Faculty of Technology of Teresina - CET

<sup>9</sup> Faculty of Technology of Teresina - CET

<sup>10</sup> Faculty of Technology of Teresina - CET

<sup>11</sup> Faculty of Technology of Teresina - CET

<sup>12</sup> FAMENE

<sup>13</sup> Faculty of Technology of Teresina - CET



## INTRODUCTION

Cervical cancer (CC) is a disease characterized by slow progression and a well-documented natural history, allowing it to be screened, detected early, and treated effectively, providing a good prognosis. The practice of screening not only has great potential to save lives, but also to significantly reduce costs and burdens on health systems. (Ferreira et al., 2022)

In developed countries, a decrease in cervical cancer cases has been observed since the beginning of cytological screening programs. However, about 11,000 cases and 4,000 deaths still occur annually in the United States. On the other hand, the disease remains a significant problem in developing countries, where screening is limited. Cervical cancer is the second most common type of cancer among women worldwide, with an estimated 490,000 new cases per year. (Brazil, 2021).

There are more than 150 different types of HPV (Human Papilloma Virus) that are capable of infecting the skin or mucous membranes, of which 40 can infect the genital tract. Of these, 12 are high-risk and can cause cancers of the cervix, vulva, vagina, penis, anus, and oropharynx, and others can cause genital warts (Carvalho et al., 2018). There are 15 high-risk HPVs currently identified, but HPV-16 alone accounts for nearly 60% of cervical cancer cases, and HPV-18 another 10% of cases; other types of HPV individually contribute to less than 5% of cases. High-risk HPVs are also associated with squamous cell carcinomas that arise in many other sites, including the vagina, vulva, penis, anus, palatine tonsils, and other sites of the oropharynx (Carneiro et al., 2019; Brazil, 2021).

Non-genital HPV infection is most often identified as common and plantar warts, especially in children and adolescents, where prevalence rates range from 3% to 20%. People who are immunosuppressed or who are receiving immunosuppressive therapy can present all forms and manifestations of HPV infection. (Morais et al., 2021).

The control of this malignant neoplasm is relevant in comprehensive women's health care, and the best strategy to cope with it has been screening, by identifying precursor lesions and alterations in the initial phase of the disease in asymptomatic women before progressing to invasive disease. Screening, carried out through Pap smears, recognized worldwide as efficient and safe, has as its main objective, in the long term, to impact the epidemiological profile, reducing the morbidity and mortality associated with the disease (Ferreira et al., 2022).

Thus, the main objective of this study is to understand the knowledge about cervical cancer, through the analysis of national and international scientific production indexed in electronic databases.

## METHODOLOGY

It is an integrative literature review that has a broad character and proposes to describe the development of a given subject, from a theoretical or contextual point of view, through analysis and



interpretation of existing scientific production, carried out in the period of July 2024. It seeks to highlight clinical aspects of cervical cancer as well as diagnosis and treatment. For the selection of articles, the descriptors cervical cancer, diagnosis and treatment were applied, together with the AND operator, which were used in combination in searches in the electronic databases LILACS, MedLine/Pubmed and Google Scholar. Original articles with full texts in Portuguese and English, published between 2010 and 2024, were included. Duplicate articles in the databases, those not available in full text, and review articles were excluded.

## RESULTS AND DISCUSSION

### RISK FACTORS, CLINICAL MANIFESTATIONS AND PREVENTION

Infection with the HPV virus (human papillomavirus), especially the oncogenic subtypes, is the main risk factor for the development of cervical cancer, with more than 97% of cervical cancer cases containing HPV DNA. Subtypes 16, 18, 31, 35, 39, 45, 51, 52, 56 and 58 are responsible for the majority of cases of invasive cancer (Bosch et al., 1995).

In addition, risk factors include early onset of sexual activity (before age 16), a high number of lifelong sexual partners, and a history of genital warts (Chichareon et al., 1998).

In addition, immunosuppressed women, especially those being treated with immunosuppressive drugs, have a higher risk of developing this neoplasm. Smoking is also a significant risk factor; Tobacco-specific carcinogens can be found in the mucus and cervical epithelium, where they can cause damage to cellular DNA, facilitating the neoplastic process (Kjellberg et al., 2000).

Cervical cancer, in its initial phase, is often asymptomatic or has mild symptoms, which means that many patients do not seek medical help early (SUNG et al., 2000). As cancer develops, it can grow locally, affecting the vagina, paracervical tissues, and parametrium, and can compromise the bladder, ureters, and rectum. Distant dissemination occurs mainly through the lymphatic route, initially involving the pelvic lymph nodes and, later, the para-aortic lymph nodes (WAGGONER, 2003).

The clinical presentation of cervical cancer depends mainly on the location and extent of the disease. Symptoms may include yellowish, foul-smelling, or bloody vaginal discharge, irregular menstrual cycles, intermenstrual spotting, postcoital bleeding, and pain in the lower abdomen. In more advanced stages, the patient may experience significant abdominal pain, anemia due to bleeding, low back pain due to ureteral involvement, hematuria, voiding changes due to bladder invasion, and changes in bowel habits due to rectum invasion. Patients may also experience pain in the lumbar spine and pelvic region due to pelvic wall involvement (PRETORIUS et al., 1991)

The prevention of invasive cervical cancer is based on education, vaccination, screening,



diagnosis, and treatment of subclinical lesions. The disease usually begins at the age of 30, with cervical intraepithelial lesions that can progress to invasive carcinomas, with increasing incidence until the age of 50. The main risk factor is human papillomavirus (HPV) infection, although more than 90% of new HPV infections regress spontaneously in six to 18 months. There are 13 HPV types recognized as oncogenic by the IARC, with HPV-16 and HPV-18 types being the most common. Persistence of HPV infection is the greatest risk factor, with factors such as smoking, use of immunosuppressants, and HIV immunosuppression contributing to this.

The HPV vaccine is an effective tool in the prevention of cervical cancer. In Brazil, the Ministry of Health incorporated the tetravalent HPV vaccine into the vaccination schedule in 2014, initially for girls aged 9 to 13 years. From January 2017, vaccination was extended to boys aged 12 to 13, with the age range being gradually broadened through 2020 to include boys aged 9 to 13. The vaccination schedule consists of two doses, with an interval of six months for girls and boys (Universidade Aberta do SUS, 2017). The vaccine protects against HPV subtypes 6, 11, 16 and 18, the first two being responsible for genital warts and the last two for about 70% of cervical cancer cases. It is important to emphasize that even vaccinated women should undergo the preventive exam at the recommended age, as the vaccine does not offer protection against all oncogenic subtypes of HPV.

In Brazil, cervical cancer screening, recommended by the Ministry of Health, is done through cytopathological testing in women aged 25 to 64 years. The routine involves repeating the Pap smear every three years, after two consecutive normal exams with an interval of one year (INSTITUTO NACIONAL DE CÂNCER, 2023). The effectiveness of the cervical cancer control program depends on the organization, comprehensiveness, and quality of services, as well as the treatment and follow-up of patients.

## DIAGNOSIS AND TREATMENT

According to the Ministry of Health, cervical cancer screening should be carried out through the cytological test, known as the Pap smear. This exam should be started at the age of 25 for women who have already started sexual activity, regardless of whether they are pregnant or not. After two consecutive negative tests with an interval of one year, the following tests can be performed every three years. Screening in women under 25 years of age is not recommended to avoid the diagnosis and treatment of asymptomatic precursor lesions (INSTITUTO NACIONAL DE CÂNCER (NATIONAL CANCER INSTITUTE, 2016).

For women over the age of 64, screening can be stopped if there are at least two consecutive negative tests in the last five years and no history of cervical pathology. In postmenopausal women, estrogenization prior to test collection may improve the quality of the smear. Those who have



undergone total hysterectomy for benign lesions, with no history of high-grade cervical lesions, may also be excluded from screening, as long as their previous examinations have been normal (INSTITUTO NACIONAL DE CÂNCER, 2016).

For immunosuppressed women, cytologic testing should be performed after initiation of sexual activity at six-monthly intervals in the first year and, if normal, continue with annual follow-up for as long as immunosuppression factor persists. HIV-positive women should undergo the cytological examination every six months. Some national and international guidelines recommend the use of HPV detection tests, associated with cytology, for women aged 30 years or older, due to the higher sensitivity and high negative predictive value of these tests, allowing the interval between collections to be extended from three to five years when both tests are negative (PEIRSON et al., 2013; GIRIANELLI et al., 2016).

The success of the screening program depends on its organized performance, including the periodic performance of the test (every three years) in women aged 25 to 64 years, the sending of invitations to perform the test to 95% of women, the collection of the cytological test in 85% of women, the appropriate management of altered results in 85% of women, and the maintenance of good quality control of the tests and treatments performed (INSTITUTO NACIONAL DE CÂNCER, 2016).

The Pap smear remains the most widely used method in Brazil and in the world for screening cervical cancer and its precursor lesions (INSTITUTO NACIONAL DE CÂNCER, 2016; NAYAR; WILBUR, 2015). This test aims to detect negative or positive cells for intraepithelial neoplasia or malignancy in the ectocervix and endocervix of women with apparently normal cervix, based on changes in the degree of cytoplasmic maturation, presence of abnormal mitotic figures, and changes in the shape and size of the nucleus.

Currently, the most widely used classification for cytological results is the Bethesda classification, updated in 2014, which categorizes results as negative cytology for intraepithelial lesion and malignancy, or with squamous or glandular cell abnormalities, with progressive degrees of atypia, from indeterminate atypia to cytological alterations suggestive of invasive carcinoma (NAYAR; WILBUR, 2015). The most common collection method is conventional cytology, although liquid-based cytology is increasingly used in developed countries. Liquid-based cytology offers advantages in sample quality, reducing artifacts and allowing the detection of HPV in the same material collected (HODA et al., 2013). Comparative studies have shown that the accuracy of liquid-based cytology is comparable to that of conventional cytology, although its large-scale implementation in Brazil depends on cost-benefit analyses.

Colposcopy is a complementary technique recommended for women with positive cervical cytology results in screening programs (INSTITUTO NACIONAL DE CÂNCER, 2016). This test



must be conducted by qualified and trained professionals, and is inappropriate as a primary screening method for cervical cancer (INSTITUTO NACIONAL DE CÂNCER, 2016). Colposcopy enables several important functions:

- Evaluation of pre-invasive and invasive lesions of the cervix;
- Complementation to conventional screening methods;
- Determination of the extent of the lesions;
- Guidance for biopsies of suspicious areas;
- Assistance in treatment with procedures such as cryotherapy or LEEP;
- Monitoring after treatment of pre-invasive lesions of the cervix.

Chart 1: Recommendations from the Febrasgo Manual for the initial conduct of altered cytopathological test results.

DIAGNÓSTICO CITOPATOLÓGICO		FAIXA ETÁRIA	CONDUTA INICIAL
Células escamosas atípicas de significado indeterminado (ASCUS)	Possivelmente não neoplásicas (ASC-US)	< 25 anos	Repetir em 3 anos
		Entre 25 e 29 anos	Repetir a citologia em 12 anos
	≥ 30 anos	Repetir a citologia em 6 anos	
	Não se podendo afastar lesão de alto grau (ASC-H)		Encaminhar para colposcopia
Células glandulares atípicas de significado indeterminado (AGC)	Possivelmente não neoplásicas ou não se podendo afastar lesão de alto grau		Encaminhar para colposcopia
Células atípicas de origem indefinida (AOI)	Possivelmente não neoplásicas ou não se podendo afastar lesão de alto grau		Encaminhar para colposcopia
Lesão de Baixo Grau (LSIL)		< 25 anos	Repetir em 3 anos
Lesão de Alto Grau (HSIL)		≥ 25 anos	Repetir a citologia em 6 anos
Lesão intraepitelial de alto grau não podendo excluir microinvasão			Encaminhar para colposcopia
Carcinoma escamoso invasor			Encaminhar para colposcopia
Adenocarcinoma <i>in situ</i> (AIS) ou invasor			Encaminhar para colposcopia

Source: Manual of Recommendations Screening, diagnosis and treatment of cervical cancer FEBRASGO, 2017.

## FINAL CONSIDERATIONS

The literature on cervical cancer highlights Human Papillomavirus (HPV) infection as its main causal factor, emphasizing the importance of vaccination and screening in preventing the disease. In addition to HPV, other risk factors are discussed, emphasizing the multifactorial complexity of this condition. Advances in research have improved our understanding of the mechanisms of cervical cancer development, guiding public health policies to promote effective prevention and treatment strategies.

Therefore, cervical cancer remains a significant public health concern globally, despite progress in prevention through vaccination and screening. It remains one of the leading causes of



cancer mortality among women in various parts of the world. Awareness and universal access to vaccination programs and preventive screenings are essential to reduce their incidence and mortality, providing better health outcomes for women.



## REFERENCES


1. Instituto Nacional de Câncer José Alencar Gomes da Silva (INCA). (2019). \*Estimativa 2020: incidência de câncer no Brasil\*. Rio de Janeiro: INCA.
2. Pierz, A. J., Randall, T. C., Castle, P. E., Adedimeji, A., Ingabire, C., Kubwimana, G., Uwinkindi, F., Hagenimana, M., Businge, L., Musabyimana, F., Munyaneza, A., & Murenzi, G. (2020). A scoping review: facilitators and barriers of cervical cancer screening and early diagnosis of breast cancer in Sub-Saharan African health settings. \*Gynecologic Oncology Reports, 33\*, 100605.
3. Ferreira, M. de C. M., et al. (2022). Detecção precoce e prevenção do câncer do colo do útero: conhecimentos, atitudes e práticas de profissionais da ESF. \*Ciência & Saúde Coletiva\*, 27(06), 2291-2302. <https://doi.org/10.1590/1413-81232022276.17002021>
4. Santos, M. de O., Lima, F. C. da S., Martins, L. F. L., Oliveira, J. F. P., Almeida, L. M. de, & Cancela, M. de C. (2023). Estimativa de Incidência de Câncer no Brasil, 2023-2025. \*Revista Brasileira de Cancerologia\*, 69(1), e-213700. <https://rbc.inca.gov.br/index.php/revista/article/view/3700>
5. Bosch, F. X., Manos, M. M., Muñoz, N., Sherman, M., Jansen, A. M., Peto, J., et al. (1995). Prevalence of human papillomavirus in cervical cancer: a worldwide perspective. International biological study on cervical cancer (IBSCC) Study Group. \*Journal of the National Cancer Institute, 87\*(11), 796-802.
6. Chichareon, S., Herrero, R., Muñoz, N., Bosch, F. X., Jacobs, M. V., Deacon, J., et al. (1998). Risk factors for cervical cancer in Thailand: a case-control study. \*Journal of the National Cancer Institute, 90\*(1), 50-57.
7. Kjellberg, L., Hallmans, G., Ahren, A. M., Johansson, R., Bergman, F., Wadell, G., et al. (2000). Smoking, diet, pregnancy and oral contraceptive use as risk factors for cervical intra-epithelial neoplasia in relation to human papillomavirus infection. \*British Journal of Cancer, 82\*(7), 1332-1338.
8. Sung, H., Kearney, K. A., Miller, M., Kinney, W., Sawaya, G. F., & Hiatt, R. A. (2000). Papanicolaou smear history and diagnosis of invasive cervical carcinoma among members of a large prepaid health plan. \*Cancer, 88\*(10), 2283-2289.
9. Waggoner, S. E. (2003). Cervical cancer. \*Lancet, 361\*(9376), 2217-2225.
10. Pretorius, R., Semrad, N., Watring, W., & Fotheringham, N. (1991). Presentation of cervical cancer. \*Gynecologic Oncology, 42\*(1), 48-52.
11. Universidade Aberta do SUS (UNA-SUS). HPV [Internet].
12. Instituto Nacional de Câncer (INCA). (2023). \*Relatório Anual 2023\*. Disponível em: [https://www.inca.gov.br/sites/ufu.sti.inca.local/files/media/document/dados\\_e\\_numeros\\_colo\\_22marco2023.pdf](https://www.inca.gov.br/sites/ufu.sti.inca.local/files/media/document/dados_e_numeros_colo_22marco2023.pdf)
13. Instituto Nacional de Câncer (INCA), Coordenação de Prevenção e Vigilância, Divisão de Detecção Precoce e Apoio à Organização de Rede. (2016). \*Diretrizes brasileiras para o rastreamento do câncer do colo do útero\* (2ª ed. rev. atual.). Rio de Janeiro: INCA.





14. Nayar, R., & Wilbur, D. C. (Eds.). (2015). \*The Bethesda system for reporting cervical cytology: definitions, criteria, and explanatory notes\* (3rd ed.). Switzerland: Springer.
15. Hoda, R. S., Loukeris, K., & Abdul-Karim, F. W. (2013). Gynecologic cytology on conventional and liquid-based preparations: a comprehensive review of similarities and differences. \*Diagnostic Cytopathology, 41\*(3), 257-278.
16. Peirson, L., Fitzpatrick-Lewis, D., Ciliska, D., & Warren, R. (2013). Screening for cervical cancer: a systematic review and meta-analysis. \*Systematic Reviews, 2\*, 35.
17. Girianelli, V. R., Thuler, L. C., & Azevedo e Silva, G. (2016). Predictive capability of HPV and pap tests in screening for cervical cancer over a three-year follow-up. \*Revista Brasileira de Ginecologia e Obstetrícia, 38\*(3), 147-153.

## Similarities of clinical practice guidelines in the management of lower pain: Literature review

 <https://doi.org/10.56238/sevned2024.016-025>

Josilene de Souza da Conceição Kaminski<sup>1</sup>, Aline dos Santos Moreira de Carvalho<sup>2</sup> and Paloma Martins Mendonça<sup>3</sup>

### ABSTRACT

**Introduction:** Clinical practice guidelines aim to assist reasoning and clinical decision-making, improve the effectiveness and efficiency of health care and standardize conduct, including care for patients with low back pain. Considering that evidence-based practice is necessary and that healthcare decisions integrate scientific evidence, knowledge and early adherence by healthcare professionals to clinical practice guidelines can accelerate recovery and reduce costs associated with low back pain. There is no informational material that is easy to read and interpret that encompasses the similarities of important national and international guidelines in the management of low back pain. **Objective:** To unify the similarities in the practice guidelines of low back pain clinics, involving diagnosis and request for imaging exams, to later prepare informative material for health professionals on this topic. **Methods:** This is a literature review, with a bibliographic survey carried out in electronic databases: National Library of Medicine (Medicine–PubMed), Medical Literature Analysis and Retrieval System (Medline), Latin American and Caribbean Literature in Health Sciences (Lilacs), Scientific Electronic Library Online (SciELO) and Google Scholar. **Results:** Ten guidelines were part of this study. Recommendations for taking anamnesis and physical examination were found in all guidelines. Diagnostic screening aims to identify patients with specific conditions as the cause of low back pain, in addition to the possibility of the presence of red and yellow flags. All guidelines discussed recommend that imaging should be avoided unless there is clinical suspicion of red flag pathology, or severe or progressive neurological deficit, such as radiculopathy, neurogenic claudication, or if imaging is likely to guide additional management. **Conclusion:** Clinical practice guidelines for low back pain present well-established similarities in the management of low back pain. Most have common information regarding anamnesis, physical and neurological examinations and request for imaging exams. All guidelines in this study agree that imaging exams should be avoided. The preparation of the informative material will be presented in a future article, which will assist health professionals in better managing low back pain.

**Keywords:** Clinical Practice Guidelines, Backache, Lower Back Pain, Diagnosis, Image Exams.

---

<sup>1</sup> PhD student in Health Sciences at Universidade Columbia Del Paraguay/Instituto IDEIA Brasil  
Contributed with the study conception, methodology, data acquisition, analysis and interpretation, and writing approved the final version

ORCID: <https://orcid.org/0000-0003-3831620>

E-mail: [josilenesouzaconceicao@gmail.com](mailto:josilenesouzaconceicao@gmail.com)

<sup>2</sup> PhD student in Educational Sciences at Universidade Columbia Del Paraguay/Instituto IDEIA–Brasil  
Contributed with the study conception, methodology, data acquisition, analysis and interpretation, and writing approved the final version

ORCID: <https://orcid.org/0000-0001-9969566>

E-mail: [Bioaline2017@yahoo.com](mailto:Bioaline2017@yahoo.com)

<sup>3</sup> Collaborating Researcher at the Medical and Forensic Entomology Laboratory (IOC/Fiocruz). Teacher at the Universidad Columbia Del Paraguay/Instituto IDEIA–Brasil

Contributed with the methodology data interpretation, and discussion of results approved the final version

ORCID: <https://orcid.org/0000-0003-3182-0477>

E-mail: [prof.paloma.martins@gmail.com](mailto:prof.paloma.martins@gmail.com)



## INTRODUCTION

Clinical Practice Guidelines (CPD) are documents produced by expert groups and healthcare institutions that provide scientific evidence-based recommendations for healthcare professionals on the management of different health conditions (NICE, 2020). They constitute a useful tool for health professionals to update current recommendations and have more information to support their clinical practice (LAW; MACDERMID, 2008).

In recent years, several CPDs have emerged to improve the effectiveness and efficiency of health care (DAHAN; BORKAN; BROWN; REIS et al., 2007; FREEMAN, 2010) and to standardize behaviors that assist reasoning and clinical decision-making. Currently, there is a strong growth in research that addresses guidelines for the management of low back pain, including recommendations regarding diagnosis (CECIN, 2008; CHOU; QASEEM; OWENS; SHEKELLE, 2011; CHOU; QASEEM; SNOW; CASEY et al., 2007; KREINER; MATZ; BONO; CHO et al., 2020) and radiological examinations (BARBOSA, 2008; HUTCHINS; PECKHAM; SHAH; PARSONS et al., 2021; PANGARKAR; KANG; SANDBRINK; BEVEVINO et al., 2019).

Low back pain is the second most prevalent reason for consultations with the family doctor (GONZALEZ MAZA; MOSCOSO LÓPEZ; RAMÍREZ ELIZALDE; ABDO ANDRADE, 2010), and is the second most cited chronic disease in the National Household Sample Survey (PNAD) of the Brazilian Institute of Geography and Statistics (IBGE) (INSTITUTO BRASILEIRO DE GEOGRAFIA E, 2010). Furthermore, according to a recent survey by the Ministry of Labor and Social Security, which analyzed the ranking of the five most prevalent sick pay requests, it identified that complications related to the lumbar spine were present in three of the five conditions, being even more prevalent than those due to coronavirus infections (FERNANDES; SCHETTINI; SANTOS; COSTANZI, 2020).

Direct costs for the treatment of low back pain are increasing rapidly in the Brazilian hospital service, and are probably driven by the increase in the number of surgical procedures that almost doubled in the six-year period (2013 to 2018) (MENDONÇA; OLIVEIRA; FONSECA; OLIVEIRA, 2021). Surgical intervention is based on imaging tests, which should be requested in accordance with current evidence for the management of this symptom. However, the increase in the number and financial costs of surgeries over the years is at odds with current evidence for the treatment of this condition.

It has become essential to implement new policies aimed at changes in the management of low back pain, in order to avoid unnecessary surgeries and their high costs, following current clinical recommendations (LEMMERS; VAN LANKVELD; WESTERT; VAN DER WEES et al., 2019; OSTERMAN; SUND; SEITSALO; KESKIMÄKI, 2003). When recommending effective evidence-based interventions and discourage interventions without scientific support, CPDs seek to optimize



the quality of care, reducing waste and potential harm associated with ineffective or unsafe interventions (O'CONNELL; WARD, 2018).

Considering that evidence-based practice is essential and that health decision-making integrates scientific evidence, early adherence to CPD can accelerate recovery and reduce costs associated with low back pain (FRITZ; CLELAND; BRENNAN, 2007). However, many health professionals have not adhered to these guidelines (DE SOUZA; LADEIRA; COSTA; 2017), requesting imaging exams outside these recommendations (JENKINS; DOWNIE; MAHER; MOLONEY et al., 2018; KAMPER; LOGAN; COPSEY; THOMPSON et al., 2020) causing an increase in the financial and social burden, as patients need to undergo several exams, referrals and even additional surgeries with questionable effectiveness (CHOU; RANGER; PEIRIS; CICUTTINI et al., 2018; JENKINS; DOWNIE; MAHER; MOLONEY et al., 2018).

The publication of a CPD does not guarantee that clinical practice will change, as multiple barriers prevent change in clinical practice (FISCHER; LANGE; KLOSE; GREINER et al., 2016; SLADE; KENT; PATEL; BUCKNALL et al., 2016 ), including the knowledge and understanding of health professionals, including doctors, about the guideline, the willingness to accept some recommendations (often in the face of deeply held beliefs, clinical experience, preferences and acquired interests), among other factors (FIGG - LATHAM; RAJENDRAN, 2017; FISCHER; LANGE; KLOSE; GREINER et al., 2016; SLADE; KENT; PATEL; BUCKNALL et al., 2016).

Changing clinical practice is a complex process and there is insufficient evidence to support any specific strategy (MESNER; FOSTER; FRENCH, 2016; SUMAN; DIKKERS; SCHAAFSMA; VAN TULDER et al., 2016), however, addressing the similarities of important clinical practice guidelines in the management of low back pain (diagnosis and imaging exams), would make it easier for health professionals who deal with this health condition. In view of the above, this study aims to unify the similarities of the Clinical Practice Guidelines for low back pain, involving the diagnosis and request for imaging exams, to subsequently, prepare informative material for health professionals on this topic. This informative material will enable better resolution of low back pain, as the clinical practice of health professionals will be based on the best scientific evidence.

## **METHODS**

### **SEARCH STRATEGY**

The bibliographic survey was carried out in electronic databases: National Library of Medicine (Medicine–PubMed), Medical Literature Analysis and Retrieval System (Medline), Latin American and Caribbean Literature in Health Sciences (Lilacs), Scientific Electronic Library Online (SciELO) and Google Scholar. The descriptors used were: combination of terms in Portuguese such as “clinical practice guidelines” and “lumbar pain”, “low back pain” and “clinical guidelines”, and in



English, such as “low back pain practice guidelines”, alone and combined with “and diagnosis”. The searches were refined for the period from 2005 to 2023. Some databases allowed the “full text” filter. There was a restriction on the publication language; guidelines in English, Portuguese and Spanish were accepted. After searching the databases, an exploratory and later systematic analysis of the abstracts was carried out according to the inclusion and exclusion criteria, mentioned below.

The National Guideline Clearinghouse ([www.guideline.gov](http://www.guideline.gov); keyword “low back pain” and the National Institute for Health and Clinical Excellence (NICE) ([www.nice.org.uk](http://www.nice.org.uk); keyword: “low back pain”) were also searched. Two authors (J.S.C.K. and P.M.M) independently selected the titles and abstracts of the research. There was no disagreement, and a third author was unnecessary to carry out the judgment.

## INCLUSION CRITERIA

National and international guidelines that provided recommendations on the diagnosis and/or radiological examinations of low back pain and aimed at any audience, but including medical professionals, were considered eligible. Only guidelines available in English, Portuguese and Spanish were included because the author can read these languages.

It sought to include guidelines from several countries and without distinction regarding the population addressed (acute, subacute and chronic low back pain). The focus also involved guidelines whose examinations of spine imaging addressed were plain x-rays, computed tomography and magnetic resonance imaging.

## EXCLUSION CRITERIA

Studies were not eligible if they were not part of the inclusion criteria presented above, did not provide information exclusively on low back pain, such as chronic pain, which included low back pain. Guidelines in languages other than Portuguese, English and Spanish, and which did not have complete texts, were excluded. Studies whose imaging exams were myelography, discography and/or positron emission tomography were excluded, as these exams are generally requested by specialists before surgical intervention and, therefore, were not included in this review. Guidelines that were not available in full, or that were paid for, were also excluded.

## DATA EXTRACTION AND DATA SYNTHESIS

Two independent authors extracted the following data using a standardized form: recommendations regarding diagnosis (Anamnesis, Physical Examination, Classification of low back pain, red flags, yellow flags, language used, target population) and imaging exams (indications and no indications). We will present the guideline recommendations in table 1.

## RESULTS

Electronic searches carried out on April 2, 2023 resulted in 4871 records. Duplicate guidelines were removed and after screening titles and abstracts, 82 full texts were evaluated, according to the previously established inclusion criteria. Of these, 72 full texts were excluded, due to reasons such as not focusing on diagnosis and imaging exams, focusing more on treatment and rehabilitation, or due to other exclusion criteria already mentioned. Finally, 10 clinical practice guidelines were selected:

1. COST ACTION B13 - Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care (VANTULDER; BECKER; BEKKERING; BREEN *et al.*, 2006);
2. COST ACTION B13 Chapter 4. European guidelines for the management of chronic nonspecific low back pain (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT *et al.*, 2006);
3. American College of Physicians (ACP) e American Pain Society (APS) - Diagnosis and treatment of low back pain: a joint clinical practice guideline (CHOU; QASEEM; SNOW; CASEY *et al.*, 2007) e Diagnostic imaging for low back pain: advice for high-value healthcare (CHOU; QASEEM; OWENS; SHEKELLE, 2011).
4. American College of Physicians and the American Pain Society (Associação Médica Brasileira/ Conselho Federal de Medicina (AMB/CFM) - Diretriz II: Diagnóstico clínico e Diretriz III e IV: Diagnóstico complementar (BARBOSA, 2008; CECIN, 2008);
5. Toward Optimized Practice Low Back Pain (TOP)-Evidence-Informed Primary Care Management of Low Back Pain (TOP, 2015);
6. Agency for Clinical Innovation (ACI) – Management of people with acute low back pain: model of care (INNOVATION, 2016);
7. Malaysian Association for the study of pain. The Malaysian low back pain management guidelines (HUSSEIN; SINGH; MANSOR; KAMIL *et al.*, 2016).
8. National Institute for Health and Care Excellence (NICE Guideline) - Low back pain and sciatica in over 16s: assessment and management (NICE, 2020);
9. North American Spine Society (NASS)-Evidence-Based Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Low Back Pain (NASS, 2020) e Guidelines summary review: an evidence-based clinical guideline for the diagnosis and treatment of low back pain (KREINER; MATZ; BONO; CHO *et al.*, 2020);
10. Veterans Affairs/ Department of Defense (VA/DoD) - Clinical Practice Guideline: Diagnosis and Treatment of Low Back Pain (PANGARKAR; KANG; SANDBRINK; BEVEVINO *et al.*, 2019; VA/DOD, 2022).

Guidelines from the following countries were included: United States (3), Europe (2), Brazil (1), Canada (1), United Kingdom (1), Australia (1) and Malaysia (1).

## DIAGNOSTIC RECOMMENDATIONS AND IMAGING EXAMS

Table 1 describes the recommendations regarding diagnosis and imaging that each clinical practice guideline addresses.

Three guidelines (CECIN, 2008; NASS, 2020; NICE, 2020) (30%) provided recommendations regardless of symptom duration. One guideline (TOP, 2015) (10%) provided recommendations for patients with acute, subacute, and chronic low back pain. Three guidelines focused on acute and chronic low back pain (CHOU; QASEEM; SNOW; CASEY et al., 2007; HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016; VA/DOD, 2022) (30%), two on acute low back pain (INNOVATION, 2016; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006) (13%) and one guideline (10%) focused exclusively on chronic low back pain (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006).

Recommendations for taking anamnesis and physical examination were found in all guidelines, as well as diagnostic screening to identify patients with specific conditions as the cause of low back pain (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; CECIN, 2008; CHOU; QASEEM; SNOW; CASEY et al., 2007; HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016; INNOVATION, 2016; NASS, 2020; NICE, 2020; TOP, 2015; VA/DOD, 2022; VAN TULDER ; BECKER; BEKKERING; BREEN et al., 2006). Of these, eight guidelines (80%) recommend diagnostic screening to identify patients with radiculopathy (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; CECIN, 2008; CHOU; QASEEM; SNOW; CASEY et al., 2007; HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016; INNOVATION, 2016; TOP, 2015; VA/DOD, 2022; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006).

More than half of the guidelines (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; CECIN, 2008; CHOU; QASEEM; SNOW; CASEY et al., 2007; HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016; INNOVATION, 2016; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006) (60%) recommend diagnostic screening to classify patients into one of three categories: specific low back pain, nonspecific low back pain or radiculopathy. None of the guidelines in this review recommended classifying only specific and nonspecific low back pain, without distinguishing the group of patients with radiculopathy.

All the guidelines analyzed brought recommendations for the diagnostic screening of red and yellow flags. Tables 1 and 2 describe the red and yellow flags presented by the clinical practice guidelines in this review.

Two guidelines (INNOVATION, 2016; NICE, 2020)(20%) recommend assessing yellow flags using validated prognostic screening tools, such as STarT Back and Orebro.

Patient education through the language to be used and/or avoided during the interview and physical examination was addressed in four guidelines (40%) (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; INNOVATION, 2016; TOP, 2015; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006).

Five guidelines (CECIN, 2008; CHOU; QASEEM; SNOW; CASEY et al., 2007; HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016; VA/DOD, 2022; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006) (50%) discussed neurological examinations to identify radiculopathy, including the straight leg elevation test. However, of these, the European guidelines of this review state that based on the evidence, they cannot provide recommendations either against or in favor of such a test (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006). Furthermore, for one of the guidelines, neurological assessment must include the assessment of strength, reflexes and sensory symptoms (CHOU; QASEEM; SNOW; CASEY et al., 2007). The Brazilian guideline also included several other tests to be used in physical assessment, including maneuvers such as Valsalva and Romberg, the De Sèze points sign and the “rope bow”, in addition to movements such as flexion and extension of the lumbar spine (CECIN, 2008 ). The De Sèze tip sign test was also recommended in another guideline (HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016)

Four guidelines (40%) did not make any reference to orthopedic tests in the physical examination of patients with low back pain (INNOVATION, 2016; NASS, 2020; NICE, 2020; TOP, 2015).

Regarding the request for imaging exams, the majority of guidelines in this review (90%) indicate the request for imaging exams, such as magnetic resonance imaging, for example, when the patient presents severe or progressive neurological deficits, signs or symptoms that indicate a severe or specific underlying condition and red flag symptoms (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; CECIN, 2008; CHOU; QASEEM; SNOW; CASEY et al., 2007; HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016; INNOVATION, 2016; NASS, 2020; TOP, 2015; VA/DOD, 2022; VAN TULDER; BECKER;

BEKKERING; BREEN et al., 2006). The guidelines also brought some other recommendations for the indication of imaging exams, such as in cases of severe and intractable pain syndromes that failed treatment (NASS, 2020; TOP, 2015), low back pain persistent or radiculopathy whose pain persists beyond 4 to 6 weeks (BARBOSA, 2008; TOP, 2015; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006), as well as in cases of low back pain with or without sciatica, if the outcome is susceptible to change in management (NICE, 2020).



The majority of guidelines also included cases in which there is no indication or routine indication for imaging exams, including acute or chronic low back pain, in cases of absence of red flags (NASS, 2020; TOP, 2015), acute non-specific low back pain (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; INNOVATION, 2016; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006) and absence of radiculopathy, neurogenic claudication or clinical warning signs (TOP, 2015).

## DISCUSSION

Low back pain is a major public health problem, with a global lifetime prevalence estimate of 70-85% (KEBEDE; ABEBE; WOLDIE; YENIT, 2019). This condition is considered the main global cause of disability and absenteeism at work, causing loss of production, high socioeconomic expenses and premature retirements (HARTVIGSEN; HANCOCK; KONGSTED; LOUW et al., 2018; PETREÇA; SANDRESCHI; RODRIGUES; KOASKI et al. , 2017; RODRIGUES; OLIVEIRA; FERNANDES; TELES et al., 2019).

The appropriate management of low back pain must be outlined by the healthcare professional and must be based on reliable information about diagnosis, management and prognosis, information contained in clinical practice guidelines (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006).

International guidelines (CHOU; QASEEM; SNOW; CASEY et al., 2007; NASS, 2020; PANGARKAR; KANG; SANDBRINK; BEVEVINO et al., 2019; VA/DOD, 2022) and

national (CECIN, 2008) selected in this review show that for the diagnosis of patients with low back pain, the recommendation is to carry out anamnesis and physical examination, in order to identify warning signs (red flags), assessment of psychosocial factors (yellow flags) and neurological tests to identify radiculopathy.

In the assessment (anamnesis and physical examination), red flags, named in most guidelines as red flags, constitute warning signs that deserve special attention. These signs or symptoms may be due to systemic illnesses other than acute common mechanics low back pain, raising suspicion of a serious underlying condition such as cauda equina syndrome (CES), malignancy/tumor, fracture, trauma, or infection. In cases of suspected red flags, such as cauda equina syndrome, immediate referral to the emergency service is necessary. However, it is important to emphasize that serious red flag conditions such as neoplasia, infection and cauda equina syndromes are extremely rare (CARRAGEE; HANNIBAL, 2004).

“Yellow flags”, represent biopsychosocial factors that should always be evaluated in the management of low back pain, as they can predict the prognosis (PINCUS; BURTON; VOGEL; FIELD, 2002), and are strongly associated with lumbar pain chronification (KOES; VAN TULDER;

LIN; MACEDO et al., 2010). The Toward Optimized Practice Guideline (TOP, 2015), adapted from eight “descending” guidelines published between 2003 and 2010, was the guideline for this review that provided detailed information regarding this assessment and for each yellow flag condition, it provided information on how to act. Eight other guidelines (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; CECIN, 2008; CHOU; QASEEM; SNOW; CASEY et al., 2007; INNOVATION, 2016; NASS, 2020; NICE, 2020; VA/DOD, 2022; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006) did not provide recommendations as detailed as these, they only highlighted that yellow flags should be part of the assessment. In only one guideline in this review, it was addressed that the evidence is insufficient to recommend methods to assess psychosocial factors and emotional distress (VA/DOD, 2022).

All guidelines in this review agree that imaging should be avoided, with magnetic resonance imaging being indicated, for example, when the patient presents severe or progressive neurological deficits, such as radiculopathy, neurogenic claudication, signs or symptoms that indicate a condition severe or specific underlying and red flag signs and symptoms (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006; CHOU; QASEEM; SNOW; CASEY et al., 2007; INNOVATION, 2016; TOP, 2015; VA/DOD, 2022; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006). The guidelines also brought some other recommendations for the indication of imaging exams, such as in cases of severe and intractable pain syndromes that failed treatment (NASS, 2020; TOP, 2015), persistent low back pain or radiculopathy whose pain persists beyond 4 to 6 weeks (BARBOSA, 2008; CECIN, 2008; TOP, 2015; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006), as well as in cases of low back pain with or without sciatica, if the outcome is likely to alter management (NICE, 2020), if imaging is likely to guide further management (e.g. surgery or direct treatment (e.g., invasive treatments) (CHOU; QASEEM; SNOW; CASEY et al., 2007). Magnetic resonance imaging was still indicated in the case of surgical intervention or therapeutic injection in moderate to severe low back pain (TOP, 2015).

Therefore, imaging exams should not be used routinely as a strategy for the initial management of low back pain, as their results do not normally change the clinical outcome (HALL; AUBREY-BASSLER; THORNE; MAHER, 2021).

A particularity that the NICE guideline makes clear is that its information is intended to be used in the United Kingdom, and that it is the responsibility of healthcare professionals to make decisions regarding the individual (NICE, 2020).

Regarding the orthopedic tests recommended in the physical examination when evaluating low back pain, four of the guidelines (INNOVATION, 2016; NASS, 2020; NICE, 2020; TOP, 2015) did not provide any recommendations on such tests. The AMB/CFM Guideline (CECIN, 2008) details several tests, including movements such as flexion and extension of the lumbar spine,

maneuvers such as Valsalva, Lasègue, Romberg, Sèze points sign, “rope bow” (Macnab ) and non-organic signs of psychosomatic low back pain (Wadell's signs). No other guideline was found with such detailed information on how to perform the physical examination as this Brazilian guideline.

A test frequently discussed in the guidelines of this review is the straight/extended leg raise test (CECIN, 2008; CHOU; QASEEM; SNOW; CASEY et al., 2007; HUSSEIN; SINGH; MANSOR; KAMIL et al., 2016; VA /DOD, 2022; VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006), also known as Lasègue (CECIN, 2008). Although it is considered by many authors to be the standard test and is widely used in cases of low back pain (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006), it is important to note that this test presents high variability in diagnostic sensitivity and specificity (VA /DOD, 2022). One of the guidelines states that this test is not sufficient to diagnose radiculopathy, as despite the high sensitivity for nerve root pain, it has low specificity (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006). Unlike the crossed straight leg raise test, that had low sensitivity and high specificity. No single test has high sensitivity and specificity for radiculopathy. Therefore, clinicians and researchers must treat such tests with caution (AIRAKSINEN; BROX; CEDRASCHI; HILDEBRANDT et al., 2006).

A topic covered in some guidelines is the language to be used or avoided when managing patients with low back pain. The ACI guideline provided clear and well-explanatory information about language that promotes beliefs, for example, ‘You have degeneration/arthritis/disc disease’, ‘You have the back of a 70 year old’, ‘It's wear and tear’, ‘You have to be careful/take it easy from now on’, ‘You should avoid bending/lifting’, ‘I wouldn't be surprised if you ended up in a wheelchair’ (INNOVATION, 2016). Another guideline also provided information on terms to avoid, such as instability, disc displacement, vertebra slippage (spondylolisthesis) and hypo-mobility and hypermobility (TOP, 2015). However, the other guidelines present only superficial information about the language to be addressed in the management of low back pain.

It is necessary to pay attention to the language to be used and/or avoided in the assessment of patients with low back pain and provide adequate information to reassure the patient. A full explanation should be provided in terms that the patient understands, for example, ‘back pain is very common’; ‘although back pain is often recurrent, the outlook is generally very good’; ‘hurting does not mean harm’; ‘can arise from various structures, such as muscles, discs, joints or ligaments’ (VAN TULDER; BECKER; BEKKERING; BREEN et al., 2006), in addition to advising patients to remain active and providing information on self-care options, preventing kinesiophobia and catastrophizing (TOP, 2015; VA/DOD, 2022).

## **FINAL CONSIDERATIONS**

Low back pain clinical practice guidelines have several similarities. Most have common



information regarding anamnesis, physical and neurological examinations and request for imaging exams. All guidelines in this study agree that imaging should be avoided, particularly in patients with nonspecific low back pain, unless there is clinical suspicion of red flag pathology, signs or symptoms that indicate a serious underlying pathology, severe or progressive neurological deficit, or whether the image is likely to guide further management.

The history and physical examination must be carried out by a healthcare professional with competent skills. However, competence will depend on adequate training.

More comprehensive studies are needed, such as systematic reviews on this topic, which can determine these similarities with greater precision.

### **CONFLICT OF INTERESTS**

The authors have no conflict of interest.

### **FINANCING SOURCE**

The authors declare that they did not receive funding to carry out this research.



## REFERENCES

1. Airaksinen, O., Brox, J. I., Cedraschi, C., Hildebrandt, J., et al. (2006). Chapter 4. European guidelines for the management of chronic nonspecific low back pain. \*European Spine Journal, 15\*(Suppl 2), S192-300.
2. Barbosa, M. H. (2008). Diretrizes III E IV: diagnóstico complementar. \*Revista Brasileira de Reumatologia, 48\*(Suppl 1), 13-14.
3. Carragee, E. J., & Hannibal, M. (2004). Diagnostic evaluation of low back pain. \*Orthopedic Clinics, 35\*(1), 7-16.
4. Cecin, H. A. (2008). Diretriz II: diagnóstico clínico. \*Revista Brasileira de Reumatologia, 48\*(Suppl 1), 8-12.
5. Chou, L., Ranger, T. A., Peiris, W., Cicuttini, F. M., et al. (2018). Patients' perceived needs for medical services for non-specific low back pain: A systematic scoping review. \*PLoS One, 13\*(11), e0204885.
6. Chou, R., Qaseem, A., Owens, D. K., & Shekelle, P. (2011). Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. \*Annals of Internal Medicine, 154\*(3), 181-189.
7. Chou, R., Qaseem, A., Snow, V., Casey, D., et al. (2007). Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. \*Annals of Internal Medicine, 147\*(7), 478-491.
8. Dahan, R., Borkan, J., Brown, J. B., Reis, S., et al. (2007). The challenge of using the low back pain guidelines: a qualitative research. \*Journal of Evaluation in Clinical Practice, 13\*(4), 616-620.
9. de Souza, F. S., Ladeira, C. E., & Costa, L. O. P. (2017). Adherence to Back Pain Clinical Practice Guidelines by Brazilian Physical Therapists: A Cross-sectional Study. n. 1528-1159(Electronic).
10. Fernandes, A. Z., Schettini, B. P., Santos, C. F. D., & Costanzi, R. N. (2020). Análises sobre Concessão e Cessação de Auxílio-doença. \*Informe da Previdência Social, 32\*, 11.
11. Figg-Latham, J., & Rajendran, D. (2017). Quiet dissent: The attitudes, beliefs, and behaviours of UK osteopaths who reject low back pain guidance - A qualitative study. \*Musculoskeletal Science and Practice, 27\*, 97-105.
12. Fischer, F., Lange, K., Klose, K., Greiner, W., et al. (2016). Barriers and Strategies in Guideline Implementation - A Scoping Review. \*Healthcare (Basel), 4\*(3).
13. Freeman, M. D. (2010). Clinical practice guidelines versus systematic reviews; which serves as the best basis for evidence-based spine medicine? \*The Spine Journal, 10\*(6), 512-513.
14. Fritz, J. M., Cleland, J. A., & Brennan, G. P. (2007). Does adherence to the guideline recommendation for active treatments improve the quality of care for patients with acute low back pain delivered by physical therapists? \*Medical Care, 45\*(10), 973-980.
15. Gonzalez Maza, C., Moscoso López, L., Ramírez Elizalde, G., & Abdo Andrade, A. (2010). [Multimodal treatment of chronic unspecific low back pain]. \*Acta Ortopédica Mexicana, 24\*(2), 88-94.



16. Hall, A. M., Aubrey-Bassler, K., Thorne, B., & Maher, C. G. (2021). Do not routinely offer imaging for uncomplicated low back pain. *\*BMJ, 372\**, n291.
17. Hartvigsen, J., Hancock, M. J., Kongsted, A., Louw, Q., et al. (2018). What low back pain is and why we need to pay attention. *\*The Lancet, 391\*(10137), 2356-2367.*
18. Hussein, A. M. M., Singh, D., Mansor, M., Kamil, O. I. M., et al. (2016). The Malaysian Low Back Pain Management Guidelines. *\*Malaysian Association for the Study of Pain (MASP). Spine Society Malaysia\**.
19. Hutchins, T. A., Peckham, M., Shah, L. M., Parsons, M. S., et al. (2021). ACR appropriateness Criteria® low back pain: 2021 update. *\*Journal of the American College of Radiology, 18\*(11), S361-S379.*
20. Innovation, N. A. F. C. (2016). Management of people with acute low back pain: model of care. *\*Chatswood: NSW Health\**, 39 p.
21. Instituto Brasileiro de Geografia e Estatística. (2010). *\*IBGE\**. Rio de Janeiro.
22. Jenkins, H. J., Downie, A. S., Maher, C. G., Moloney, N. A., et al. (2018). Imaging for low back pain: is clinical use consistent with guidelines? A systematic review and meta-analysis. *\*Spine Journal, 18\*(12), 2266-2277.*
23. Kamper, S. J., Logan, G., Copsey, B., Thompson, J., et al. (2020). What is usual care for low back pain? A systematic review of health care provided to patients with low back pain in family practice and emergency departments. *\*Pain, 161\*(4), 694-702.*
24. Kebede, A., Abebe, S. M., Woldie, H., & Yenit, M. K. (2019). Low Back Pain and Associated Factors among Primary School Teachers in Mekele City, North Ethiopia: A Cross-Sectional Study. *\*Occupational Therapy International\**, 3862946.
25. Koes, B. W., van Tulder, M., Lin, C. W., Macedo, L. G., et al. (2010). An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. *\*European Spine Journal, 19\*(12), 2075-2094.*
26. Kreiner, D. S., Matz, P., Bono, C. M., Cho, C. H., et al. (2020). Guideline summary review: an evidence-based clinical guideline for the diagnosis and treatment of low back pain. *\*The Spine Journal, 20\*(7), 998-1024.*
27. Law, M. C., & MacDermid, J. (2008). *\*Evidence-based rehabilitation: A guide to practice\**. Slack Incorporated. 1556427689.
28. Lemmers, G. P. G., van Lankveld, W., Westert, G. P., & van der Wees, P. J., et al. (2019). Imaging versus no imaging for low back pain: a systematic review, measuring costs, healthcare utilization and absence from work. *\*European Spine Journal, 28\*(5), 937-950.*
29. Mendonça, A. G., Oliveira, V. C., Fonseca, L. S., & Oliveira, M. X. (2021). Custos diretos da dor lombar em hospitais financiados pelo Sistema Único de Saúde. *\*Revista Pesquisa em Fisioterapia, 11\*(1), 181-189.*
30. Mesner, S. A., Foster, N. E., & French, S. D. (2016). Implementation interventions to improve the management of non-specific low back pain: a systematic review. *\*BMC Musculoskeletal*



Disorders, 17\*, 258.

31. NASS. (2020). Evidence-Based Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Low Back Pain. \*North American Spine Society\*.
32. NICE, G. (2020). Low back pain and sciatica in over 16s: assessment and management. \*National Institute for Health and Care Excellence\*.
33. O'Connell, N. E., & Ward, S. P. (2018). Low Back Pain: What Have Clinical Guidelines Ever Done for Us? \*Journal of Orthopaedic & Sports Physical Therapy, 48\*(2), 54-57.
34. Osterman, H., Sund, R., Seitsalo, S., & Keskimäki, I. (2003). Risk of multiple reoperations after lumbar discectomy: a population-based study. \*Spine (Phila Pa 1976), 28\*(6), 621-627.
35. Pangarkar, S. S., Kang, D. G., Sandbrink, F., Bevevino, A., et al. (2019). VA/DoD Clinical Practice Guideline: Diagnosis and Treatment of Low Back Pain. \*Journal of General Internal Medicine, 34\*(11), 2620-2629.
36. Petreça, D., Sandreschi, P., Rodrigues, F., Koaski, R., et al. (2017). Viva bem com a coluna que você tem: ação multidisciplinar no tratamento da lombalgia. \*Revista Brasileira de Atividade Física & Saúde, 22\*(4), 413-418.
37. Pincus, T., Burton, A. K., Vogel, S., & Field, A. P. (2002). A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. \*Spine (Phila Pa 1976), 27\*(5), E109-120.
38. Rodrigues, I. S. A., Oliveira, L. M. M. D., Fernandes, F., Teles, M. E. V., et al. (2019). Ocorrência de Lombalgia em uma Unidade de Pronto Atendimento. \*Revista de Pesquisa: Cuidado é Fundamental, 11\*, 823-827.
39. Slade, S. C., Kent, P., Patel, S., Bucknall, T., et al. (2016). Barriers to Primary Care Clinician Adherence to Clinical Guidelines for the Management of Low Back Pain: A Systematic Review and Metasynthesis of Qualitative Studies. \*Clinical Journal of Pain, 32\*(9), 800-816.
40. Suman, A., Dikkers, M. F., Schaafsma, F. G., van Tulder, M. W., et al. (2016). Effectiveness of multifaceted implementation strategies for the implementation of back and neck pain guidelines in health care: a systematic review. \*Implementation Science, 11\*(1), 126.
41. TOP. (2015). Evidence-informed primary care management of low back pain: clinical practice guideline. \*Alberta, Canada: Alberta Institute of Health Economics\*.
42. VA/DoD. (2022). Clinical Practice Guideline - VA/DoD. \*The Diagnosis and Treatment of Low Back Pain\*. Washington, DC: U.S. Government Printing Office.
43. van Tulder, M., Becker, A., Bekkering, T., Breen, A., et al. (2006). Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care. \*European Spine Journal, 15\* Suppl 2, S169-191.
44. Zioli, F. A., Patta, S. B., dos S. C. F., & Nagamine, C. R. (2020). Análises sobre Concessão e Cessação de Auxílio-doença. \*Informe da Previdência Social, 32\*, 11.
45. NICE. (2020). Low back pain and sciatica in over 16s: assessment and management. In National Institute for Health and Care Excellence (Ed.).



46. Law, M. C., & MacDermid, J. (2008). \*Evidence-based rehabilitation: A guide to practice\*. Slack Incorporated.
47. Dahan, R., Borkan, J., Brown, J. B., Reis, S., Hermoni, D., & Harris, S. (2007). The challenge of using the low back pain guidelines: a qualitative research. \*Journal of Evaluation in Clinical Practice, 13\*(4), 616-620.
48. Freeman, M. D. (2010). Clinical practice guidelines versus systematic reviews; which serve as the best basis for evidence-based spine medicine? \*The Spine Journal, 10\*(6), 512-513.
49. Chou, R., Qaseem, A., Snow, V., Casey, D., Cross, J. T., Jr., Shekelle, P., et al. (2007). Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. \*Annals of Internal Medicine, 147\*(7), 478-491.
50. Chou, R., Qaseem, A., Owens, D. K., & Shekelle, P. (2011). Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. \*Annals of Internal Medicine, 154\*(3), 181-189.
51. Cecin, H. A. (2008). Diretriz II: diagnóstico clínico. \*Revista Brasileira de Reumatologia, 48\* Supl 1, 8-12.
52. Kreiner, D. S., Matz, P., Bono, C. M., Cho, C. H., Easa, J. E., Ghiselli, G., et al. (2020). Guideline summary review: an evidence-based clinical guideline for the diagnosis and treatment of low back pain. \*The Spine Journal, 20\*(7), 998-1024.
53. Barbosa, M. H. (2008). Diretrizes III E IV: diagnóstico complementar. \*Revista Brasileira de Reumatologia, 48\* Supl 1, 13-14.
54. Pangarkar, S. S., Kang, D. G., Sandbrink, F., Bevevino, A., Tillisch, K., Konitzer, L., et al. (2019). VA/DoD Clinical Practice Guideline: Diagnosis and Treatment of Low Back Pain. \*Journal of General Internal Medicine, 34\*(11), 2620-2629.
55. Hutchins, T. A., Peckham, M., Shah, L. M., Parsons, M. S., Agarwal, V., Boulter, D. J., et al. (2021). ACR appropriateness Criteria® low back pain: 2021 update. \*Journal of the American College of Radiology, 18\*(11), S361-S379.
56. Gonzalez Maza, C., Moscoso López, L., Ramírez Elizalde, G., & Abdo Andrade, A. (2010). [Multimodal treatment of chronic unspecific low back pain]. \*Acta Ortopédica Mexicana, 24\*(2), 88-94.
57. Instituto Brasileiro de Geografia e Estatística. (2010). \*IBGE\*. Rio de Janeiro.
58. Zioli, F. A., Patta, S. B., dos S. C. F., & Nagamine, C. R. (2020). Análises sobre Concessão e Cessação de Auxílio-doença. \*Informe da Previdência Social, 32\*, 11.
59. Fernandes, A. Z., Schettini, B. P., Santos, C. F. D., & Costanzi, R. N. (2020). Análises sobre Concessão e Cessação de Auxílio-doença. \*Informe da Previdência Social, 32\*, 11.
60. Mendonça, A. G., Oliveira, V. C., Fonseca, L. S., & Oliveira, M. X. (2021). Custos diretos da dor lombar em hospitais financiados pelo Sistema Único de Saúde. \*Revista Pesquisa em Fisioterapia, 11\*(1), 181-189.





61. Osterman, H., Sund, R., Seitsalo, S., & Keskimäki, I. (2003). Risk of multiple reoperations after lumbar discectomy: a population-based study. *\*Spine (Phila Pa 1976)*, 28\*(6), 621-627.
62. Lemmers, G. P. G., van Lankveld, W., Westert, G. P., van der Wees, P. J., & Staal, J. B. (2019). Imaging versus no imaging for low back pain: a systematic review, measuring costs, healthcare utilization and absence from work. *\*European Spine Journal*, 28\*(5), 937-950.
63. O'Connell, N. E., & Ward, S. P. (2018). Low Back Pain: What Have Clinical Guidelines Ever Done for Us? *\*Journal of Orthopaedic & Sports Physical Therapy*, 48\*(2), 54-57.
64. Fritz, J. M., Cleland, J. A., & Brennan, G. P. (2007). Does adherence to the guideline recommendation for active treatments improve the quality of care for patients with acute low back pain delivered by physical therapists? *\*Medical Care*, 45\*(10), 973-980.
65. de Souza, F. S., Ladeira, C. E., & Costa, L. O. P. (2017). Adherence to Back Pain Clinical Practice Guidelines by Brazilian Physical Therapists: A Cross-sectional Study. *\*Journal of Orthopaedic & Sports Physical Therapy\**.
66. de Souza, F. S., Ladeira, C. E., & Costa, L. O. P. (2017). Adherence to Back Pain Clinical Practice Guidelines by Brazilian Physical Therapists: A Cross-sectional Study. *\*Journal of Orthopaedic & Sports Physical Therapy\**.
67. Jenkins, H. J., Downie, A. S., Maher, C. G., Moloney, N. A., Magnussen, J. S., & Hancock, M. J. (2018). Imaging for low back pain: is clinical use consistent with guidelines? A systematic review and meta-analysis. *\*The Spine Journal*, 18\*(12), 2266-2277.
68. Kamper, S. J., Logan, G., Copsey, B., Thompson, J., Machado, G. C., Abdel-Shaheed, C., et al. (2020). What is usual care for low back pain? A systematic review of health care provided to patients with low back pain in family practice and emergency departments. *\*Pain*, 161\*(4), 694-702.
69. Chou, L., Ranger, T. A., Peiris, W., Cicuttini, F. M., Urquhart, D. M., Sullivan, K., et al. (2018). Patients' perceived needs for medical services for non-specific low back pain: A systematic scoping review. *\*PLoS One*, 13\*(11), e0204885.
70. Slade, S. C., Kent, P., Patel, S., Bucknall, T., & Buchbinder, R. (2016). Barriers to Primary Care Clinician Adherence to Clinical Guidelines for the Management of Low Back Pain: A Systematic Review and Metasynthesis of Qualitative Studies. *\*Clinical Journal of Pain*, 32\*(9), 800-816.
71. Fischer, F., Lange, K., Klose, K., Greiner, W., & Kraemer, A. (2016). Barriers and Strategies in Guideline Implementation-A Scoping Review. *\*Healthcare (Basel)*, 4\*(3).
72. Figg-Latham, J., & Rajendran, D. (2017). Quiet dissent: The attitudes, beliefs and behaviours of UK osteopaths who reject low back pain guidance - A qualitative study. *\*Musculoskeletal Science & Practice*, 27\*, 97-105.
73. Mesner, S. A., Foster, N. E., & French, S. D. (2016). Implementation interventions to improve the management of non-specific low back pain: a systematic review. *\*BMC Musculoskeletal Disorders*, 17\*, 258.
74. Suman, A., Dikkers, M. F., Schaafsma, F. G., van Tulder, M. W., & Anema, J. R. (2016). Effectiveness of multifaceted implementation strategies for the implementation of back and neck pain guidelines in health care: a systematic review. *\*Implementation Science*, 11\*(1), 126.



75. van Tulder, M., Becker, A., Bekkering, T., Breen, A., del Real, M. T., Hutchinson, A., et al. (2006). Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care. \*European Spine Journal, 15\*(Suppl 2), S169-S191.
76. Airaksinen, O., Brox, J. I., Cedraschi, C., Hildebrandt, J., Klaber-Moffett, J., Kovacs, F., et al. (2006). Chapter 4. European guidelines for the management of chronic nonspecific low back pain. \*European Spine Journal, 15\*(Suppl 2), S192-S300.
77. National Institute for Health and Care Excellence (NICE). (2020). Low back pain and sciatica in over 16s: assessment and management. In National Institute for Health and Care Excellence (Ed.).
78. Law, M. C., & MacDermid, J. (2008). \*Evidence-based rehabilitation: A guide to practice\*. Slack Incorporated.
79. Dahan, R., Borkan, J., Brown, J. B., Reis, S., Hermoni, D., & Harris, S. (2007). The challenge of using the low back pain guidelines: a qualitative research. \*Journal of Evaluation in Clinical Practice, 13\*(4), 616-620.
80. Freeman, M. D. (2010). Clinical practice guidelines versus systematic reviews; which serve as the best basis for evidence-based spine medicine? \*The Spine Journal, 10\*(6), 512-513.
81. Chou, R., Qaseem, A., Snow, V., Casey, D., Cross, J. T., Jr., Shekelle, P., et al. (2007). Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. \*Annals of Internal Medicine, 147\*(7), 478-491.
82. Chou, R., Qaseem, A., Owens, D. K., & Shekelle, P. (2011). Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. \*Annals of Internal Medicine, 154\*(3), 181-189.
83. Cecin, H. A. (2008). Diretriz II: diagnóstico clínico. \*Revista Brasileira de Reumatologia, 48\*(Suppl 1), 8-12.
84. Kreiner, D. S., Matz, P., Bono, C. M., Cho, C. H., Easa, J. E., Ghiselli, G., et al. (2020). Guideline summary review: an evidence-based clinical guideline for the diagnosis and treatment of low back pain. \*The Spine Journal, 20\*(7), 998-1024.
85. Barbosa, M. H. (2008). Diretrizes III e IV: diagnóstico complementar. \*Revista Brasileira de Reumatologia, 48\*(Suppl 1), 13-14.
86. Pangarkar, S. S., Kang, D. G., Sandbrink, F., Bevevino, A., Tillisch, K., Konitzer, L., et al. (2019). VA/DoD Clinical Practice Guideline: Diagnosis and Treatment of Low Back Pain. \*Journal of General Internal Medicine, 34\*(11), 2620-2629.
87. Hutchins, T. A., Peckham, M., Shah, L. M., Parsons, M. S., Agarwal, V., Boulter, D. J., et al. (2021). ACR appropriateness Criteria® low back pain: 2021 update. \*Journal of the American College of Radiology, 18\*(11), S361-S379.
88. Gonzalez Maza, C., Moscoso López, L., Ramírez Elizalde, G., & Abdo Andrade, A. (2010). [Multimodal treatment of chronic unspecific low back pain]. \*Acta Ortopédica Mexicana, 24\*(2), 88-94.



89. Instituto Brasileiro de Geografia e Estatística (IBGE). (2010). IBGE Rio de Janeiro.
90. Zioli, F. A., Patta, S. B., dos S. C. F., & Nagamine, C. R. (2020). Análises sobre Concessão e Cessação de Auxílio-doença. \*Informe da Previdência Social\*, p. 11.
91. Fernandes, A. Z., Schettini, B. P., Santos, C. F. d., & Costanzi, R. N. (2020). Análises sobre Concessão e Cessação de Auxílio-doença. \*Informe da Previdência Social\*, p. 11.
92. Mendonça, A. G., Oliveira, V. C., Fonseca, L. S., & Oliveira, M. X. (2021). Custos diretos da dor lombar em hospitais financiados pelo Sistema Único de Saúde. \*Revista Pesquisa em Fisioterapia, 11\*(1), 181-189.
93. Osterman, H., Sund, R., Seitsalo, S., & Keskimäki, I. (2003). Risk of multiple reoperations after lumbar discectomy: a population-based study. \*Spine (Phila Pa 1976), 28\*(6), 621-627.
94. Lemmers, G. P. G., van Lankveld, W., Westert, G. P., van der Wees, P. J., & Staal, J. B. (2019). Imaging versus no imaging for low back pain: a systematic review, measuring costs, healthcare utilization and absence from work. \*European Spine Journal, 28\*(5), 937-950.
95. O'Connell, N. E., & Ward, S. P. (2018). Low back pain: What have clinical guidelines ever done for us? \*Journal of Orthopaedic & Sports Physical Therapy, 48\*(2), 54-57.
96. Fritz, J. M., Cleland, J. A., & Brennan, G. P. (2007). Does adherence to the guideline recommendation for active treatments improve the quality of care for patients with acute low back pain delivered by physical therapists? \*Medical Care, 45\*(10), 973-980.
97. de Souza, F. S., Ladeira, C. E., & Costa, L. O. P. (2017). Adherence to back pain clinical practice guidelines by Brazilian physical therapists: A cross-sectional study. (1528-1159 (Electronic)).
98. de Souza, F. S., Ladeira, C. E., & Costa, L. O. P. (2017). Adherence to back pain clinical practice guidelines by Brazilian physical therapists: A cross-sectional study. (1528-1159 (Electronic)).
99. Jenkins, H. J., Downie, A. S., Maher, C. G., Moloney, N. A., Magnussen, J. S., & Hancock, M. J. (2018). Imaging for low back pain: Is clinical use consistent with guidelines? A systematic review and meta-analysis. \*The Spine Journal, 18\*(12), 2266-2277.
100. Kamper, S. J., Logan, G., Copsey, B., Thompson, J., Machado, G. C., Abdel-Shaheed, C., et al. (2020). What is usual care for low back pain? A systematic review of health care provided to patients with low back pain in family practice and emergency departments. \*Pain, 161\*(4), 694-702.
101. Chou, L., Ranger, T. A., Peiris, W., Cicuttini, F. M., Urquhart, D. M., Sullivan, K., et al. (2018). Patients' perceived needs for medical services for non-specific low back pain: A systematic scoping review. \*PLoS One, 13\*(11), e0204885.
102. Slade, S. C., Kent, P., Patel, S., Bucknall, T., & Buchbinder, R. (2016). Barriers to Primary Care Clinician Adherence to Clinical Guidelines for the Management of Low Back Pain: A Systematic Review and Metasynthesis of Qualitative Studies. \*Clinical Journal of Pain, 32\*(9), 800-816.
103. Fischer, F., Lange, K., Klose, K., Greiner, W., & Kraemer, A. (2016). Barriers and Strategies in Guideline Implementation-A Scoping Review. \*Healthcare (Basel), 4\*(3).



104. Figg-Latham, J., & Rajendran, D. (2017). Quiet dissent: The attitudes, beliefs and behaviours of UK osteopaths who reject low back pain guidance - A qualitative study. \*Musculoskeletal Science and Practice, 27\*, 97-105.
105. Mesner, S. A., Foster, N. E., & French, S. D. (2016). Implementation interventions to improve the management of non-specific low back pain: a systematic review. \*BMC Musculoskeletal Disorders, 17\*, 258.
106. Suman, A., Dijkers, M. F., Schaafsma, F. G., van Tulder, M. W., & Anema, J. R. (2016). Effectiveness of multifaceted implementation strategies for the implementation of back and neck pain guidelines in health care: a systematic review. \*Implementation Science, 11\*(1), 126.
107. van Tulder, M., Becker, A., Bekkering, T., Breen, A., del Real, M. T., Hutchinson, A., et al. (2006). Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care. \*European Spine Journal, 15\*(Suppl 2), S169-S191.
108. Airaksinen, O., Brox, J. I., Cedraschi, C., Hildebrandt, J., Klaber-Moffett, J., Kovacs, F., et al. (2006). Chapter 4. European guidelines for the management of chronic nonspecific low back pain. \*European Spine Journal, 15\*(Suppl 2), S192-S300.
109. TOP TOpLBP. (2015). Evidence-informed primary care management of low back pain: clinical practice guideline. Alberta, Canada: Alberta Institute of Health Economics Canada.
110. Innovation NafC. (2016). Management of people with acute low back pain: model of care. Chatswood: NSW Health. p. 39.
111. Hussein, A. M. M., Singh, D., Mansor, M., Kamil, O. I. M., Choy, C. Y., & Cardoso, M. S., et al. (2016). The Malaysian Low Back Pain Management Guidelines. First edition ed: Malaysian Association for the Study of Pain (MASP) Spine Society Malaysia.
112. NASS. (2020). Evidence-Based Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Low Back Pain. In: Society NAS, editor.
113. VA/DoD. (2022). Clinical Practice Guideline - VA/DoD. In: Pain TDaToLB, editor. Washington, DC: U.S: Government Printing Office.
114. Kebede, A., Abebe, S. M., Woldie, H., & Yenit, M. K. (2019). Low Back Pain and Associated Factors among Primary School Teachers in Mekele City, North Ethiopia: A Cross-Sectional Study. \*Occupational Therapy International, 2019\*, 3862946.
115. Hartvigsen, J., Hancock, M. J., Kongsted, A., Louw, Q., Ferreira, M. L., Genevay, S., et al. (2018). What low back pain is and why we need to pay attention. \*The Lancet, 391\*(10137), 2356-2367.
116. Petreça, D., Sandreschi, P., Rodrigues, F., Koaski, R., Becker, L., Júnior, N., et al. (2017). Viva bem com a coluna que você tem: ação multidisciplinar no tratamento da lombalgia. \*Revista Brasileira de Atividade Física & Saúde, 22\*(4), 413-418.
117. Rodrigues, I. S. A., Oliveira, L. M. M. d., Fernandes, F., Teles, M. E. V., & Sena, V. S. (2019). Ocorrência de Lombalgia em uma Unidade de Pronto Atendimento. \*Revista Fundamentos & Cuidados, 9\*(4), 823-827.
118. Carragee, E. J., & Hannibal, M. (2004). Diagnostic evaluation of low back pain. \*Orthopedic Clinics of North America, 35\*(1), 7-16.



119. Pincus, T., Burton, A. K., Vogel, S., & Field, A. P. (2002). A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. *\*Spine, 27\*(5), E109-E120.*
120. Koes, B. W., van Tulder, M., Lin, C. W., Macedo, L. G., McAuley, J., & Maher, C. (2010). An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. *\*European Spine Journal, 19\*(12), 2075-2094.*
121. Hall, A. M., Aubrey-Bassler, K., Thorne, B., & Maher, C. G. (2021). Do not routinely offer imaging for uncomplicated low back pain. *\*BMJ, 372\*, n291.*

Table 1. Recommendations of the Clinical Practice Guidelines for the Diagnosis of Low Back Pain

Guideline	Author(s) Year of Publication	Country	Diagnostic Recommendations								
			Anamnesis and Physical Examination: identification of specific diseases	Anamnesis and Physical Examination: identification of radiculopathy	Classification of low back pain into: non-specific, specific and radiculopathy	AV Red Flags	AV Yellow Flags	Language to be addressed and/or avoided in VA	Orthopedic tests recommended in the Physical Examination	Recommendations for Imaging Exams (Radiographs, MRI and CT)	
COST ACTION B13. Europeanguidelines for the management of acute nonspecific low back pain in primary care	VANTULDER et al., 2006	Europe	X	X	X	X	X	X		Straight leg elevation test	SI: *Acute nonspecific low back pain. I: CXR= *Specific underlying pathology suspected (based on 'warning signs') *Suggested as optional in case of persistent low back pain for more than 4 to 6 weeks.
COST ACTION B13. Europeanguidelines for the management of chronic nonspecific low back pain	AIRAKSI NEN et al., 2006	Europe	X	X	X	X	X	X		The following tests are not recommended: CV palpation, segmental range of motion, soft tissue tests and straight leg elevation (Lasègue).	Routine SI: *Acute nonspecific low back pain. *Chronic nonspecific low back pain unless a specific cause is strongly suspected. I: RM= *Radiculopathy symptoms. *Suspicion of discitis or neoplasia. RX: *Assessment of deformity structures.
ACP e APS. Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice. Diagnostic imaging for low back pain: advice for high-value health care	CHOU et al., 2007 CHOU R, QASEEMA, OWENS DK et al., 2011	USA	X	X	X	X	X	-		Straight leg raise test Crossed Straight Leg Raise Test Neurological examination: assessment of strength, distribution of sensory symptoms and reflexes of the knee (L4 nerve root), hallux and foot dorsiflexion strength (L5 nerve root), plantar flexion of the foot and ankle reflexes (S1 nerve root).	Routine SI: *Nonspecific low back pain. I: *Severe or progressive neurological deficits. *Signs or symptoms that indicate a serious or specific underlying condition.
AMB/CFM. Low back pain and lumbar sciatic pain. Guideline II: Diagnosis clinical.	BARBOSA, 2008; CECIN, 2008	Brazil	X	X	X	X	X	-		Flexion and extension of the CL. Valsalva maneuver, Lasègue and Romberg Sign of the de Sèze points, "string bow" and	I: X-ray: *Chronic common mechanical low back pain for elucidation pathophysiological. CT and MRI: Low back pain and acute sciatica atypical evolution



										and/or unsatisfactory evolution, the causes of which have not been
Guidelines III and IV: complementary diagnosis									Wadell	determined after six weeks of clinical treatment. * RX=Recurrence or persistence of the clinical picture beyond the 4th week of the onset of symptoms. SI: acute common mechanical low back pain, mainly in young adults.
TOP. Evidence-informed primary care management of low back pain.	TOP, 2015	Canada	X	X	-	X	X	X	None addressed	SI: Acute low back pain, no red flags. *In the absence of red flags, radiculopathy or neurogenic claudication or clinical warning signs. I: MRI: * Severe or progressive neurological deficit. *Severe or disabling pain in the back or legs. * Indication of surgical intervention or therapeutic injection in moderate to severe low back pain. *Radicular pain that does not respond to non-interventional therapy. *Red flags. *Radiculopathy (pain in the dominant leg) that persists after 6 weeks of treatment.
ACI. Management of people with acute low back pain: model of care	INNOVATION, 2016	Australia - Oceania	X	X	X	X	X	X	None addressed	SI: Acute nonspecific low back pain (no suspicion of serious pathology or radicular syndromes). I: MRI=*Lumbar and leg pain, with progressive neurological loss. * Tail equina syndrome = enc. immediate

The Malaysian low back pain management guideline	HUSSEIN et al., 2016	Malaysia	X	X	X	X	X	-	Straight leg raise test. Crossed straight leg raise test. Walking with heel and toe. Muscle strength - Flexion and extension of the big toe - - Flexion and extension of the ankle	I= RX= * Acute back pain that persists for more than 2 weeks. *No red flags present. *Spondylolisthesis or spondylolysis is suspected. MRI= *Suspected disc and/or nerve root prolapse or spinal cord compression. CT= *Suspicion of extraspinal pathology. *As an alternative to MRI in the presence of spinal implants
NICE. Low back pain and sciatica over 16s: assessment and management (NG59).	NICE, 2020	UK	X	Neuropathic pain unrelated to sciatica see the NICE guideline on neuropathic in adults	-	X	X	-	None addressed	I: *Low back pain with or without sciatica, if the result is likely to alter management. Do not routinely offer imaging exams in a non-specialist setting
NASS. Diagnosis & Treatment of Low Back Pain. Guidelines summary review: an evidence-based clinical guideline for the diagnosis and treatment of low back pain.	NASS, 2020 KREINER D.S., et al., 2020.	USA	X	-	-	X	X	-	None addressed	Neither for nor against obtaining imaging tests: *Acute or chronic low back pain, with no red flags. I: * Severe and intractable pain syndromes that failed treatment.
VA/DOD. Clinical Practice Guideline: Diagnosis and Treatment of Low Back Pain	PANGAR KAR et al., 2019. VA/DoD, 2022	USA	X	X	-	X	X	-	Straight leg raise test Crossed straight leg raise test I brought other tests = but they do not recommend against or in favor	Routine SI: *Acute axial low back pain (i.e., localized, non-radiating). I: * Severe or progressive neurological deficits. *Red flag symptoms.
<p>_ = The guideline did not provide any recommendations on this approach. X= The guideline endorsed/provided/confirmed this recommendation regarding this approach. COST=European Cooperation in Science &amp; Technology. ACP e APS: American College of Physicians and American Pain Society. AMB/CFM: Brazilian Medical Association and Federal Council of Medicine. TOP: Toward Optimized Practice. ACI: Agency for Clinical Innovation. NICE: National Institute for Health and Care Excellence. NASS: Diretriz North American Spine Society. VA/DOD: Veterans Affairs/Department of Defense.</p>						<p>AV: Assessment. ROM: Range of movement. MRI: Magnetic resonance imaging. CT: Computed Tomography. RX: X-ray. SI: No indication. I: Indication. CL: Lumbar spine. CV: Spine.</p>				




Chart 1 Red flags addressed by most clinical practice guidelines

	Cancer; history of malignancy	AMB/CFM;NASS;VA/DOD; ACP/APS;NICE;TOP;COSTB13European;ACI Malaysian
	Fracture – Trauma	AMB/CFM;VA/DOD; NICE;TOP;NASS;NSW; COSTB13European;Malaysian
	Infection	AMB/CFM;VA/ DOD;ACP/APS;NICE;TOP;ACI;Malaysian
	Cauda equina syndrome	AMB/CFM;NASS;VA/DOD; ACP/APS;TOP;COSTB13European;ACI; Malaysian

Chart 2 Yellow flags addressed by most clinical practice guidelines

	<b>Inappropriate attitudes and beliefs about back pain :</b> (e.g., belief back pain is harmful or potentially disabling, and/or high expectation of passive treatments rather than active participation, and/or that the activity is harmful.	TOP;ACI;COSTB13 European;Malaysian
	<b>Mental health conditions:</b> attention deficit disorder, hyperactivity, anxiety, depression, somatization, interpersonal stress at home, post-traumatic stress disorder.	AMB/NASS/ ACM/SP/TOP/COSTB13 European/Malaysian
	<b>Work-related factors:</b> low job satisfaction, lack of support from supervisors, unemployment, issues related to dissatisfaction regarding remuneration.	NASS/VADOD/ ACM/SP/TOP/ ACI/ COSTB13European/ Malaysian
	<b>Other psychosocial factors:</b> death, divorce, duration of pain, disability status, problems financial, low mood or negative mood, social withdrawal, lack of social or family support, withdrawal from social life, overprotective family.	VADOD/ACI/COST B13European/ Malaysian

## Cardiology: From anatomical and physiological discoveries to the beginnings of the medical specialty in the interior of Rio Grande do Sul

 <https://doi.org/10.56238/sevened2024.016-026>

**Naiane Ronsoni Rigo<sup>1</sup>, Natalia Demarco Kielek<sup>2</sup>, Bruna Malacarne<sup>3</sup>, Maísa Diane Turra Lena<sup>4</sup>,  
Elisabete Maria Zanin<sup>5</sup> and Miriam Salete Wilk Wisniewski<sup>6</sup>**

### ABSTRACT

In the early days of humanity, the heart was considered the central point of life, both organic and spiritual. Several peoples dedicated themselves to understanding cardiovascular anatomy and physiology, proposing theories that explained the functioning of such a complex system. In Brazil, medical researchers, including Carlos Chagas, suggested considerable advances in scientific research, such as the discovery of the pathophysiology and cardiac manifestations of Chagas Disease, in 1909. In 1943, the Brazilian Society of Cardiology was founded and in 1948 the Society of Cardiology of Rio Grande do Sul, boosting the recognition of the specialty in the country. In this context, this article intends to compose a timeline on cardiology, highlighting aspects of its regional inclusion in a municipality in the north of Rio Grande do Sul. The methodology is based on bibliographic and documentary research on the history of cardiology, taking into account global aspects of the specialty, in addition to deepening its insertion in Erechim-RS, through reports of three cardiologists, considered part of the pioneer group in care in the locality. The report was obtained through a conversation circle open to the community on November 22, 2023, called "History of Cardiology in Erechim" and which marked the 50th anniversary of the specialty in the locality.

**Keywords:** Medicine, Memory, Health.

---

<sup>1</sup> Medical student. Integrated Regional University of Alto Uruguai and the Missions – URI Erechim

<sup>2</sup> Medical student. Integrated Regional University of Alto Uruguai and the Missions – URI Erechim

<sup>3</sup> Medical student. Integrated Regional University of Alto Uruguai and the Missions – URI Erechim

<sup>4</sup> Medical student. Integrated Regional University of Alto Uruguai and the Missions – URI Erechim

<sup>5</sup> Doctor in Sciences from UFSCar. Integrated Regional University of Alto Uruguai and the Missions – URI Erechim

<sup>6</sup> Doctor in Health Sciences from UNESC/SC. Integrated Regional University of Alto Uruguai and the Missions – URI Erechim



## INTRODUCTION

### HISTORY OF CARDIOLOGY IN THE WORLD

Since the dawn of humanity, the heart has been considered the central point of the existence of living beings, both from the point of view of survival and from the perspective of spirituality (Gallian, 2010). Many scholars have tried to decipher the anatomical and physiological nuances of this organ, being responsible for what we now know as the specialty of Cardiology.

In Ancient Egypt (1500 BC), it was believed that it was from the heart that the sources of life, feelings, and thoughts came (Gallian, 2010). Its importance was such that after death, it was the only organ that would be reattached to the mummified body, since those made during the individual's life remained in his heart, and this had to be evaluated in the passage between life and death (Gallian, 2010). From an anatomical point of view, it was the main structure from which a system of channels started, which transported the substances of life (blood, feces and semen) and spiritual elements (benign and evil spirits) (Bestetti; Restini; Couto, 2014).

Hippocrates, considered the father of medicine, was a pioneer in detailing the anatomical structures of the heart, attributing to the cardiovascular system the responsibility of transporting life to the rest of the body (Bestetti; Restini; Couto, 2014). The organ was formed by two heart valves with three leaflets (tricuspid); two communicating ventricles, the right one, larger and with blood inside, and the left, thicker and made up of yellow bile, mind and spirit; the atria, although described, were not part of the structure of the organ (Bestetti; Restini; Couto, 2014; Diniz *et al.*, 2022). The blood vessels would originate from the heart itself and leave for the rest of the body (Bestetti; Restini; Couto, 2014).

Galen (first century AD) stated that the heart was a muscle formed by two ventricles, the left was more hypertrophied, since it retained air, and the right transported blood through two vessels, one that would go to the lung and the other that would reach the rest of the body (Bestetti; Restini; Couto, 2014). Blood originated from the liver, through the modification of digested food, and left for the other parts of the body (Décourt, 1990; Bolli, 2019b). The arterial system was composed of "spirituous" or "air" contents, while the venous system was called "sanguine" (Décourt, 1990). In the left ventricle, venous blood would turn into "spirituous" blood, becoming "pneuma" (Décourt, 1990; Bolli, 2019b).

As the human body was considered sacred, dissections were no longer allowed until the Renaissance, resulting in a period of hiatus from the anatomical knowledge that permeated the cardiovascular system (Bestetti; Restini; Couto, 2014).

In the tenth century, Al-Bukhari Akhawayni found that the human heart had the primary function of pumping blood and was formed by four cavities with valves that prevented blood reflux to the pulmonary vessels and aorta (Bestetti; Restini; Couto, 2014). He also described the path of the



cardiac-pulmonary circulation, emphasizing that blood from the right ventricle was directed to the lungs and then to the left ventricle and aorta, being distributed to the rest of the body (Bestetti; Restini; Couto, 2014). Ibn-Nafis, in the twelfth century, improved the idea of pulmonary circulation with the discovery of pulmonary arteries and veins (Bestetti; Restini; Couto, 2014). He also believed that the nutrition of the heart came from vessels that permeated the organ, and he was the first to hypothesize the existence of coronary arteries (Bestetti; Restini; Couto, 2014).

In Europe, the Italian physician Berengario de Carpi, in the fifteenth century, using the dissection of cadavers as a means of study, stated that the heart was composed of four chambers, two atria and two ventricles, and semilunar and atrioventricular valves, followed by papillary muscles (Bestetti; Restini; Couto, 2014). But it was Fabricius ab Aquapendente, in the seventeenth century, who described the anatomical physiology of these valves, stating that their function was to contain blood reflux (Bestetti; Restini; Couto, 2014).

Another important figure for the development of cardiology was William Harvey, a British physician, disciple of Fabricius ab Aquapendente and considered the father of cardiovascular physiology (Bolli, 2019a). In 1628, Harvey published the book *De Motu Cordis*, refuting Galen's ideas, until then accepted by the scientific community of the time (Bolli, 2019a; Bolli, 2019b). In this work, there are mentions about the physiology of cardiac contractility, in which the doctor states that the organ fills with blood passively and contracts actively, a moment synchronous with the peripheral pulsation (Bolli, 2019b). In addition, Harvey described the function of the four heart valves: pulmonary, aortic, mitral, and tricuspid, stating that the first two prevented the backflow of blood to the ventricles and the last two to the atria (Bolli, 2019b). The venous system was also the subject of study, and it was found, after performing an experiment with a tourniquet, that the blood flow from the veins was towards the heart, not the other way around (Bolli, 2019b). In addition, he made discoveries about the functioning of the pulmonary circulation, corroborating the description of Ibn al-Nafis, he stated that the blood flow started from the right ventricle and reached the lungs, returning to the cardiac chamber through the left ventricle, without the existence of pores in the ventricular septum (Bolli, 2019c).

The year 1816 was also marked by a major discovery related to the specialty of cardiology: the creation of the stethoscope, by the Frenchman René Théophile Hyacinthe Laënnec (Colognese *et al.*, 2022). Prior to the appearance of the instrument, auscultations were performed by placing an ear on the patient's chest, a practice that was uncomfortable and was often hampered by intrinsic characteristics of each patient, such as obesity (Colognese *et al.*, 2022).

The first electrical study of cardiac contraction, the electrocardiogram, was carried out in 1887, by Augustus Waller, still with some limitations (Colognese *et al.*, 2022). This feat motivated Willem Einthoven to research new techniques and improve the quality of the records, coming to the



conclusion that each electrical impulse generated five waves, which were called P, Q, R, S, and T, the nomenclature used to this day (Colognese *et al.*, 2022).

## HISTORY OF CARDIOLOGY IN BRAZIL

In Brazil, an important milestone for local medicine was the arrival of the court of King D. João VI, in 1808, which encouraged the opening of Medical Schools and the directing of health care to more specialized professionals, since in the beginning, a general practitioner needed to attend to diseases of various systems of the human body, establishing diagnoses and conducts (Colognese *et al.*, 2022).

The country continued to advance in health studies, following global scientific trends (Colognese *et al.*, 2022). The Brazilian physician Carlos Chagas was the first to publish a scientific study that dealt with a heart disease in Brazil, Chagas disease, in 1909. He also introduced the first electrocardiogram into the Manguinhos laboratory (Mesquita; Souza, 2019).

However, it was the increase in the incidence of heart disease in the population after the urbanization process in the 1930s that was the real driver of the emergence of the specialty of cardiology in Brazil, a period in which specialization courses began to be created in the cities of São Paulo and Rio de Janeiro (Mesquita; Souza, 2019).

Noting the change in the pathological profile that the country was going through, from a higher prevalence of infectious diseases to chronic diseases, the Vargas Government created, in 1941, the Cardiovascular Disease Care Service, directed by Genival Londres and Segadas Vianna (Kropf, 2023).

On August 14, 1943, in the Cardiology Service of the Municipal Hospital of São Paulo, the Brazilian Society of Cardiology (SBC) was founded, whose first president was Dante Pazzanese and 112 affiliated founding members in its first year of operation (Mesquita; Souza, 2019; Kropf, 2023). The date began to be celebrated as Cardiologist Day, from 2005 onwards (Mesquita; Souza, 2019). Subsequently, in 1948, the first SBC journal, the "Brazilian Archives of Cardiology", was created, boosting research and dissemination of scientific knowledge related to the specialty (Kropf, 2023).

In the state of Rio Grande do Sul, the Society of Cardiology of Rio Grande do Sul (SOCERGS) was founded in 1948 and had as its first president cardiologist Rubens Mário Garcia Maciel, also a founding member of SBC (ANM, 2024; SOCERGS, 2024). Rubens Maciel brought important advances to the state, such as electrocardiography (ANM, 2024). He also founded the Sul-Rio-Grandense Institute of the History of Medicine (now the Gaucho Foundation of the History of Medicine), due to his great interest in rescuing the historical facts and memories that permeated his profession (ANM, 2024).

## HISTORY OF CARDIOLOGY IN ERECHIM

The first cardiologist to establish himself in the municipality of Erechim was João Alberto Pegorini, in 1973. Subsequently, in 1977, Ivan Carlos Salomoni was the second to attend in the locality, having a brief passage, since, in 1984, he lost his life in a plane crash at the age of 36 (Genovez, 2018; Capoani; Serpa; Fahl, 2023).

In 1979, at the invitation of João Alberto Pegorini, who needed help with medical care, Mauro Roberto Capoani (Figure 1) was the third cardiologist to arrive in the city. Graduated in Medicine from the Federal University of Rio Grande do Sul (UFRGS) in 1976, he took a course in internal medicine at Santa Casa de Misericórdia de Porto Alegre and a medical residency in cardiology at the Institute of Cardiology of Porto Alegre. He started working at the Santa Terezinha Hospital (currently the Santa Terezinha de Erechim Hospital Foundation-FHSTE), at the time a private hospital. At first, he was unable to enter the public hospital, the Hospital de Caridade de Erechim (HCE) (Capoani; Serpa; Fahl, 2023).

Figure 1 – Mauro Roberto Capoani, cardiologist who worked in Erechim-RS



Source: URI-Erechim

He faced several adversities in his first care at Santa Terezinha Hospital, due to the infrastructure. The electrocardiogram, the initial exam in the care of cardiology consultations, could not be performed, since the hospital did not have it. The care of serious patients was also impaired, as basic structures such as the emergency room, laboratory and X-ray machine were not available. When faced with these situations, Mauro Roberto Capoani considered giving up, however, he chose to improve the service. On his own, he acquired a stop cart with a pacemaker and defibrillator and set up a kind of emergency room in one of the hospital's rooms, a primitive structure, but which allowed some safety when attending to severe cases (Capoani; Serpa; Fahl, 2023).

In addition to the hospital, he attended patients at home. In one of the cases, he attended a lady and, with the help of a portable heart monitor, which he used to optimize these consultations, he

found an important arrhythmia. In the middle of the physical examination, the patient unfortunately suffered a cardiac arrest, the ambulance was called and all first aid was performed immediately, but she did not survive (Capoani; Serpa; Fahl, 2023).

In 1984, after a conversation between Mauro Roberto Capoani and Ivan Carlos Salomoni, both agreed that Erechim needed to expand the cardiology service. Thus, they contacted Milton Araújo Serpa (Figure 2). The doctor graduated from the Federal Faculty of Medical Sciences Foundation of Porto Alegre (FFFCMPA, currently the Federal University of Health Sciences of Porto Alegre - UFCSPA), in 1981, and is a specialist in cardiology from the Institute of Cardiology of Rio Grande do Sul (Capoani; Serpa; Fahl, 2023).

Figure 2 – Milton Araújo Serpa, cardiologist working in Erechim-RS



Source: URI-Erechim

He arrived in the region shortly after the completion of the Intensive Care Unit (ICU) of the HCE, designed by anesthesiologist Aldo José Peixoto. With this structure, it was possible to perform a series of procedures that were not commonly performed by cities the size of Erechim, such as electrical cardioversion, the treatment of acute myocardial infarction, and the treatment of severe heart failure requiring mechanical ventilation (Capoani; Serpa; Fahl, 2023).

Another technology briefly added to the cardiology service was the echocardiogram, an innovation for the 1980s. With the exam, the diagnoses of heart diseases were made with greater precision; It was as if the doctor was looking at the cardiological pathologies through a keyhole, with the arrival of the echocardiogram, the vision expanded, a door was opened. At first, the existing device was the M-module or one-dimensional echocardiogram, limiting the visualization of the cardiac chambers and the diagnostic accuracy. In mid-1989, with the joint efforts of several physicians, diagnostic imaging was *upgraded*, after the acquisition of the two-dimensional echocardiogram, a considerable advance, especially in the area of congenital heart diseases in

neonates. Possibly, many of these cases in neonates were underdiagnosed with the unidimensional echocardiogram (Capoani; Serpa; Fahl, 2023).

Another milestone in Erechinense cardiology was the arrival of the hemodynamics service. In 2002, at the initiative of Mauro Roberto Capoani, coronary angiography, also known as catheterization, began to be performed. This service was responsible for the implantation of the first permanent pacemaker in Erechim, in 2004, in partnership with cardiac surgeon Roque Faleiro, from Passo Fundo-RS. The accreditation of the service in the Unified Health System (SUS) was denied by the State. The procedures were carried out for a short period of time and, due to financial conditions, had to be interrupted. In 2010, with the collaboration of a group of physicians, including cardiologists, vascular surgeons, neurologists, radiologists, and anesthesiologists, a new hemodynamics service was made possible, this time with private care and by health insurance (Fahl, 2020; Capoani; Serpa; Fahl, 2023). If the agreement via SUS had happened, it seems that hemodynamics in the city would have advanced considerably today, in addition to the fact that Erechim would become a reference in the subject (Capoani; Serpa; Fahl, 2023).

In 1984, shortly after Milton Araújo Serpa settled in the city, there was a cardioverter defibrillator with a pacemaker generator in the ICU of the HCE, creating the possibility of implanting temporary pacemakers in cases of bradyarrhythmias. However, there was only one pacemaker electrode, so that when the patient implanted the permanent pacemaker, the cable was returned, sterilized, and used in the next case. This cardioverter device was not mobile, a fact that prevented the safe transport of patients who were going to implant the permanent pacemaker in Porto Alegre. To solve the problem, they had, together with the cardiologists, the idea of removing a permanent pacemaker from a gentleman (with the consent of the family) who had died shortly after implantation. They sent the device to a specialized company, which disassembled, sterilized the parts and assembled a kind of *pace box*, which allowed the electrode to be connected and served as a battery, making the transport of the patient feasible. Both procedures carried out are unthinkable today, however, they were necessary at the time, both due to the lack of resources and the available infrastructure. Even with all the difficulties, the doctors thought of solutions to serve patients in the best way with the available resources, enabling increased survival. Over time, the services were updated and acquired new equipment, abolishing these practices that, in a way, were improvised and expressed considerable risks (Capoani; Serpa; Fahl, 2023).

Célio Friedholdo Fahl (Figure 3) was the fifth cardiologist to work in Erechim. He graduated in medicine from the Federal University of Pelotas (UFPel) in 1985 and specialized in internal medicine at the São Vicente de Paulo Hospital in Passo Fundo and in cardiology at the Dr. Lazzarotto Heart Hospital, in Porto Alegre (Capoani; Serpa; Fahl, 2023).



Figure 3 – Célio Friedholdo Fahl, cardiologist working in Erechim-RS



Source: URI-Erechim

In 1990, he met with Mauro Roberto Capoani during a Congress in Cardiology in the city of Recife-PE and received an invitation to join the group of cardiologists in Erechim. The municipality had low receptivity to the entry of new physicians, with a well-defined division of work between each hospital. That said, Célio Friedholdo Fahl proposed the creation of a joint clinic with Mauro Roberto Capoani and Milton Araújo Serpa, considered unfeasible at the moment, even so, the doctors established a partnership, sharing patients and procedures, dividing the work and reducing individual anguish. They made it clear, both at the Santa Terezinha Hospital and at the HCE, that they would work as a team. Célio Friedholdo Fahl and otorhinolaryngologist João Elmar de Oliveira were the first professionals to work simultaneously in the two hospitals. There were other physicians who were part of the clinical staff of both, but who, preferably, attended in a single place (Capoani; Serpa; Fahl, 2023).

He had the Santa Terezinha Hospital as the first place of care, he worked both in the emergency room and meeting the cardiology demand. At that time, the emergency care unit was located on the first floor of the building, which did not have elevators, consequently, if it was necessary to take a critically ill patient to the surgical block (on the third floor), the patient was placed on a stretcher or wheelchair and the doctor on duty and the hospital doorman carried him up the stairs. The hospital did not yet have an ICU, so the room improvised by Mauro Roberto Capoani in the past served as a monitoring unit for the most serious patients, such as in cases of need to reverse arrhythmias with medication (Capoani; Serpa; Fahl, 2023).

Two cases he attended marked him for life, both of neonates with congenital heart diseases, identified and referred for surgical correction by the doctor. The first was that of a 30-day-old girl who remained in continued care with the cardiologist for the rest of her life. The second case was that of a boy who, during the return visit, stated that he wanted to be a doctor and today has a degree in medicine and specialized in cardiology (Capoani; Serpa; Fahl, 2023).



Doctor Mauro Roberto Capoani, after a few months working in the city, managed to join the clinical staff of HCE, where he remained until his retirement in 2018. He left Santa Terezinha Hospital shortly before retiring. Currently, he no longer works in the specialty, dedicating himself exclusively to medical expertise. Milton Araújo Serpa, on the other hand, continues to serve patients in his office and at HCE, in addition to dedicating himself to intensive care, since he has a title from the Brazilian Society of Intensive Care. Cardiologist Célio Friedholdo Fahl, in addition to remaining in this occupation, is also a full professor at URI-Erechim in the courses of Medicine, Law and Dentistry, where he has worked for more than 25 years, and head of the medical department of Ypiranga Futebol Clube de Erechim (Capoani; Serpa; Fahl, 2023).

## FINAL CONSIDERATIONS

The history of cardiology in the municipality of Erechim, in the north of Rio Grande do Sul, acquires unique meaning when told by the memories of three of the first cardiologists to work in the locality. Despite the difficulties encountered at the beginning, with the lack of resources and infrastructure, the challenges were overcome by the persistence of the professionals, who always sought the best care for their patients. A timeline was built based on the dialogue of the doctors, who represented all cardiology professionals who work or have worked in the municipality.

The conversation circle brought the community closer to the scientific-academic environment, arousing interest in sharing individual memories that contribute to the understanding of the history experienced daily by health service users.




## REFERENCES

1. ANM. (2024). Rubens Mário Garcia Maciel. Disponível em: <https://www.anm.org.br/rubens-mario-garcia-maciel/#:~:text=Destacou%2Dse%20como%20um%20excelente,em%20ensino%20de%20p%C3%B3s%2Dgradua%C3%A7%C3%A3o>. Acesso em: 14 jul. 2024.
2. Bestetti, R. B., Restini, C. B. A., & Couto, L. B. (2014). Development of anatomophysiological knowledge regarding the cardiovascular system: From Egyptians to Harvey. *\*Arquivos Brasileiros de Cardiologia\**, 103(6), 538-545. Disponível em: <https://www.scielo.br/j/abc/a/JJKqv8R6cVqmr6kjfhGVYVL/?lang=pt>. Acesso em: 12 maio 2024.
3. Bolli, R. (2019a). William Harvey and the discovery of the circulation of the blood. *\*Circulation Research\**, 124(8), 1169-1171. Disponível em: <https://www.ahajournals.org/doi/10.1161/CIRCRESAHA.119.314976>. Acesso em: 13 maio 2024.
4. Bolli, R. (2019b). William Harvey and the discovery of the circulation of the blood. *\*Circulation Research\**, 124(9), 1300-1302. Ovid Technologies (Wolters Kluwer Health). <http://dx.doi.org/10.1161/circresaha.119.314977>. Disponível em: <https://www.ahajournals.org/doi/full/10.1161/CIRCRESAHA.119.314977>. Acesso em: 13 maio 2024.
5. Bolli, R. (2019c). William Harvey and the discovery of the circulation of the blood. *\*Circulation Research\**, 124(10), 1428-1429. Disponível em: <https://www.ahajournals.org/doi/10.1161/CIRCRESAHA.119.314978>. Acesso em: 13 maio 2024.
6. Capoani, M. R., Serpa, M. A., & Fahl, C. F. (2023, 22 nov.). Roda de conversa História da Cardiologia em Erechim. Erechim.
7. Colonese, B. A., Jacobina, R., & Serpa, M. A. (2022). História da cardiologia. In: R. Jacobina et al. (Orgs.), *\*História da medicina: História das especialidades médicas clínicas\** (Vol. 2, pp. 217-242). Salvador: Edufba. Disponível em: <https://repositorio.ufba.br/handle/ri/36329>. Acesso em: 14 maio 2024.
8. Décourt, L. V. (1990). O mecanismo da circulação do sangue: A verdade pela obra de Harvey. *\*Arquivos Brasileiros de Cardiologia\**, 54(1), 41-47. Disponível em: <http://cardiol.br/portal-publicacoes/Pdfs/ABC/1990/V54N1/54010008.pdf>. Acesso em: 13 maio 2024.
9. Diniz, J., & Coautores. (2022). A evolução histórica do estudo da anatomia: Uma revisão bibliográfica. *\*Revista de Saúde\**, 13(1), 6-8. Disponível em: <https://editora.univassouras.edu.br/index.php/RS/article/view/2945>. Acesso em: 12 maio 2024.
10. Fahl, C. (2020). Angiocenter celebra 10 anos em Erechim. Disponível em: <https://www.jornalbomdia.com.br/noticia/42476/angiocenter-celebra-10-anos-em-erechim>. Acesso em: 12 jul. 2024.
11. Gallian, D. M. C. (2010). O destronamento do coração: Breve história do coração humano até o advento da modernidade. *\*Memorandum: Memória e História em Psicologia\**, 18, 27-36. Disponível em: <https://periodicos.ufmg.br/index.php/memorandum/article/view/6636>. Acesso em: 12 maio 2024.



12. Genovez, G. (2018). Aconteceu em 1984 em Gaspar: Queda de avião mata cinco pessoas. Disponível em: <https://cruzeirodovale.com.br/aconteceu-em-gaspar/aconteceu-em-1984-em-gaspar-queda-de-aviao-mata-cinco-pessoas/>. Acesso em: 11 jul. 2024.
13. Kropf, S. P. (2023). Trabalhadores, tecnologia e saúde: A construção da cardiologia como especialidade médica no Brasil (décadas de 1930 e 1940). \*Revista de História\*, 182, 1-32. Disponível em: <https://www.scielo.br/j/rh/a/XdLj94ZphnDkkVngtZHcYkz/>. Acesso em: 14 maio 2024.
14. Mesquita, E. T., & Souza, A. L. A. G. de. (2019). Cardiology and the cardiologist - Yesterday, today and tomorrow. \*Arquivos Brasileiros de Cardiologia\*, 113(3), 335-338. Disponível em: <https://www.scielo.br/j/abc/a/wF4XTVt5964MdC88ZhtDkwQ/?lang=pt>. Acesso em: 14 maio 2024.
15. SOCERGS. (2024). História. Disponível em: <https://www.socergs.org.br/historia>. Acesso em: 14 jul. 2024.

## Self-medication and inappropriate use of antimicrobials in municipalities of Rondônia in the legal Amazon

 <https://doi.org/10.56238/sevened2024.016-027>

Camila Avancini da Rocha<sup>1</sup> and Ely Eduardo Saranz Camargo<sup>2</sup>

### ABSTRACT

The irrational use of medicines is strongly influenced by issues such as self-medication, advertising and biased advertising. According to the World Health Organization (WHO), antimicrobials have often been used inappropriately, without observing some criteria, such as: time of use, suggested effective dosage, correct indications, among others, can accelerate the defense mechanisms of bacteria, causing the drug to lose its efficiency. Bacterial resistance is a global health problem, rapidly growing and with varying prevalence between countries, and increasingly becoming a serious problem. The irrational use of antimicrobials can lead to bacteria adapting and multiplying, increasing and promoting antibiotic resistance. Under the practice of storing medicines, it was observed that, according to the data obtained from the forms, in Teixeiraópolis, approximately 78%, that is, 39 people interviewed, out of a total of 50, have the habit of storing medicines at home, while in Mirante da Serra 42 (84%) interviewees stated that they do this practice and in the municipality of Ji-Paraná 81 (81%) of the 100 interviewees. Therefore, it is important that there are always permanent actions aimed at health education, which are of a practical and effective nature, capable of involving the entire community so that situations such as the one described in our study are minimized.

**Keywords:** Self-medication, Irrational use, Antimicrobials, Bacterial resistance.

<sup>1</sup> Pharmaceutical. Estácio-Unijipa University Center. Rod. Pr. Antônio de Araújo, 2050 3rd district -

<sup>2</sup> Professor and researcher at the Faculty of Medicine of Ji-Paraná (Famejipa) and the Faculty of Medicine of the Estácio-Unijipa University Center. Rod. PR. Severo Antônio de Araújo, 2050 3rd



## INTRODUCTION

Self-medication is a topic of global discussion, its consequences can lead to late diagnosis and worsening, however, according to Naves, *et.al.*, 2010, they already considered that the private sector was largely responsible for contributing to self-medication. This fact can be confirmed, as it is attributed to the clerks, almost always without any academic qualification, that within a capitalist system, they are forced to practice "push therapy" to achieve better wage gains<sup>1</sup>.

Another striking fact that contributes to self-medication is related to health policies, which are not able to serve the population in a timely manner, which certainly leads the individual to seek alternative means for treatment. Thus, it is possible to observe the various practices of indications, leading to self-medication, especially of drugs used for infections, which can develop bacterial resistance, resulting in worsening of the pathological state of the same.

The fight against bacterial infections only became possible with the discovery of antibiotics. The first antibiotic to be used successfully was penicillin, discovered by Alexander Fleming in 1928 and which became available as a drug from 1940. By the mid-1940s, British and American industries were producing billions of units of penicillin. Although initial production was reserved exclusively for military personnel, penicillin became available to the civilian population in 1944<sup>2</sup>.

According to the World Health Organization (WHO)<sup>3</sup>, antibiotics have been used, often inappropriately, and in various clinical situations without evidence to prove their real indication. Antibiotics are used unnecessarily, in up to 60% of cases of respiratory infections.

The administration of antibiotics, without observing some criteria, such as: time of use, suggested effective dosage, correct indication, among others, can accelerate the defense mechanisms of bacteria, causing the drug to lose its efficiency<sup>4</sup>. Thus, it is observed that the sale of antibiotics in Brazil exceeds the sale of other drugs such as analgesics and in the last decade the increase in the sale of generic drugs has practically tripled, even observing the control by the National Service for the Management of Controlled Products (SNGPC)<sup>5</sup>.

Bacterial resistance has been considered a global health problem, rapidly growing and with variable prevalence among countries. Therefore, in developed countries, the consumption of antibiotics has been studied and control and surveillance measures have been adopted, limiting the exposure of people to this group of drugs, while in underdeveloped countries, even adopting special control measures, there is no minimization of the problems recurrent to indiscriminate use<sup>6</sup>.

It is worth noting that prior to resolution RDC No. 20, ANVISA, of May 5, 2011, which provides for the *control* of drugs based on antimicrobial substances for use under a prescription regime, alone or in combination<sup>5</sup>, the responsibility for indiscriminate use was attributed to pharmacies. However, in approximately 20 years after the establishment of control in distribution, there has been an increasing aggravation, which can be attributed to the non-observance or lack of



knowledge of prescribers, linked to advertisements, distribution of samples, and putting an end to the precariousness of the teaching of medicine and health professions in the country<sup>7</sup>.

The rate of hospital infection has increased mainly due to the indiscriminate use of antibiotics, combined with poor local conditions, overcrowding, precarious asepsis and lack of awareness of health professionals in relation to compliance with preventive measures, the wide and indiscriminate use of antibiotics in hospitals is considered a determining factor in the selection of bacteria that cause hospital infection resistant to the vast majority of antibiotics<sup>8</sup>.

The issue of indiscriminate use of antibiotics is considered a public health problem with a strong economic and social impact, being a cause for concern for all health professionals. Therefore, this study aimed to evaluate the knowledge and use of antimicrobials in the population, considering the demographic index of three municipalities, according to the index is: small, medium and large.

## METHODOLOGY

This is a cross-sectional, descriptive, qualitative and quantitative study, involving the population of small, medium and large municipalities, respectively: Teixeiraópolis, Mirante da Serra and Ji-Paraná, all located in the jurisdiction of the State of Rondônia, also considering the knowledge and use of medicines, especially antimicrobials. It was approved by the Research Ethics Committee, according to Resolution 466 of December 12, 2012 of the National Health Council (CNS)<sup>12</sup>, with CAAE No. 2,803,365 (date of opinion: August 6, 2018). The data collection of the research on the use of antimicrobial was carried out through forms distributed to the population of Teixeiraópolis, Mirante da Serra and Ji-Paraná, in the form of a voluntary survey.

The forms used in the research were elaborated with closed questions, based on questions about the correct use of medication, especially antimicrobials, as well as information about the dosage, storage and dose of administration. The research was carried out with people of both sexes, different social levels, and various age groups, freely and spontaneously, without identifying the identity of the participants.

The sample was determined in 200 forms, 50 of which were destined for the municipality of Teixeiraópolis, 50 for Mirante da Serra and 100 for the municipality of Ji-Paraná. In the data analysis, the tabulation of the results was developed and arranged in graphs for better visualization and understanding of the research.

## RESULTS AND DISCUSSION

According to the data obtained, it is observed that the population surveyed has the habit of storing medicines in their homes, perhaps due to the lack of efficient medical care or even ease of acquiring them in local pharmacies. In the municipality of Ji-Paraná it was observed that 90% of the

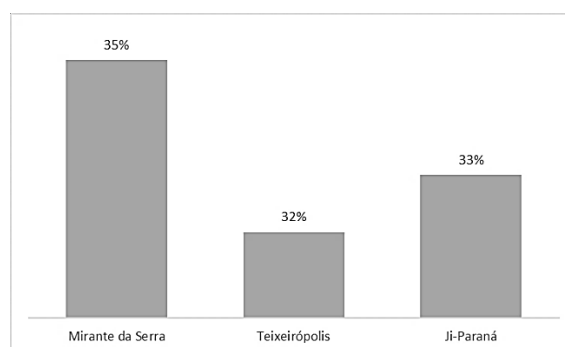
people have the habit of keeping medicines at home, in Mirante da Serra 86% and in Teixeiraópolis 92%. Thus, the practice of self-medication can be attributed, exposing patients/users to the risk of adverse drug reactions, which can lead to intoxication, worsening the health of the patient/user. Other factors, which are exposed, would be: efficacy, safety and, in the case of antimicrobials, resistance that can lead to the development of superinfections.

On the issue of self-medication, still on the use of antimicrobials, this is a serious problem, because if it is stored at home, it could mean that the patient received a prescription, used it and may have interrupted the treatment due to the disappearance of symptoms and improvement of the clinical condition. This fact has been widely observed in almost every state and without any proposal for its resolution.

In the question about which medicines people always have at home, it was found that, in addition to those used to combat symptoms caused by flu and colds, headaches and also medicines for throat infections, called by the population as medicines for sore throat, being a prohibited practice that contradicts the aegis of resolution RDC No 471/2023 Anvisa<sup>8</sup>.

This fact can be attributed to the main cause that could lead to the development of bacterial resistance, the main cause of the development of superinfection. Thus, under the practice of irrational storage of medicines, it was observed, according to the data obtained from the forms, that, in Teixeiraópolis, approximately 78%, that is, 39 people interviewed, of the total of 50 participants who answered the form, have the habit of storing medicines at home, while in Mirante da Serra 42 (84%) interviewees stated that they do this practice and in the municipality of Ji-Paraná 81 (81%) of the 100 participants interviewed.

FIGURE 1 - Percentages of people who store medicines in the municipalities of Ji-Paraná, Mirante da Serra and Teixeiraópolis



The practice of keeping several medicines stored at home, also called "home polypharmacy", is the inadequate way to guarantee access to medicines. However, keeping them stored will not impact the economy, and the same drug previously prescribed would not necessarily be used, even for a similar problem.





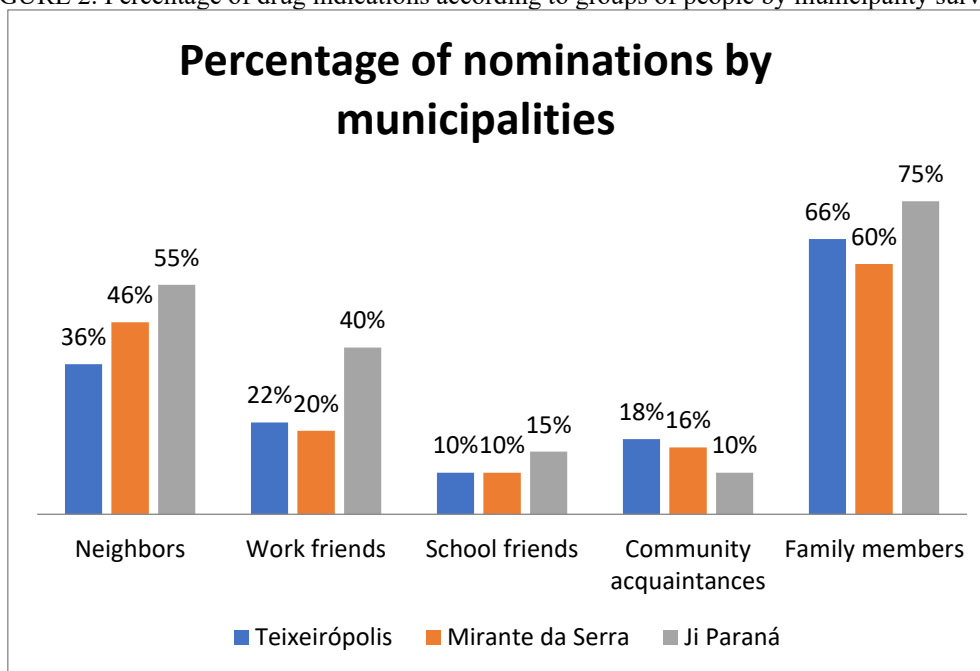
The medicines stored in homes, according to data from the formularies, are mainly those with special controls, according to health legislation, which are left over from previously prescribed treatments due to inconsistent prescriptions or, on the other hand, acquired without a prescription and even over-the-counter medicines. In addition to the risk of inappropriate use, the storage itself can affect the stability of the products, putting the health of the patient/user at risk and also the expired shelf life.

Figure 2 shows the main indications for medications, without medical and pharmaceutical guidance for the patient/user. Indications from neighbors, which presented the highest rates, reaching a percentage of approximately 55% (55) in Ji-Paraná, 46% in Mirante da Serra (23), and 36% in Teixeiraópolis (18). In the indications of friends, mainly from work, it was observed that in Ji-Paraná the index was 40% (40), in Mirante da Serra 20% (10), and in Teixeiraópolis 22% (11).

Considering recommendations from school friends, the index decreases a lot, presenting in the municipality of Ji-Paraná, a percentage of 15% (15), in Mirante da Serra, a percentage of 10% (5) of the interviewees was registered, Teixeiraópolis also presented the same percentage, 10% (5). Indications that occur among members of communities, which can be: churches, condominiums, clubs, among others, the percentages came close to the results presented by school friends, and thus, it was observed that in the municipality of Ji-Paraná, 10% (10) of the indications among members were registered, in Mirante da Serra, the percentage registered 16% (8) of the total participants, while in Teixeiraópolis, small municipality, totaled about 18% (9) of the survey participants who make nominations among members of the respective communities to which they belong.

Another curious fact is the indication of medicines made by family members, in this case, there was a greatly increased value, and according to the answers to the forms distributed in the municipalities mentioned, it was recorded that the municipality of Ji-Paraná had a rate of 75% (75) of people who make indications of medicines among family members, in the municipality of Mirante da Serra, a percentage of 60% (30) was recorded, and Teixeiraópolis, considered a smaller municipality, was recorded a value of 66% (33), according to the answers obtained in the forms. This fact can be explained by the circle of trust among family members, which would certainly facilitate the understanding of the indication.

FIGURE 2. Percentage of drug indications according to groups of people by municipality surveyed



We have to ask: who has never recommended medication to someone? It will be difficult to find such a person, because it is part of human nature. The interviewees did not answer differently, that is, most have already made indications. Table 1 shows the main indications, considering the answers obtained in the forms.

The interviewees answered that the most indicated medication was for headaches, with a percentage of 87% (87) in Ji-Paraná, Mirante da Serra 84% (42) and Teixeiraópolis 80% (40). In the case of possible sore throats, the indications were: 83% (83) in Ji-Paraná, Mirante da Serra were 76% (38) and Teixeiraópolis 84% (42), while for fever, in Ji-Paraná 88% (88), Mirante da Serra 88% (44), and Teixeiraópolis 82% (41).

Other indications were observed, the results were listed in Table 1, below, where it is possible to observe all the indications, through the symptomatology caused by any alteration in the body, which were mentioned in the forms. Thus, it can be observed that: headache, sore throat, fever and flu were the symptoms that presented the most indications, these results refer to the answers in general, without considering specific groups.

Table 1 – Percentages of indications in the municipalities of Ji-Paraná, Mirante da Serra and Teixeiraópolis, distributed by pathologies

<b>PATHOLOGY</b>	<b>JÍ PARANÁ</b>	<b>MIRANTE DA SERRA</b>	<b>TEIXEIRÓPOLIS</b>
Headache	87% (87)	84% (42)	80% (40)
Sore throat	83% (83)	76% (38)	84% (42)
Fever	88% (88)	88% (44)	82% (41)
Cold and Flu	90% (90)	90% (45)	86% (43)
Diarrhea	44% (44)	40% (20)	46% (23)
Allergy	57% (57)	48% (24)	56% (28)
Puke	69% (69)	60% (30)	52% (26)
Eye pain	23% (23)	32% (16)	26% (13)
Stomach pain	55% (55)	58% (29)	48% (24)

Within the issue of the indiscriminate use of medications, which were described above, despite causing adverse effects and consequences, often serious to the patient/user, the use of antimicrobials, without a doubt, is the one that deserves a little more attention, because the appearance of strains of bacteria resistant to these antibiotics is attributed to the indiscriminate use of antimicrobials, which can certainly lead to the patient's death from sepsis. It can be observed that the indication for sore throat, considering antimicrobials, is in second place in percentages of indication, in the municipalities of Ji-Paraná and Mirante da Serra, however, in Teixeiraópolis, according to the data collected in the forms, there was a percentage attributing the first indication of antimicrobials.

The indication of medication is relative, and a circle of trust or even known experiences with the use of certain medications is often attributed among people. Thus, the question is: Why does the patient not seek the doctor first? It would be due to the difficulty, having to face long lines and a long waiting time, or perhaps the distrust in knowledge on the part of health professionals, who are currently put to the test.

A curious fact, presented by ROCHA, 2014, in a postgraduate monograph, women consult more doctors, about 69% compared to men, which was approximately 43%<sup>9</sup>. However, according to data presented by SINITOX, women have more records of drug poisoning than men<sup>13</sup>.

The evolution of registered cases of human poisoning by toxic agent in Brazil, according to data presented on the SININOX website, the numbers of poisoning caused by medicines, compared to the second most cited which were pesticides, the difference reached approximately 24% higher for medicines. However, the rate of deaths caused by these poisonings was higher for pesticides<sup>14</sup>.

In addition to the indications by family members, neighbors, co-workers, the advertising of medicines has been a frequent stimulus for their inappropriate use. Above all, because it tends to highlight the benefits and minimize the risks and possible adverse effects, giving the impression, especially to the public without any knowledge about medicines and their respective uses, which are presented as innocuous products, influencing consumption if they were any other commodity.

Nowadays, most people know, or at least have notions about what an antibiotic is, and many already compare some drug of this class without a prescription and only on the recommendation of

family or friends. This fact, in addition to putting the health of the patient/user at risk, also disrespects the legislation that regulates the sale of antimicrobials, RDC 20, Anvisa, of May 5, 20117, updated by RDC 471, Anvisa, of February 23, 20218.

Still regarding antimicrobials, the forms were asked about the dosage of these drugs, and the answers obtained are described in Table 2, presented below. It was observed that following the dosage presented in the prescription, only a small percentage follow, this fact may be linked to information, guidance, indication of unqualified people, in short, several factors contribute to this.

Table 2 – Mode of antimicrobial use in the municipalities of Ji-Paraná, Mirante da Serra and Teixeiraópolis

<b>PATHOLOGY</b>	<b>JÍ PARANÁ</b>	<b>MIRANTE DA SERRA</b>	<b>TEIXEIRÓPOLIS</b>
They strictly obey the prescription	30% (30)	22% (11)	26% (13)
Only use until symptoms improve	50% (50)	56% (28)	50% (25)
Can't use it properly	10% (10)	12% (6)	14% (7)
Change the prescription on their own	5% (5)	4% (2)	2% (1)
Associates with anti-inflammatory	5% (5)	6% (3)	8% (4)

Self-medication can have serious consequences for patients/users, such as: undesirable effects and masking of the symptoms of evolutionary diseases. However, many of these users know the results that can occur with the interruption of the prescribed treatment, even so, they put themselves at risk by interrupting the prescribed treatment.

Necessary measures, as a preventive form that can contribute to minimize the risks caused by self-medication and consequently make visible the population's awareness of the dangers of the adverse effects that certain drugs can cause, corroborate the correct use of medication, improving the quality of life of the population.

Administering antimicrobials irrationally can cause bacteria to adapt and multiply, increasing and promoting antibiotic resistance. However, the indiscriminate use of an antibiotic can potentiate the appearance of a resistant bacterial population, making its treatment increasingly difficult.

Antibiotics are powerful drugs against bacteria, and for this reason, they are able to act against infection-causing agents and have been of great use in saving lives worldwide, but their inappropriate use can develop bacterial resistance, putting at risk the treatment options for infections caused by microbial agents. Thus, according to the results presented in this work, antimicrobials may become ineffective or even present modified activity in the fight against infections caused by microorganisms that have become resistant, due to the indiscriminate and inappropriate use of antimicrobials.



## FINAL CONSIDERATIONS

The prevention of bacterial resistance involves multidisciplinary actions focused mainly on the rational use of antimicrobials and the optimization of infection control actions. A fact of great relevance to this discussion is that the population still buys antimicrobials without any type of control, despite the current regulations, due to lack of effective inspection, some people still stop treatment with these drugs before the minimum period of 7 days of treatment recommended by the World Health Organization (WHO), as soon as the symptoms disappear the treatment is interrupted. Despite the WHO recommendations, that antimicrobial treatment should last for 5 days after the end of the fever, however, most users know the risks, but continue to act wrongly, interrupting use before the prescribed period.

The efficiency of antibiotics can be compromised if they are not ingested according to the determined schedule, as the drugs remain in the body for a certain period of time, and their doses must be administered rigorously to maintain the dose. To ensure patient safety, it is essential to raise awareness among the entire population about the risk of irrational use of medicines, especially antimicrobials.

The systemic approach to medication errors is essential in the implementation and improvement of Pharmaceutical Services practices, aiming at greater safety in the health care of the population. The training of professionals, who can safely avoid these abuses and thus promote the transformation towards the development of a safer system, promoting the strengthening of the medication administration process, making them safer and more effective.




## REFERENCES

1. Naves, J. O. S., Castro, L. L. C., Carvalho, C. M. S., & Merchán-Hamann, E. (2010). Automedicação: uma abordagem qualitativa de suas motivações. *\*Ciência & Saúde Coletiva*, 15\*(Supl. 1), 1751-1762.
2. Aminov, R. I. (2010). A brief history of the antibiotic era: Lessons learned and challenges for the future. *\*Frontiers in Microbiology*, 1\*, 134. <https://doi.org/10.3389/fmicb.2010.00134>
3. Organização Pan-Americana de Saúde. (2018). Novo relatório da OMS revela diferenças no uso de antibióticos entre 65 países. OPAS/OMS. Disponível em: <https://www.paho.org/pt/noticias/12-11-2018-novo-relatorio-da-oms-revela-diferencas-no-uso-antibioticos-entre-65-paises>. Acesso em: 23 jul. 2024.
4. Novaretti, M. C. Z., Aquino, S., & Piscopo, M. R. (2014). Controle de vendas de antibióticos no Brasil: Análise do efeito dos atos regulatórios no uso abusivo pelos consumidores. *\*Revista Acadêmica São Marcos*, 4\*(2), 25-39.
5. Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária. (2024). Sistema Nacional de Gerenciamento de Produtos Controlados (SNGPC). Disponível em: <https://www.gov.br/anvisa/pt-br/assuntos/fiscalizacao-e-monitoramento/sngpc>. Acesso em: 23 jul. 2024.
6. Paiva, C. L., Zani, L. B., Duarte, I. D., & Jonis-Silva, M. D. A. (2013). Uso indiscriminado de antibióticos e superbactérias KPC: Temas CTSA controverso no ensino de biologia. *\*Revista Eletrônica Debates em Educação Científica e Tecnológica*, 3\*(1), 32-40.
7. Brasil. Agência Nacional de Vigilância Sanitária. (2011). Resolução de Diretoria Colegiada – RDC nº 20, de 05 de maio de 2011. Dispõe sobre o controle de medicamentos à base de substâncias classificadas como antimicrobianos, de uso sob prescrição, isoladas ou em associação. *\*Diário Oficial da União\**, (seção 1), 39-40.
8. Brasil. Agência Nacional de Vigilância Sanitária. (2021). Resolução de Diretoria Colegiada – RDC nº 471, de 23 de fevereiro de 2021. Dispõe sobre o controle de medicamentos à base de substâncias classificadas como antimicrobianos, de uso sob prescrição, isoladas ou em associação. *\*Diário Oficial da União\**, 85.
9. Spellberg, B., Gidycz, R., & Gilbert, D. (2008). The epidemic of antibiotic-resistant infections: A call to actions for the medical community from the Infectious Diseases Society of America. *\*Clinical Infectious Disease*, 46\*, 155-164.
10. Dandolini, B. W., Batista, L., Souza, L. H. F., Galato, D., & Piovezan, A. P. (2012). Uso racional de antibióticos: Uma experiência para educação em saúde com escolares. *\*Ciência & Saúde Coletiva*, 17\*(5), 1323-1331.
11. Amato Neto, V., Levi, G. C., Lopes, H. V., Mendonça, J. S., & Baldy, J. L. (2000). *\*Antibióticos na prática médica\** (5ª ed.). São Paulo: Roca.
12. Brasil. Ministério da Saúde. (2012). Resolução CNS nº 466, de 12 de dezembro de 2012. Conselho Nacional de Saúde. Disponível em: <https://conselho.saude.gov.br/resolucoes/2012/Reso466.pdf>. Acesso em: 19 jul. 2024.



13. Rocha, A. L. R. (2014). \*Uso racional de medicamento\* [Monografia de Pós-Graduação Lato Sensu, Instituto de Tecnologia de Fármacos – Farmanguinhos/FIOCRUZ]. Rio de Janeiro.
14. Fundação Oswaldo Cruz. (2017). SINITOX: Sistema Nacional de Informação Tóxico-Farmacológico. Disponível em: <https://sinitox.iciet.fiocruz.br/>. Acesso em: 20 jun. 2020.

## Obstetric violence and the multidisciplinary team

 <https://doi.org/10.56238/sevened2024.016-028>

Isabelle Melo Martins<sup>1</sup>

---

### ABSTRACT

Obstetric violence is a broad, complex and multifaceted public health problem, which causes economic impacts and morbidity and mortality rates in women, generating many victims with physical and emotional sequelae, often permanent. Currently, there are high rates of obstetric violence in the care sectors for these women. The deficit in the training of health professionals on this topic compromises the reduction of cases of this type of violence. Learning about the recognition, prevention and notification of obstetric violence improves health professionals about obstetric violence. This chapter presents information on the rights of parturients, the identification of obstetric violence, and the prevention of obstetric violence, with the objective of training health professionals about obstetric violence and impacting the perception of obstetric violence, consequently improving the quality of obstetric care.

**Keywords:** Obstetric Violence, Health Education, Women's Health.

---

<sup>1</sup> Nurse Master in Health Care Practice  
Federal University of Ceará  
E-mail: [isabelle\\_martins\\_@hotmail.com](mailto:isabelle_martins_@hotmail.com)  
ORCID: <https://orcid.org/0000-0002-4455-0499>





## INTRODUCTION

Violence is a broad and multifaceted public health problem, which has a great impact on society, generating victims and resulting in physical and emotional sequelae, often permanent (SOUTO et al., 2017).

Women are a large group of people vulnerable to violence, and violence directed at this group is considered gender-based, usually practiced by those who have the greatest share of power in a relationship and transform this power into a hierarchical relationship.

The expression gender violence emerged in the 1990s in order to give visibility to violence committed against women (HASSE, 2016).

In this group there is a specific type of violence, obstetric violence, which are violent actions that harm women's health during the phases of pregnancy, childbirth and puerperium, proving to be another type of gender violence (BRITO, OLIVEIRA and COSTA, 2020).

It is also institutional violence, as it occurs in institutions that provide health care, and violence is carried out by health professionals (LIMA, 2019).

Thus, any type of negligence or abuse in care, social discrimination, verbal violence (rude treatment, threats, reprimand, yelling, intentional humiliation), interventions practiced without explicit and informed consent, physical violence, and sexual abuse with pregnant women, parturients, or postpartum women during obstetric care is characterized as obstetric violence (PAIVA et al., 2022).

BRANDT et al. (2018) reveal that one in four women who have already experienced childbirth have suffered some form of obstetric violence at least once during their lives.

The types of obstetric violence that most women suffer in health services are: verbal violence, omission of health care, physical and psychological violence (OLIVEIRA et al, 2020).

In 2022, in Santa Catarina, the Law that provides for Public Policies to Combat Violence Against Women was sanctioned and measures were implemented to inform and protect pregnant and parturient women against obstetric violence, characterizing the practices of obstetric violence, aiming at their knowledge and eradication (SANTA CATARINA, 2022).

In view of this theme, the importance of studies, training and guidance of multidisciplinary health professionals on the identification and combat of obstetric violence is perceived.

Orso et al. (2021) report that many professionals are unaware of the term obstetric violence.

Multidisciplinary health professionals play an important role in reducing the practice of violence in the obstetric field due to their work during the clinical phases of the prepartum, childbirth, and puerperium process, both vaginal and cesarean section (ISMAEL et al., 2020).



The Code of Ethics for Nursing Professionals - CEPE, Resolution No. 564/2017, Chapter I – Rights – in its Article 6 and the Code of Ethics for Medical Professionals establish that it is the right of health professionals to improve their technical, scientific and cultural knowledge (COFEN, 2020).

In view of this, multidisciplinary health professionals must always be looking to improve their skills.

In addition, to ensure care that respects and meets the needs of women, it is essential that multidisciplinary health professionals who provide care to victims of violence in the obstetric field exercise and recognize their role in the face of cases, helping to reduce resistant attitudes regarding the recognition of this process and carrying out health education actions (SOUSA et al., 2021).

The authors Martins and Macedo (2024) produced a training guide for professionals on violence in the obstetric field, which can be a search material for the improvement of multidisciplinary health professionals.

The training of multidisciplinary health professionals is essential for a good development of the work process and should provide understanding capable of impacting care practice (GRAY et al., 2019).

Antunes and Martins (2022) report that the insertion of obstetric nurses in the care of parturients generates a reduction in interventionism in low-risk normal childbirth and an increase in the performance of practices based on scientific evidence, which is also a WHO recommendation.

It should also be noted that multidisciplinary health professionals must respect their Codes of Ethics regarding their responsibilities and duties with the profession, exercising the profession with justice, commitment, equity, problem-solving, dignity, competence, responsibility, honesty and loyalty, and basing their relationships on law, prudence, respect, solidarity and diversity of opinion and ideological position, in addition to communicating to its corresponding professional councils and competent bodies, facts that infringe legal provisions and that may harm professional practice (COFEN, 2020).

In view of this, it is believed that the debate and training on obstetric violence by multidisciplinary health professionals are essential for the evolution of the protection of women's rights in childbirth, but that it still requires expansion, better applicability, and greater space for the dissemination of information, in order to enable its prevention, in order to promote the physical and mental well-being of these women and humanized care throughout the prepartum process. childbirth and puerperium, through the implementation of campaigns and improvement courses aimed at combating this violence (SOUSA et al., 2021).

This chapter confirms that it is possible to foster studies to support the knowledge of professionals about obstetric violence, as well as to stimulate education with the use of technologies that enable innovation, open knowledge and free access, considering that multidisciplinary health



professionals who participate in improvement and qualification courses in a given practice have higher levels of perception than those who have never undergone any training.




## REFERENCES

1. Souto, R. M. C. V., et al. (2017). Perfil epidemiológico do atendimento por violência nos serviços públicos de urgência e emergência em capitais brasileiras, *Viva 2014. \*Ciência & Saúde Coletiva*, 22\*(9), 2811-2823. Disponível em: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S1413-81232017002902811&lng=pt&nrm=iso](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-81232017002902811&lng=pt&nrm=iso). Acesso em: 13 jun. 2022.
2. Hasse, M. (2016). *\*Violência de gênero contra mulheres: em busca da produção de um cuidado integral\** (Dissertação de Mestrado, Escola de Enfermagem de Ribeirão Preto da Universidade de São Paulo). Disponível em: <https://www.teses.usp.br/teses/disponiveis/83/83131/tde-13022017-204029/pt-br.php>. Acesso em: 05 ago. 2022.
3. Brito, C. M. C. de, Oliveira, A. C. G. de A., & Costa, A. P. C. de A. (2020). Violência obstétrica e os direitos da parturiente: O olhar do poder judiciário brasileiro. *\*Cadernos Ibero-Americanos de Direito Sanitário*, 9\*(1). Disponível em: <https://doi.org/10.17566/ciads.v9i1.604>. Acesso em: 23 jun. 2022.
4. Lima, T. M. M. de. (2019). *\*Violência obstétrica: As disputas discursivas e a luta das mulheres\** (Tese de Doutorado, Universidade Federal de Pernambuco). Disponível em: <https://repositorio.ufpe.br/handle/123456789/33886>. Acesso em: 05 jun. 2022.
5. Paiva, A. de M. G., Pereira, A. M. M., Dantas, S. L. da C., Rodrigues, A. R. M., Silva, F. W. O. da, & Rodrigues, D. P. (2022). Representações sociais da violência obstétrica para puerperas e profissionais da saúde: Análise fatorial de correspondência. *\*Cogitare Enfermagem*, 27\*, 75198. Disponível em: <https://www.scielo.br/j/cenf/a/QwjYXhTt8BKBzhqcn3RRLqv/abstract/?lang=pt>. Acesso em: 03 ago. 2022.
6. Brandt, G. P., Souza, S. J. P. D., Migoto, M. T., & Weigert, S. P. (2018). Violência obstétrica: A verdadeira dor do parto. *\*Revista Gestão e Saúde*, 19\*(1), 19-37. Disponível em: <https://www.herrero.com.br/revista/19/01>. Acesso em: 05 maio. 2022.
7. Oliveira, M., et al. (2020a). Mulher e parto: Significados da violência obstétrica e a abordagem de enfermagem. *\*Revista Enfermagem UFPE Online\**. Disponível em: <https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1096980>. Acesso em: 11 ago. 2022.
8. Santa Catarina. (2022). Lei Nº 18.322, de 05 de janeiro de 2022. Consolida as Leis que dispõem sobre Políticas Públicas de Enfrentamento à Violência Contra as Mulheres. Santa Catarina: Assembleia Legislativa de Santa Catarina. Disponível em: [http://leis.alesc.sc.gov.br/html/2022/18322\\_2022\\_lei.html](http://leis.alesc.sc.gov.br/html/2022/18322_2022_lei.html). Acesso em: 17 jun. 2022.
9. Orso, L., et al. (2021). Violência obstétrica: Experiência da equipe multidisciplinar em saúde. *\*Revista Enfermagem UFPE Online\**. Disponível em: <https://periodicos.ufpe.br/revistas/revistaenfermagem/article/view/246960/39477>. Acesso em: 03 ago. 2022.
10. Ismael, F. M., Souza, G. K. R., Esteves, N. S., & Aoyama, E. D. A. (2020). Assistência de enfermagem na prevenção da violência obstétrica. *\*Revista Brasileira Interdisciplinar de Saúde\**. Disponível em: <https://revistarebis.rebis.com.br/index.php/rebis/article/view/92>. Acesso em: 05 jun. 2022.



11. Conselho Federal de Enfermagem (COFEN). (2020). \*Código de Ética dos Profissionais de Enfermagem\*. Disponível em: [http://www.cofen.gov.br/wp-content/uploads/2012/03/resolucao\\_311\\_anexo.pdf](http://www.cofen.gov.br/wp-content/uploads/2012/03/resolucao_311_anexo.pdf). Acesso em: 03 jun. 2022.
12. Sousa, M. P. V. D., Santos, L. S. A., Caldas, G. R. F., Batista, F. A. M., & Lopes, C. R. da S. (2021). Violência obstétrica: Fatores desencadeantes e medidas preventivas de enfermagem. \*Revista Nursing (São Paulo), 24\*(279), 6015-6024. Disponível em: <https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1343402>. Acesso em: 09 jul. 2022.
13. Martins, I. M., & Macedo, L. C. (2024). \*Capacitação profissional acerca da violência obstétrica: Pelo combate à violência\*. Fortaleza: IMAC.
14. Gray, T., Mohan, S., Lindow, S., & Farrell, T. (2019). Obstetric violence: Clinical staff perceptions from a video of simulated practice. \*European Journal of Obstetrics & Gynecology and Reproductive Biology: X, 1\*. Disponível em: <https://www.sciencedirect.com/science/article/pii/S2590161319300432>. Acesso em: 05 ago. 2022.
15. Antunes, M. D. C., & Martins, W. (2022). Nursing assignments in the face of obstetric violence. \*Revista Científica Multidisciplinar, 3\*(8). Disponível em: <https://recima21.com.br/index.php/recima21/article/view/1793/1389>. Acesso em: 08 jul. 2022.

## Intersectorality, the health of the elderly and the exercise orientation service: A documental analysis

 <https://doi.org/10.56238/sevned2024.016-029>

Leonardo Perovano Camargo<sup>1</sup> and Carlos Nazareno Ferreira Borges<sup>2</sup>

### ABSTRACT

The Health Academy Program, instituted by Brazilian Ministry of Health's in 2011, had its origins in some previous municipal programs, like the Exercise Orientation Service (SOE) from Vitória/ES, implanted in 1990. The population aging is a worldwide phenomenon that requires adaptations in the public policies for the elderly population. The National Health Promotion Policy points to intersectorality as an institutional element and form of management that enhances public health services. In addition, social participation, one of the elements of intersectorality, is as a relevant aspect for the protection and promotion of active life for the elderly. Thus, despite the pioneering of SOE as public policy for health promotion, still not clear how the intersectorality influence the management of the program. Thus, this study aimed to analyze the elements of intersectorality, through a documentary analysis, related to the health of the elderly population, inside the Exercise Orientation Service (SOE). Richardson's documentary analysis was used as the methodology of research. Among Dye's models of political analysis, the beginning of SOE were classified as the elite model and currently acting as the incremental model, which are variations on the past, applying small improvements in already consolidated policies, to avoid political conflicts and spending on new or large reformulations. It is concluded that SOE, despite being a vanguard public policy and national reference, still has incipient intersectoral relations, classified as horizontal governmental articulations, which is an embryonic intersectorality, opening way to build a public policy with more reach and quality.

**Keywords:** Exercise, Intersectoral Collaboration, Public Policy, Aging, Unified Health System.

---

<sup>1</sup> PhD in Physical Education - Federal University of Espírito Santo-UFES

<sup>2</sup> PhD in Physical Education - Federal University of Pará - UFPA



## INTRODUCTION

The Brazilian Federal Constitution of 1988<sup>1</sup> provided legal bases for the search to fulfillment of social rights of the population, being subsequently concretized in public policies, some as State Policies (constitutional policies, with mandatory compliance by the elected government, as an example in health, the Unified Health System - SUS) and other as Government Policies (specific mandate actions).

Currently, a phenomenon that has been occurring in the world in general is found, which is the increase of life expectancy and the fall of fertility rate, promoting the aging of the world population<sup>2</sup>.

The scientific evolution and the search for expanded access to opportunities for the elderly, takes place in two branches that consider the analysis of the aging process: geriatrics and gerontology. While geriatrics is a branch dedicated to the medical problems of the elderly, gerontology is a field of multidisciplinary studies on the aging process, and which takes into account biological, educational, psychological, sociological, geographical factors, among many others<sup>3</sup>.

Despite this generalist definition, elderly cannot receive a single classification that disregards the life history, current lifestyle, and also the community and society in which they are inserted. Thus, Veras<sup>4</sup> advises that "it is not possible to establish universally acceptable concepts and a globally standardized terminology for aging, there are political and ideological connotations associated with the concept, which can be better viewed inside specific societies."

Starting with the specific case of the municipality of Vitória, capital of the state of Espírito Santo, a mapping was produced<sup>5</sup> where the Exercise Orientation Service (SOE) appears as the oldest Public Policy among those listed. SOE has a good population coverage and, although it is not aimed exclusively for elderly, these age group is one of the main target of the program.

The alliance between physical activity and health is seen almost as a social consensus. In Brazil, this occurs especially through the medical discourse that presented Physical Education as a synonym for physical activity and health, through the disclosure of habits of a hygienist characteristic, and as a means of eugenizing the Brazilian race and the construction of youth morality<sup>6</sup>.

The implementation of SUS enabled an expanded the view of health in Brazil, with an indication of decentralization in the actions of this portfolio<sup>7</sup>. This decentralization, combined with intersectoriality (as a new management strategy) enabled the participation of different sectors of civil society with the State. The municipality, allied in different levels, started to meet the population's health demands<sup>5</sup>.



Decentralized and intersectoral management proposes to improve the quality of life of the citizens, offering better services and inviting them to participate in the process of implementing Public Policies. Thus, interventions have an integrated and equitable characteristic<sup>8</sup>.

The expansion of the discourse of 'physical activity, equal to health, which is equal to Physical Education', is not a negation of the relationship between these factors, since several authors have found a beneficial relationship between physical activity, body practice, health and Physical Education, to the point of being important tools in the area of public health<sup>9</sup>.

Speaking of intersectorality, Junqueira<sup>8,10,11,12</sup> shows that the approach to social problems in an expanded way, taking into account multifactorial issues and analyzing them in an integrated way, enables a strategy of excellence and efficient public administration. Health, being a social right, has State actions in different spheres that end up acting on citizen's rights. Therefore, it is necessary to analyze these actions in Public Health Policies, and also to count on social participation as an essential element in the exercise of citizenship<sup>5</sup>.

Intersectorality as a new form of management seeks the elimination of bureaucracy and greater contact with the population, seeking to ensure greater efficiency in actions. The main characteristic of decentralization in the social sphere is social participation in supporting decision making, thus sharing responsibilities with the State. In the political sphere, it provides the distribution of power to peripheric levels of governance<sup>13</sup>.

Thus, despite being a new form of management, transferring decision-making power to municipalities in the interrelationship between departments and possibilities for popular participation, there are difficulties in implementing this management model. It is known that Brazil, as a country of continental dimensions, brings with it, different issues, such as economic, cultural, social particularities, which directly impact on the success or failure of the application of new management strategies.

Therefore, the objective of this study is to analyze the elements of intersectorality, through a documentary analysis, related to the health of the elderly population, inside the Exercise Orientation Service (SOE). This analysis may assist in the evaluation and planning of policies more aligned with constitutional rights and building more rational analysis tools.

SOE started with a 1985 law and municipal decree<sup>14</sup>, which instituted the Exercise Physiology Orientation Service (SORFE), dictating the locus of initial activity (which would be the 'Leisure Bathing Zones', understood by the beaches of Camburi, Enseada Frade and Enseada do Suá).

The results of pre and post intervention evaluations of physical activity programs such as SOE and others municipal programs from Recife/PE, Belo Horizonte/MG and Curitiba/PR, revealed health benefits for the health of the participants and territories. In addition to increasing access to leisure activities, studies have shown an improvement in the use of urban spaces. Moreover, the





points best evaluated by users were the 'quality of professionals' and the 'quality of activities', getting the worst assessments in 'quality of structures' and 'safety of the site'<sup>15</sup>.

The results of the evaluations were positive, leading the Ministry of Health, at the federal level, to institute the Health Academy Program in 2011. The pillars of this program are Social Participation and Intersectoriality, based on the conceptual concept of the international Health Promotion movement, the 1988 Federal Constitution and the SUS guidelines of 1990.

In this context, once SOE is considered similar to Health Academy Program, it wasn't necessary to promote structural changes, what can be considered a advantage for being one of the inspiring projects.

## **METHODS**

The methodological option to achieving the research objectives was the documental analysis proposed by Richardson<sup>16</sup>.

Documental analysis is part of content analysis, which is a broader form of analysis of these human communications. Thus, it makes it possible to study or analyze documents (written records, laws and decrees) in the search for social and / or economic circumstances for the construction of meaningful relationships.

During the production of the data for this research, an analysis of the documents was performed using a quantitative and then descriptive analytical matrix, in search of meanings, using the following descriptors: 'Physical Education', 'Elderly', 'Body Practices' (Dance, Martial Arts / Fights, Sports, Gymnastics and Games), 'Health', 'Leisure' and 'Intersectoriality' (Articulation, integration and Interdisciplinarity).

The procedure of this analysis was the search for the occurrences of these descriptors, in digital files of PDF (Portable Document Format) type, of the analyzed laws: Federal Constitution of 1988, Statute of the Elderly, Organic Law of Vitória-ES and Law / Decree of SOE institution . The numbers of occurrences of each of the descriptors were noted, and in the sequence, the sections where the occurrences were identified.

The subsequent treatment of the data, presents the interpretative relationship of the selected excerpts with the concepts found in the literature, in order to understand the actions found in the documents as Public Policies. The strategy then allowed the analysis of actions as Public Policies and verification of the occurrence of intersectoriality, or the possibility of intersectoral relations as well as their consequences.



## RESULTS AND DISCUSSION

The documentary analysis was carried out, with three documents already found in digital format (Federal Constitution<sup>1</sup>, Statute for the Elderly<sup>17</sup>, and the Organic Law of Vitória<sup>18</sup>) and two scanned documents<sup>14</sup> that were digitalized for the research by descriptors in the Adobe Reader software. After the first phase of searching only for the words directly and as they are written, a second phase of searching for meanings was carried out. In this phase, the excerpts found should have a significant relationship with the research theme to be selected.

The descriptor 'intersectoriality' was not found directly (requiring the semantic interpretation of passages similar to the concept in analysis) in none of the analyzed documents. A possible justification for the absence of the exact term is the period in which the documents were written, that is, intersectoriality is considered a management option that has been most discussed and applied recently. The Federal Constitution is from 1988, the Organic Law of Vitória is from 1990 and the Law and Decree of the SOE are from 1985. The Statute of the Elderly is from 2003, that although not so old, also does not present the term directly analyzed.

In article 214 of the federal constitution, the articulation and integration of various spheres of the Public Power, at different levels of education, is mentioned, making a proposal of intersectoriality in favor of education: 'the law will establish the national plan of education, of multiyear duration, aiming at the articulation and development of education at its different levels and the integration of public authority actions'<sup>1</sup>. Despite the scope of this section, the creation of a 'national youth plan' is mentioned in the second paragraph, a fact that deserves attention, by excluding elderly individuals from that plan.

In the case of the Organic Law of Vitória, it is noted that there is an intention in the text to promote intercity partnerships in article 3, when we read in the document that: 'the Municipality of Vitória will seek the economic, political, social and cultural integration of the populations of neighboring municipalities and those under the influence of the hydrographic basins of the Jucu and Santa Maria rivers, which supply it'<sup>18</sup>.

Article 19 of the same law mentions the integration of disadvantaged individuals, in which the intention is: 'to combat the causes of poverty and the factors of marginalization, promoting the social integration of disadvantaged sectors'<sup>18</sup>. Still in the Organic Law of the municipality, article 151 reads about the incentive to intersectoriality between policies, made possible by: 'complementarity and integration of policies, plans and sectoral programs'<sup>18</sup>. In article 247 it is established that they will be articulated between different portfolios, the following actions: 'the Municipal Government will support and encourage amateur sports linked to the area of education and culture, as well as leisure, as a form of social integration'<sup>18</sup>. It is also read that sports and leisure activities should be offered to the elderly, with the objective of achieving 'social integration in the elderly': 'The Municipality will



encourage special sports and leisure activities for the elderly, as a way of promoting and social integration in old age<sup>18</sup>.

The section of the Organic Law that talks about integrating disadvantaged sectors ends up in conflict with the SOE's original documents, which establish that: 'Leisure Areas are established on the beaches of the urban area of Vitória'; that 'constitute the Leisure Bathing Areas of the Municipality of Vitória: Praia de Camburi; Aterro Beach of Enseada do Frade; Praia do Aterro da Enseada do Suá'<sup>14</sup>. It seems to us that when prioritizing beaches in prime areas of the municipality, SOE ends up fitting as a policy in the elite model, proposed by Dye<sup>19</sup>.

The elite model essentially aims at policy formulation, legislation and regulation, focusing more on the benefits of the economically privileged strata. Assuming that society is divided between the few with power and the many that do not, these few who govern do not typically represent the masses that are governed.

The same model also states that to maintain stability between the layers, some concepts are implemented, such as 'meritocracy', in addition to proposing the basic consensus of the social system to preserve the system, such as respect for private property, the delimitation of the government and individual freedom. In this model, Public Policies reflect the values of the elite and, thus, the 'changes' in policies and governments only contribute to increasing what is already in place<sup>19</sup>.

The SOE, as previously mentioned, is used mainly by the elderly population, perhaps for this reason, the incentive to sports and leisure activities for social integration are offered. However, no statistical data were found to demonstrate the reach of meeting the policies for the elderly population, in order to fully comply with the legal guidance for the right of each and every one.

It ends up being odd to offer these activities mainly in upscale areas of the city, when there is more need in the periphery. A possible cause for this situation may be the historical question of linking the rights of the elderly to the right of the worker, the one who produced capital, and not as a social issue, of the 'right of the aging person'<sup>20</sup>.

Next, the descriptor 'health' appears very frequently in the analyzed legislation, both in the Constitution, in the Statute and in the Organic Law. However, in a curious way the term health does not appear in the SOE Decree and Law, the program is directly linked to the municipal Health Department. Even with the law presenting formal equality to all, it is known that access to health is unequal, depending on the health system, on factors such as' income, housing and social and environmental conditions'<sup>20</sup>.

The World Health Organization (WHO) thinks about promoting the specific health of the elderly by citing "the process of optimizing opportunities for health, participation and safety with the aim of improving the quality of life as people get older"<sup>21</sup>. In this case, there is a need to think, in addition to financial investments in Public Policies and the training of the professionals involved,



new ways of managing these policies, moving from fragmented and centralized views to intersectoral models of political action. In addition to these issues related to intersectorality, it must be considered that this strategy is no longer a management option, since it was institutionalized since the creation of the National Health Promotion Policy in 2006<sup>22</sup>.

Within the models of analysis by Dye<sup>19</sup>, the beginning of the action is classified as the elite model, by establishing the SOE within bathing leisure areas, which would be beaches in prime areas of the city. The public option appears as a risk model of partnership with the private sector, pointing out that individuals act for their own benefit, including in public spheres, in which the concern for social welfare was expected. One of the best options would be the rational model, which is decision making based on data, with the objective of better corporate gain. However, it is concluded that the policies operate in general, including the SOE, with the incremental model, which are variations on the past, applying small improvements in already consolidated policies, to avoid political friction and spending on new or major reformulations.

## CONCLUSIONS

The results of the study points that SOE has incipient intersectoral relations, despite being a program that tries to align with health promotion trends.

Through the revised literature, it was noticed that intersectoral relations appear to enhance the actions of guaranteeing the rights of individuals, thus being a path to be followed by Public Policies for health promotion.

The embryonic discussion carried out allows us to state that despite the scenario found, SOE can still be considered one of the models for the creation of Public Policies, since it was an inspiration for the 'Academia da Saúde'.

Studies relating health and the elderly, leisure and the elderly, sports and the elderly, Public Policies and the elderly become increasingly relevant in a society that becomes proportionately older and longer-lived. It is that when perceiving the worldwide phenomenon of increased life expectancy and falling fertility rate, which results in population aging, it is also noticed that Public Policies need to adapt to offer better services, with more population reach and higher quality in interventions.

It appears that people no longer age in isolation, but that the entire populations of nations are experiencing this phenomenon collectively, a fact that is observed even in countries considered young. This suggests creative and advanced forms of management.

It is concluded that the SOE, despite being announced as a vanguard Public Policy and national reference, still has incipient intersectoral relations, classified as horizontal governmental articulations<sup>23</sup>. These articulations demonstrate an embryonic intersectorality, paving the way for the construction of a Policy Public with more reach and quality. There is the possibility of expanding



services for the elderly in the poorest regions and inviting them to social participation within the formulations. First because they are less traditionally served, second because they are entitled, and finally because this is one of the most interesting characteristics of intersectorality.



## REFERENCES

1. Brasil. (1988). \*Constituição da República Federativa do Brasil\*. Brasília, DF: Senado.
2. Ramos, L. R. (2003). Fatores determinantes do envelhecimento saudável em idosos residentes em centro urbano: Projeto Epidoso, São Paulo. \*Cadernos de Saúde Pública, 19\*(3), 793-798.
3. Isayama, H. F., & Gomes, C. L. (2008). Lazer e as fases da vida. In N. C. Marcellino (Org.), \*Lazer e sociedade: Múltiplas relações\* (pp. 155-174). Campinas: Alínea.
4. Veras, R. (2009). Envelhecimento populacional contemporâneo: Demandas, desafios e inovações. \*Revista de Saúde Pública, 43\*(3), 548-554.
5. Bachetti, J. R. (2014). \*Limites e possibilidades da educação física nas políticas públicas de saúde de Vitória - ES\* (Dissertação de mestrado). Universidade Federal do Espírito Santo, Vitória.
6. Abreu Junior, L. M., & Carvalho, E. V. (2012). O discurso médico-higienista no Brasil do início do século XX. \*Trabalho, Educação e Saúde, 10\*(3), 427-451.
7. Venturim, L. F. (2011). \*Análise de políticas públicas de esporte e lazer a partir da intersetorialidade: O caso do programa esporte e lazer da cidade (PELC) em Vitória\* (Dissertação de mestrado). Universidade Federal do Espírito Santo, Vitória.
8. Junqueira, L. A. P. (2004). A gestão intersetorial das políticas sociais e o terceiro setor. \*Saúde e Sociedade, 13\*(1), 25-36.
9. Ferreira, M. S. (2001). Aptidão física e saúde na educação física escolar: Ampliando o enfoque. \*Revista Brasileira de Ciências do Esporte, 22\*(2), 41-54.
10. Junqueira, L. A. P. (1997). Novas formas de gestão na saúde: Descentralização e intersetorialidade. \*Saúde e Sociedade, 6\*(2), 31-46.
11. Junqueira, L. A. P. (1998). Descentralização e intersetorialidade na construção de um novo modelo de gestão. \*Revista de Administração Pública, 32\*(1), 11-22.
12. Junqueira, L. A. P. (2005). Articulações entre o serviço público e o cidadão. In \*Anais do X Congreso Internacional del Clad sobre la reforma del estado y de la administración pública\*, Santiago, Chile.
13. Guimarães, M. C. L. (2002). O debate sobre a descentralização de políticas públicas: Um balanço bibliográfico. \*Organizações & Sociedade, 9\*(23), 1-17.
14. Vitória. (1985). Lei 3267/85 e Decreto 7092/85, de 09 de julho de 1985. Instituem o Serviço de Orientação da Fisiologia do Exercício e dá outras providências. \*Diário Oficial PMV\*, 09 de julho de 1985.
15. Brasil. (2013). \*Avaliação de efetividade de programas de educação física no Brasil\* [recurso eletrônico]. Ministério da Saúde, Secretaria de Vigilância Sanitária em Saúde, Departamento de Análise de Situação em Saúde. Brasília: Ministério da Saúde.
16. Richardson, R. J. (1999). \*Pesquisa social: Métodos e técnicas\* (3ª ed.). São Paulo: Atlas.

Aqui está a continuação das referências em formato APA com a numeração sequencial:



17. Brasil. (2003). Lei n. 10.741, de 1º de outubro de 2003. Dispõe sobre o Estatuto do Idoso e dá outras providências. \*Diário Oficial da União\*, 1 de outubro de 2003.
18. Vitória. (1990). Lei orgânica do município de Vitória, Estado do Espírito Santo, de 05 de abril de 1990. \*Diário Oficial PMV\*, 05 de abril de 1990.
19. Dye, T. R. (2005). Models of politics: Some help in thinking about public policy. In T. R. Dye, \*Understanding public policy\* (11ª ed.). New Jersey: Prentice Hall.
20. Faleiros, V. P. (2008). Direitos da pessoa idosa: Sociedade, política e legislação. In B. Dantas et al. (Orgs.), \*Constituição de 1988: O Brasil 20 anos depois\*. Brasília: Senado Federal.
21. Organização Pan-Americana de Saúde. (2005). \*Envelhecimento ativo: Uma política de saúde\*. Brasília: Organização Pan-Americana de Saúde.
22. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde, Secretaria de Atenção à Saúde. (2006). \*Política Nacional de Promoção da Saúde\*. Brasília: Ministério da Saúde.
23. Farah, M. F. S. (2001). Parcerias, novos arranjos institucionais e políticas públicas no nível local de governo. \*Revista de Administração Pública\*, 35\*(1), 119-145.

REALIZATION:

**SEVEN**  
publicações acadêmicas

ACCESS OUR CATALOGUE!



[WWW.SEVENPUBLI.COM](http://WWW.SEVENPUBLI.COM)

CONNECTING THE **RESEARCHER** AND **SCIENCE** IN A SINGLE CLICK.