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Replica of the Trevi Fountain in Serra Negra city, state of São Paulo
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Hostages to Social Networks and Mental Health

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The Oxford dictionary's word of the year for 2024, "brain rot," refers to the perceived deterioration of mental or intellectual abilities caused by excessive consumption of material—especially online content—that is trivial or not very challenging. The emblematic choice of this word draws attention to a disastrous reality that affects a large portion of the world's population, posing serious risks to mental health and emotional balance. However, this expression is not new; it dates to 1854, when Thoreau, in his book *Walden*, criticized the tendency to devalue complex ideas—those open to multiple interpretations—in favor of simple ones, indicating intellectual decline.[1]

In recent decades, social networks usage among adolescents and young adults has risen dramatically, rising from 12% in 2005 to 90% by 2015.[2] During the COVID-19 pandemic, this trend further intensified as people turned to social media as a coping mechanism during lockdown. By 2022, of the world's 7.91 billion people, 4.62 billion were active social networks users, spending an average of 6 hours and 58 minutes online daily, with 2 hours and 27 minutes specifically on social networking platforms.[3]

Brazil ranks second globally in terms of screen time, with Brazilians spending 56% of their day online—second only to South Africans, who spend 58.2% of their day on digital activities. Among the nine hours that Brazilian Internet spend **online each day**, four are dedicated to platforms such as Instagram, Facebook, TikTok, and X.[4]

The increasing use of social networks often leads to non-adaptive behaviors, collectively referred to in scientific literature as problematic use of social networks (PUSN), which manifests itself through various cyber behaviors, including:

- *Internet gaming disorder*: Recognized as a mental illness by the World Health Organization and included in the 11th International Classification of Diseases (ICD-11).[5] Symptoms includes prioritizing electronic games over other activities and losing control over their use, whether on a cell phone, computer, or video game.
- *FoMO ("Fear of Missing Out")*: Characterized by the anxiety stemming from the possibility of not participating in rewarding online experiences, leading individuals to feel compelled to constantly monitor their online social interactions.
- *Nomophobia ("No Mobile Phobia")*: Describes the anxiety experienced when being without a cell phone or disconnected from technology.
- *Phubbing* ("phone" + "snubbing"): Ignoring face-to-face social interaction in favor of using a cell phone.
- *Digital addiction, technology addiction, or digital dependence*: Involves excessive, compulsive use of electronic devices, negatively impacting daily activities.
- *Phantom text syndrome*: Reflects insecurity in virtual relationships, often characterized by distress when a response to a message is not immediate.
- *Phantom ringing*: The sensation of hearing or feeling ringtones and vibrations from a cell phone when the device is silent or absent.
- *Cyberchondria*: A compulsive tendency to search for symptoms and diseases online, often leading to exaggerated or irrational health concerns.
- *Selfitis*: An obsession with repeatedly taking selfies and sharing them on social networks, often reflecting a need for self-promotion.

- *Digital nausea*: Includes symptoms like disorientation, dizziness, and nausea caused by excessive interaction on social networks.
- *Digital decision fatigue*: The mental exhaustion and overload resulting from the constant decisions required during online interactions.
- *Facebook depression*: A term introduced by the American Academy of Pediatrics to describe symptoms of depression observed in children and adolescents who spend excessive time on social networks.[6]

The boundary between frequent, non-problematic use and problematic, potentially addictive use of social networks are often subtle. For instance, *FoMO* can lead to habits that gradually evolve **into addiction**, while Nomophobia, initially can be a way to stay connected, can also foster addictive behaviors.

Mental Health and Social Networks

Social networks promote identity formation and the development of virtual connections, regardless of physical distance. However, they can negatively affect mental health through unwanted feedback, lack of social validation, and negative comparisons. These effects are directly proportional to the frequency of network use and are often linked to sensitivity about personal appearance.[7]

In addition, reliance on technology can impoverish social skills, which are increasingly sacrificed in favor of continuous digital engagement. Shortened attention spans and reduced capacity for information retention have led to individuals being described as *"alone together"*: although connected through technology, they remain isolated in reality.[8]

The symptoms associated with excessive online engagement often resemble those of chemical dependency. The first literature review on social network addiction, published in 2011,[9] marked a significant milestone in the study of this phenomenon, as research in this field has advanced rapidly since.

Excessive use of social networks by young adults has been associated with lower self-esteem, reduced subjective well-being, and decreased levels of satisfaction with life over time.[10] Younger generations are particularly vulnerable in developing this addiction, with differing generational perceptions further complicating this issue. Young people often perceive their extensive network use as less problematic than their parents do, viewing it instead as a way of being independent from psychopathological symptoms.

Social networks are frequently used to escape negative emotions, making individuals more vulnerable to anxiety and depression.[11] A preference for digital socialization also increases the risk of developing social phobia, while cyberbullying exacerbates anxiety and depressive symptoms. Consequently, excessive use of social networks is a strong predictor of depression and poor social connections.

Self-harm, a common symptom of psychiatric disorders in adolescents and young adults, spans a continuum between non-suicidal acts and suicidal ideation. Social networks can expose young people to various methods of self-harm and suicide, creating an alarming sense of helplessness and hopelessness.

Digital Wellbeing

Neuroplasticity in the brain is shaped by environmental stimuli and how they are processed. The impact is not so much about the technology we use but how we use it: whether for learning, problem solving, or creative expression, we are stimulating positive neuroplasticity, which connects and keeps the neurons active. However, passive, repetitive, or superficial use promotes negative neuroplasticity, weakening these connections.[12]

JoMO, the acronym for "Joy of Missing Out," represents the pleasure of intentionally opting out activities or a philosophy of not "getting carried away" by the addictive pull of social networks—contrasting with FoMO.[12] This more conscious and relaxed mindset encourages satisfaction with personal choices, even when missing out on social events. *JoMO* emphasizes avoiding constant comparison with others, prioritizing personal goals, values, and enjoying one's own company without reliance on external validation.

Psychoeducation plays a vital role in helping individuals make informed choices regarding media consumption. Early interventions often incorporate behavioral approaches to address excessive or addictive use. Among non-pharmacological treatments for Internet addiction, cognitive-behavioral therapy (CBT) shows the strongest evidence of effectiveness.[13] Unlike substance addiction, treatment for Internet addiction focuses on control rather than abstinence, as the Internet use is deeply integrated into daily life.[14] Therapy emphasizes on establishing balanced use and increasing awareness of the risks associated with media overuse.

Currently, there is limited evidence supporting pharmacological treatments for social network addiction and other forms of problematic Internet use. Existing research has explored the potential benefits of medications used for other addictions and impulsive-compulsive disorders. Antidepressants and stimulants may alleviate compulsive internet use and online gaming disorders.[15,16] Additionally, glutamate modulators and opioid receptor antagonists show promise in treating certain behavioral addictions.[17,18]

Future research could explore neuromodulator treatments, such as transcranial magnetic stimulation, which have proven beneficial in other contexts.[19] However, pharmacological treatment becomes necessary when psychiatric conditions such as depression and anxiety coexist with problematic social network use.

REFERENCES

1. Oxford University Press. 'Brain rot' named Oxford Word of the Year 2024. Available from: https://corp.oup.com/news/brain-rot-named-oxford-word-of-the-year-2024/. Accessed in 2024 (Nov 20).

2. Perrin A. Social media usage: 2005–2015. Pew Res Center. 2015;125:52-68. Available from: https://www.pewresearch.org/wp-content/uploads/sites/9/2015/10/PI_2015-10-08_Social-Networking-Usage-2005-2015_FINAL.pdf. Accessed in 2024 (Nov 20).

3. Datareportal. We Are Social. Digital 2022: Global Overview Report. 2022. Available from: https://datareportal.com/reports/digital-2022-global-overview-report. Accessed in 2024 (Nov 20).

4. Datareportal. Digital 2024: Global Overview Report. Available from: https://datareportal.com/reports/digital-2024-global-overview-report. Accessed in 2024 (Jul 10).

5. World Health Organization. International classification of diseases 11th revision (ICD-11). Available from: https://icd.who.int/. Accessed in 2024 (Nov 20).

6. O'Keeffe GS, Clarke-Pearson K, Council on Communications and Media. The impact of social media on children, adolescents, and families. Pediatrics. 2011;127(4):800-4. PMID: 21444588; https://doi.org/10.1542/peds.2011-0054.

7. Hawes T, Zimmer-Gembeck MJ, Campbell SM. Unique associations of social media use and online appearance preoccupation with depression, anxiety, and appearance rejection sensitivity. Body Image. 2020;33:66–76. PMID: 32113009; https://doi.org/10.1016/j.bodyim.2020.02.010.

8. Turkle S. Alone Together. Why We Expect more from Technology and Less from Each Other. Philadelphia: Basic Books; 2013.

9. Kuss DJ, Griffiths MD. Online social networking and addiction-a review of the psychological literature. Int J Environ Res Public Health. 2011;8(9):3528-52. PMID: 22016701; https://doi.org/10.3390/ijerph8093528.

10. Kross E, Verduyn P, Demiralp E, et al. Facebook use predicts declines in subjective well-being in young adults. PLoS One. 2013;8(8):e69841. PMID: 23967061; https://doi.org/10.1371/journal.pone.0069841.

11. Vannucci A, Ohannessian CM. Social media use subgroups differentially predict psychosocial well-being during early adolescence. J Youth Adolesc. 2019;48(8):1469-93. PMID: 31256313; https://doi.org/10.1007/s10964-019-01060-9.

12. Durao M, Etchezahar ED, Gómez Yepes T, Muller ME. Hiperconectados: Los desafíos psicológicos de la era digital. Madrid: TechPsyLab; 2024.

13. King DL, Delfabbro PH, Wu AMS, et al. Treatment of Internet gaming disorder: An international systematic review and CONSORT evaluation. Clin Psychol Rev. 2017;54:123-33. PMID: 28458097; https://doi.org/10.1016/j.cpr.2017.04.002.

14. Kuss DJ, Griffiths MD. Social Networking Sites and Addiction: Ten Lessons Learned. Int J Environ Res Public Health. 2017;14(3):311. PMID: 28304359; https://doi.org/10.3390/ijerph14030311.

15. Dell'Osso B, Hadley S, Allen A, et al. Escitalopram in the treatment of impulsive-compulsive internet usage disorder: an open-label trial followed by a double-blind discontinuation phase. J Clin Psychiatry. 2008;69(3):452-6. PMID: 18312057; https://doi.org/10.4088/jcp.v69n0316.

16. Han DH, Renshaw PF. Bupropion in the treatment of problematic online game play in patients with major depressive disorder. J Psychopharmacol. 2012;26(5):689-96. PMID: 21447539; https://doi.org/10.1177/0269881111400647.

17. Grant JE, Kim SW, Hartman BK. A double-blind, placebo-controlled study of the opiate antagonist naltrexone in the treatment of pathological gambling urges. J Clin Psychiatry. 2008;69(5):783-9. PMID: 18384246; https://doi.org/10.4088/jcp.v69n0511.

18. Łukawski K, Rusek M, Czuczwar SJ. Can pharmacotherapy play a role in treating internet addiction disorder? Expert Opin Pharmacother. 2019;20(11):1299-301. PMID: 31058549; https://doi.org/10.1080/14656566.2019.1612366.

19. Koran LM, Blair Simpson H. Guideline Watch (March 2013): Practice Guideline for the Treatment of Patients with Obsessive-Compulsive Disorder. APA Practice Guidelines; 2013. Available from: https://psychiatryonline.org/pb/assets/raw/sitewide/practice_guidelines/guidelines/ocd-watch.pdf. Accessed in 2024 (Nov 20).

Sociodemographic and clinical profiles of patients receiving home care and the occurrence and management of healthcare-associated infections: a cross-sectional study

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ABSTRACT

BACKGROUND: Home care is increasingly adopted worldwide to improve patients' quality of life and reduce the burden on hospitals. However, the risk of healthcare-related infections in home settings is a growing concern that necessitates further investigation and preventive measures.

OBJECTIVES: We aimed to describe the sociodemographic and clinical profiles of home care patients, determine the incidence and management of healthcare-associated infections at home, and evaluate the risk factors.

DESIGN AND SETTING: This quantitative, observational, analytical, cross-sectional study was conducted in Teresina, PI, Brazil.

METHODS: Data were collected from 130 patients receiving home care between April 2016 and September 2020 in the state capital of Northeast Brazil. The data were retrospectively collected from hospital records using a previously validated form and analyzed.

RESULTS: The cohort predominantly comprised men (53.1%), older adults (53.1%), and patients with neurological disorders (61.9%). Healthcare-associated infections were prevalent in 46.2% of home care patients, with respiratory infections being the most common (47.2%). Clinical diagnoses were made in 66.7% of these patients. Patients with female caregivers, with a tracheostomy, using invasive feeding devices for >6 months, and with a greater degree of dependence were more predisposed to infections. Adult patients, those with young adult caregivers, those who received long-term home care, and those who required prolonged tracheostomy were also at increased risk.

CONCLUSION: This study underscores the home care patient profiles, prevalence of associated infections, and risk factors. Preventive measures and specific interventions are needed to enhance home care quality and reduce the infection risk.

INTRODUCTION

Home care (HC) practices, especially those for patients with acute and chronic illnesses, palliative care needs, and functional disabilities, are expanding globally. Successful programs that offer health services directly to patients' homes demonstrate this trend.[1-2] These initiatives aim to transition care from hospital settings, often viewed as challenging, to the home environment, aiming to improve quality of life and facilitate recovery.[3]

The benefits of home hospitalization include reduced hospital discharges, decreased hospital congestion, lower costs, increased turnover of hospital beds, and complementary care.[4] Furthermore, HC enhances the humanization of care and improves the quality of life, by involving family members in patient care and strengthening the relationships between the healthcare team, the patient, and their families.[5]

Evaluating the effectiveness of HC services, particularly concerning healthcare-associated infections (HAIs), is essential.[6] HAIs are the most frequent adverse outcomes in healthcare delivery and pose a serious public health problem owing to their high morbidity and mortality and significant financial burden on healthcare systems. Cross-contamination, the primary transmission route of microbial infections, is a common issue that can also occur during HC, underscoring the need for thorough investigation and prevention of these infections in all healthcare settings.[7]

National and international ordinances regulate the surveillance and monitoring of infections in hospital settings, establishing specific standards and guidelines to ensure patient safety and prevent the spread of disease. These ordinances establish hygiene protocols, cleaning and disinfection procedures, and provide guidelines for the appropriate use of personal protective equipment by healthcare professionals.[8] Extensive scientific literature exists on protocols for preventing and controlling hospital infections. However, investments in HC environments are limited and based on fragmented information, leading to the lack of robust prevention, control, and standardized monitoring programs for infections.[9]

In Brazil, HC is part of the "Better at Home" program in the Urgency and Emergency Network, regulated by Ordinance No. 825/2016 of the Ministry of Health (MH). The ordinance established the Home Care Service (HCS) to manage and operationalize multidisciplinary home care teams (MHCTs). The service is organized into three modalities: HC 1, focusing on primary care, and HC 2 and HC 3, which cater to medium- and high-complexity patients requiring assistance at least once a week.[10]

Despite this, Brazilian scientific research on HC primarily focuses on the characterization of the service, with limited attention given to infections in the home environment.[11] The national program for preventing and controlling healthcare-related infections only briefly mentions HC, challenging health professionals to implement HAI prevention and control measures at home due to the lack of specific theoretical guidelines.[12]

Considering the complexity of the home environment, understanding these patients and the occurrence and management of HAIs at home is essential, given the risk factors similar to those in the hospital settings and the specific factors that require further studies.[7]

OBJECTIVE

This study aimed to describe the sociodemographic and clinical profiles of patients receiving home care, investigate the occurrence and management of HAIs at home, and evaluate the factors associated with these infections.

METHODS

Type of study

The study employs a quantitative, observational, analytical, and cross-sectional design, characterized by the systematic analysis of numerical data and detailed observations captured at a specific time point.[13] This study adhered to the Strengthening the Reporting of Observational Studies script in Epidemiology guidelines, to improve the quality and transparency of reports on epidemiological observational studies.[14]

Study location

The study was conducted in the state capital of Northeast Brazil. Data were collected from the medical records of emergency hospitals. This hospital, managed by the Municipal Health Foundation in collaboration with the State Health Department, exclusively provides care through the Unified Health System (UHS).

This hospital was selected as at the time of data collection, it was the only hospital accredited by the HCS and operated two MHCTs. Patient records are maintained in printed form by the hospital's medical and statistical archive service, and the MHCTs discharge patients from the same health unit.

Population, sample, and sampling

The study population included all medium- and high-complexity patients who received MHCT care from April 2016 to September 2020. This period was established in line with the implementation of Ordinance No. 825/2016 of the MS, which redefined HC in the context of the UHS and updated the qualified teams despite the program having existed since 2011.[10] Data collection concluded after reviewing all available medical records within this pre-determined timeframe, resulting in a total of 130 patients.

Inclusion and exclusion criteria

The study included patients of both sexes and all ages registered at the HC, treated by the MHCT, and discharged from the hospital. Meanwhile, patients with illegible data or inconsistent medical record filling, owing to the difficulty in extracting information for analysis, were excluded.

We selected patients who exhibited signs and symptoms of infection only after 72 hours of hospital discharge to distinguish HAIs at the hospital from HAIs at home.[15] Additionally, we verified whether patients had been hospitalized for infection before receiving assistance from the MHCTs. This step aimed to differentiate between HAIs at the hospital, HAIs at home, and community-acquired infections, thus reducing the bias in attributing infections from other sources, such as HAIs acquired at home.

Data collection technique

Data were collected retrospectively from the medical records of a local hospital using a standardized form. Information was gathered from identification forms, admission and discharge summaries, progress notes recorded by healthcare professionals during care, and test results attached to the medical records. Data were collected from August 10 to September 22, 2020, with the participation of three researchers: a master's student in nursing and two previously trained nursing undergraduates. The researchers collaborated as a team during the collection process, often working in pairs or trios, after establishing a prior alignment during the pilot testing phase.

The form used in the study was validated by experts and was utilized in the dissertation titled, "Occurrence of infections among patients in home care: insights for epidemiological surveillance." This instrument comprises four distinct sections: sociodemographic data (8 fields), housing data (2 fields), clinical data (28 fields), and infection data (17 fields), totaling 55 fields.[16]

Variables

The independent variables were classified into three distinct groups: sociodemographic, clinical, and infection related. The sociodemographic group included variables such as sex, age group (years), education (years), marital status, caregiver's sex, caregiver's age group, relationship with the caregiver, and area of residence. In the clinical group, we included variables such as primary pathology, length of hospital stay (in days), duration of home care (in days), use of venous catheters, duration of tracheostomy (in days), feeding route, duration of invasive feeding device use, route of elimination, use of an indwelling urinary catheter, degree of dependence (assessed using the Spanish scale), presence and number of pressure injuries, and current comorbidities. In the infection-related group, variables included the occurrence of infection, number of infections, topography of infections, method of infection diagnosis, infection management, results of culture examinations, antibiograms, antimicrobial multi-resistance, and infection recurrence.

We also considered the occurrence of infection as a dependent variable after performing inferential statistical analyses to establish significant associations between several variables and HAI occurrence at home.

Data processing and analysis

Initially, we manually organized the forms, tabulated the data, and performed double entry using Microsoft Excel® version 2016 (Microsoft Corporation®, Redmond, WA, USA). Subsequently, we imported the data into the Statistical Package for the Social Sciences software version 22.0 for Windows (IBM®, Armonk, NY, USA) for further analysis.

For statistical analysis, we conducted univariate analyses of independent variables, including frequency distribution (mean, standard deviation, and median). Fisher's exact test was used to investigate the association between sociodemographic and clinical data (categorical variables) and the occurrence of HAIs at home. Furthermore, we employed Poisson logistic regression to calculate the adjusted odds ratio (AOR) for variables with a P value of less than 0.05. Subsequently, we used the Mann-Whitney U test to compare sociodemographic and clinical data (continuous variables) with the occurrence of HAIs at home.

Ethical and legal aspects

This study was approved by the Research Ethics Committee of the Univerisdade Federal do Piauí under opinion number 3,982,462, on April 21th, 2020.

RESULTS

After excluding 45 medical records due to incomplete data, the final study sample comprised 130 patients from the initial 175 recruited at the institution providing HC services.

The results indicated a majority of male patients (53.1%) and a predominance of older adults, with over half of the sample (53.1%) being aged ≥60 years. Most patients had 1 and 9 years of education (47.2%) and were single or had no spouse (61.1%). The caregivers were predominantly women (83.2%) and primarily adults (74.7%), with the most common relationship being with the caregiver of a son or daughter (31%). Urban residences were the predominant location compared with rural residences (92.3%) (**Table 1**).

Of the 130 patients assessed, 61.9% had a neurological pathology. The average hospital stay was 59.78 days, while the average home care duration was 258.40 days. Most patients did not use venous catheters (95.3%) or required respiratory support (83.8%).

Table 1. Demographic characterization of home care patients

Variables	n (%)	M ± SD	MD
Sex			
Male	69 (53.1)		
Female	61 (46.9)		
Age group (in years)			
Up to 19 years (youth)	7 (5.4)		
20–59 years (adults)	54 (41.5)	59.42 ± 23.49	61
≥ 60 years (older adult)	69 (53.1)		
Education (in years)*			
Illiterate	33 (37.1)		
1–9 years of education	42 (47.2)		
> 9 years of education	14 (15.7)		
Marital status*			
Single, widowed, or separated	69 (61.1)		
Married or in a stable union	44 (38.9)		
Caregiver's gender*			
Male	21 (16.8)		
Female	104 (83.2)		
Caregiver's age group			
Up to 19 years (youth)	2 (1.5)		
20 to 59 years (adults)	97 (74.7)	42.6 ± 14.48	41.5
≥ 60 years (older adult)	31 (23.8)		
Relationship with caregiver*			
Father	7 (5.9)		
Mother	22 (18.5)		
Son or daughter	37 (31.1)		
Brother or sister	15 (12.6)		
Spouse	14 (11.8)		
Other	24 (20.1)		
Residential area*			
Urban	119 (92.3)		
Rural	10 (7.7)		

M = mean; SD = standard deviation; MD = median; *Quantity of data not available: education (in years) (n = 41), marital status (n = 17), sex (caregiver) (n = 5), relationship with caregiver (n = 11), and residential area (n = 1).

Approximately 52.3% of patients used a tracheostomy (average duration: 360.17 days), while 53.1% used a nasoenteral tube for feeding, typically for up to 6 months (66.7%). Physiological elimination was predominant (95.3%), and the majority were classified as totally dependent (85.2%) based on the Spanish Dependence Scale scores. Pressure injuries were observed in 76.9% of the patients, with the majority having only one injury (58.3%). Approximately one-third of the patients had comorbidities (35.2%). HC outcomes included discharge with improvement (43.1%) and death (33.6%) (**Table 2**).

Approximately 46.2% of the patients developed HAIs at home, with the majority (75.0%) being affected by only one type of infection, primarily a respiratory infection (47.2%). Approximately 66.7% of the patients were clinically diagnosed with HAI, but only 47.3% received antibiotic therapy, while culture and antibiogram testing were performed in 11.7% of the patients. All seven identified microorganisms exhibited multidrug resistance (100%). Twenty-two patients (36.7%) developed infection recurrence, while 38 patients (63.3%) did not experience recurrence (**Table 3**).

Significant associations were found between several variables and HAIs at home, with Fisher's exact test indicating a predisposition in patients assisted by female caregivers (P = 0.001), who required tracheostomies (P = 0.048), with prolonged use of invasive feeding devices (P < 0.001), and had a higher degree of dependence (P = 0.018) (**Table 4**).

Poisson logistic regression analysis revealed that patients assisted by female caregivers were approximately seven times more likely to acquire the infection (AOR = 6.611). Tracheostomy use increased the likelihood of infection by more than four times (AOR = 4.335). Patients who used invasive feeding devices for more than 6 months had a 15-fold increased risk of infection (AOR = 15.044) than those who used such devices for a shorter duration. Patients with total dependence had approximately four times higher odds of infection (AOR = 3.892) than those who were independent or partially dependent (**Table 5**).

The comparative analysis further revealed that adult patients (54.57 ± 24.91), those cared for by young adult caregivers (38.76 ± 13.43), those who received prolonged home care (386.21 ± 362.64), and those who required prolonged tracheostomy (470.34 ± 459.42) were more susceptible to infections (**Table 6**).

DISCUSSION

Some similarities with previous studies were observed in the sociodemographic characteristics of home-cared patients, revealing a predominance of older adults and adults in the sample.[17] Furthermore, the literature shows that the rate of home admissions increases proportionally with age.[12]

In the context of relationships with caregivers, a predominance of women as primary caregivers emerged, especially as they approached the later stages of adulthood and the reproductive phase.

These findings, commonly reported in the scientific literature, indicate that despite advancements in gender equality, women remain predominantly responsible for caring for sick family members.[18]

With regard to the main pathology, a high incidence of neurological disorders, primarily caused by cerebrovascular accidents (CVAs), has emerged. These disorders are associated with several risk factors, such as high blood pressure, diabetes, smoking, high cholesterol, obesity, sedentary lifestyle, family history, and advanced age. These findings underscore the importance of adopting healthy habits, preventing chronic diseases, and continuously monitoring patients to improve their health behaviors and prevent CVA recurrence.[19]

The relevance of home care was evident as patients stayed longer at home than in the hospital. This suggests that home-based treatments are more suitable for these patients. According to the literature, home care is not only beneficial to patients, but is also economically advantageous for the healthcare system, thereby supporting the need for its expansion and enhancement.[20]

Just over half of the treated patients underwent tracheostomy, required invasive feeding devices, and had a high degree of dependence. This finding highlights the complexity of public-serving HC. These data corroborate those of a study in Brazil that demonstrated a high volume of outpatient home procedures, including consultations, multidisciplinary care, nursing care, and physiotherapy.[11]

One concerning issue was the occurrence of pressure injuries in home care patients. This can cause pain and distress in patients and increase the burden on caregivers. Literature suggests that adherence to pressure-relief schedules may be lower in home settings due to caregiver unawareness of pressure injuries and the importance of repositioning. These findings emphasize the need for new approaches to prevent such injuries.[21]

The primary outcome that emerged was discharge with improvement, highlighting the importance of HC. HC is fundamental owing to its unique approach in delivering care, which requires a thorough examination of the diverse experiences of both users and caregivers. This perspective goes beyond the simple organization of the network and its pre-established flows, demanding strategies capable of recognizing and addressing the needs of users and their families.[22]

The incidence rate of HAIs at home was high. However, national and international studies on the occurrence of these infections in home care patients are limited, outdated, and present different methodologies, making it difficult to generalize the results. However, these infections should be explored more thoroughly in the literature to facilitate their integration in both care practices and educational contexts.[23]

With regard to the topography and recurrence of infections, the present study revealed a predominance of respiratory infections, with a recurrence rate of more than one-third. These findings

Table 2. Clinical characteristics of home care patients

Variables	n (%)	M ± SD	Md
Primary pathology*			
Neurological pathologies	78 (61.9)		
Respiratory pathologies	14 (11.1)		
Infectious pathologies	7 (5.6)		
Other pathologies	27 (21.4)		
Length of hospital stay (in days)*		59.78 ± 63.18	43.00
Length of home care (in days)*		258.40 ± 309.46	131.50
Use of venous catheters*			
Yes	6 (4.7)		
No	123 (95.3)		
Breathing			
Unassisted	109 (83.8)		
Assisted	21 (16.2)		
Use of tracheostomy			
Yes	68 (52.3)		
No	62 (47.7)		
Duration of tracheostomy use (in days)*		360.17 ± 403.17	192.50
Feeding route			
Oral	33 (25.4)		
Nasoenteral tube	69 (53.1)		
Gastrostomy	28 (21.5)		
Duration of invasive feeding device use *			
Up to 6 months	48 (66.7)		
More than 6 months	24 (33.3)		
Elimination route*			
Physiological	122 (95.3)		
Colostomy	4 (3.1)		
Cystostomy	2 (1.6)		
Use of indwelling urinary catheter			
Yes	42 (32,3)		
No	88 (67.7)		
Degree of dependency (Spanish scale)*			
Independent	4 (3.1)		
Partially dependent	15 (11.7)		
Totally dependent	109 (85.2)		
Presence of pressure ulcer			
Yes	100 (76.9)		
No	30 (23.1)		
Number of pressure ulcers*			
One	56 (58.3)		
Two	18 (18.8)		
Three or more	22 (22.9)		
Current comorbidities*			
Yes	43 (35.2)		
No	79 (64.8)		
Discharge with improvement			
Hospital readmission	20 (17.2)		
Death	39 (33.6)		
Discharge with improvement	50 (43.1)		
Others	7 (6.0)		

M = mean; SD = standard deviation; Md = median; *Quantities of data unavailable: primary pathology (n = 4), length of hospital stay (in days) (n = 28), length of home care (in days) (n = 10), duration of tracheostomy use (in days) (n = 14), duration of invasive feeding device use (n = 25), elimination route (n = 2), degree of dependency (Spanish scale) (n = 2), number of pressure ulcers (n = 4), and current comorbidities (n = 8).

Table 3. Characteristics of infections and patient management in home care

Variables	n (%)
Occurrence of infection	
Yes	60 (46.2)
Not	70 (53.8)
Number of infections	
Two types of infections	45 (75.0)
Method of infection diagnosis	15 (25.0)
Infection site*	
Urinary tract infection	24 (32.4)
Respiratory infection	35 (47.2)
Skin infection	6 (8.1)
Surgical site infection	1 (1.4)
Bloodstream infection	2 (2.7)
Gastrointestinal infection	5 (6.8)
Others	1 (1.4)
Method of infection diagnosis	
Clinical examination	40 (66.7)
Laboratory test	9 (15.0)
Clinical examination and laboratory test	11 (18.3)
Management of infection†	
Hospital readmission	13 (23.6)
Antibiotic therapy	26 (47.3)
More than one management	16 (29.1)
Performance of culture tests	
Yes	7 (11.7)
Not	53 (83.3)
Performance of antibiograms	
Yes	7 (11.7)
Not	53 (83.3)
Multidrug resistance	
Yes	7 (100)
Not	-
Infection recurrence	
Yes	22 (36.7)
Not	38 (63.3)

*In the "infection site" variable, patients who presented more than one type of infection were considered; †Quantity of data not available: management of infection (n = 5).

Table 4. Association between sociodemographic and clinical variables with the occurrence of HAIs at home

Occurrence of infection related to home care			
Variables	Yes n (%)	Not n (%)	P value*
Caregiver's Sex**			
Male	3 (2.4)	18 (14.4)	0.001
Female	56 (44.8)	48 (38.4)	
Use of tracheostomy			
Yes	37 (28.5)	31 (23.8)	0.048
No	23 (17.7)	39 (30.0)	
Duration of invasive feeding device usage **			
Up to 6 months	16 (22.2)	32 (44.4)	< 0.001
More than 6 months	20 (27.8)	4 (5.6)	
Degree of dependency (Spanish scale)**			
Independent or partially dependent	4 (3.1)	15 (11.7)	0.018
Totally dependent	55 (43.0)	54 (42.2)	

*Fisher's exact test; **Quantities of data unavailable: caregiver's sex (n = 5), duration of invasive feeding device usage (n = 25), and degree of dependency (Spanish scale) (n = 2).

align with those of a study involving 199,462 patients from 8,255 home healthcare agencies, which identified that infections were responsible for 17% of unplanned hospitalizations. Respiratory infections, wound infections or deterioration, and urinary tract infections are the leading causes, and three of the six main reasons for unplanned hospitalization are related to infections.[24]

Scientific literature provides strategies for combating these infections. Effective approaches include employing a trained infection prevention professional who implements strict surveillance criteria and utilizes different methodologies to identify and combat the underreporting of these infections. Establishing an infection prevention and epidemiology committee to develop annual prevention plans and adhering to appropriate surveillance definitions can aid in identifying at-risk populations and providing accurate data using evidence-based surveillance.[25]

In managing HAIs at home, clinical diagnosis and antibiotic therapy were predominant, with limited use of culture and

Table 5. Logistic regression for the occurrence of HAIs at home

Patient with healthcare-associated infection at home			
Variables	AOR	95% CI	P value*
Caregiver's sex**			
Male	-	-	0.004
Female	6.611	1.826–23.933	
Use of tracheostomy			
Yes	4.335	1.045–17.977	0.043
No	-	-	
Duration of invasive feeding device usage **			
Up to 6 months	-	-	0.002
More than 6 months	15.044	2.759–82.033	
Degree of dependency (Spanish scale)**			
Independent or partially dependent	-	-	0.024
Totally dependent	3.819	1.191–12.246	

AOR = adjusted odds ratio; 95%CI = 95% confidence interval; *Poisson logistic regression; **Quantities of unavailable data: caregiver sex (n = 5), duration of invasive feeding device usage (n = 25), and degree of dependency (Spanish scale) (n = 2).

Table 6. Comparison of sociodemographic and clinical variables with occurrence of HAI at home

Occurrence of infection related to healthcare at home			
	Yes	Not	P value*
Variables	M ± SD*	M ± SD	
Age	54.57 ± 24.91	63.61 ± 21.58	0.049
Caregiver's age	38.76 ± 13.43	44.90 ± 14.97	0.014
Length of home care (in days)**	386.21 ± 362.64	146.00 ± 198.21	< 0.001
Duration of tracheostomy use (in days)**	470.34 ± 459.42	219.65 ± 265.85	0.001

M = mean; SD = standard deviation; *Mann-Whitney U test; ** quantities of data unavailable: length of home care (in days) (n = 10) and duration of tracheostomy use (in days) (n = 14).

antibiogram tests. Although clinical diagnosis is useful, complementing it with cultures and antibiograms is crucial for guiding precise antibiotic treatment. Without adequate microbiological investigation, the indiscriminate prescription of antibiotics can generate multidrug-resistant strains, underscoring the need to reduce inappropriate antibiotic use through effective diagnosis and responsible management.[26]

Other statistical analyses did not find an association between female caregivers and a greater risk of infection in home care patients, underscoring the need to consider these data with caution. These findings may be attributed to the workload associated not only with caring for patients in a home care setting but also with addressing the individual needs of children, husbands, and other dependents, which can impact the quality of care provided by the female caregiver.[18,27]

The influence of patient and caregiver age on the occurrence of infections during comparative analysis may be explained by several factors. First, younger patients might be less susceptible to infections than older patients, potentially leading to neglect in care.[28] The age of caregivers and the occurrence of infections, especially in those cared for by younger individuals, can be attributed to the frequent demands of daily responsibilities. These responsibilities can affect the quality of care provided and even the caregiver's health.[29]

The association between total dependence and infections corroborates the above findings, as these patients may require more intensive and continuous care, which can overwhelm caregivers, particularly those with additional daily responsibilities. Furthermore, the literature that highly dependent individuals are more susceptible to health complications and require constant assistance with daily living activities, increasing their exposure to the risk factors for infections and further compromising their health.[30]

The relationship between the occurrence of infections in tracheostomized patients can be attributed to their increased susceptibility to infections due to the direct airway access, which facilitates pathogen entry to the body.[31] Conversely, the incidence of infections associated with tracheostomy use can be attributed to the higher likelihood of microorganism colonization on these devices over time, which can consequently increase the risk of infectious complications and compromise patient health.[32]

The use of invasive feeding devices for more than 6 months increases the risk of infection. This finding may be related to the patient's greater exposure to pathogenic agents, colonization of the device by microorganisms over time, and difficulty in maintaining hygiene. Difficulty in maintaining hygiene can cause skin irritation or tissue damage and encourage the entry of infections.[33]

Notably, the difficulty in maintaining hygiene, which may also have influenced the occurrence of infections in patients who spent more time in home care, may have been aggravated by the lack of adequate structures in the home environment. Such challenges further emphasize the importance of guidance from home care professionals, considering the caregivers' ability to understand the information, their cultural beliefs, and the resources available for implementing care instructions.[34]

This study has some limitations, including issues related to the quality of retrospective data, such as incomplete records, omissions, erasures, and inappropriate terminology. Furthermore, as a cross-sectional study, causal relationships could not be established. However, strict inclusion and exclusion criteria were applied to medical records to mitigate these biases and used a validated instrument. Obtaining complete data can be challenging due to the reduced production of in-home care. Despite these limitations, this study significantly advances the understanding of home care and infection control.

CONCLUSION

This study identified a predominance of male and elderly patients with a high incidence of neurological pathologies. Patients stayed longer in home care than in hospital settings, highlighting the importance of home treatment. The study found a high rate of HAIs at home, with respiratory infections being the most common. Clinical diagnosis was predominant, while the conduct of culture and antibiogram tests was limited. Patients assisted by female caregivers, with a tracheostomy, using invasive feeding devices for more than 6 months, and with a greater degree of dependence were more predisposed to infections. Furthermore, adult patients, those who received home care from young adult caregivers, those who extended home care durations, and those who required prolonged tracheostomy were at risk of contracting infections.

This study significantly enhances the understanding of home care and infection control, especially in an area where data are limited. The results provide valuable data on the profile of patients treated at home, the occurrence of HAIs at home, and the factors associated with these infections. It also highlights the need for preventive measures and specific interventions to improve the quality of home care and reduce the risk of infection.

Given the complexity of the home environment and the limitations identified in this study, future research should focus on identifying the risk factors of HAIs in home care settings. Further studies should explore more effective prevention strategies, refine diagnostic and treatment protocols, and assess the impact of specific interventions on infection rates. Furthermore, expanding the scope of the research to include a broader and more diverse patient sample and investigating home care practices in diverse regional contexts are crucial.

REFERENCES

1. Levine DM, Ouchi K, Blanchfield B, et al. Hospital-level care at home for acutely ill adults: a randomized controlled trial. Ann Intern Med. 2020;172(2):77-85. PMID: 31842232; https://doi.org/10.7326/M19-0600.

2. Roberts B, Robertson M, Ojukwu EI, et al. Home based palliative care: known benefits and future directions. Curr Geriatr Rep. 2021;10(4):141-7. PMID: 34849331; https://doi.org/10.1007/s13670-021-00372-8.

3. Rusli KDB, Tan AJQ, Ong SF, et al. Home-based nursing care competencies: a scoping review. J Clin Nurs. 2023;32(9-10):1723-37. PMID: 34897853; https://doi.org/10.1111/jocn.16169.

4. Megido I, Sela Y, Grinberg K. Cost effectiveness of home care versus hospital care: a retrospective analysis. Cost Eff Resour Alloc. 2023;21(1):13. PMID: 36732792; https://doi.org/10.1186/s12962-023-00424-0.

5. Sya'diyah H, Nursalam, Mahmudah, et al. Effectiveness of home care intervention on family ability to do caregiving at home and increase the independence among elderly with dementia. J Public Health Res. 2022;11(3):22799036221115774. PMID: 35992583; https://doi.org/10.1177/22799036221115774.

6. Gidey K, Gidey MT, Hailu BY, et al. Clinical and economic burden of healthcare-associated infections: a prospective cohort study. PLoS One. 2023;18(2):e0282141. PMID: 36821590; https://doi.org/10.1371/journal.pone.0282141.

7. Hoxha A, Duysburgh E, Mortgat L. Healthcare-associated infections in home healthcare: an extensive assessment, 2019. Euro Surveill. 2021;26(5):1900646. PMID: 33541482; https://doi.org/10.2807/1560-7917.ES.2021.26.5.1900646.

8. Kubde D, Badge AK, Ugemuge S, et al. Importance of hospital infection control. Cureus. 2023;15(12):e50931. PMID: 38259418; https://doi.org/10.7759/cureus.50931.

9. Hannum SM, Oladapo-Shittu O, Salinas AB, et al. Controlling the chaos: information management in home-infusion central-line-associated bloodstream infection (CLABSI) surveillance. Antimicrob Steward Healthc Epidemiol. 2023;3(1):e69. PMID: 37113198; https://doi.org/10.1017/ash.2023.134.

10. Brasil. Ministério da Saúde. Portaria nº 825, de 25 de abril de 2016. redefine a atenção domiciliar no âmbito do sistema único de saúde (SUS) e atualiza as equipes habilitadas. Available from: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2016/prt0825_25_04_2016.html. Accessed in 2024 (April 21).

11. Rajão FL, Martins M. Home Care in Brazil: an exploratory study on the construction process and service use in the Brazilian Health System. Cien Saude Colet. 2020;25(5):1863-77. PMID: 32402051; https://doi.org/10.1590/1413-81232020255.34692019.

12. Agência Nacional de Vigilância Sanitária. Gerência de Vigilância e Monitoramento em Serviços de Saúde. Gerência Geral de Tecnologia em Serviços de Saúde. Programa nacional de prevenção e controle de infecções relacionadas à assistência à saúde (PNPCIRAS) 2021 a 2025. Available from: https://www.gov.br/anvisa/pt-br/centraisdeconteudo/publicacoes/servicosdesaude/publicacoes/pnpciras_2021_2025.pdf. Accessed in 2024 (April 21).

13. Polit DF, Beck CT. Fundamentos de pesquisa em enfermagem: avaliação de evidências para a prática da enfermagem. 9ª ed. Porto Alegre: Artmed; 2019.

14. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008;61(4):344-9. PMID: 18313558; https://doi.org/10.1016/j.jclinepi.2007.11.008.

15. Brasil. Ministério da Saúde. Portaria nº 2616, de 12 de maio de 1998. Available from: https://bvsms.saude.gov.br/bvs/saudelegis/gm/1998/prt2616_12_05_1998.html. Accessed in 2024 (April 21).

16. Sousa JL. Ocorrência de infecções entre pacientes em assistência domiciliar: subsídios para a vigilância epidemiológica [dissertation]. Universidade Federal do Piauí: Teresina, Brasil; 2021. Available from: http://repositorio.ufpi.br:8080/xmlui/handle/123456789/3214. Accessed in 2024 (April 21).

17. Cavalcante MEPL, Santos MM, Toso BRGO, et al. It is better at home: characterization of home care services. Esc Anna Nery 2022;26:e20220001. https://doi.org/10.1590/2177-9465-EAN-2022-0001en.

18. Guerra HS, Almeida NAM, Souza MR. Reflection on the public home care caregivers profiles. Fisioter Mov. 2017;30(2):227-235. http://dx.doi.org/10.1590/1980-5918.030.002.AO03.

19. Wen K, Shen MJ, Deng CS, et al. Association between chronic illness resources and health behaviors in hypertensive stroke patients at 6 months after discharge: a cross-sectional study. Ann Transl Med. 2022;10(8):460. PMID: 35571442; https://doi.org/10.21037/atm-22-1193.

20. Megido I, Sela Y, Grinberg K. Cost effectiveness of home care versus hospital care: a retrospective analysis. Cost Eff Resour Alloc. 2023;21(1):13. PMID: 36732792; https://doi.org/10.1186/s12962-023-00424-0.

21. Jafari M, Nassehi A, Rafiei H, et al. Pressure injury prevention knowledge among family caregivers of patients needing home care. Home Healthc Now. 2021;39(4):203-10. PMID: 34190704; https://doi.org/10.1097/NHH.0000000000000975.

22. Procópio LCR, Seixas CT, Avelar RS, et al. Home care within the unified health system: challenges and potentialities. Saúde debate. 2022;43(121):592-604. https://doi.org/10.1590/0103-1104201912123.

23. Valle ARMC, Andrade D, Sousa FL, et al. Infection prevention and control in households: nursing challenges and implications. Acta Paul Enferm. 2016;29(2):239-44. https://doi.org/10.1590/1982-0194201600033.

24. Shang J, Larson E, Liu J, et al. Infection in home health care: results from national Outcome and Assessment Information Set data. Am J Infect Control. 2015;43(5):454-9. PMID: 25681302; https://doi.org/10.1016/j.ajic.2014.12.017.

25. Adawee M, Cole S. Establishing an evidence-based infection surveillance program for home care and hospice: a large Midwest health system's experience. Am J Infect Control. 2021;49(12):1551-3. PMID: 34400245; https://doi.org/10.1016/j.ajic.2021.08.007.

26. Murugaiyan J, Kumar PA, Rao GS, et al. Progress in alternative strategies to combat antimicrobial resistance: focus on antibiotics. Antibiotics (Basel). 2022;11(2):200. PMID: 35203804; https://doi.org/10.3390/antibiotics11020200.

27. Silva YC; Silva KL. Constitution of the caregiver subject at home care: psycho-affective, cognitive and moral dimensions. Esc Anna Nery. 2020;24(4):e20190335. https://doi.org/10.1590/2177-9465-EAN-2019-0335.

28. Glynn JR, Moss PAH. Systematic analysis of infectious disease outcomes by age shows lowest severity in school-age children. Sci Data. 2020;7(1):329. PMID: 33057040; https://doi.org/10.1038/s41597-020-00668-y.

29. Long working hours and health. Lancet Reg Health West Pac. 2021;11:100199. PMID: 34327371; https://doi.org/10.1016/j.lanwpc.2021.100199.

30. Martin SJ, Yost RJ. Infectious diseases in the critically ill patients. J Pharm Pract. 2011;24(1):35-43. PMID: 21507873; https://doi.org/10.1177/0897190010388906.

31. Tan CY, Chiu NC, Lee KS, et al. Respiratory tract infections in children with tracheostomy. J Microbiol Immunol Infect. 2020;53(2):315-20. PMID: 30131258. https://doi.org/10.1016/j.jmii.2018.07.002.

32. Cader SHA, Shah FA, Nair SKGR. Tracheostomy colonisation and microbiological isolates of patients in intensive care units-a retrospective study. World J Otorhinolaryngol Head Neck Surg. 2020;6(1):49-52. PMID: 32426703; https://doi.org/10.1016/j.wjorl.2019.04.002.

33. Krishna S, Singh S, Dinesh KR, et al. Percutaneous endoscopic gastrostomy (PEG) site infections: a clinical and microbiological study from university teaching hospital, India. J Infect Prev. 2015;16(3):113-6. PMID: 28989413. https://doi.org/10.1177/1757177414558956.

34. Dowding D, Russell D, Trifilio M, et al. Home care nurses' identification of patients at risk of infection and their risk mitigation strategies: a qualitative interview study. Int J Nurs Stud. 2020;107:103617. PMID: 32446014; https://doi.org/10.1016/j.ijnurstu.2020.103617.

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Prevalence of alcohol consumption and the associated factors among students at a Brazilian public university: a cross-sectional study

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ABSTRACT

BACKGROUND: The World Health Organization estimated that approximately 43% of the global population consumes alcohol, with an average annual consumption of 4.6 L per person. However, little is known about the factors influencing alcohol intake among students.

OBJECTIVES: This study aimed to determine the factors that influence alcohol intake in students at a Brazilian public institution.

DESIGN AND SETTING: This cross-sectional study was conducted at a public university in the Brazilian Midwest.

METHODS: In total, 348 Brazilian university students (124 men and 224 women; convenience sample) were recruited. The alcohol use disorder identification test (AUDIT) was used to examine alcohol use, the habitual physical activity questionnaire (Baecke) was used to assess physical activity levels, and the Brazil Economic Classification Standard Criterion was used to assess socioeconomic status. A generalized linear model (GLM) with a 95% confidence interval (CI) and odds ratio (OR) estimation was constructed using the Tweedie probability distribution and log link function, with AUDIT questionnaire scores as the dependent variable.

RESULTS: The prevalence of excessive alcohol consumption was 18.7% (9.8% in men and 8.9% in women). The GLM analysis indicated that being single and attending an agricultural science course increased the likelihood of excessive alcohol intake; however, living with family or alone had a protective effect. Being single and pursuing a course in agricultural science increased the likelihood of binge drinking.

CONCLUSIONS: Universities and families can use the study findings to develop initiatives aimed at enhancing students' understanding of the harmful effects of alcohol, particularly among agricultural science students.

INTRODUCTION

Harmful alcohol intake is associated with increased morbidity, mortality, and disability rates.[1] It is linked to later menopause[2] and an increased risk of cardiovascular, hepatic, and oncologic illnesses; pancreatitis and diabetes;[3,4] and metabolic syndrome.[5] Additionally, it increases the likelihood of memory loss, falls, traffic accidents, interpersonal conflicts, and unprotected sex.[6] According to the National Alcohol and Drug Survey, the incidence of binge drinking increased by 31.1% from 2006 to 2012 (from 45% to 59% of the population).[7] Consequently, alcohol intake accounts for 5.3% of all deaths worldwide.[1]

Alcohol is the most common risk factor among university students, who often overestimate its negative consequences, thereby increasing their risk exposure.[8] Previous studies found that university students consume more alcohol than nonuniversity students, with a higher prevalence observed among male students[9,10] Alemu et al.[11] studied 741 university students at Jimma University in Ethiopia. They found that 26.5% of students had alcohol-related problems. Being single (odds ratio (OR) = 1.98, 95% confidence interval (CI) = 1.21–3.22), experiencing peer pressure to drink alcohol (OR = 2.72, 95%CI = 1.76–4.19), and having mental distress (OR = 2.81, 95%CI = 1.83–4.32) were independently and positively associated with alcohol use disorders.

According to Heather et al.,[12] the prevalence of alcohol use varies significantly among colleges. In a binary logistic regression analysis of the effects of attending university, younger age, White ethnicity, and both on-campus and off-campus term-time student housing were identified as factors associated with alcohol use disorder, as measured using the Alcohol Use Disorders Identification Test (AUDIT). Furthermore, a study conducted in an Irish institution reported a

66.4% prevalence of excessive alcohol use. Students studying law and business were more than twice as likely to report harmful alcohol consumption compared with their peers studying science and engineering. This observation suggests that the field of study is a significant factor associated with increased alcohol consumption among male students (OR = 2.26; 95%CI = 1.46, 3.49; P < 0.001) and female students (OR = 2.12; 95%CI = 1.44, 3.14; P < 0.001). Alcohol intake has also been associated with poor self-rated health among university students.[13] Additionally, student income can negatively affect alcohol consumption.[14]

The relationship between sports, exercise, and alcohol consumption is an ongoing area of research.[15] Alcohol remains the most commonly used drug among athletes and regular exercisers, with alcohol-related issues appearing to be more prevalent in these groups.[16,17] In human experimental research, alcohol consumption is categorized as acute (single dose) and chronic (repeated doses over time).[18] According to this research, alcohol consumption impairs the utilization of glucose and amino acids by skeletal muscles, reducing energy supply and disrupting the metabolic processes during exercise.[18] Furthermore, chronic alcohol consumption is associated with increased citrate synthase enzyme activity and decreased cross-sectional area of type I, IIa, and IIb fibers.[18,19] Exercise appears to slow the ethanol-induced reduction in hepatic mitochondria and accelerate the liver's ethanol metabolism.[18] Additionally, regular training seems to reduce the extent of alcohol-induced oxidative damage.[18]

A study conducted by Wagner and Andrade[20] in Brazil highlighted that the transition to university is a critical period of vulnerability for both initiation and continued use of alcohol and other drugs. Furthermore, alcohol misuse has been linked to an increase in depressive symptoms and a higher risk of suicide attempts.[21,22] Learning difficulties, higher failure rates, decreased study commitment (e.g., reduced time spent studying and lower class attendance), and poor academic performance are some of the negative repercussions of heavy alcohol consumption in this population. Increased risk behaviors, such as increased frequency of unprotected sexual intercourse with different partners, sexual abuse, drunk driving, traffic accidents, public intoxication, physical altercations, violent deaths, and future problems with psychoactive substances (including dependence and the use of other psychoactive substances) have also been linked to heavy alcohol consumption.[23-28] Given the limited research on factors influencing alcohol consumption among Brazilian university students, further investigation in this area is essential. This argument is further supported by the fact that factors related to excessive alcohol intake among university students vary owing to social, cultural, and economic differences. Therefore, gaining a deeper understanding of the factors related to alcohol consumption among Brazilian university students may reveal unique characteristics. Mapping these elements is crucial for

establishing public policies aimed at reducing alcohol consumption among university students.

OBJECIVE

This study aimed to determine the factors influencing alcohol intake in a convenience sample of students at a Brazilian public university. We hypothesized that marital status, family circumstances, field of study, socioeconomic status, and physical activity would influence alcohol use among Brazilian college students.

METHODS

Participants

For this quantitative and cross-sectional study, 348 Brazilian university students (124 men and 224 women) from the Universidade Federal de Jataí (previously Universidade Federal de Goiás – Regional Jataí) were recruited. The participants were personally invited to the university and included undergraduate students and those aged > 18 years. Those who provided inaccurate responses to the surveys were excluded from the study. Before data collection, all participants were informed of the study methods and provided written informed consent. The study was approved by the Ethics Committee of the Universidade Federal Goiás (permission number: 124/13, date of approval: 11/04/2013) and adhered to the Declaration of Helsinki.

Sociodemographic variables

A sociodemographic questionnaire was used to collect data on sex (male or female), age (years), undergraduate major (exact sciences, biological sciences, engineering, health sciences, agricultural sciences, linguistics, social sciences, and humanities), marital status (single or married), and place of residence.

Alcohol consumption

The AUDIT[29,30] was used to assess alcohol intake. This straightforward screening tool facilitates quick evaluations of excessive alcohol consumption.[31] The AUDIT has been translated and validated in Brazilian Portuguese.[32] The questionnaire comprises 10 items divided into three domains: (i) harmful alcohol use (frequency of consumption, typical quantity, and frequency of heavy drinking), (ii) dependence symptoms (impaired control over morning drinking and drinking), and (iii) harmful consequences of alcohol use (guilt after drinking, blackouts, alcohol-related injuries, and other alcohol-related concerns). The first eight items are scored on a scale of 0 to 4, while the last two items are scored as 0, 2, and 4.[32] Scores of 0–7 indicate a "low-risk consumption," 8–15 denote "overuse," 16–19 suggest "possible dependence," and 20–40 signify "clear dependence." The AUDIT scores demonstrated good reliability, with a Cronbach's alpha of

0.75, confirming its suitability for screening alcohol consumption problems in the university setting.[33]

Habitual physical activity level

The level of habitual physical activity was assessed using a Brazilian Portuguese-translated and validated version of the Baecke questionnaire. The questionnaire contained 16 questions that assessed three categories of habitual physical activity over the past year: occupational physical activity (eight questions), leisure-time physical exercise (four questions), and sports physical activity (four questions). An overall score for habitual physical activity was derived by summing the scores from these three categories. Higher scores indicate frequent physical activity. The test-retest reliabilities of the work, sport, and leisure time indices were 0.88, 0.81, and 0.75, respectively.[34]

Socioeconomic level

The Brazil Economic Classification Standard Criterion[35] was used to assess socioeconomic status. This questionnaire comprised 10 questions divided into two domains: possession and education level of the head of the household. The responses are scored as follows: A1, 42–46; A2, 35–41; B1, 29–34; B2, 23–27; C1, 18–22; C2, 14–17; D, 8–13; and E, 0–7 points. Despite its widespread use, no study has evaluated its reliability.

Statistical analysis

SPSS 23.0 (IBM Corp., Chicago, Illinois, USA) was used to perform all analyses. The Kolmogorov–Smirnov test was used to determine the normality of the data. The Mann–Whitney U test was used to compare AUDIT scores, age, occupational physical activity, sports physical activity, leisure-time physical activity, and socioeconomic status.

A generalized linear model (GLM) was developed using the Tweedie probability distribution and log link function with the AUDIT questionnaire scores used as dependent variables. The model included 95% confidence intervals (95%CI) and odds ratio (OR) estimates. Sex; marital status (single or married); age group (18–28 years old, 29–38 years old, and ≥ 39–48 years old); housing arrangements; field of study; socioeconomic status; and levels of occupational physical activity, sports physical activity, and leisure-time physical activity were used as independent variables. Univariate models were constructed sequentially, each involving one independent variable and one response variable, while all independent variables were included in the multivariate model. The model distributions were selected based on convergence parsimony and the lowest quality value according to the Akaike information criterion.[36] Furthermore, the omnibus test was employed to confirm that the model outperformed the null hypothesis, (P < 0.05). The significance level was set at 5%.

RESULTS

The study included 348 Brazilian university students with an average age of 22.87 ± 5.47 (18–57) years. The distribution of categorical variables by sex is presented in **Table 1**. Overall, the majority of participants (86.2%) were unmarried, lived with their families (66.4%), had an economic classification of B1/B2 (47.7%), and consumed alcohol (74.1%).

When alcohol intake was assessed, 65 (18.7%) participants reported consuming alcohol, comprising 34 (9.8%) men and 31 (8.9%) women.

A comparison of AUDIT scores of men and women, age, occupational physical activity, sports physical activity, leisure-time physical activity, and socioeconomic status is presented in **Table 2**.

According to the multivariate GLM with Tweedie distribution, the risk of excessive alcohol consumption was 65% higher (OR = 1.65; 95%CI = 1.09–2.48) among single individuals than in married individuals and 64% higher (OR = 1.64; 95%CI = 1.10–2.44) in agricultural science students than in humanities students. Furthermore, students living alone or with family members had 32% (OR = 0.68; 95%CI = 0.48–0.95) and 33% (OR = 0.67; 95%CI = 0.51–0.88) less likely to engage in excessive alcohol intake, respectively (**Table 3**).

Table 1. Characteristics of the study participants according to sex

	Total	Men	Women
	n (%)	n (%)	n (%)
Marital status			
Single	300 (86.2)	115 (92.7)	185 (82.6)
Married	48 (13.8)	9 (7.3)	36 (17.4)
Family arrangement			
Alone	59 (17.0)	23 (18.5)	36 (16.1)
Family	231 (66.4)	71 (57.3)	160 (71.4)
Friends	58 (16.7)	30 (24.2)	38 (12.5)
Economic classification			
A1/A2	25 (7.2)	9 (7.3)	16 (7.1)
B1/B2	166 (47.7)	73 (58.9)	93 (41.5)
C1/C2	122 (35.1)	37 (29.8)	85 (37.9)
D/E	35 (10.1)	5 (4.0)	30 (13.4)
Alcohol consumption			
No	90 (25.9)	28 (22.6)	62 (27.7)
Yes	258 (74.1)	96 (77.4)	162 (72.3)
Field of undergraduate course			
Exact	35 (10.1)	25 (20.2)	10 (4.5)
Biological	15 (4.3)	3 (2.4)	12 (5.4)
Engineering	43 (12.4)	23 (18.5)	20 (8.9)
Health	67 (19.3)	8 (6.5)	59 (26.3)
Agrarian	55 (15.8)	30 (24.2)	25 (11.2)
Linguistics	12 (3.4)	6 (4.8)	6 (2.7)
Social	48 (13.8)	20 (16.1)	28 (12.5)
Human	73 (21.0)	9 (7.3)	64 (28.6)

Data are expressed as absolute (relative) frequency.

Table 2. Characteristics of the participants according to sex

	Total	Men	Women	P
	(n = 348)	(n = 124)	(n = 224)	
AUDIT (score)	3.0 (6.0)	4.0 (8.0)	2.0 (5.0)	0.005
Age (years)	21.0 (4.0)	21.0 (3.0)	21.0 (5.0)	0.829
Occupational physical activity	2.2 (0.7)	2.2 (0.7)	2.3 (0.6)	0.287
Sports physical activity	2,0 (1.0)	2.5 (1.2)	2.0 (1.0)	< 0.001
Leisure-time physical activity	2,2 (1.0)	2.2 (1.0)	2.2 (1.0)	0.091
Socioeconomic level	23.0 (10.0)	25.0 (10.0)	22.0 (10.0)	0.001

Data are expressed as mean (standard deviation). AUDIT = alcohol use disorders identification test.

Table 3. A generalized model employing univariate and multivariate Tweedie distributions to analyze the relationship between independent variables and Alcohol Use Disorders Identification Test scores

		AUDIT			
		Univariate		Multivariate*	
Variables	%	OR (95%CI)	P	OR (95%CI)	P
Marital status			< 0.001		0.016
Single	86.2	2.61 (1.82–3.74)		1.65 (1.09–2.48)	
Married	13.8	1		1	
Family arrangement			< 0.001		0.010
Alone	17.0	0.63 (0.45–0.89)		0.68 (0.48–0.95)	
Family	66.4	0.59 (0.45–0.77)		0.67 (0.51–0.88)	
Friends	16.7	1		1	
Field of study			0.002		0.014
Exact	10.1	1.24 (0.79–1.96)		0.81 (0.50–1.31)	
Biological	4.3	1.36 (0.79–2.34)		1.16 (0.67–2.03)	
Engineering	12.4	1.80 (1.14–2.85)		1.33 (0.86–2.04)	
Health	19.3	1.34 (0.87–2.09)		1.15 (0.77–1.72)	
Agricultural	15.8	2.28 (1.55–3.36)		1.64 (1.10–2.44)	
Linguistics	3.4	0.73 (0.32–1.66)		0.77 (0.34–1.74)	
Social	13.8	1.93 (1.29–2.89)		1.47 (0.99–2.19)	
Human	21.0	1		1	
Economic classification			0.001		0.009
A1/A2	7.2	1.39 (0.81–2.36)		1.39 (0.82–2.36)	
B1/B2	47.7	1.03 (0.69–1.53)		0.96 (0.67–1.40)	
C1/C2	35.1	0.65 (0.43–0.98)		0.69 (0.47–1.01)	
D/E	10.1	1		1	
Occupational physical activity		1.11 (0.94–1.32)	0.198	1.10 (0.94–1.29)	0.203
Sports physical activity		1.15 (0.99–1.35)	0.064	1.01 (0.85–1.20)	0.855
Leisure-time physical activity		1.12 (0.96–1.32)	0.138	1.06 (0.89–1.27)	0.465

*Adjusted for sex and age. AUDIT = alcohol use disorders identification test; OR = odds ratio; CI = confidence interval.

DISCUSSION

This study aimed to determine the factors associated with alcohol use among the students of a Brazilian public institution. The study findings indicated that marital status, living arrangements, study area, and socioeconomic status were associated with excessive alcohol use, thus confirming our initial hypothesis.

In terms of marital status, being single increased the likelihood of excessive alcohol consumption by 65% compared with being married. Living with family and alone reduced the likelihood of excessive alcohol consumption by 33% and 32%, respectively, compared with living with friends. Additionally, students majoring in agricultural sciences were 64% more likely to engage in excessive alcohol use than those with other majors, and a higher socioeconomic status significantly increased the risk of excessive alcohol consumption.

Previous research has established a link between increased alcohol use and academic settings. For example, more than 66% of United Kingdom university students reported excessive alcohol intake.[37] Our findings align with those of Santos et al.[38], who identified a 24% prevalence in a sample of 1,290 Brazilian university students of both sexes. In comparison, a study of Colombian university students reported a prevalence rate of 20.5%.[39] Similarly,

the prevalence rate among students in the United States was 18%.[40] In addition, a study conducted in Morocco showed an 8.5% prevalence in a sample of 1,236 students of both sexes.[41] The difference in alcohol consumption prevalence is attributed to the different tools used to evaluate alcohol use; the influence of local public laws that control alcohol use; and cultural, economic, social, and religious aspects.[24] For example, compared with other regions worldwide, Muslim countries have lower prevalence rates of excessive alcohol intake among young people aged 15–19 years; their low ranking may be attributable to the religious prohibition against consuming alcoholic beverages.[41] The high alcohol consumption rate observed among our participants may be related to the experience of being a university student, as it often provides individuals an initial opportunity to be part of a large group of peers without familial supervision.[42] Consequently, individuals may become more inclined to try new things, such as alcohol consumption.

In our study, the prevalence of excessive alcohol consumption was 9.8% in men and 8.9% in women, with no significant difference in alcohol use between the sexes. However, other studies have found a link between sex and alcohol use.[38,43-45] Sociocultural factors may account for these variations in alcohol intake between men and women. Although men are twice as likely as women to abuse alcohol, the severity and types of alcohol-related issues are often similar.[46] The factors contributing to our findings could include a shift in women's societal roles and a trend toward gender equality, in which women invest more in education, work outside the home, adopt behaviors traditionally associated with men, and consume more alcohol, thereby reducing disparities in the consequences of alcohol use.[46] Furthermore, women's increased alcohol consumption may be influenced by stress from balancing work and domestic responsibilities.[46]

A few studies have examined the effect of marital status on the prevalence of excessive alcohol consumption. In the present study, marital status emerged as a significant factor in the multivariate model, revealing that single individuals were 65% more likely to drink excessively than married people. Similar findings have been reported in other studies.[44,47-50] In Sweden, students in committed relationships, whether dating or married, were less likely to consume large amounts of alcohol and exhibited lower AUDIT scores compared with their single peers.[51] In Finland, marital status did not influence the prevalence of alcohol consumption among students, although only married male students consumed less alcohol than unmarried counterparts. In Italy, no significant relationship was found between marital status and excessive alcohol consumption.

Several studies have explored the relationship between alcohol consumption and living arrangements, such as living with friends, family, or alone. These studies found that students who lived alone, in student housing, or with roommates consumed more alcohol or had higher rates of binge drinking compared with those who lived with their parents, a partner, and/or children.[52] According to the Cutting down, Annoyance by criticism, Guilty feeling, and Eye openers (CAGE) screening instrument (another instrument for assessing alcohol consumption),[52] students living with their families drink alcohol more frequently, but report fewer problems related to alcohol abuse. Kuntsche et al.[53] found that social drinkers consumed alcohol more frequently at mixed parties but not at home, in bars, or with family members. Enhancement drinkers drank with same-sex friends at home, with friends, and in bars. By contrast, coping drinkers drank at home but not at parties or with family members.[53] The factors influencing alcohol consumption include the tendency to take risks and test limits, the tendency to seek new and potentially dangerous situations, general impulsivity typical of young people, the desire for acceptance by peers (which are environmental factors that influence the development of the habit of drinking and the reference of parents and family),[54] and having a positive/pleasant experience (e.g., being more communicative, having more success in looking for partners, and having more fun).[54]

The patterns of alcohol and drug use vary depending on the academic field of students; however, no systematic research has explored this topic.[52] All studies indicated significant variations between study locations; however, no apparent pattern was found.[52] Specific interests, the relationship between academic knowledge with behavior, varying workloads, gender distribution, ethnic diversity, and physical activities can influence alcohol and drug consumption patterns.[52] Alcohol consumption among medical students is of particular concern, as their perspectives on alcohol may shape their future clinical practice, especially when treating patients with alcohol-related issues.[52] Country music is one of the most prevalent cultural aspects in the daily lives of the Brazilian people. It frequently features lyrics that encourage alcohol consumption. This influence is particularly significant among university students, who are at higher risk of excessive alcohol consumption.[54] This may explain why agricultural undergraduate students reported higher levels of alcohol consumption. Furthermore, UFG-Jataí is located in a rural community with a thriving agricultural industry.

With regard to the current state of alcohol consumption in Brazil, the World Health Organization Global Report on Alcohol and Health 2018 indicated an 11% decrease in alcohol consumption per capita in the country over 6 years, dropping from 8.8 L in 2010 to 7.8 L in 2016. In the same period, the prevalence of alcohol use disorders also declined (from 5.6% to 4.2%).[1,55] These results were influenced by the implementation of the prohibition law no. 11,705/2008, along with its subsequent intensification (in 2012 and 2016) and law no. 13,106/2015, which criminalized the provision of alcohol to individuals below 18 years old.[1,55] However, several challenges persist, including the need for further research

on prevention and treatment to reduce the prevalence of harmful alcohol use. Other key areas of focus include reducing average daily consumption to levels comparable to those in the Americas, decreasing the frequency of binge drinking, preventing early alcohol experimentation among children and adolescents, and lowering the incidence of alcohol-related hospitalizations among the elderly population.[1,55]

In Sweden, web-based screening and brief interventions have been proven to be practicable, acceptable to students, and effective in reducing drinking risks for 6–12 months.[51] Similarly, a study conducted by Kypri et al.[56] demonstrated that brief interventions delivered in primary care settings could prevent excessive alcohol intake. This research aimed to assess the young people's acceptance of screening offers in primary care settings, identify their alcohol consumption levels, and estimate the proportion of patients who would benefit from a brief virtual intervention and follow-up. This study shows that primary care settings can effectively facilitate remote access to a large number of people who consume excessive amounts of alcohol. In another study, two 24-h sessions of motivational intervention and psychoeducation significantly reduced alcohol consumption in 12 months among students whose parents had alcohol issues.[57] Physical exercise also emerged as a highly effective intervention for lowering the consumption of several addictive substances. It promotes dopamine, glutamate, and endogenous opioid pathways, which help lower acute cravings, enhance the experience of pleasure, regulate mood, and alleviate the symptoms of depression and anxiety.[58] These insights underscore the importance of providing university students with tools to identify and address the risk factors and implementing practical and cost-effective interventions to reduce hazardous alcohol use.

The current study has some limitations. First, like other questionnaire-based studies, the accuracy of these results relies on the respondents' honesty and memory. Second, potential confounding factors, such as a family history of alcoholism, were not assessed. Third, the cross-sectional design of the study limits our ability to infer causality. Despite these limitations, the findings remain significant and contribute valuable insights.

CONCLUSION

In conclusion, the study population showed a high prevalence of excessive alcohol consumption. Factors such as being unmarried, living with friends, participating in undergraduate agricultural sciences programs, and having a good socioeconomic status were associated with excessive alcohol intake. Identifying these factors is crucial for formulating public policies aimed at reducing alcohol use among university students. Future longitudinal studies should prioritize interventions aimed at reducing alcohol consumption among university students.

REFERENCES

1. World Health Organization. Global status report on alcohol and health 2018. Geneva: WHO; 2018. Available from: https://iris.who.int/handle/10665/274603. Accessed in 2024 (Dec. 20).

2. Taneri PE, Kiefte-de Jong JC, Bramer WM, et al. Association of alcohol consumption with the onset of natural menopause: a systematic review and meta-analysis. Hum Reprod Update. 2016;22(4):516-28. PMID: 27278232; https://doi.org/10.1093/humupd/dmw013.

3. Parry CD, Patra J, Rehm J. Alcohol consumption and non-communicable diseases: epidemiology and policy implications. Addiction. 2011;106(10):1718-24. PMID: 21819471; https://doi.org/10.1111/j.1360-0443.2011.03605.x.

4. Zhao F, Liu Q, Li Y, et al. Association between alcohol consumption and hypertension in Chinese adults: findings from the CHNS. Alcohol. 2020;83:83-8. PMID: 31525410; https://doi.org/10.1016/j.alcohol.2019.09.004.

5. Oh SS, Kim W, Han KT, Park EC, Jang SI. Alcohol consumption frequency or alcohol intake per drinking session: Which has a larger impact on the metabolic syndrome and its components? Alcohol. 2018;71:15-23. PMID: 29929088; https://doi.org/10.1016/j.alcohol.2018.01.005.

6. Gunzerath L, Faden V, Zakhari S, Warren K. National Institute on Alcohol Abuse and Alcoholism report on moderate drinking. Alcohol Clin Exp Res. 2004;28(6):829-47. PMID: 15201626; https://doi.org/10.1097/01.alc.0000128382.79375.b6.

7. Pinsky I, Zaleski M, Laranjeira R, et al. First national survey on patterns of alcohol consumption in the Brazilian population. Braz J Psychiatry. 2010;32(3):214-5. PMID: 20945019.

8. Paulitsch RG, Dumith SC, Susin LRO. Simultaneity of behavioral risk factors for cardiovascular disease in university students. Rev Bras Epidemiol. 2017;20(4):624-35. PMID: 29267748; https://doi.org/10.1590/1980-5497201700040006.

9. Kypri K, Cronin M, Wright CS. Do university students drink more hazardously than their non-student peers? Addiction. 2005;100(5):713-4. PMID: 15847629; https://doi.org/10.1111/j.1360-0443.2005.01116.x.

10. Htet H, Saw YM, Saw TN, et al. Prevalence of alcohol consumption and its risk factors among university students: a cross-sectional study across six universities in Myanmar. PLoS One. 2020;15(2):e0229329. PMID: 32084226; https://doi.org/10.1371/journal.pone.0229329.

11. Alemu D, Soboka M, Tesfaye E, Ahmed G, Tesfaye Y. Alcohol use disorder and associated factors among Jimma University undergraduate students. Psychol Res Behav Manag. 2020;13:609-18. PMID: 32801958; https://doi.org/10.2147/prbm.s251510.

12. Heather N, Partington S, Partington E, et al. Alcohol use disorders and hazardous drinking among undergraduates at English universities. Alcohol Alcohol. 2011;46(3):270-7. PMID: 21450698; https://doi.org/10.1093/alcalc/agr024.

13. Da Silva Ferreira M, Nunes SAN, Papini CB, De Sousa TF. Prevalence of negative self-rated health in university students and its relationship with the co-occurrence of risk behaviors. J Phys Educ. 2022;33(1):e-3321. https://doi.org/10.4025/jphyseduc.v33i1.3321.

14. Collins SE. Associations between socioeconomic factors and alcohol outcomes. Alcohol Res. 2016;38(1):83-94. PMID: 27159815.

15. Leasure JL, Neighbors C, Henderson CE, Young CM. Exercise and alcohol consumption: what we know, what we need to know, and why it is important. Front Psychiatry. 2015;6:156. PMID: 26578988; https://doi.org/10.3389/fpsyt.2015.00156.

16. Kokotailo PK, Henry BC, Koscik RE, Fleming MF, Landry GL. Substance use and other health risk behaviors in collegiate athletes. Clin J Sport Med. 1996;6(3):183-9. PMID: 8792050; https://doi.org/10.1097/00042752-199607000-00008.

17. Leichliter JS, Meilman PW, Presley CA, Cashin JR. Alcohol use and related consequences among students with varying levels of involvement in college athletics. J Am Coll Health. 1998;46(6):257-62. PMID: 9609972; https://doi.org/10.1080/07448489809596001.

18. El-Sayed MS, Ali N, El-Sayed Ali Z. Interaction between alcohol and exercise: physiological and haematological implications. Sports Med. 2005;35(3):257-69. PMID: 15730339; https://doi.org/10.2165/00007256-200535030-00005.

19. Fernandez-Solà J, Preedy VR, Lang CH, et al. Molecular and cellular events in alcohol-induced muscle disease. Alcohol Clin Exp Res. 2007;31(12):1953-62. PMID: 18034690; https://doi.org/10.1111/j.1530-0277.2007.00530.x.

20. Wagner G.A, Andrade A.G. The use of alcohol, tobacco and other drugs among Brazilian college students. Rev Psiq Clín. 2008;35(suppl 1):48-54. https://doi.org/10.1590/S0101-60832008000700011.

21. Mekonen T, Fekadu W, Chane T, Bitew S. Problematic alcohol use among university students. Front Psychiatry. 2017;8:86. PMID: 28579966; https://doi.org/10.3389/fpsyt.2017.00086.

22. Zadarko-Domaradzka M, Barabasz Z, Sobolewski M, et al. Alcohol consumption and risky drinking patterns among college students from selected countries of the Carpathian Euroregion. Biomed Res Int. 2018;2018:6084541. PMID: 30671465; https://doi.org/10.1155/2018/6084541.

23. Andrade AG, Duarte PC, Barroso LP, et al. Use of alcohol and other drugs among Brazilian college students: effects of gender and age. Braz J Psychiatry. 2012;34(3):294-305. PMID: 23429775; https://doi.org/10.1016/j.rbp.2012.02.002.

24. Karam E, Kypri K, Salamoun M. Alcohol use among college students: an international perspective. Curr Opin Psychiatry. 2007;20(3):213-21. PMID: 17415072; https://doi.org/10.1097/yco.0b013e3280fa836c.

25. Pillon SC, O'Brien B, Piedra Chavez KA. The relationship between drugs use and risk behaviors in Brazilian university students. Rev Lat Am Enfermagem. 2005;13(Spec 2):1169-76. PMID: 16501789; https://doi.org/10.1590/s0104-11692005000800011.

26. Pereira DS, Souza RS De, Buaiz V, Siqueira MM De. Uso de substâncias psicoativas entre universitários de medicina da Universidade Federal do Espírito Santo. J Bras Psiquiatr. 2008;57(3):188-95. https://doi.org/10.1590/S0047-20852008000300006.

27. Andrade AG. I Levantamento nacional sobre uso de álcool, tabaco e outras drogas entre os universitários das 27 capitais brasileiras. 2009. Available from: https://cetadobserva.ufba.br/sites/cetadobserva.ufba.br/files/634.pdf. Accessed in 2023 (Dec 13).

28. Nemer ASA, Fausto MA, Silva-Fonseca VA, Ciomei MH, Quintais KD. Pattern of alcoholic beverage consumption and academic performance among college students. Arch Clin Psychiatry. 2013;40(2):65-70. https://doi.org/10.1590/S0101-60832013000200003.

29. Saunders JB, Aasland OG, Amundsen A, Grant M. Alcohol consumption and related problems among primary health care patients: WHO collaborative project on early detection of persons with harmful alcohol consumption-I. Addiction. 1993;88(3):349-62. PMID: 8461852; https://doi.org/10.1111/j.1360-0443.1993.tb00822.x.

30. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption-II. Addiction. 1993;88(6):791-804. PMID: 8329970; https://doi.org/10.1111/j.1360-0443.1993.tb02093.x.

31. World Health Organization. AUDIT: The Alcohol Use Disorders Identification Test: guidelines for use in primary care. 2nd ed. Geneva: WHO; 2001. Available from: https://iris.who.int/handle/10665/67205. Accessed in 2024 (Dec. 20).

32. Méndez EB. Uma versão brasileira do AUDIT - Alcohol Use Disorders Identification Test. [MSc thesis]. Pelotas: Universidade Federal de Pelotas; 1999.

33. García Carretero MÁ, Novalbos Ruiz JP, Martínez Delgado JM, O'Ferrall González C. Validation of the Alcohol Use Disorders Identification Test in university students: AUDIT and AUDIT-C. Adicciones. 2016;28(4):194-204. PMID: 26990260; https://doi.org/10.20882/adicciones.775.

34. Baecke JA, Burema J, Frijters JE. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. Am J Clin Nutr. 1982;36(5):936-42. PMID: 7137077; https://doi.org/10.1093/ajcn/36.5.936.

35. Associação Brasileira de Empresas de Pesquisa-ABEP. Critério Brasil. ABEP. 2019.

36. Akaike, H. A new look at the statistical model identification. IEEE Transactions on Automatic Control, 1974;19(6):716-23. http://dx.doi.org/10.1109/TAC.1974.1100705.

37. Davoren MP, Demant J, Shiely F, Perry IJ. Alcohol consumption among university students in Ireland and the United Kingdom from 2002 to 2014: a systematic review. BMC Public Health. 2016;16:173. PMID: 26895824; https://doi.org/10.1186/s12889-016-2843-1.

38. Santos Jr. A, Neves MC, Azevedo RCS, et al. Hazardous use of alcohol among undergraduate students at a public university. Arch Clin Psychiatry. 2014;41(6):150-5. https://doi.org/10.1590/0101-60830000000033.

39. Castaño-Perez GA, Calderon-Vallejo GA. Problems associated with alcohol consumption by university students. Rev Lat Am Enfermagem. 2014;22(5):739-46. PMID: 25493668; https://doi.org/10.1590/0104-1169.3579.2475.

40. Slutske WS. Alcohol use disorders among US college students and their non-college-attending peers. Arch Gen Psychiatry. 2005;62(3):321-7. PMID: 15753245; https://doi.org/10.1001/archpsyc.62.3.321.

41. Ben El Jilali L, Benazzouz B, El Hessni A, Ouichou A, Mesfioui A. Prevalence of alcohol consumption and alcohol use disorders among middle and high school students in the province of Khemisset, Morocco: a cross-sectional study. Int J Adolesc Youth. 2020;25(1):638-48. http://dx.doi.org/10.1080/02673843.2019.1700807.

42. Kuntsche E, Knibbe R, Gmel G, Engels R. Who drinks and why? A review of socio-demographic, personality, and contextual issues behind the drinking motives in young people. Addict Behav. 2006;31(10):1844-57. PMID: 16460883; https://doi.org/10.1016/j.addbeh.2005.12.028.

43. Buscemi J, Martens MP, Murphy JG, Yurasek AM, Smith AE. Moderators of the relationship between physical activity and alcohol consumption in college students. J Am Coll Health. 2011;59(6):503-9. PMID: 21660805; https://doi.org/10.1080/07448481.2010.518326.

44. Alemu D, Soboka M, Tesfaye E, Ahmed G, Tesfaye Y. Alcohol use disorder and associated factors among Jimma University undergraduate students. Psychol Res Behav Manag. 2020;13:609-18. PMID: 32801958; https://doi.org/10.2147%2fprbm.s251510.

45. Andrade AG, Duarte Pdo C, Barroso LP, et al. Use of alcohol and other drugs among Brazilian college students: effects of gender and age. Braz J Psychiatry. 2012;34(3):294-305. PMID: 23429775; https://doi.org/10.1016/j.rbp.2012.02.002.

46. Silveira CM, Siu ER, Wang YP, et al. Gender differences in drinking patterns and alcohol-related problems in a community sample in São Paulo, Brazil. Clinics. 2012;67(3):205-12. PMID: 22473399; https://doi.org/10.6061/clinics/2012(03)01.

47. Sahraian A, Sharifian M, Omidvar B, Javadpour A. Prevalence of Substance Abuse Among the Medical Students. Shiraz E-Medical Journal. 2010;11(4):198-202. Available from: https://brieflands.com/articles/semj-73087.pdf. Accessed in 2024 (Dec. 18).

48. Power C, Rodgers B, Hope S. Heavy alcohol consumption and marital status: disentangling the relationship in a national study of young adults. Addiction. 1999;94(10):1477-87. PMID: 10790900; https://doi.org/10.1046/j.1360-0443.1999.941014774.x.

49. Liang W, Chikritzhs T. Brief report : marital status and alcohol consumption behaviours. J Subst Use. 2012;17(1):84-90. http://dx.doi.org/10.3109/14659891.2010.538463.

50. Silva LV, Malbergier A, Stempliuk Vde A, de Andrade AG. Factors associated with drug and alcohol use among university students. Rev Saude Publica. 2006;40(2):280-8. PMID: 16583039; https://doi.org/10.1590/s0034-89102006000200014.

51. Bendtsen P, Johansson K, Akerlind I. Feasibility of an email-based electronic screening and brief intervention (e-SBI) to college students in Sweden. Addict Behav. 2006;31(5):777-87. PMID: 15996827; https://doi.org/10.1016/j.addbeh.2005.06.002.

52. Wicki M, Kuntsche E, Gmel G. Drinking at European universities? A review of students' alcohol use. Addict Behav. 2010;35(11):913-24. PMID: 20624671; https://doi.org/10.1016/j.addbeh.2010.06.015.

53. Kuntsche E, Knibbe R, Gmel G, Engels R. Who drinks and why? A review of socio-demographic, personality, and contextual issues behind the drinking motives in young people. Addict Behav. 2006;31(10):1844-57. PMID: 16460883; https://doi.org/10.1016/j.addbeh.2005.12.028.

54. Callan JP. Underage drinking. JAMA. 1993;269(11):1385-6. PMID: 8441210.

55. Andrade AG. Álcool e a saúde dos brasileiros. Centro de Informações sobre Saúde e álcool - CISA. 2019; Available from: https://cisa.org.br/images/upload/Panorama_Alcool_Saude_CISA2019.pdf. Accessed in 2023 (Dec 13).

56. Kypri K, Stephenson S, Langley J, Cashell-Smith M, Saunders J, Russell D. Computerised screening for hazardous drinking in primary care. N Z Med J. 2005;118(1224):U1703. PMID: 16258578.

57. Hansson H, Rundberg J, Zetterlind U, Johnsson KO, Berglund M. An intervention program for university students who have parents with alcohol problems: a randomized controlled trial. Alcohol Alcohol. 2006;41(6):655-63. PMID: 16926171; https://doi.org/10.1093/alcalc/agl057.

58. Zschucke E, Gaudlitz K, Ströhle A. Exercise and physical activity in mental disorders: clinical and experimental evidence. J Prev Med Public Health. 2013;46(Suppl 1):S12-21. PMID: 23412549; https://doi.org/10.3961/jpmph.2013.46.s.s12.

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Comparative analysis prediction of prostate and testicular cancer mortality using machine learning: accuracy study

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ABSTRACT

BACKGROUND: The mortality rates of prostate and testicular cancer are higher mortality in the northeast region.

OBJECTIVE: We aimed to compare the efficacy of machine learning libraries in predicting testicular and prostate cancer mortality.

DESIGN AND SETTING: A comparative analysis of the pyMannKendall and Prophet machine-learning algorithms was conducted to develop predictive models using data from DATASUS (TabNet) to Caicó (Brazil) and Rio Grande do Norte (Brazil).

METHODS: Data on prostate and testicular cancer mortality in men from 2000 to 2019 were collected. The prediction accuracy of the Prophet algorithm was evaluated using the mean squared error (MSE), the root mean squared error and analyzed using the pyMannKendall, and Prophet libraries.

RESULTS: The research data were made publicly available on GitHub. The machine test confirmed the accuracy of the predictions, with the root MSE (RMSE) values closely matching the observed data for Caicó (RMSE = 2.46) and Rio Grande do Norte (RMSE = 22.85). The Prophet algorithm predicted an increase in prostate cancer mortality by 2030 in Caicó and Rio Grande do Norte. This prediction was corroborated by the pyMannKendall analysis, which indicated a 99% probability of a rising mortality trend in Caicó (P < 0.01; tau = 0.586; intercept = 2.59) and Rio Grande do Norte (P = 2.06; tau = 0.84, and intercept = 119.63). For testicular cancer, no significant mortality trend was identified by Prophet or pyMann-Kendall.

CONCLUSIONS: Libraries are reliable tools for predicting mortality, providing support for strategic health planning, and implementing preventive measures to ensure men's health. Addressing the gender gap in DATASUS is essential.

INTRODUCTION

Cancer mortality is influenced by socioeconomic factors and exposure to risk factors, including lifestyle and social conditions, all of which are determinants of disease probability.[1] The National Cancer Institute (INCA) projected 625,000 patients with newly diagnosed cancer in Brazil for the period 2020–2023, with prostate cancer being the second most prevalent, affecting 66,000 individuals.[2]

Prostate cancer is one of the leading causes of cancer-related mortality in Brazil, primarily affecting cisgender men aged 50 years and older.[3] By contrast, testicular cancer, though considered rare, affects cisgender men aged 15–39 years, leading to significant social and reproductive consequences particularly within the economically active population.[3] These cancer types are not exclusive to cisgender patients; transgender and transvestite women are also at risk.[4] The use of hormones by these women may increase their susceptibility to developing reproductive cancers, including prostate and testicular cancers.[4] However, due to the barriers to accessing healthcare, social discrimination, and the lack of appropriate guidance, reports of such cases remain scarce.[5]

In Brazil, the National Policy for Integral Attention to Men's Health has been implemented to promote health education among men, addressing social, cultural, political, and economic aspects while respecting regional differences.[6] However, the trends in cancer incidence and mortality, such as testicular and prostate cancer, exhibit regional disparities, with notably higher mortality rates in the northeast region.[7] These disparities are influenced by factors beyond geographical

location. Age, ethnicity, diet, family history, obesity, cigarette smoking, genetic factors, gender identity, lifestyle, and the availability of screening tests are all risk factors that increase the likelihood of developing a disease or health problem and affect the understanding of prostate cancer mortality.[8] In addition, testicular cancer screening is less developed compared with prostate cancer screening.

Machine learning (ML) algorithms, a prominent subfield of artificial intelligence (AI), have been developed and utilized to analyze medical datasets since their initial development.[9] This innovation enhances epidemiology as it optimizes the analysis of large data from multicenter databases, such as the Mortality Information System (SIM), thereby improving the quality and transparency of information.[10] However, no study has employed these tools in the R and Python languages. ML is widely used for prediction in various fields, including primary healthcare, where it can forecast testosterone deficiency without requiring expensive medical tests.[11] Additionally, ML has demonstrated its value in clinical prediction, facilitating diagnostic decision-making for conditions like aggressive breast cancer[12] and predicting cancer risk, susceptibility, and recurrence across multiple types, such as lung, colorectal, esophageal, prostate, stomach, and thyroid.[13]

Splitting data into training and test sets is a standard practice in predictive analytics.[14] Configuration selection is a critical aspect in tuning machine learning models, as overfitting can significantly impact the performance of different learning algorithms and must be carefully addressed in empirical evaluations.[15] Various machine learning techniques, such as Prophet Library and pyMannKendall, are already being used for predictive analysis across different pathologies. In the clinical field, machine learning has been applied to address orthopedic issues, such as predicting the advancement of articular cartilage degeneration in chronic osteoarthrosis[16] and forecasting the relative risk of dengue transmission in different locations.[17]

The Prophet library, an open-source forecasting model developed by Facebook based on ML techniques, automates parameter selection. This feature allows users to easily adjust model parameters to best fit the input data.[15] It was designed to be a practical and accessible tool for time series forecasting.[18] This enables Prophet's forecasts customizable for non-experts and adaptable to the specific needs of health analysis, such as predicting the progression of coronavirus disease 2019 (COVID-19) cases in hospital intensive care units (ICUs).[19] Intuitive parameter customization, such as smoothing for trend and seasonality, and the integration of prior information for growth curve boundaries, makes it possible to tailor the model to the specific needs of each analysis. This enhances the completeness and accuracy of health data analysis.

Despite its common use in environmental studies for analyzing the temporal and seasonal trends, pyMannKendall has not been widely applied in the health sector, particularly in the analysis of prostate and testicular cancer mortality.[20] Google Colab, a platform that utilizes Python language for code execution and analysis, was effectively employed for breast cancer mortality analysis owing to its ease of use and the ability to rapidly integrate various Python libraries.[21]

OBJECTIVES

We aimed to assess the accuracy of machine learning in predicting prostate and testicular cancer mortality in Rio Grande do Norte (RN) and Caicó, Brazil. The data and findings were made publicly available on GitHub (https://github.com/jpbraz/nano-med-colab-prophet-googlesheets). We also aimed to compare Prophet and pyManKendall tools to optimize mortality predictions in both regions, refining the quality of the results.

METHODS

Data

Data were collected from the TabNet platform, integrated into DATASUS, and publicly accessible (https://datasus.saude.gov.br/informacoes-de-saude-tabnet). Thus, this study uses public data and therefore does not require approval by an Ethics Committee. The "1996 International Classification of Diseases, Tenth Revision (ICD-10) mortality data" were used, selecting "general mortality" for RN and Caicó. We focused on the ICD-10 categories C61 (malignant prostate neoplasm) and C62 (malignant neoplasm of the testes) for the period 2000 and 2019, specifically for the male population. The tables were exported to CSV format and made available on Google Spreadsheets (https://docs.google.com/spreadsheets). Additionally, we collected the population data by age group for Caicó, RN, and Brazil to calculate the crude and age-adjusted prostate and testicular cancer-specific mortality rates. We used a direct method with the Brazilian population serving as the reference (**Table 1**).

Prophet Method and Analysis on Google Collaboratory

The Prophet comprises annual and weekly seasonal effect components, a list of holidays, and a linear trend curve. The model is expressed using the following formula:

$$y(t)=g(t)+s(t)+h(t)+\varepsilon(t)$$

where y(t) denotes the observed value in the time series at time t, g(t) is the trend component at time t, s(t) is the seasonal component at time t, h(t) is the user-supplied holiday component at time t, and ε(t) is the forecast error at time t. The Prophet facilitates the analysis of different time series and filters out noise and outliers from the datasets.[22] Then, prediction was performed using the "predict" method, and the DataFrame with the predicted values was obtained.

Table 1. Prostate and testicular cancer mortality rates in the municipality of Caicó and in the state of Rio Grande do Norte from 2000 to 2019

Year	Caicó				Rio Grande do Norte			
	Population	Number of deaths	Crude mortality rate/100,000 pop.	Age adjusted mortality rate/100,000 pop.	Population	Number of deaths	Crude mortality rate/100,000 pop.	Age adjusted mortality rate/100,000 pop.
2000	58,594	3	5.1	4.1	2.853,035	74	2,6	2.3
2001	59,217	3	5.1	2.3	2,896,569	90	3.1	2.8
2002	59,808	5	8.4	6.3	2,937,858	97	3.3	2.8
2003	60,381	1	1.7	3.0	2,977,895	124	4.2	3.6
2004	60,937	2	3.3	3.1	3,016,738	131	4.3	3.6
2005	61,499	6	9.8	5.5	3,056,025	166	5.4	4.4
2006	62,053	7	11.3	5.8	3,094,682	199	6.4	4.9
2007	62,572	4	6.4	4.0	3,130,943	198	6.3	5.7
2008	63,094	5	7.9	5.9	3,167,448	226	7.1	6.4
2009	63,626	7	11.0	4.4	3,204,610	230	7.2	6.5
2010	64,132	3	4.7	2.4	3,239,939	239	7.4	6.9
2011	64,583	10	15.5	9.7	3,271,415	275	8.4	7.7
2012	65,031	10	15.4	7.2	3,302,720	235	7.1	6.7
2013	65,463	8	12.2	9.5	3,332,952	232	7.0	6.3
2014	65,895	10	15.2	9.3	3,363,084	272	8.1	7.5
2015	66,335	10	15.1	6.9	3,393,814	264	7.8	7.3
2016	66,750	16	24.0	11.9	3,422,843	289	8.4	8.0
2017	67,148	8	11.9	5.9	3,450,669	294	8.5	8.1
2018	67,554	7	10.4	5.6	3,479,010	272	7.8	7.5
2019	67,952	11	16.2	10.5	3,506,853	284	8.1	8.0

To evaluate the quality of the Prophet's predictions, different metrics, such as mean square error (MSE) and root mean square error (RMSE), can be used to evaluate and compare the performance of the models:

$$MSE = \frac{1}{N} \sum_{i=1}^{N} (y_i - \hat{y})^2$$

$$RMSE = \sqrt{MSE} = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (y_i - \hat{y})^2}$$

The notebook was created using the Google Collaboratory environment. The code blocks added for installing libraries were necessary for the manipulation and analysis of the data available in the spreadsheets. Among them, the "pystan" and "Prophet" libraries were used for training the data and predicting future results. Additionally, all auth (google.colab) and default (google.auth) packages were imported ("import") to authenticate the user and obtain the necessary credentials to access their spreadsheets. In addition, we imported Gspread (a Python programming interface for manipulating Google Sheets), Prophet (Facebook), to train and predict future results), and pandas (for working with tabular data structures).

The Pandas library[23] was used to create the DataFrames. The libraries were exported and loaded with entries (rows and columns) of the selected page with the year and corresponding mortality cases. Once the DataFrame was created, the column labeled "Year" was renamed to "ds," while the column containing the number of cases was renamed to "y." Next, an instance of the Prophet was created. The model was trained using the "fit" method, with the DataFrame as the input parameter. Additionally, the "make_future_dataframe" method was employed to define the future period for which predictions would be made.

PyMannKendall Analysis on Google Collaboratory

The trend analysis of the dependent variables was performed using the non-parametric Mann-Kendall test to identify linear or non-linear temporal trends.[24] For this analysis, the pyMannKendall package was used, a Python package that performs trend tests with non-parametric data using the Mann-Kendall algorithm and a vectorization approach to increase its performance.[20]

The pyMannKendall package was installed and imported into the Google Colab environment, along with other packages for authentication and data manipulation (e.g., Auth, Gspread, and Pandas). After authentication and selection of the appropriate worksheet, the data were loaded into a DataFrame using pandas. The relevant column (containing the number of cases for each neoplasm) was extracted and converted into a list for analysis. This list was analyzed using the PyMannKendall's "originaltest" method, which provided results of the trend, h, P, z, tau, s, var_s, slope, and intercept parameters.

RESULTS

Description measures

The data obtained from DATASUS for the period 2000–2019 (before COVID-19) include the number of deaths, population, and both crude and age-adjusted mortality rates by year in Caicó and RN (**Table 1**). Additionally, the distribution of cancer mortality rates in Caicó and RN revealed the presence of seasonality and trends (**Figure 1A-B**).

Prophet analysis for prostate cancer mortality in RN and Caicó

The data obtained from DATASUS until 2019 allowed the analysis of prediction between 2010 and 2019 for RN and Caicó (**Table 2**). The Prophet's machine training predictions for RN reflect an approximation of the number of deaths when comparing the actual and predicted values. This prediction training behavior by Prophet was similar for the municipality of Caicó; however, it was more accurate in this municipality, with only a slight difference between the actual and predicted number of cases. In RN state, the analysis revealed a reduction in the predicted number of deaths in 2010–2016, an equal number of deaths in 2017, and an increase in the number of deaths in 2018 and 2019. **Figure 2A** and **B** demonstrates that the Prophet algorithm accurately captured the trend and seasonality of the data. The RMSE for the Caicó data was 2.46, indicating a good fit, while that for the RN series was 22.85, suggesting a greater variability.

Thus, future predictions for 2020–2030 were established using the Prophet, noting an upward trend in the number of cases for RN (**Table 3**). The comparison of the actual data from 2010 to 2019 and the predictions from 2020 to 2030 showed an increase in the number of deaths from prostate cancer. The predicted values were approximate rather than exact.

The prediction indicates an increase in the number of deaths from prostate cancer in Caicó (**Figure 2A**) and RN (**Figure 2B**). Despite this upward trend, the data revealed distinct patterns: Caicó demonstrated no growth in the number of deaths per year, while RN exhibited a consistent and steady increase in mortality rates. This behavior was illustrated with blue lines for Caicó and RN, while the Prophet's forecast was denoted by a red curve, illustrating predictions over a 20-month period.

Prophet analysis for testicular neoplasm mortality in RN and Caicó

No trends were observed in the number of deaths from malignant testicular neoplasia in Caicó and between 2020 and 2030.

PyMannKendall analysis of prostate cancer mortality in RN and Caicó

The pyMannKendall (Python Library) analysis revealed a significant upward trend in prostate cancer mortality in Caicó, with a

Table 2. Machine training prediction of deaths from malignant prostate cancer performed by Prophet for the period between 2010 and 2019 for the state of Rio Grande do Norte (RN, Brazil) and the municipality of Caicó (RN, Brazil)

Year	Expected cases RN	Expected cases Caicó
2010-12-31	216	7
2011-12-31	229	7
2012-12-31	236	9
2013-12-31	249	9
2014-12-31	261	9
2015-12-31	274	9
2016-12-31	281	11
2017-12-31	294	11
2018-12-31	307	11
2019-12-31	320	11
Total	2,666	92
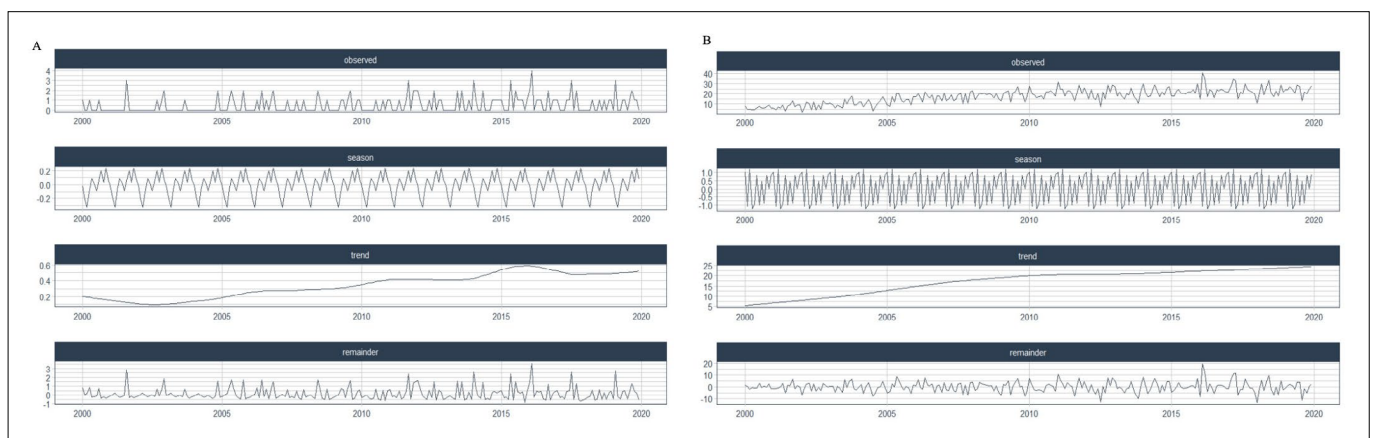
Figure 1. Distribution of the number of cancer-related deaths in Caicó (A) and Rio Grande do Norte State (B) using artificial intelligence.
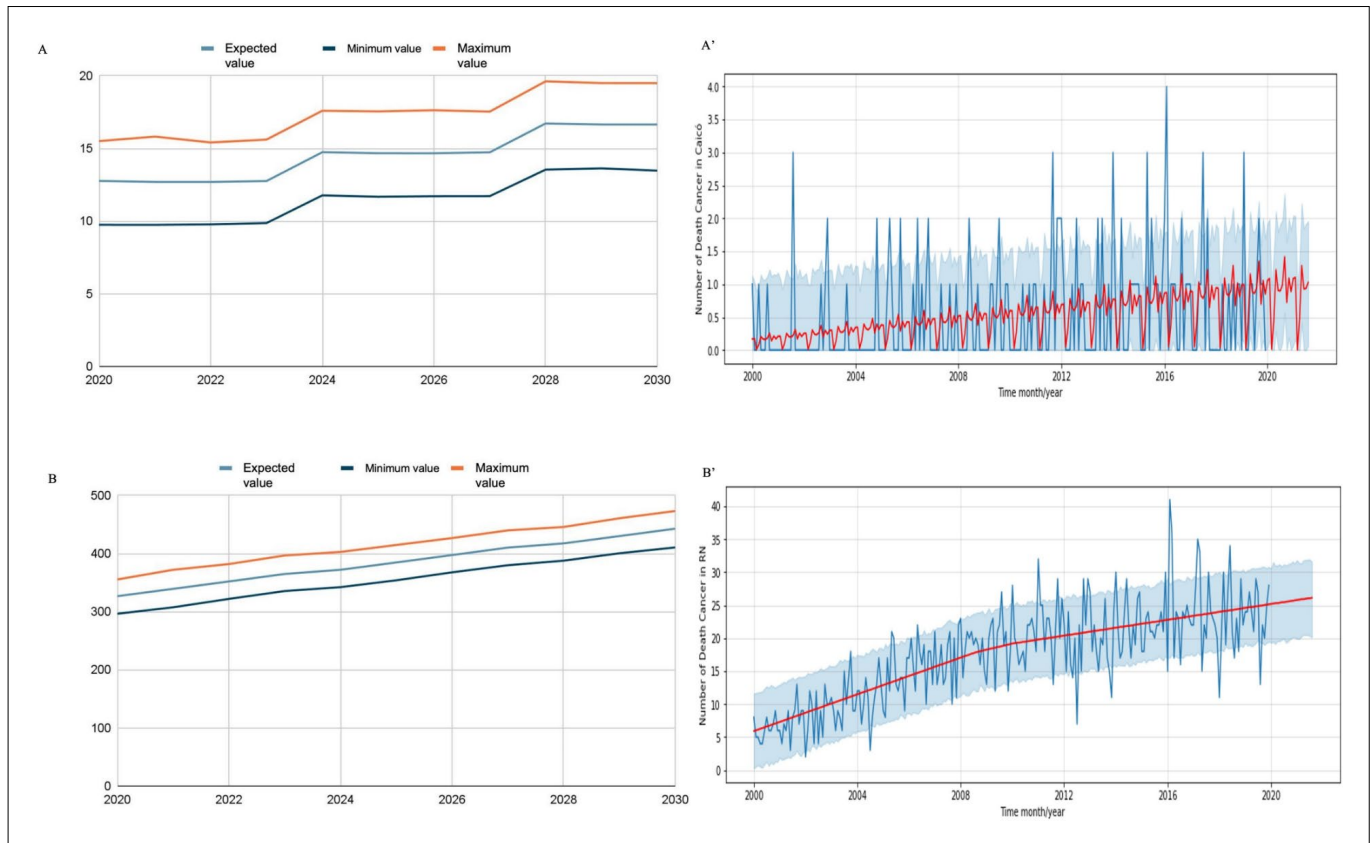
Figure 2. Prophet prediction analysis. A: Growth trend in mortality from malignant prostate cancer in Caicó; A': Analysis of the number of deaths in Caicó using the Prophet model; B: Growth trend in mortality from malignant prostate cancer in Rio Grande do Norte; B': Analysis of the number of deaths in Rio Grande do Norte using the Prophet, created using artificial intelligence

Table 3. Prostate malignant neoplasm mortality growth trend – Rio Grande do Norte (2020–2030) by Prophet

Year	Expected cases	Minimum expected cases	Maximum expected cases
2020	327	296	355
2021	339	308	372
2022	352	322	382
2023	365	336	397
2024	372	342	403
2025	385	354	415
2026	397	368	427
2027	410	380	440
2028	417	388	446
2029	430	401	461
2030	443	411	473
Total	4,237	3,906	4,216

probability greater than 99% ($P < 0.01$). This indicates a moderate correlation; as time progresses, the number of prostate cancer deaths increases (tau = 0.586). The onset of the increase in prostate cancer deaths was determined using a variable intercept of 2.59. PyMannKendall analysis also indicated an increasing trend in mortality from prostate cancer in RN. However, the high P-value ($P = 2.06$) suggests that this trend is less significant, with a tau value of 0.84 and an intercept of 119.63.

PyMannKendall analysis of testicular neoplasm mortality in RN and Caicó

For testicular neoplasia, no growth trend was detected in Caicó, with a P value of 0.6, a tau = 0.036, and an intercept of 0. Similarly, no growth trend was observed in RN, with a $P = 0.43$, a tau = -0.33, and an intercept of 5.5. These results indicate a reduced likelihood of an increase in the number of deaths from testicular cancer over the years ($P > 0.05$) and a weak correlation between the variables and tau values.

DISCUSSION

Machine learning can aid in analyzing various health-related parameters, including monitoring of trends in disease prevalence.[10] Therefore, we applied these Python libraries to analyze the mortality trend of two diseases that directly impact human health, with the potential for similar applications in other cities. Our analysis revealed an increasing trend in the number of deaths from prostate

cancer in Caicó and RN, in addition to a stable trend in testicular cancer mortality. However, the DATASUS database does not distinguish between population groups and gender. This data gap posed a limitation in the analysis of the prediction of pathologies related to the lesbian, gay, bisexual, transgender, queer, questioning, intersex, and asexual (LGBTQIA+) population in our study.

The use of the Prophet revealed a growing trend in the number of deaths from prostate cancer in 2020–2030 in the state of RN (35.4%), with the municipality of Caicó exhibiting a similar trend (30.7%). This increase was twice as high as that observed in 2010–2019, potentially linked to the aging population, particularly among men aged over 65 years, and improvements in death certification.[25] However, a stabilization trend was noted in Caicó between 2024 and 2027, but not in the state of RN.

Nevertheless, the mortality from testicular cancer, analyzed using Prophet and pyMannKendall, did not show an upward trend. This may be due to the low incidence of this cancer type in Brazil (3.2/100,000 inhabitants),[25] as well as underreporting due to the limited access to healthcare services for men[26] or incomplete data entered in Tabnet.[27] This result differs from the projected trend of increased testicular cancer mortality in northeast Brazil (27.5%) by 2026–2030.[28] Although this increase is smaller compared with that observed in other regions, it can be attributed to the unequal distribution of services essential for diagnosing and treating cancer patients. Our study revealed the lack of data from DATASUS regarding the special screening test for prostate cancer (CID: Z12.5), which is a key strategy for early cancer detection, both in the city of Caicó and the state of RN. Additionally, efforts targeting male health are limited, largely due to sociocultural factors related to the patriarchal system, which portrays men as bold, courageous, and confident, often neglecting their health needs.[29]

Therefore, the application of machine learning libraries can aid in situational strategic planning and decision-making at the state and municipal levels in Brazil. This approach aims to guide the healthcare team in implementing strategies that reduce the incidence of new cases of prostate and testicular cancer and minimizing the impact of these diseases on diagnosed patients.[30] For preventive actions to be effectively integrated into healthcare, adapting health services to meet the current demands is essential. Guiding healthcare professionals through established guidelines is essential for setting goals and strategies to achieve a sustainable and resilient healthcare system that comprehensively addresses men's health.[31] Thus, screening tests are crucial for reducing the number of deaths from prostate cancer.

According to Cavalcanti,[32] a comprehensive understanding of men's health needs is crucial for the development of preventive actions.[21] These actions are deemed successful when strategies are effectively implemented to enhance men's access to and engagement in healthcare. Such strategies include hosting lectures, forming educational groups, providing individual consultations, and distributing brochures. According to Moura,[33] these strategies for addressing the health/disease process ensure universal and continuous access to quality healthcare services according to the principles of universalization, equity, and comprehensiveness within the Unified Health System in Brazil (SUS).

Despite their ability to optimize data analysis, these technologies have limitations, including the need for prior knowledge of system programming, which is unknown to most healthcare professionals.[34] Additionally, the DATASUS system has certain limitations, as it only accounts for biological sex and does not address the needs of transsexual women and transvestites in relation to prostate and testicular cancer. This gender health data gap could impact the quality and representativeness of mortality prediction.[35] In this sense, although concrete studies on the mortality trend from prostate and testicular cancer in this population in Brazil are lacking, some authors have already highlighted the challenges that the LGBTQIA+ population faces when accessing the healthcare system.[35] This lack of representation and visibility of transsexual bodies can lead transsexual women to feel unmotivated to seek preventive care or remain unaware of this need. They are often subjected to institutional violence, denial of rights, and neglect.[36] This exacerbates the vulnerability of transgender women in Brazil, who have an average life expectancy of approximately 35 years.[37] Additionally, the lack of cultural competence by healthcare providers, financial barriers, and discrimination hinder the provision of universal and comprehensive access to healthcare for this population.

Therefore, Brazil established the National Policy for the Comprehensive Health of Lesbians, Gays, Bisexuals, Transvestites, and Transsexuals (PNSI LGBT, Ministry of Health). This policy aims to improve health surveillance instruments related to gender identity and sexual orientation, thereby enhancing health information quality to monitor and evaluate health indicators for this population.[30] However, currently, the Notifiable Diseases Information System only includes quantifiable data related to interpersonal and self-inflicted violence in its notification forms. Despite the advances made after the establishment of the LGBT PNSI, the transgender population continues to encounter difficulties in accessing healthcare services, ranging from primary care to high complexity.

CONCLUSIONS

Machine learning models such as Prophet and pyMannKendall have accurately predicted the mortality rates of prostate and testicular cancers in the male population. However, integrating gender data, including information on transgender, into DATASUS/TabNet is essential. In addition, these results encourage the education system to create a strategy to train healthcare professionals in programming as advancements in health information technology are improving the analysis of disease trends.

REFERENCES

1. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68(6):394-424. 2020;70(4):313. PMID: 30207593; https://doi.org/10.3322/caac.21492.

2. Instituto Nacional do Câncer. Estimativa 2020: incidência de câncer no Brasil. Rio de Janeiro: INCA; 2019. Available at: https://www.inca.gov.br/sites/ufu.sti.inca.local/files/media/document/estimativa-2020-incidencia-de-cancer-no-brasil.pdf. Accessed in 2022 (Sep. 22).

3. Ferlay J, Colombet M, Soerjomataram I, et al. Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods. Int J Cancer. 2019;144(8):1941-53. PMID: 30350310; https://doi.org/10.1002/ijc.31937.

4. Joint R, Chen ZE, Cameron S. Breast and reproductive cancers in the transgender population: a systematic review. BJOG. 2018;125(12):1505-12. PMID: 29706033; https://doi.org/10.1111/1471-0528.15258.

5. Tabaac AR, Sutter ME, Wall CSJ, Baker KE. Gender Identity Disparities in Cancer Screening Behaviors. Am J Prev Med. 2018;54(3):385-93. PMID: 29338956; https://doi.org/10.1016/j.amepre.2017.11.009.

6. Brasil. Portaria no 1.944, de 27 de agosto de 2009. Brasília: Ministério da Saúde; 2009. Available at: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2009/prt1944_27_08_2009.html. Accessed in 2023 (Nov. 09).

7. Lima MS, Siqueira HFF, Moura AR, et al. Temporal trend of cancer mortality in a Brazilian state with a medium Human Development Index (1980-2018). Sci Rep. 2020;10(1):21384. PMID: 33288835; https://doi.org/10.1038/s41598-020-78381-4.

8. Rawla P. Epidemiology of Prostate Cancer. World J Oncol. 2019;10(2):63-89. PMID: 31068988; https://doi.org/10.14740/wjon1191.

9. Kononenko I. Machine learning for medical diagnosis: history, state of the art and perspective. Artif Intell Med. 2001;23(1):89-109. PMID: 11470218; https://doi.org/10.1016/s0933-3657(01)00077-x.

10. Massato Harayama R. Reflexões sobre o uso do big data em modelos preditivos de vigilância epidemiológica no Brasil. Cad Ibero Am Direito Sanit. 2020;9(3):153-65. https://doi.org/10.17566/ciads.v9i3.702.

11. Novaes MT, Ferreira de Carvalho OL, Guimarães Ferreira PH, et al. Prediction of secondary testosterone deficiency using machine learning: a comparative analysis of ensemble and base classifiers, probability calibration, and sampling strategies in a slightly imbalanced dataset. Inform Med Unlocked. 2021;23:100538. https://doi.org/10.1016/j.imu.2021.100538.

12. Aličković E, Subasi A. Breast cancer diagnosis using GA feature selection and Rotation Forest. Neural Comput Applic. 2017;28(4):753-63. https://doi.org/10.1007/s00521-015-2103-9.

13. Cruz JA, Wishart DS. Applications of machine learning in cancer prediction and prognosis. Cancer Inform. 2007;2:59-77. PMID: 19458758.

14. Chollet F. Deep learning with Python. Simon and Schuster; 2021. Available from: https://tanthiamhuat.files.wordpress.com/2018/03/deeplearningwithpython.pdf. Accessed in 2022 (Oct.8).

15. Cawley GC, Talbot NL. On over-fitting in model selection and subsequent selection bias in performance evaluation. JMLR. 2010;11:2079-107. Available from: https://jmlr.org/papers/v11/cawley10a.html. Accessed in 2023 (Oct. 08).

16. Cabitza F, Locoro A, Banfi G. Machine Learning in Orthopedics: A Literature Review. Front Bioeng Biotechnol. 2018;6:75. PMID: 29998104; https://doi.org/10.3389/fbioe.2018.00075.

17. Vásquez P, Sanchez F, Barboza LA, et al. Mathematical and statistical models for the control of mosquito-borne diseases: the experience of Costa Rica. Rev Panam Salud Publica. 2022;46:e113. PMID: 36060201; https://doi.org/10.26633/rpsp.2022.113.

18. Taylor SJ, Letham B. Forecasting at Scale. Am Stat. 2017;72(1):37-45. https://doi.org/10.1080/00031305.2017.1380080.

19. Borges D, Nascimento MCV. COVID-19 ICU demand forecasting: A two-stage Prophet-LSTM approach. Appl Soft Comput. 2022;125:109181. PMID: 35755299; https://doi.org/10.1016/j.asoc.2022.109181.

20. Hussain Md, Mahmud I. pyMannKendall: a python package for non parametric Mann Kendall family of trend tests. JOSS. 2019;4(39):1556. https://doi.org/10.21105/joss.01556.

21. Balaraman S. Comparison of classification models for breast cancer identification using Google Colab. Math Comput Sci. 2020. http://dx.doi.org/10.20944/preprints202005.0328.v1.

22. Belikov D, Arshinov M, Belan B, et al. Analysis of the diurnal, weekly, and seasonal cycles and annual trends in atmospheric CO_2 and CH_4 at Tower Network in Siberia from 2005 to 2016. Atmosphere. 2019;10(11):689. http://dx.doi.org/10.3390/atmos10110689.

23. McKinney W. pandas: a foundational Python library for data analysis and statistics. Python for high performance and scientific computing. 2011;14(9):1-9. Available from: https://dlr.de/sc/portaldata/15/resources/dokumente/pyhpc2011/submissions/pyhpc2011_submission_9.pdf. Accessed in 2022 (Mar. 05).

24. Kendall M. Trend analysis of pahang river using non-parametric analysis: Mann Kendall's trend test. Malays J Anal Sci. 2015;19:1327-34. Available from: https://mjas.analis.com.my/wp-content/uploads/2018/11/NurHishaam_19_6_23.pdf. Accessed in 2022 (Mar. 05).

25. Lima CA, da Silva BEB, Hora EC, et al. Trends in prostate cancer incidence and mortality to monitor control policies in a northeastern Brazilian state. PLoS One. 2021;16(3):e0249009. PMID: 33765051; https://doi.org/10.1371/journal.pone.0249009.

26. Boccolini CS, de Souza Junior PR. Inequities in Healthcare utilization: results of the Brazilian National Health Survey, 2013. Int J Equity Health. 2016;15(1):150. PMID: 27852269; https://doi.org/10.1186/s12939-016-0444-3.

27. Correia LO, Padilha BM, Vasconcelos SM. Methods for assessing the completeness of data in health information systems in Brazil: a systematic review. Cien Saude Colet. 2014;19(11):4467-78. PMID: 25351313; https://doi.org/10.1590/1413-812320141911.02822013.

28. Soares SCM, Dos Santos KMR, de Morais Fernandes FCG, Barbosa IR, de Souza DLB. Testicular Cancer mortality in Brazil: trends and predictions until 2030. BMC Urol. 2019;19(1):59. PMID: 31277621; https://doi.org/10.1186/s12894-019-0487-z.

29. Baker P, Shand T. Men's health: time for a new approach to policy and practice? J Glob Health. 2017;7(1):010306. PMID: 28400949; https://doi.org/10.7189/jogh.07.010306.

30. Müller N, Hortelan MP da SM, Gentil DF, Calças IRR, Reis CB, Machado AAV. Strategic planning in health and continuing education in health: grounds for changes in the assistance profile. BJHR. 2021;4(1):475-84. https://doi.org/10.34119/bjhrv4n1-038.

31. Breneol S, Curran JA, Marten R, et al. Strategies to adapt and implement health system guidelines and recommendations: a scoping review. Health Res Policy Syst. 2022;20(1):64. PMID: 35706039; https://doi.org/10.1186/s12961-022-00865-8.

32. Cavalcanti J da RD, Ferreira J de A, Henriques AHB, Morais GS da N, Trigueiro JVS, Torquato IMB. Assistência Integral a Saúde do Homem: necessidades, obstáculos e estratégias de enfrentamento. Esc Anna Nery Rev de Enferm. 2014;18:628-34. https://doi.org/10.5935/1414-8145.20140089.

33. Moura EC, Santos WD, Neves AC, Gomes R, Schwarz E. Atenção à saúde dos homens no âmbito da Estratégia Saúde da Família [Men's health care in the scope of the Family Health Strategy]. Cien Saude Colet. 2014;19(2):429-38. PMID: 24863819; https://doi.org/10.1590/1413-81232014192.05802013.

34. Santos HGD, Nascimento CFD, Izbicki R, Duarte YAO, Porto Chiavegatto Filho AD. Machine learning for predictive analyses in health: an example of an application to predict death in the elderly in São Paulo, Brazil. Cad Saude Publica. 2019;35(7):e00050818. PMID: 31365698; https://doi.org/10.1590/0102-311x00050818.

35. Lego VD. Uncovering the gender health data gap. Cad Saude Publica. 2023;39(7):e00065423. PMID: 37585901; https://doi.org/10.1590/0102-311xen065423.

36. Jesus MKMRD, Moré IAA, Querino RA, Oliveira VHD. Experiências de mulheres transexuais no sistema de saúde: visibilidade em direção à equidade. Interface. 2023;27:e220369. https://doi.org/10.1590/interface.220369.

37. Krüger A, Sperandei S, Bermudez XPCD, Merchán-Hamann E. Characteristics of hormone use by travestis and transgender women of the Brazilian Federal District. Rev Bras Epidemiol. 2019;22(Suppl 1):e190004. PMID: 31576980; https://doi.org/10.1590/1980-549720190004.supl.1.

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Physical activity and factors associated with the costs of low back pain among adults after 18 months of follow-up: a cohort study

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ABSTRACT

BACKGROUND: Chronic low back pain (CLBP) is a substantial health problem that causes considerable economic losses. Several studies have demonstrated the protective effect of habitual physical activity; however, little data are available regarding its impact on the costs associated with CLBP.

OBJECTIVE: The primary aim of this study was to analyze the costs of CLBP in the Brazilian Health System and associated factors among adults.

DESIGN AND SETTING: An 18-month cohort study was conducted in two basic health units in Presidente Prudente (SP), Brazil.

METHODS: A total of 198 patients were interviewed and evaluated four times: at baseline, with retrospective data covering the previous 12 months, and at six, 12, and 18 months. The Nordic and Baecke questionnaires were used to classify CLBP, and the Baecke questionnaire was used for physical activity assessment. The costs were calculated by reviewing the demand for services from medical records. Body mass index (kg/m²) was determined using body mass and height values collected during the interviews. The questionnaire included confounding variables, such as sex, age, ethnicity, and socioeconomic status.

RESULTS: A high prevalence of CLBP was observed, which was associated with female sex and younger age. CLBP resulted in high costs for medical consultations (without: US$ 34.25 ± 23.21; with: US$ 39.62 ± 27.25; P = 0.049), while cycling was negatively associated with costs (rho = -0.289; P = 0.049).

CONCLUSION: Lower back pain was associated with higher costs of medical consultations, while cycling was associated with reduced costs.

INTRODUCTION

The epidemiological aspects of chronic low back pain (CLBP) have been analyzed worldwide, primarily because CLBP is highly prevalent among adults.[1,2] In developing nations, the prevalence of CLBP ranges from 4.2% to 14.7%, while any episode of CLBP during a given year affects 50–60% of the population.[3,4]

According to Barrey et al.,[5] CLBP is a serious public health problem, and spending on its treatment has steadily increased over the last four decades. This financial burden can be attributed to various therapeutic interventions, such as medical consultations, physiotherapy sessions, imaging tests, and medications.[5]

CLBP is a substantial health issue, ranking as the second most common cause of medical consultations worldwide.[6] In developed countries, such as the United States, United Kingdom, and Australia,[7–10] CLBP leads to considerable economic losses; however, little is known about its economic burden in developing settings.

Furthermore, CLBP is a major cause of work absence. In addition to financial costs, CLBP has psychological and social consequences for patients, reducing productivity and limiting mobility, which may hinder socialization.[2,11,12]

Studies have demonstrated the protective effect of habitual physical activity (PA), distinct from exercise protocols conducted in laboratory settings, on various diseases, including CLBP.[2,13,14] A systematic review and meta-analysis of 13 studies involving 597 patients undergoing aquatic activities during CLBP treatment found that this form of activity reduced pain sensation, improved quality of life, and decreased physical disability.[15]

Another literature review investigated the effects of different forms of physical exercise on CLBP, and after analyzing 89 studies with 5,578 patients, the authors concluded that interventions including Pilates, stabilization, resistance, and aerobic exercises are the most effective in treating CLBP.[16]

Thus, PA is a non-pharmacological intervention often associated with lower healthcare costs.[17–19] However, data on its impact on costs related to CLBP are limited. A clear understanding of the influence of PA on costs in patients with CLBP is crucial for identifying opportunities to reduce the high costs associated with CLBP in adults.

We hypothesize that regular PA can help alleviate CLBP symptoms and, consequently, reduce the demand for medical consultations and hospital admissions. Furthermore, high levels of PA may help lower public health costs.

OBJECTIVE

This study aimed to analyze the costs of CLBP in the Brazilian National Health System and their correlates among adults after 18 months of follow-up.

METHODS

Sample

The Ethical Board of the Universidade Estadual Paulista (UNESP) approved the research project on April 9, 2013 (case number: 241291/2013), and the Municipal Department of Health authorized contact with the participants and the use of two facilities responsible for medical services in the city of Presidente Prudente (having approximately 200,000 inhabitants), western São Paulo State. Health units linked to the Brazilian National Health Service (NHS; in Portuguese, SUS) were chosen for convenience, and all patients signed a written consent form.

The researchers remained in facilities linked to the Brazilian NHS for 30 consecutive days, and all patients with medical appointments who fulfilled all inclusion criteria were invited to participate in the study. The participants were contacted at four time points: baseline, 6 months, 12 months, and 18 months. Only participants with no missing data during the follow-up period were included (final sample after 18 months: 198 patients). At baseline, the inclusion criteria were active registration in the NHS, age ≥ 50 years, and residence in the metropolitan region of Presidente Prudente for at least 2 years (**Figure 1**).

Chronic low back pain

The questionnaire developed by Kuorinka et al.,[20] which was previously validated in Portuguese,[21,22] was used to evaluate the occurrence of musculoskeletal symptoms (pain, formication, or numbness) in different regions of the body (neck, shoulder, upper back, elbows, wrists/hands, lower back, hip/thigh, knees, and ankles/

feet). For each body region, there were four dichotomous questions (yes or no) related to (i) the presence of musculoskeletal disorders in the previous 12 months, (ii) impairment of daily activities in the previous 12 months due to these disorders, (iii) any health professional consultations due to these disorders, and (iv) experience with these disorders in the week immediately before the interview.

In the current study, we only considered the lower back region, and the presence of CLBP was considered positive for participants who answered "yes" to all four questions. Considering the first measurement (baseline) and the last measurement of the follow-up period (18 months), the participants were classified according to the occurrence of CLBP: none (no CLBP), yes once (presence of CLBP at either baseline or follow-up), and yes twice (presence of CLBP at both baseline and follow-up).

Healthcare costs

The healthcare costs of each patient during follow-up were verified by the demand for the services recorded in the medical records.[19,23] The analysis comprised all 18 months of follow-up. The following information was obtained: medicines supplied to the patient, laboratory tests performed, and the number of consultations. To convert the procedures into currency, data from the medical records were recorded, and the amounts paid by the
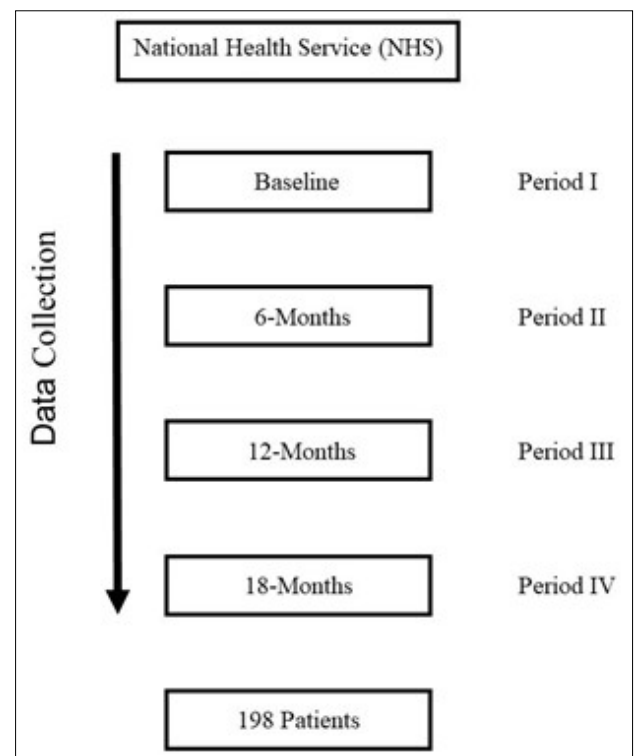
Figure 1. Flowchart demonstrating the collection periods used in the study.

Municipal Health Department were used. Initially, the amount of money was estimated in the Brazilian currency (Real, R$) and then converted into US Dollars (US$). Healthcare costs were classified into quartiles, with the highest quartile ($\geq$ P75) adopted as an indicator of high healthcare costs.[19,23]

Habitual physical activity

PA during leisure time and work was evaluated using the questionnaire developed by Baecke et al.[24] and translated in to Portuguese by Florindo et al.[25] The questionnaire provides a general PA score representing the sum of occupational, leisure time, and active transportation activities. Moreover, the last section of the questionnaire provides the frequency (never, rarely, sometimes, often, and always) of certain behaviors (walking, cycling, and watching television) during leisure time. In the present study, PA was identified using the general PA score and walking, cycling, and watching television behaviors.

Covariates

Sex, chronological age, and ethnicity (1 = White, 2 = Black, and 3 = Other) were used as covariates. Economic conditions (EC) were estimated using a standard questionnaire (face-to-face interview), which divided EC into five categories, from A (highest) to E (lowest). The variables were categorized as high EC (categories A and B) and low EC (categories C, D, and E), as adopted by Fernandes et al.[13] Finally, body weight (kg) and height (m) were collected to calculate the body mass index (BMI [kg/m^2]). Overweight individuals (BMI $\geq$ 25 kg/m^2) were identified in the sample.

Statistical analysis

Descriptive data were presented as means, standard deviations, and 95% confidence intervals. Due to the non-parametric distribution, the Mann–Whitney U test was used to compare numerical data between the two groups. Analysis of variance and the Kruskal–Wallis test were used to compare numerical data among three or more groups when the dataset was normally and non-parametrically distributed, respectively. Spearman's rank-order correlation (*rho*) was used to analyze the relations between the variables. Categorical variables are expressed as absolute and percentage values, with univariate statistical tests applied, including the chi-squared test (χ^2). Significant associations were included in multivariate models (binary logistic regression) to express the magnitude of the associations in terms of the odds ratio and 95% confidence interval. Multivariate models were adjusted for covariates (sex, ethnicity, economic status, BMI, and age). Statistical analyses were performed using a specific software (BioEstat version 5.0), and the significance level adopted was 5% for all procedures.

RESULTS

The total sample comprised 198 adults, mostly women (70.7%) and people classified as White (70.7%). The prevalence of overweight and obesity was high (78.3%) (**Table 1**). After the follow-up period, the prevalence of CLBP was higher in women (15%) than in men (3.4%), and younger individuals reported a higher occurrence of the outcome (**Table 2**).

Individuals who reported any episode of CLBP had high consultation costs (with CLBP: US$ 39.62 [27.25]; without CLBP: US$ 34.25 [23.21]) (P = 0.049) (**Table 3**).

Comparisons between different domains of PA and healthcare costs in patients with and without CLBP identified an inverse relation between cycling and overall cost in people with CLBP (rho = -0.289, P = 0.021) but not in those without the outcome (**Table 4**). Moreover, a significant relation was observed between cycling and the cost of medical consultations in patients with CLBP (rho = -0.239, P = 0.021).

Table 1. Numerical characteristics of patients aged 50 years or older who are users of two basic health units of the Brazilian health system in Presidente Prudente (SP)

| Variables | Entire sample (n = 198) | | Chronic low back pain | | | ANOVA P value |
	Mean	(95% CI)	No (n = 134) Mean (SD)	Yes once (n = 41) Mean (SD)	Yes both (n = 23) Mean (SD)	
Numerical						
Age years	61.6	(60.4 to 62.8)	62.8 (8.6)	60.8 (8.2)[a]	55.8 (7.8)[a,b]	**0.001**
Height cm	157.2	(156.0 to 158.4)	157.6 (8.8)	157.2 (8.1)	154.6 (7.4)	0.298
Weight kg	73.0	(70.9 to 75.0)	72.6 (14)	75.5 (16.8)	70.6 (13.2)	0.379
BMI kg/m^2	29.51	(28.7 to 30.2)	29.2 (5)	30.5 (6.4)	29.4 (4.8)	0.374
PA score	27.3	(26.8 to 27.9)	27.4 (4.1)	26.8 (3.5)	27.4 (3.9)	0.673
Health care costs	**Mean**	**(95% CI)**	**Median (IR)**	**Median (IR)**	**Median (IR)**	**Kruskal–Wallis**
Consultation	38.34	(35.40 to 41.25)	34.25 (23.21)	39.81 (26.78)	37.53 (28.25)	0.076
Exams	12.18	(9.56 to 14.81)	0 (23.99)	0 (16.46)	0 (30.94)	0.462
Medicines	46.84	(39.50 to 54.184)	27.48 (45.63)	35.88 (41.39)	46.28 (60.47)	0.210
Overall	118.65	(108.34 to 128.93)	103.69 (77.3)	114.65 (59.14)	134.26 (104.96)	0.194

Descriptive data are presented as means, standard deviations (SD), and 95% confidence intervals (CI). Analysis of variance (ANOVA) was used for comparisons between groups, with a significance level of 5% (P $\leq$ 0.05). BMI = body mass index; PA = physical activity; IR = interquartile range.

Finally, there was an association between more medical consultations and CLBP; however, this association was not significant after adjusting for confounders ($P \geq 0.05$) (**Table 5**).

DISCUSSION

This 18-month longitudinal study found elevated occurrences of CLBP among participants, which were linked to higher healthcare expenditures associated with medical consultations, whereas cycling appeared to mitigate this relation. This analysis verified that the sample consisted mainly of women ($\geq 70\%$) and that the prevalence of overweight and obesity was present in approximately 80% of the population. Furthermore, a prevalence of CLBP of 18.4% was found in the analyzed sample, and individuals with CLBP cost the public health system US\$ 5.37 more than those without CLBP.

The greater number of women in the sample is not surprising. Women more often use the primary care services provided by the Brazilian NHS because cultural barriers decrease the number of men accessing these services.[26] Moreover, the high number of people with a low income in the sample is justified by the fact that although the Brazilian NHS offers healthcare services to the entire population, those with lower incomes are the main users.[27] Therefore, even though the sampling process was not representative of the entire city, some characteristics of the sample were similar to the national setting, reinforcing the idea that the selection bias in our sample was not large.

Low back pain seems to be a relevant public health problem in Brazil. In the present study, a prevalence of 18.4% was observed in the analyzed sample. These findings demonstrate values greater than those of previous studies conducted in the country. A study

that investigated the occurrence of CLBP in Presidente Prudente (SP) observed a prevalence of 11.3%, whereas another study conducted in the city of Salvador (BA) found a prevalence of 14.7% in the sample analyzed.[3,28]

Studies investigating the determinants of CLBP found that higher age, female sex, and overweight/obesity were significant correlates of this outcome.[3,28] Similar to these previous reports, sex and age were significantly associated with any episode of low back pain during our follow-up, but not overweight/obesity. The absence of significant associations may be attributed to the widespread occurrence of overweight/obesity in the analyzed sample ($\geq 75\%$).

CLBP is a musculoskeletal outcome with the potential to increase healthcare costs.[6] However, this phenomenon has not been thoroughly investigated in developing settings. In the USA, lower back pain is the second most common cause of medical

Table 3. Correlates of chronic low back pain and direct healthcare costs in patients aged 50 years or older who are users of two basic health units of the Brazilian health system in Presidente Prudente (SP)

Health care costs (US$)	Chronic low back pain*		Mann–Whitney P value
	No (n = 134)	Yes (n = 64)	
	Median (IR)	Median (IR)	
Consultations	34.25 (23.21)	39.62 (27.25)	**0.049**
Exams	0.00 (23.96)	0.00 (19.09)	0.839
Medicines	27.48 (45.65)	38.35 (47.53)	0.118
Overall	103.69 (77.40)	128.41 (75.18)	0.071

The Mann–Whitney U test was used for comparisons between groups, with a significance level of 5% ($P \leq 0.05$). *Chronic low back pain was defined as any episode of chronic low back pain during follow-up (four affirmative answers to the questionnaire). IR = interquartile range.

Table 2. Categorical characteristics of patients aged 50 years or older who are users of two basic health units of the Brazilian health system in Presidente Prudente (SP)

Variables	Chronical low back pain*						χ^2 P value
	Entire sample (n = 198)		No (n = 134)	Yes once (n = 41)	Yes both (n = 23)		
Categorical	N	(%)	n (%)	n (%)	n (%)		
Sex							**0.005**
Male	58	(29,3)	47 (81)	9 (15.5)	2 (3.4)		
Female	140	(70.7)	87 (62.1)	32 (22.9)	21 (15)		
Ethnicity							0.881
White	140	(70.7)	95 (67.9)	27 (19.2)	18(12.9)		
Black	35	(17.7)	24 (68.6)	8 (22.9)	3 (8.6)		
Others	23	(11.6)	15 (65.2)	6 (26.1)	29 (8.7)		
Age							**0.006**
< 65 years	128	(64.6)	78 (60.9)	31 (24.2)	19 (14.9)		
≥ 65 years	70	(35.4)	56 (80.0)	10 (14.3)	4 (5.7)		
BMI							0.991
Normal	43	(21.7)	29 (67.4)	9 (20.9)	5 (11.7)		
Overweight/ Obesity	155	(78.3)	105 (67.7)	32 (20.6)	18 (11.7)		

Frequency analysis and the chi-squared test (χ2) were used to analyze the association between groups, with a significance level of 5% ($P \leq 0.05$). * Chronic low back pain was identified by four affirmative answers to the questionnaire. BMI = body mass index.

Table 4. Correlates between different domains of physical activity, presence or absence of chronic low back pain, and cost indicators in patients aged 50 years or older who are users of two basic health units of the Brazilian health system in Presidente Prudente (SP)

PA	Medical consultations		Exams		Medicines		Overall	
	rho	P value	rho	P value	rho	P value	rho	P value
Entire Sample (n= 198)								
Television	-0.001	0.987	0.072	0.314	-0.004	0.950	-0.004	0.950
Walking	-0.072	0.314	0.041	0.564	-0.075	0.291	-0.089	0.215
Cycling	-0.064	0.368	-0.099	0.167	-0.132	0.064	**-0.164**	**0.021**
Overall PA	-0.010	0.886	-0.011	0.882	-0,016	0.819	-0.052	0.465
No CLBP (n = 134)								
Television	-0.064	0.462	0.106	0.224	-0.059	0.495	-0.049	0.576
Walking	-0.112	0.196	0.058	0.507	-0.099	0.257	-0.117	0.179
Cycling	0.012	0.892	-0.079	0.365	-0.108	0.216	-0.109	0.209
Overall PA	0.034	0.701	0.064	0.461	-0.028	0.746	-0.029	0.738
Yes CLBP (n = 64)								
Television	0.100	0.433	0.005	0.971	0.129	0.311	0.085	0.506
Walking	0.095	0.457	-0.020	0.873	0.021	0.867	0.062	0.625
Cycling	-0.239	0.057	-0.193	0.127	-0.171	0.177	**-0.289**	**0.021**
Overall PA	-0.086	0.500	-0.190	0.133	0.014	0.910	-0.106	0.405

Spearman's rank-order correlation (rho) was used, with a significance level of 5% (P ≤ 0.05); PA = physical activity; CLBP = chronic low back pain.

Table 5. Association and adjusted odds ratios (ORs) for chronic low back pain in patients aged 50 years or older who are users of two basic health units of the Brazilian health system in Presidente Prudente (SP)

	Consultations			Exams		Medicines		Overall	
	≥ P75			≥ P75	χ^2	≥ P75	χ^2	≥ P75	χ^2
	χ^2 p-value n (%)	OR (95% CI)	OR $_{adj}$ (95% CI)	n (%)	P value	n (%)	P value	n (%)	P value
CLBP*	0.025				0.900		0.194		0.410
No	27 (20.1)	1.00	1.00	35 (26.1)		31 (23.1)		32 (23.9)	
Yes once	13 (31.7)	**1.84 (1.00–4.02)**	1.76 (0.89–3.93)	7 (17)		9 (22)		9 (22)	
Yes both times	9 (39.1)	**2.54 (1.05–6.50)**	2.29 (0.95–6.08)	7 (30.4)		9 (39.1)		8 (34.8)	

Chi-squared test (χ^2) was used. ORs are adjusted for sex, age, ethnicity, economic condition, body mass index, and physical activity. 95% confidence intervals (CIs) are provided. Hosmer–Lemeshow test result: P = 0.847. *Chronic low back pain (CLBP) was defined as four affirmative answers to the questionnaire. ≥ P75 = ≥ percentile 75.

consultations, similar to our findings, in which people with a self-report of CLBP presented costs associated with medical consultations 15.6% higher than those without a self-report of CLBP.[6–8]

In other countries, the burden of CLBP on individual costs is higher than that observed in the current study: € 3,100 per year in Sweden[29] and € 1,322 per year in Germany.[30] These differences can be explained by methodological issues, as those studies were carried out with the general population, whereas our data are exclusive to individuals older than 50 years and attended by the NHS.

Several studies have reported treatments that are beneficial for or prevent CLBP.[2,14,31] Carvalho et al.[32] indicated joint stabilization and control exercises to treat CLBP, while increasing PA levels has been recommended by health agencies.[33] However, there are still doubts about the most effective exercise protocol.[34,35] In the current study, cycling was associated with lower overall costs after 18 months only in people with self-reported low back pain. In fact, higher habitual PA (not exercise protocols) seems to mitigate healthcare costs,[19] and

this is the first report on this effect in people experiencing episodes of low back pain. Apparently, actions to increase habitual PA can be beneficial for decreasing costs in the NHS through two pathways: i) preventing the development of low back pain and ii) decreasing the costs of treatment in people suffering from low back pain.

The results of the present study can serve as an indication of the prevalence of low back pain in the Brazilian population, especially among residents in medium-sized municipalities in the state of São Paulo, and thus contribute to the implementation of public policies to minimize its occurrence. Furthermore, it is clear that the habitual practice of PA can reduce the occurrence of CLBP and the demand for health facilities by individuals who suffer from this condition, as well as reduce medical appointments and spending on medicines.

Therefore, the present study contributes to the literature by investigating the association between the practice of physical activities and a reduction in healthcare costs in patients treated by the

Brazilian NHS. However, some limitations must be acknowledged. Clinical assessments to diagnose lower back pain are better than face-to-face interviews, reducing the risk of false-positive cases. Moreover, objectively measuring PA could improve the potential for identifying the burden of different PA intensities on low back pain. In addition, a national survey on this issue would improve the inferences of the findings of our study. Finally, the age of the population needs to be considered, as the population investigated was over 50 years old.

CONCLUSION

It is possible to conclude that lower back pain is associated with greater healthcare costs, while cycling seems to be a relevant behavior that can reduce the costs for people suffering from lower back pain.

REFERENCES

1. Ma J, Chen X. Advances in pathogenesis and treatment of essential hypertension. Front Cardiovasc Med. 2022;9:1003852. PMID: 36312252; https://doi.org/10.3389/fcvm.2022.1003852.

2. Suh JH, Kim H, Jung GP, Ko JY, Ryu JS. The effect of lumbar stabilization and walking exercises on chronic low back pain: a randomized controlled trial. Medicine. 2019;98(26):e16173. PMID: 31261549; https://doi.org/10.1097/md.0000000000016173.

3. Zanuto EAC, Codogno JS, Christófaro DGD, et al. Prevalence of low back pain and associated factors in adults from a middle-size Brazilian city. Cien Saude Colet. 2015;20(5):1575-82. PMID: 26017959; https://doi.org/10.1590/1413-81232015205.02162014.

4. Silva MC, Fassa AG, Valle NCJ. Dor lombar crônica em uma população adulta do Sul do Brasil: prevalência e fatores associados. Cad Saude Publica. 2004;20(2):377-85. PMID: 15073617; https://doi.org/10.1590/s0102-311x2004000200005.

5. Barrey CY, Le Huec JC; French Society for Spine Surgery. Chronic low back pain: Relevance of a new classification based on the injury pattern. Orthop Traumatol Surg Res. 2019;105(2):339-46. PMID: 30792166; https://doi.org/10.1016/j.otsr.2018.11.021.

6. Deyo RA, Mirza SK, Martin BI. Back Pain Prevalence and Visit Rates: estimates from U.S. national surveys, 2002. Spine. 2006;31(23):2724-7. PMID: 17077742; https://doi.org/10.1097/01.brs.0000244618.06877.cd.

7. George SZ, Fritz JM, Silfies SP, et al. Interventions for the management of acute and chronic low back pain: revision 2021. J Orthop Sports Phys Ther. 2021;51(11):CPG1-CPG60. PMID: 34719942; https://doi.org/10.2519/jospt.2021.0304.

8. Wewege MA, Bagg MK, Jones MD, et al. Comparative effectiveness and safety of analgesic medicines for adults with acute non-specific low back pain: systematic review and network meta-analysis. BMJ. 2023;380:e072962. PMID: 36948512; https://doi.org/10.1136/bmj-2022-072962.

9. Ahern M, Dean CM, Dear BF, Willcock SM, Hush JM. The experiences and needs of people seeking primary care for low-back pain in Australia. Pain Rep. 2019;4(4):e756. PMID: 31579850; https://doi.org/10.1097/pr9.0000000000000756.

10. Ndlovu M, Bedson J, Jones PW, Jordan KP. Pain medication management of musculoskeletal conditions at first presentation in primary care: analysis of routinely collected medical record data. BMC Musculoskelet Disord. 2014;15:418. PMID: 25492581; https://doi.org/10.1186/1471-2474-15-418.

11. Popescu A, Lee H. Neck Pain and Lower Back Pain. Med Clin North Am. 2020;104(2):279-92. PMID: 32035569; https://doi.org/10.1016/j.mcna.2019.11.003.

12. Urits I, Burshtein A, Sharma M, et al. Low Back Pain , a Comprehensive Review : Pathophysiology, Diagnosis, and Treatment. Curr Pain Headache Rep. 2019;23(3):23. PMID: 30854609; https://doi.org/10.1007/s11916-019-0757-1.

13. Quentin C, Bagheri R, Ugbolue UC, et al. Effect of Home Exercise Training in Patients with Nonspecific Low-Back Pain : A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2021;18(16):8430. PMID: 34444189; https://doi.org/10.3390/ijerph18168430.

14. Fernández-Rodríguez R, Álvarez-Bueno C, Cavero-Redondo I, et al. Best exercise options for reducing pain and disability in adults with chronic low back pain: pilates, strength, core-based, and mind-body. A network meta-analysis. J Orthop Sport Phys Ther. 2022;52(8):505-21. PMID: 35722759; https://doi.org/10.2519/jospt.2022.10671.

15. Ma J, Zhang T, He Y, et al. Effect of aquatic physical therapy on chronic low back pain: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2022;23(1):1050. PMID: 36460993; https://doi.org/10.1186/s12891-022-05981-8.

16. Owen PJ, Miller CT, Mundell NL, et al. Which specific modes of exercise training are most effective for treating low back pain? Network meta-analysis. Br J Sports Med. 2020;54(21):1279-87. PMID: 31666220; https://doi.org/10.1136/bjsports-2019-100886.

17. Schulz C, Evans R, Maiers M, et al. Spinal manipulative therapy and exercise for older adults with chronic low back pain : a randomized clinical trial. Chiropr Man Therap. 2019;27:21. PMID: 31114673; https://doi.org/10.1186/s12998-019-0243-1.

18. Moore C, Holland J, Shaib F, et al. Prevention of low back pain in sedentary healthy workers: a pilot study. Am J Med Sci. 2012;344(2):90-5. PMID: 22173041; https://doi.org/10.1097/maj.0b013e3182364942.

19. Codogno JS, Turi BC, Kemper HCG, et al. Physical inactivity of adults and 1-year health care expenditures in Brazil. Int J Public Health. 2015;60(3):309-16. PMID: 25680327; https://doi.org/10.1007/s00038-015-0657-z.

20. Kuorinka I, Jonsson B, Kilbom A, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon. 1987;18(3):233-7. PMID: 15676628; https://doi.org/10.1016/0003-6870(87)90010-x.

21. de Barros ENC, Alexandre NMC. Cross-cultural adaptation of the Nordic musculoskeletal questionnaire. Int Nurs Rev. 2003;50(2):101-8. PMID: 12752909; https://doi.org/10.1046/j.1466-7657.2003.00188.x.

22. Pinheiro FA, Troccoli BT, Carvalho CV. Validity of the Nordic Musculoskeletal Questionnaire as morbidity measurement tool. Rev Saúde Pública. 2002;36(3):307-12. PMID: 12131969; https://doi.org/10.1590/s0034-89102002000300008.

23. Codogno JS, Fernandes RA, Sarti FM, Freitas Júnior IF, Monteiro HL. The burden of physical activity on type 2 diabetes public healthcare expenditures among adults: a retrospective study. BMC Public Health. 2011;11:275. PMID: 21542924; https://doi.org/10.1186/1471-2458-11-275.

24. Baecke J, Burema J, Frijters J. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. Am J Clin Nutr. 1982;36(5):936-42. PMID: 7137077; https://doi.org/10.1093/ajcn/36.5.936.

25. Florindo AA, Latorre Mdo R, Jaime PC, Tanaka T, Zerbini CA. Methodology to evaluation the habitual physical activity in men aged 50 years or more. Rev Saude Publica. 2004;38(2):307-14. PMID: 15122389; https://doi.org/10.1590/s0034-89102004000200022.

26. Figueiredo WS, Schraiber LB. Male users' and primary care services health professionals' conceptions of gender and possible impacts on men's health, São Paulo, Brazil. Cien Saude Colet. 2011;16(suppl 1):935-44. PMID: 21503441; https://doi.org/10.1590/s1413-81232011000700025.

27. Boing AC, Andrade FB, Bertoldi AD, et al. Prevalence rates and inequalities in access to medicines by users of the Brazilian Unified National Health System in 2013 and 2019. Cad Saude Publica. 2022;38(6):e00114721. PMID: 35703669; https://doi.org/10.1590/0102-311xpt114721.

28. Almeida ICGB, Sá KN, Silva M, et al. Chronic low back pain prevalence in the population of the city of Salvador. Rev Bras Ortop. 2008;43(3):96-102. https://doi.org/10.1590/S0102-36162008000200007.

29. Ekman M, Jönhagen S, Hunsche E, Jönsson L. Burden of illness of chronic low back pain in Sweden: a cross-sectional, retrospective study in primary care setting. Spine. 2005;30(15):1777-85. PMID: 16094281; https://doi.org/10.1097/01.brs.0000171911.99348.90.

30. Wenig CM, Schmidt CO, Kohlmann T, Schweikert B. Costs of back pain in Germany. Eur J Pain. 2009;13(3):280-6. PMID: 18524652; https://doi.org/10.1016/j.ejpain.2008.04.005.

31. de Oliveira NTB, Ricci NA, Dos Santos Franco YR, et al. Effectiveness of the Pilates method versus aerobic exercises in the treatment of older adults with chronic low back pain : a randomized controlled trial protocol. BMC Musculoskelet Disord. 2019;20(1):250. PMID: 31122227; https://doi.org/10.1186/s12891-019-2642-9.

32. Fontana Carvalho AP, Dufresne SS, Rogerio de Oliveira M, et al. Effects of lumbar stabilization and muscular stretching on pain, disabilities, postural control and muscle activation in pregnant woman with low back pain. Eur J Phys Rehabil Med. 2020;56(3):297-306. PMID: 32072792; https://doi.org/10.23736/s1973-9087.20.06086-4.

33. Zanuto EAC, Fernandes RA, Turi-Lynch BC, et al. Chronic low back pain and physical activity among patients within the Brazilian National Health System: a cross-sectional study. Sao Paulo Med J. 2020;138(2):106-11. PMID: 32491085; https://doi.org/10.1590/1516-3180.2019.0312.r1.19112019.

34. Ozsoy G, Ilcin N, Ozsoy I, et al. The effects of myofascial release technique combined with core stabilization exercise in elderly with non-specific low back pain: a randomized controlled, single-blind study. Clin Interv Aging. 2019;14:1729-40. PMID: 31631992; https://doi.org/10.2147/cia.s223905.

35. IJzelenberg W, Oosterhuis T, Hayden JA, et al. Exercise therapy for treatment of acute non-specific low back pain. Cochrane Database Syst Rev. 2023;8(8):CD009365. PMID: 37646368; https://doi.org/10.1002/14651858.cd009365.pub2.

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Effectiveness of short term acute electroconvulsive therapy at three Brazilian sites: an observational cohort study

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ABSTRACT

BACKGROUND: Electroconvulsive therapy (ECT) remains a target of prejudice, and finding places to administer it remains a challenge. The main reason for the recommendation of ECT is its effectiveness, especially when compared with other treatments for severe and refractory patients.

OBJECTIVE: This study aimed to assess the response rates across a broader patient sample undergoing ECT in three distinct Brazilian states.

DESIGN AND SETTING: This observational cohort study was conducted at the following three sites: Universidade Federal do Tocantins (by partnership with Hospital Geral de Palmas, Palmas-TO), Pax Instituto de Psiquiatria (Goiânia – GO), and Clínica Animus (Joao Pessoa – PB).

METHODS: A total of 212 patients who received ECT at three different Brazilian services were assessed for improvement in symptoms in the first week after treatment and 30 and 60 days after treatment completion.

RESULTS: Safety and efficacy of ECT was well established, as evidenced by the zero mortality rate among the study participants, with side effects observed in only 10.5% of cases. The immediate response rate was impressive at 95.8%, and the response rate after 30 and 60 days was 90.6% and 87.7%, respectively. The regression analysis highlighted session frequency as a key determinant of positive responses.

CONCLUSION: The effectiveness of short term ECT (two months) is one of the greatest among psychiatric treatments. Future research should focus on predictive models for treatment responses to enable personalized approaches.

INTRODUCTION

Since its establishment in 1938, electroconvulsive therapy (ECT) has been subjected to improvements with the objective of enhancing its therapeutic effectiveness while simultaneously reducing potential negative consequences.[1] Currently, ECT is widely recognized and accepted as a safe and effective treatment option in the field of therapy. It is essential to follow precise procedural guidelines with great care and attention to detail. The responsibility of overseeing, implementing, and monitoring falls squarely within the domain of the medical professionals involved in its delivery.[2-7]

Some authors are still skeptical of its usefulness because of small impact size and high sample heterogeneity of the research. In addition, there are several factors unique to ECT that make it challenging to compare results. Most studies have shown efficacy; however, others have cast doubt. Regardless of diagnosis, a recent study found an instant response rate of 94.8% and a 30-day response rate of 84.5%.[6] Besides, there is also a significant lack of public assistance for ECT, mainly affecting poor and severely ill patients.[8]

OBJECTIVES

This study primarily aimed to examine the response rates of patients undergoing ECT in three distinct regions of Brazil (Tocantins, Goiás, and Paraíba). This investigation was motivated by the increasing challenges associated with accessing facilities that offer this procedure as well as the recognition of its effectiveness as a key factor for its indication. To achieve this objective, a larger sample size encompassing patients from three different healthcare services was used.

METHODS

This observational cohort study investigated the effectiveness of ECT at three services in three separate states. Data were collected from the medical records of patients with various mental illnesses. All prospectively registered cases were assessed. The inclusion criteria were as follows: age ≥ 18 years, record of symptoms and medical records by scales, and record of other research variables. The exclusion criteria were patients with indications for ECT who did not undergo any sessions.

Statistical analysis

The primary outcome measures consisted of three time points: immediate reaction (occurring within the initial 7 days), response at 30 days post-ECT, and response at 60 days post-ECT. The response was deemed an improvement in symptoms, as assessed by the Brief Psychiatric Rating Scale (BPRS), Altman Scale, and Hamilton Scale, with a minimum of 50% reduction in symptoms. The study considered several secondary characteristics including age, gender, diagnosis, number of sessions, side effects, and treatment discontinuation. Nominal variables were represented using numerical values and percentages. The use of continuous variables is a common practice for calculating measures of central tendency, such as the mean, and measures of dispersion, such as the standard deviation. The response rate was reported in both numerical and percentage forms, based on patients who demonstrated a minimum of 50% improvement in symptoms at each of the three time points.

A logistic regression analysis was conducted to ascertain the potential impact of secondary factors on the primary results. A significance level of 0.05 was established, which was adjusted to account for the number of variables included in each model.

Ethical approval

This study protocol was approved by the Ethics Committee of the Universidade do Tocatins (CAAE: 68987823.0.0000.5519, Parecer: 6.085.547, 05/28/2023).

RESULTS

The immediate response rate was 95.8%, and it was 90.6% and 87.7% after 30 and 60 days, respectively. Lower results were observed in Palmas and higher in João Pessoa. Detailed results are presented in **Table 1**.

When the response rate was calculated by diagnosis, the immediate response rate was 92.0% for schizophrenia, 97.3% for bipolar disorder, 91.7% for schizoaffective disorder, 100.0% for depressive disorder, 100.0% for induced psychosis, and 100.0% for organic mental disorder. After 30 days, the response rates by diagnosis was 86.7% for schizophrenia, 93.2% for bipolar disorder, 91.7% for schizoaffective disorder, 95.5% for depressive disorder, 33.3% for induced psychosis, and 100.0% for organic mental disorder. After 60 days, the response rates by diagnosis was 80.0% for schizophrenia, 91.9% for bipolar disorder, 91.7% for schizoaffective disorder, 95.5% for depressive disorder, 0% for induced psychosis, and 100.0% for organic mental disorder.

Demographic and clinical data are presented in **Table 2**. Logistic regression data to predict responses are presented in **Table 3**.

Abandonment was a risk factor for immediate response. For response 30 days after finishing ECT, Substance use disorder (SUD) and abandonment were risk factors for a good outcome, and the number of sessions was a protective factor. For response 60 days after completing ECT, age, sex, and number of sessions were protective factors, and TUS and abandonment were risk factors for a favorable outcome.

A new logistic model with only significant variables for response 30 days after completing ECT was performed, and the number of sessions was a protective factor [Exp(B) 1.293, P = 0.006] and abandonment a risk factor in this model [Exp(B) 0.036, P = 0.005]. A new logistic model was used to assess the response 60 days after the completion of ECT. The number of sessions [Exp(B) = 1.205, P = 0.003] was the only protective factor in this model.

DISCUSSION

ECT elicit response rates between 10% and 75% for acute schizophrenia and between 10% and 90% for chronic schizophrenia, depending on the specific parameters employed. In addition to symptom manifestation, ECT has shown efficacy in diminishing the need for physical restraint and facilitating prompt reassurance. Additionally, it had the ability to enhance the rate of discharge in a range of 10-22% based on the instances examined.[9-13] Early ECT may reduce length of hospital stay without increasing total hospitalization costs or fatal adverse events in patients with major depressive disorder.[14] The response rate in individuals with depression varied between 44.4% and 90%, with ECT demonstrating a more favorable response compared

Table 1. Total number of responses immediately, 30, and 60 days after electroconvulsive therapy at the three sites

Variable	Number n = 212	Immediate response n = 203 (95.8%)	30 days response n = 192 (90.6%)	60 days response n = 186 (87.7%)
Local				
Palmas	58 (27.4%)	54 (93.1%)	48 (82.8%)	45 (77.6%)
Goiânia	102 (48.1%)	99 (97.1%)	92 (90.2%)	89 (87.3%)
João Pessoa	52 (24.5%)	50 (96.2%)	52 (100.0%)	51 (98.1%)

Table 2. Demographic and clinical data of all participants

Variable	Values (n = 212)
Gender	
Male (n, %)	113 (53.3%)
Female (n, %)	99 (46.7%)
Age (Mean ± SD)	38.4 ± 15.5
Diagnosis	
Schizophrenia (n, %)	75 (35.4%)
Bipolar disorder (n, %)	74 (34.9%)
Schizoaffective disorder (n, %)	12 (5.7%)
Depressive disorder (n, %)	44 (20.8%)
Puerperal psychosis (n, %)	2 (0.9%)
Induced psychosis (n, %)	3 (1.4%)
Organic mental disorder (n, %)	2 (0.9%)
Substance use disorder	
No (n, %)	190 (89.6%)
Yes (n, %)	22 (10.4%)
Personality disorder	
No (n, %)	201 (94.8%)
Yes (n, %)	11 (5.2%)
Indication	
Resistant (n, %)	130 (61.3%)
Pregnancy (n, %)	5 (2.4%)
Suicide behavior (n, %)	14 (6.6%)
Severity (n, %)	59 (27.8%)
Catatonia (n, %)	2 (0.9%)
Severe depression (n, %)	2 (0.9%)
Adverse effects	
No (n, %)	205 (96.7%)
Yes (n, %)	6 (2.8%)
Backpain (n, %)	2 (0.9%)
Headache (n, %)	1 (0.5%)
Muscle pain (n, %)	3 (1.4%)
Agitation after crisis (n, %)	1 (0.5%)
Dropout	
No (n, %)	206 (97.2%)
Yes (n, %)	6 (2.8%)
Mean number of sessions (Mean ± SD)	8.3 ± 5.3

SD = standard deviation.

to antidepressant medications.[9,15-23] For mania, the response rate varied between 80% and 92.3%.[15,24] In comparison to our sample, Brazil exhibited greater response rates, particularly for conditions such as schizophrenia, schizoaffective disorder, bipolar disorder, and depression.

We found that a greater number of ECT sessions was associated with better results. Recent research has demonstrated increased efficacy with increasing doses (up to 12 times); however, clinically, increasing doses is limited by a commensurate increase in cognitive side-effects.[12,25] In another investigation, patients with major depressive disorder (MDD) exhibited distinct and clinically relevant response trajectories to ECT. Patients with MDD with more severe depression at baseline were associated with a rapid response trajectory. In contrast, patients with MDD with severe symptoms and older age had a lower response trajectory. Future investigations should prioritize the identification of factors that may predict favorable outcomes in the context of personalized therapeutic interventions.[26]

In addition to our dataset, unsatisfactory outcomes have been frequently observed in the literature. A modest body of research supports the utilization of this intervention, particularly when employed in conjunction with antipsychotic medications for individuals diagnosed with schizophrenia who exhibit suboptimal response to pharmacotherapy in isolation.[27] Moderate-quality evidence indicates that relative to standard care, ECT has a positive effect on medium-term clinical response for people with treatment-resistant schizophrenia. However, there are no clear and convincing advantages or disadvantages of adding ECT to standard care for other outcomes. The available evidence is too weak to indicate whether adding ECT to standard care is superior or inferior to adding sham ECT or other antipsychotics, and there is insufficient evidence to support or refute the use of ECT alone. Better-quality evidence is required before firm conclusions can be made.[28]

Table 3. Results of logistic regression analysis to predict responses

Variable	Immediate	After 30 days	After 60 days
Demographic			
Age	Exp(B) = 1.018, P = 0.487	Exp(B) = 1.024, P = 0.192	Exp(B) = 1.042, P = 0.022
Gender	Exp(B) = 3.143, P = 0.160	Exp(B) = 2.145, P = 1.135	Exp(B) = 2.781, P = 0.029
Clinical			
Diagnosis	Exp(B) = 2.537, P = 0.061	Exp(B) = 0.934, P = 0.654	Exp(B) = 0.961, P = 0.770
Substance use disorder	Exp(B) = 0.912, P = 0.934	Exp(B) = 0.248, P = 0.014	Exp(B) = 0.283, P = 0.016
Personality disorder	Exp(B) = 0.234, P = 0.226	Exp(B) = 1.050, P = 0.966	Exp(B) = 1.494, P = 0.715
Indication	Exp(B) = 0.916, P = 0.719	Exp(B) = 1.366, P = 0.147	Exp(B) = 1.257, P = 0.193
Technical			
Number of sessions	Exp(B) = 1.085, P = 0.288	Exp(B) = 1.364, P < 0.001	Exp(B) = 1.235, P < 0.001
Complications			
Adverse effects	-	-	Exp(B) = 0.884, P = 0.724
Dropout	Exp(B) = 0.031, P < 0.001	Exp(B) = 0.016, P < 0.001	Exp(B) = 0.062, P = 0.002

The varied outcomes observed in ECT in the literature can be attributed to variations in the protocols used. Among other factors, various services may have distinct indications, response criteria, device settings, and diverse methods of administering anesthesia. This observation indicates that many investigations on ECT are influenced by heterogeneity.

Regarding side effects, our rate was 10.5%, which was not severe. In the literature, the most frequent side effects observed were headache after the crisis in 45% and nausea in 1-23% of patients.[15] Total side effects was reported in 14% patients with schizophrenia.[13] As for other side effects, cardiovascular, pulmonary, and cerebrovascular events are reported; these may be minimized by screening for risk factors and physiologic monitoring. Although most cognitive adverse effects of ECT are short-lasting, troublesome retrograde amnesia and other cognitive symptoms may rarely persist.[7,23,29] Moreover, sometimes, patients show more subjective than objective cognitive adverse effects of ECT.[30] As for fear of mortality, our sample had no fatal cases. In remote literature, mortality has been reported in 0.1 to 0.3% of samples from over 500 patients.[9]

This study has two inherent limitations that require further consideration and resolution. Initially, the patients' assessments were constrained to brief post-procedural follow-ups with a duration not exceeding 2 months. This limitation is a direct result of the need to effectively manage patients referred from many healthcare facilities to the three treatment programs in question. Furthermore, to assess the global response rate to ECT across various settings, the potential impact of additional factors such as the specific anesthetic employed or the drug supplied to the patients was not considered. Additional investigations are necessary to address these limitations, including conducting longitudinal follow-up assessments many months after the administration of electroconvulsive treatment, and including other types of short- and long-term medications. However, a significant advantage of this study is its robust sample size and incorporation of a multicenter sample, thus demonstrating its ability to replicate the findings across several locations.

CONCLUSION

ECT demonstrated both safety and efficacy. The observed mortality rate in the tested group was zero; however, the incidence of adverse effects was 10.5%. The initial response rate was 95.85%, which decreased to 90.6% after 30 days and further decreased to 87.7% after 60 days. The regression analysis revealed that the increased number of sessions had the strongest association with response variable. Although further studies with extended follow-up are required, the existing literature suggests that a minimum of 12 sessions is recommended to obtain improved response rates and longer-lasting effects. ECT did not yield any discernible benefits in the context of psychosis.

REFERENCES

1. Abrams R. Stimulus titration and ECT dosing. J ECT. 2002;18(1):3-9. PMID: 11925511; https://doi.org/10.1097/00124509-200203000-00002.

2. Baldaçara LR, Fidelis FAP, Fidalgo TM, et al. Matriz de competências em psiquiatria. Debates em Psiquiatria. 2022;12:1-24. https://doi.org/10.25118/2763-9037.2022.v12.350.

3. Comissão Nacional de Residência Médica. Resolução CNRM n. 18, de 6 de julho de 2021. Aprova a matriz de competências dos programas de Residência Médica em Psiquiatria no Brasil. Diário Oficial da União. 2021;126(1):456.

4. Conselho Federal de Medicina. Resolução CFM n. 1.640. Dispõe sobre a eletroconvulsoterapia e dá outras providências. Diário Oficial da União. 2002;153(1):185.

5. Conselho Federal de Medicina. Resolução CFM n. 2.057. Consolida as diversas resoluções da área da Psiquiatria e reitera os princípios universais de proteção ao ser humano, à defesa do ato médico privativo de psiquiatras e aos critérios mínimos de segurança para os estabelecimentos hospitalares ou de assistência psiquiátrica de quaisquer naturezas, definindo também o modelo de anamnese e roteiro pericial em psiquiatria. Diário Oficial da União. 2013;220(1):165-71.

6. Ferroli B, Baldaçara L. History of the implementation of electroconvulsive therapy at the General Public Hospital of Palmas. RSD. 2023;12(6):e21712642206. https://doi.org/10.33448/rsd-v12i6.42206.

7. Stella F, Radanovic M, Gallucci-Neto J, Forlenza OV. Electroconvulsive therapy for treating patients with agitation and related behavioral disorders due to dementia: a systematic review. Dement Neuropsychol. 2023;17:e20230007. PMID: 37533598; https://doi.org/10.1590/1980-5764-dn-2023-0007.

8. Ribeiro RB, Melzer-Ribeiro DL, Rigonatti SP, Cordeiro Q. Electroconvulsive therapy in Brazil after the "psychiatric reform": a public health problem — example from a university service. J ECT. 2012;28(3):170-3. PMID: 22551774; https://doi.org/10.1097/yct.0b013e31824d2889.

9. Turek IS, Hanlon TE. The effectiveness and safety of electroconvulsive therapy (ECT). J Nerv Ment Dis. 1977;164(6):419-31. PMID: 325181; https://doi.org/10.1097/00005053-197706000-00008.

10. Petrides G, Malur C, Braga RJ, et al. Electroconvulsive therapy augmentation in clozapine-resistant schizophrenia: a prospective, randomized study. Am J Psychiatry 2015;172(1):52-8. PMID: 25157964; https://doi.org/10.1176/appi.ajp.2014.13060787.

11. Phutane VH, Thirthalli J, Muralidharan K, et al. Double-blind randomized controlled study showing symptomatic and cognitive superiority of bifrontal over bitemporal electrode placement during electroconvulsive therapy for schizophrenia. Brain Stimul. 2013;6(2):210-7. PMID: 22560048; https://doi.org/10.1016/j.brs.2012.04.002.

12. Ali SA, Mathur N, Malhotra AK, Braga RJ. Electroconvulsive therapy and schizophrenia: a systematic review. Mol Neuropsychiatry. 2019;5(2):75-83. PMID: 31192220; https://doi.org/10.1159/000497376.

13. Lally J, Tully J, Robertson D, et al. Augmentation of clozapine with electroconvulsive therapy in treatment resistant schizophrenia: A systematic review and meta-analysis. Schizophr Res. 2016;171(1-3):215-24. PMID: 26827129; https://doi.org/10.1016/j.schres.2016.01.024.

14. Yamazaki R, Ohbe H, Matsuda Y, et al. Early electroconvulsive therapy in patients with major depressive disorder: a propensity score-matched analysis using a nationwide inpatient database in Japan. J ECT. 2021;37(3):176-81. PMID: 33840805; https://doi.org/10.1097/yct.0000000000000763.

15. Payne NA, Prudic J. Electroconvulsive therapy: Part I. A perspective on the evolution and current practice of ECT. J Psychiatr Pract. 2009;15(5):346-68. PMID: 19820553; https://doi.org/10.1097/01.pra.0000361277.65468.ef.

16. Frey R, Schreinzer D, Heiden A, Kasper S. Use of electroconvulsive therapy in psychiatry. Nervenarzt. 2001;72(9):661-76. PMID: 11572099; https://doi.org/10.1007/s001150170045.

17. van Duist M, Spaans HP, Verwijk E, Kok RM. ECT non-remitters: prognosis and treatment after 12 unilateral electroconvulsive therapy sessions for major depression. J Affect Disord. 2020;272:501-7. PMID: 32553394; https://doi.org/10.1016/j.jad.2020.03.134.

18. Yildiz A, Mantar A, Simsek S, et al. Combination of pharmacotherapy with electroconvulsive therapy in prevention of depressive relapse: a pilot controlled trial. J ECT. 2010;26(2):104-10. PMID: 19935091; https://doi.org/10.1097/yct.0b013e3181c189f7.

19. Spaans HP, Verwijk E, Comijs HC, et al. Efficacy and cognitive side effects after brief pulse and ultrabrief pulse right unilateral electroconvulsive therapy for major depression: a randomized, double-blind, controlled study. J Clin Psychiatry. 2013;74(11):e1029-36. PMID: 24330903; https://doi.org/10.4088/jcp.13m08538.

20. Pluijms EM, Kamperman AM, Hoogendijk WJG, van den Broek WW, Birkenhager TK. Influence of adjuvant nortriptyline on the efficacy of electroconvulsive therapy: a randomized controlled trial and 1-year follow-up. Acta Psychiatr Scand. 2022;145(5):517-28. PMID: 35152416; https://doi.org/10.1111/acps.13408.

21. UK ECT Review Group. Efficacy and safety of electroconvulsive therapy in depressive disorders: a systematic review and meta-analysis. Lancet. 2003;361(9360):799-808. PMID: 12642045; https://doi.org/10.1016/s0140-6736(03)12705-5.

22. Carvalho I, Da Silva YH. Eletroconvulsoterapia para depressão unipolar não responsiva: uma revisão bibliográfica. Braz J Health Rev. 2023;6(3):12021-34. https://doi.org/10.34119/bjhrv6n3-283.

23. Landry M, Moreno A, Patry S, Potvin S, Lemasson M. Current practices of electroconvulsive therapy in mental disorders: a systematic review and meta-analysis of short and long-term cognitive effects. J ECT. 2021;37(2):119-27. PMID: 33009218; https://doi.org/10.1097/yct.0000000000000723.

24. Mohan TS, Tharyan P, Alexander J, Raveendran NS. Effects of stimulus intensity on the efficacy and safety of twice-weekly, bilateral electroconvulsive therapy (ECT) combined with antipsychotics in acute mania: a randomised controlled trial. Bipolar Disord. 2009;11(2):126-34. PMID: 19267695; https://doi.org/10.1111/j.1399-5618.2009.00668.x.

25. Loo CK, Schweitzer I, Pratt C. Recent advances in optimizing electroconvulsive therapy. Aust N Z J Psychiatry. 2006;40(8):632-8. PMID: 16866758; https://doi.org/10.1080/j.1440-1614.2006.01862.x.

26. Su L, Zhang Y, Jia Y, et al. Predictors of electroconvulsive therapy outcome in major depressive disorder. Int J Neuropsychopharmacol. 2023;26(1):53-60. PMID: 36190694; https://doi.org/10.1093/ijnp/pyac070.

27. Tharyan P, Adams CE. Electroconvulsive therapy for schizophrenia. Cochrane Database Syst Rev. 2002;(2):CD000076. PMID: 12076380; https://doi.org/10.1002/14651858.cd000076.

28. Sinclair DJ, Zhao S, Qi F, et al. Electroconvulsive therapy for treatment-resistant schizophrenia. Cochrane Database Syst Rev 2019;3(3):CD011847. PMID: 30888709; https://doi.org/10.1002/14651858.cd011847.pub2.

29. Andrade C, Arumugham SS, Thirthalli J. Adverse effects of electroconvulsive therapy. Psychiatr Clin North Am. 2016;39(3):513-30. PMID: 27514303; https://doi.org/10.1016/j.psc.2016.04.004.

30. Hammershøj LG, Petersen JZ, Jensen HM, Jørgensen MB, Miskowiak KW. Cognitive adverse effects of electroconvulsive therapy: a discrepancy between subjective and objective measures? J ECT. 2022;38(1):30-8. PMID: 34699394; https://doi.org/10.1097/yct.0000000000000797.

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Short version of the Problem Areas in Diabetes scale (PAID-13) in Brazilian patients with diabetes: a structural and criterion validity study

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ABSTRACT

BACKGROUND: The Problem Areas in Diabetes scale (PAID) is used to measure emotional distress levels related to diabetes mellitus (DM). However, consensus on its internal structure is lacking.

OBJECTIVE: To compare the different internal structures of the PAID and propose a shortened version for Brazilian patients with diabetes.

DESIGN AND SETTING: Structural and criterion validity study.

METHODS: We included Brazilian patients with type 1 DM (DM1) and type 2 DM (DM2) in this study. In accordance with the international consensus recommendations, we assessed the structural validity using confirmatory factor analysis (CFA) and used the following indices to evaluate model fit: root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker–Lewis index (TLI), standardized root mean square residual (SRMR), chi-square/degrees of freedom (DF), Akaike information criterion (AIC) and sample-size adjusted Bayesian information criterion (SABIC). Modification indices and factor loadings were used to reduce the number of items.

RESULTS: One hundred eighty-five patients, most of whom included women with DM2, participated in the study. The reduction in the PAID generated a unidimensional structure with 13 items (PAID-13). The PAID-13 presented the best-fit indices (chi-square/DF = 2.15, CFI = 0.989, TLI = 0.986, RMSEA = 0.079, and SRMR = 0.049). When the PAID versions with 13 and 20 items (original version) were correlated, a strong correlation was observed (rho = 0.941, P < 0.001).

CONCLUSION: The short version of the PAID scale with 13 items presented a more appropriate internal structure for Brazilian patients with diabetes.

INTRODUCTION

Patients with type 1 diabetes mellitus (DM1) and type 2 diabetes mellitus (DM2) frequently report emotional distress. The Problem Areas in Diabetes scale (PAID) is a 20-item self-assessment tool designed to measure emotional distress levels associated with diabetes mellitus (DM). The scale quantifies the perception and emotional experiences of patients with DM throughout their course of living with the disease. This instrument was created in 1995 in the United States.[1]

The PAID was translated into Portuguese language and validated for use in Brazil in 2007.[2] The authors found a high Cronbach's alpha value, indicating satisfactory internal consistency with the original version. Furthermore, they evaluated the factorial structure using exploratory factor analysis (EFA), finding a single dimension; however, they chose to consider the PAID with four dimensions, as established by previous studies;[3] therefore, there are no studies in the Brazilian literature that compare the different internal structures of the PAID.

In specialized literature, consensus regarding the dimensionality of this instrument is lacking. Several studies that validated the instrument for their respective countries evaluated the factorial structure by means of EFA and principal components analysis (PCA) and structures with four,[3] three,[4] two,[5,6] and one domain[7] were found, in addition to a short version with 5 items,[8] consensus regarding the best factorial structure for the PAID is lacking.

Lee et al.[9] attempted to justify this disagreement: they stated that cultural differences could explain these findings. However, this hypothesis does not justify similar structures in studies from different countries and different dimensions in the same culture. Furthermore, most of these studies analyzed a single sample group, that is, individuals with DM1 and/or DM2, which may have influenced the results.[10]

Structural validity is an important psychometric property that measures whether results reflect the hypothetical dimensionality of a construct.[11] EFA is used to identify correlations between defined variables and yet undefined factors, whereas confirmatory factor analysis (CFA) allows checking the correlation between variables and their respective factors in already validated or originally pre-established models.[12]

Given the instrument's ability to measure emotional distress levels related to DM, we emphasize its relevance in scientific research and clinical applicability. However, no Brazilian study has compared the different factorial structures of the PAID to identify the most suitable one. In this study, we hypothesized that the short version of the PAID would present the best factorial structure, correlating strongly with the long version.

OBJECTIVE

Considering the divergence between the dimensionality of the PAID and the lack of studies that verify the best Brazilian version for this scale, the objective of this study was to compare the different internal structures of the PAID using CFA and propose a short version for Brazilian patients with DM.

METHODS

Study design

This was a structural and criterion validation study. Data were collected online using Google Forms (Mountain View, United States). This research was disseminated through Facebook, Instagram, and WhatsApp (Meta Platforms Inc., Menlo Park, United States). All the participants provided virtual consent for inclusion in the study.

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of the Universidade Ceuma, in São Luís (Maranhão, northeast Brazil) on August 29, 2018 (number 2.853.570) in accordance with the Declaration of Helsinki. All respondents freely participated in the study and signed an informed consent form.

Participants and sampling

The sample size followed the recommendations of the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN): seven times the number of items in the questionnaire),[12] which recommended a minimum of 140 individuals. The inclusion criteria were: men and women aged over 18 years, speakers of Brazilian Portuguese, and diagnosed with DM1 or DM2. Individuals diagnosed with cognitive changes and/or with the inability to read or write were excluded.

Problems Areas in Diabetes scale (PAID)

The PAID is a self-administered self-report instrument originally developed at Joslin Diabetes Center in Boston, Massachusetts, USA. This scale assesses, from the patients' perspective, the impact of diabetes and its treatment on their lives. The Brazilian version of the PAID comprises 20 items covering a range of emotional states frequently reported by patients with DM1 and DM2. The PAID produces a total score ranging from 0 to 100, with a high score indicating a high level of emotional distress. It uses a 5-point Likert scale ranging from: "Not a problem" = 0, "Small problem" = 1, "Moderate problem" = 2, "Almost a serious problem" = 3, "Serious problem" = 4. A total score of 0-100 was reached by summing the 0-4 responses given on the 20 items of the PAID and multiplying this sum by 1.25.[2]

Statistical analysis

Descriptive statistical analysis was performed; the values are presented as means and standard deviations for quantitative variables and absolute numbers and percentages for qualitative variables. Descriptive analysis was performed using SPSS software version 17.0 (IBM, Chicago, United States).

We used CFA with the R Studio software (Boston, MA, USA) and the lavaan and semPlot packages. CFA was performed using a polychoric matrix and a robust diagonally weighted least squares (RDWLS) extraction method, as recommended by specialized literature for ordinal data.[13,14] Model fit was assessed using the following indices: root mean square error of approximation (RMSEA) with 90% confidence interval (CI), comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR), and chi-square/degrees of freedom (DF).[15,16]

In this study, values >0.90 were considered adequate for CFI and TLI, and values < 0.08 were considered adequate for RMSEA and SRMR. Values < 3.00 were considered adequate in the interpretation of chi-square/DF.[17,18] To compare the PAID structures, the Akaike information criterion (AIC) and sample-size-adjusted Bayesian information criterion (SABIC) indices were used. The structure with the lowest AIC and BIC values was considered as the most parsimonious model, as recommended in the literature. In CFA, factor loadings ≥ 0.40 were considered adequate for the domain.[15,19]

We used modification indices and factor loadings to reduce the PAID. We considered items redundant in the PAID when the modification indices were greater than 10.0.[19,20] In each pairwise analysis, we deleted redundant items with the lowest factor loadings.

Criterion validity was assessed by applying Spearman's correlation coefficient (rho) between the PAID version with 13 items and the original version with 20 items (considered the gold standard according to COSMIN). Thus, criterion validity was met when rho ≥ 0.70.[12]

RESULTS

We included 185 patients diagnosed with DM1 or DM2. The majority of the sample comprised women (75.1%) with a mean age of 49 years, married, with DM2 and with incomplete primary education. **Table 1** presents the personal and clinical characteristics of the patients.

The original version of the PAID scale, with one domain and 20 items, was tested using CFA and presented inadequate fit indices, as shown in **Table 2**. Therefore, PAID reduction was performed based on the modification indices shown in **Table 3,** generating a unidimensional structure of the PAID scale with 13 items (PAID-13).

In this new scenario, the internal structure of PAID-13 (Structure 1) was compared with other structural models found in the literature, in addition to the original version (Structure 2). As described in **Table 2**, we also compared the following structures: structure with two domains and 20 items (structure 3) validated by Miller et al.;[6] structure with two domains and 20 items (structure 4) validated by Veld et al.;[5] structure with three domains and 20 items (structure 5) validated by Papathanasiou et al.;[4] structure with four domains and 20 items (structure 6) validated by Snoek et al.;[3] and structure with one domain and five items (structure 7) proposed by McGuire et al.[8]

Using CFA, adequate fit indices were found only in structure 1 of the PAID with 13 items (after adding four covariances to the model): chi-square/DF = 2.15, CFI = 0.989, TLI = 0.986,

RMSEA = 0.079, and SRMR = 0.049. **Table 2** also presents the appropriate factor loadings (≥ 0.40) of the PAID-13 (structure 1). Regarding criterion validity, we observed a high correlation magnitude of 0.941 ($P < 0.001$) between the PAID versions with 13 and 20 items, even after reducing the number of items.

The Brazilian Portuguese version of the PAID-13 is available at https://questionariosbrasil.blogspot.com. To calculate the total PAID-13 score, all marked values were added, divided by 13, and multiplied by 25, generating a score ranging from 0 to 100 (higher scores indicating greater emotional distress).

DISCUSSION

This study identified the most appropriate structure for the Brazilian version of the PAID with one domain and 13 items (PAID-13) using modification indices as a technique for reducing the instrument. This reduction was proposed after the original version of the PAID scale with one domain and 20 items presented inadequate fit indices.

The structure of the Brazilian version of the PAID was evaluated using EFA and only one domain was found.[2] However, according to the authors, due to the small sample size, they opted to maintain a structure with 4 domains and 20 items—as established in the study conducted by Snoek et al.[3] that investigated the dimensionality of the PAID in Dutch and North American patients with diabetes. These authors observed a suitable CFI for structures with one domain (0.93) and four domains (0.95).[3] In our study, the CFI and TLI values were also adequate (> 0.90) for the same structures tested by Snoek et al.[3] However, we reject both instrument structures, as we observed inappropriate values of RMSEA and SRMR. However, Snoek et al.[3] did not investigate model residuals, which limits their analysis of the internal structure of PAID.

The PAID structure has been verified in several studies in different cultures, with different dimensions found in countries with the same culture and similar structures in different countries.[9] Therefore, no consensus has been reached on the dimensions of this instrument. Our study is pioneering in proposing a new structure (the PAID-13) and comparing this new structure with existing structures using the AIC and SABIC fit indices.

Huang et al.[21] and Lee et al.[9] pointed out some problems with the EFA used in most of these validation studies and recommended CFA as the best statistical evaluation method. Although the choice of EFA in these studies is justified by the fact that the original study did not evaluate this measurement property, there is a mistake by some authors when considering PCA as a synonym for EFA, which is not true. Our study used CFA to verify the dimensionality of the PAID using a methodology suitable for the instrument's categorical ordinal responses (i.e., the polychoric correlation matrix and RDWLS extraction method).

Table 1. Patient characteristics (n = 185)

Variables	Mean (standard deviation) or number (%)
Age (years)	49.20 (14.90)
Sex (female)	139 (75.1%)
Body mass (kg)	71.53 (14.0)
Stature (m)	1.63 (0.07)
Body mass index (kg/m²)	26.91 (5.00)
Diabetes	
Type 1	54 (29.1%)
Type 2	131 (70.8%)
Marital status	
Single	54 (29.1%)
Married	117 (63.2%)
Divorced	7 (3.7%)
Widower	7 (3.7%)
Schooling	
Primary	81 (43.7%)
Secondary	37 (20.0%)
Superior	39 (21.8%)
Postgraduate	28 (15.1%)
PAID	
20 items (score, 0-100)	40.76 (24.95)
13 items (score, 0-100)	36.15 (28.07)

PAID = Problem Areas in Diabetes scale.

Table 2. Comparison between the different structures of the Problem Areas in Diabetes scale (PAID)

Structures	Chi-square/DF	CFI	TLI	RMSEA (90% CI)	SRMR	AIC	SABIC
Structure 1	2.15 *	0.989 *	0.986 *	0.079 (0.061, 0.098) *	0.049 *	6824.401	6825.993
Structure 2	4.88	0.913 *	0.902 *	0.145 (0.136, 0.155)	0.111	10844.783	10846.905
Structure 3	4.83	0.914 *	0.904 *	0.144 (0.135,0.154)	0.109	10824.593	10826.768
Structure 4	4.59	0.915 *	0.905 *	0.144 (0.134,0.154)	0.110	10810.865	10813.040
Structure 5	4.22	0.929 *	0.919 *	0.132 (0.122, 0.143)	0.103	10729.012	10731.293
Structure 6	4.22	0.931 *	0.919 *	0.132 (0.122, 0.143)	0.100	10686.191	10688.684
Structure 7	26.16	0.894	0.787	0.370 (0.317, 0.426)	0.193	2919.856	2920.387
Factor loadings of the structure 1							
Item 2 = 0.76							
Item 3 = 0.79							
Item 5 = 0.57							
Item 6 = 0.90							
Item 7 = 0.87							
Item 8 = 0.88							
Item 9 = 0.64							
Item 10 = 0.89							
Item 13 = 0.84							
Item 14 = 0.76							
Item 15 = 0.65							
Item 16 = 0.88							
Item 17 = 0.86							

DF = degree of freedom; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = Standardized Root Mean Squared Residual; AIC = Akaike information criterion; SABIC = Sample-size adjusted Bayesian information criterion.
Structure 1 = 1 domain and 13 items (items 2, 3, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16 and 17);
Structure 2 = 1 domain and 20 items;
Structure 3 = 2 domains and 20 items (domain 1: items 1, 2, 14, 15, 16, 17, and 18; domain 2: items 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 19 and 20);
Structure 4 = 2 domains and 20 items (domain 1: items 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 19; domain 2: items 15, 16, 17, 18 and 20;
Structure 5 = 3 domains and 20 items (domain 1: items 1, 2, 3, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19 and 20; domain 2: items 4, 5 and 11; domain 3: items 17 and 18);
Structure 6 = 4 domains and 20 items (domain 1: items 3, 6, 7, 8, 9, 10, 12, 13, 14, 16, 19 and 20; domain 2: items 1, 2 and 15; domain 3: items 4, 5 and 11; domain 4: items 17 and 18);
Structure 7 = 1 domains and 5 items (items 3, 6, 12, 16 and 19).
* Adequate fit indices (chi/square/DF < 3, CFI and TLI > 0.90, RMSEA and SRMR < 0.08). Lower AIC and SABIC values indicate the best factor structure.

Table 3. Exclusion of redundant items from the Problem Areas in Diabetes scale (PAID)

Redundant Items	Item Description	MI	Factor Loading	Item Deleted
Decision 1				
Item 12	Worrying about the future and the possibility of serious complications?	198.023	0.632	Item19
Item 19	Coping with complications of diabetes?		0.508	
Decision 2				
Item 4	Uncomfortable social situations related to your diabetes care (e.g., people telling you what to eat)?	84.266	0.584	Item 4
Item 5	Feelings of deprivation regarding food and meals?		0.686	
Decision 3				
Item 5	Feelings of deprivation regarding food and meals?	41.272	0.686	Item 11
Item 11	Feeling constantly concerned about food and eating?		0.621	
Decision 4				
Item 1	Not having clear and concrete goals for your diabetes care?	29.647	0.715	Item 1
Item 2	Feeling discouraged with your diabetes treatment plan?		0.795	
Decision 5				
Item 16	Feeling that diabetes is taking up too much of your mental and physical energy every day?	15.700	0.886	Item 20
Item 20	Feeling "burned out" by the constant effort needed to manage diabetes?		0.753	
Decision 6				
Item 17	Feeling alone with your diabetes?	14.215	0.866	Item 18
Item 18	Feeling that your friends and family are not supportive of your diabetes management efforts?		0.717	
Decision 8				
Item 7	Not knowing if your mood or feelings are related to your diabetes?	10.198	0.838	Item 12
Item 12	Worrying about the future and the possibility of serious complications?		0.632	

MI = Modification indices.

This study has some limitations that must be considered. The sample primarily comprised women diagnosed with DM2. The proposal to reduce the PAID presented in this study was developed based on the Brazilian version of the instrument. Therefore, we recommend that PAID-13 be tested and validated in other languages. Notably, the PAID-13 score was derived from responses to the Brazilian version of the PAID with 20 items, which may have contributed to the high correlation between the PAID versions. In this sense, it is advisable that future research independently evaluate the criterion validity of the PAID-13, in addition to investigating its reliability, construct validity, and responsiveness.

CONCLUSION

The short version of the PAID, with 13 items, presented a more adequate internal structure and excellent correlation with the long version. Therefore, this tool is recommended for use with patients with diabetes.

REFERENCES

1. Polonsky WH, Anderson BJ, Lohrer PA, et al. Assessment of diabetes-related distress. Diabetes Care. 1995;18(6):754-60. PMID: 7555499; https://doi.org/10.2337/diacare.18.6.754.

2. Gross CC, Scain SF, Scheffel R, Gross JL, Hutz CS. Brazilian version of the Problem Areas in Diabetes Scale (B-PAID): validation and identification of individuals at high risk for emotional distress. Diabetes Res Clin Pract. 2007;76(3):455-9. PMID: 17081645; https://doi.org/10.1016/j.diabres.2006.09.022.

3. Snoek FJ, Pouwer F, Welch GW, Polonsky WH. Diabetes-related emotional distress in Dutch and U.S. diabetic patients: cross-cultural validity of the problem areas in diabetes scale. Diabetes Care. 2000;23(9):1305-9. PMID: 10977023; https://doi.org/10.2337/diacare.23.9.1305.

4. Papathanasiou A, Koutsovasilis A, Shea S, et al. The Problem Areas in Diabetes (PAID) scale: psychometric evaluation survey in a Greek sample with type 2 diabetes. J Psychiatr Ment Health Nurs. 2014;21(4):345-53. PMID: 22340071; https://doi.org/10.1111/j.1365-2850.2012.01875.x.

5. Huis In 't Veld EM, Makine C, et al. Validation of the Turkish version of the problem areas in diabetes scale. Cardiovasc Psychiatry Neurol. 2011;2011:315068. PMID: 22195273; https://doi.org/10.1155/2011/315068.

6. Miller ST, Elasy TA. Psychometric evaluation of the Problem Areas in Diabetes (PAID) survey in Southern, rural African American women with Type 2 diabetes. BMC Public Health. 2008;8:70. PMID: 18294380; https://doi.org/10.1186/1471-2458-8-70.

7. Welch GW, Jacobson AM, Polonsky WH. The Problem Areas in Diabetes Scale. An evaluation of its clinical utility. Diabetes Care. 1997;20(5):760-6. PMID: 9135939; https://doi.org/10.2337/diacare.20.5.760.

8. McGuire BE, Morrison TG, Hermanns N, et al. Short-form measures of diabetes-related emotional distress: the Problem Areas in Diabetes Scale (PAID)-5 and PAID-1. Diabetologia. 2010;53(1):66-9. PMID: 19841892; https://doi.org/10.1007/s00125-009-1559-5.

9. Lee EH, Lee YW, Lee KW, Kim YS, Nam MS. Measurement of diabetes-related emotional distress using the Problem Areas in Diabetes scale: psychometric evaluations show that the short form is better than the full form. Health Qual Life Outcomes. 2014;12:142. PMID: 25358396; https://doi.org/10.1186/s12955-014-0142-z.

10. Sigurdardottir AK, Benediktsson R. Reliability and validity of the Icelandic version of the Problem Area in Diabetes (PAID) Scale. Int J Nurs Stud. 2008;45(4):526-33. PMID: 17161401; https://doi.org/10.1016/j.ijnurstu.2006.10.008.

11. Souza AC, Alexandre NMC, Guirardello EB. Psychometric properties in instruments evaluation of reliability and validity. Epidemiol Serv Saude. 2017;26(3):649-59. PMID: 28977189; https://doi.org/10.5123/s1679-49742017000300022.

12. Prinsen CAC, Mokkink LB, Bouter LM, et al. COSMIN guideline for systematic reviews of patient-reported outcome measures. Qual Life Res. 2018;27(5):1147-57. PMID: 29435801; https://doi.org/10.1007/s11136-018-1798-3.

13. Li CH. Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. Behav Res Methods. 2016;48(3):936-49. PMID: 26174714; https://doi.org/10.3758/s13428-015-0619-7.

14. Ullman JB. Structural equation modeling: reviewing the basics and moving forward. J Pers Assess. 2006;87(1):35-50. PMID: 16856785; https://doi.org/10.1207/s15327752jpa8701_03.

15. Rocha DS, Dibai-Filho AV, Pinheiro JS, et al. The Baecke Habitual Physical Activity Questionnaire (BHPAQ): a valid internal structure of the instrument to assess healthy Brazilian adults. Rev Assoc Med Bras (1992). 2022;68(7):912-6. PMID: 35946767; https://doi.org/10.1590/1806-9282.20211374.

16. Ferreira CSB, Dibai-Filho AV, Almeida DODS, et al. Structural validity of the Brazilian version of the Western Ontario and McMaster Universities Osteoarthritis Index among patients with knee osteoarthritis. Sao Paulo Med J. 2020;138(5):400-6. PMID: 33084741; https://doi.org/10.1590/1516-3180.2020.0046.r1.26062020.

17. Schermelleh-Engel K, Moosbrugger H, Müller H. Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures. MPR-online. 2003;8:23-74. https://doi.org/10.23668/psycharchives.12784.

18. Brown T. Confirmatory factor analysis for applied research. 2nd ed. New York: Guilford Publications; 2015.

19. Fidelis-de-Paula-Gomes CA, Guimarães-Almeida MQ, Pontes-Silva A, et al. Ten-Item Lower Extremity Functional Scale (LEFS-10): Instrument Reduction Based on Brazilian Patients With Lower Limb Dysfunction. Arch Phys Med Rehabil. 2023;104(3):438-43. PMID: 36183808; https://doi.org/10.1016/j.apmr.2022.09.010.

20. Whittaker TA. Using the modification index and standardized expected parameter change for model modification. The Journal of Experimental Education. 2012;80(1):26-44. https://doi.org/10.1080/00220973.2010.531299.

21. Huang MF, Courtney M, Edwards H, McDowell J. Validation of the Chinese version of the Problem Areas in Diabetes (PAID-C) scale. Diabetes Care. 2010;33(1):38-40. PMID: 19808922; https://doi.org/10.2337/dc09-0768.

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Rating of perceived exertion versus heart rate for isometric exercise prescription: Reliability and agreement study

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ABSTRACT

BACKGROUND: Previous studies have shown that isometric exercise training reduces systolic blood pressure by approximately 8 mmHg and diastolic blood pressure by approximately 4 mmHg in both normotensive and hypertensive individuals. However, the prescription of isometric exercises can be based on the rating of perceived exertion (RPE) or heart rate (HR) obtained during the maximal incremental isometry test. The reliability and agreement of this test have not been assessed.

OBJECTIVES: To analyze the reliability and agreement indicators of HR and RPE during isometric wall squat incremental tests.

DESIGN AND SETTING: A reliability and agreement study was conducted at Universidade Federal de Pernambuco.

METHODS: Twenty-eight healthy subjects (54% men, 26 ± 5 years) performed two isometric wall squat incremental tests. The test began with a knee joint angle of 135° (knee and leg) progressively reduced by 10° at each stage. Each stage lasts 2 minutes or until voluntary exhaustion. The HR and RPE were obtained during the tests. Reliability and agreement were established using test-retest (paired t-test or Wilcoxon test), intraclass correlation coefficient (ICC), standard error of measurement (SEM), coefficient of variation (CV), and Bland-Altman plots.

RESULTS: The HR and RPE increased significantly during both tests. The HR and RPE at each stage were similar between the two test sessions (P > 0.05). Both HR_{max} (ICC: 0.695, P = 0.002, SEM = 8.1 bpm and CV = 5.8%) and RPE_{max} (ICC: 0.525, P = 0.036, SEM = 0.4 and CV = 3.6%) presented similar reliability indicators, and no statistically significant differences were obtained between the two test sessions (P > 0.05). The Bland-Altman plots indicated good agreement between HR_{max} and RPE_{max}.

CONCLUSION: HR and RPE showed similar reliability and agreement during the isometric wall squat incremental test.

INTRODUCTION

Isometric exercise training has resulted in clinically significant reductions of approximately 8 mmHg in systolic blood pressure and 4 mmHg in diastolic blood pressure in both normotensive and hypertensive individuals.[1-4] These reductions are equal to or greater than those observed in other forms of exercise, such as aerobic or dynamic resistance training.[2]

In contrast to other forms of isometric exercises, such as handgrip and leg extension, wall squat training does not require equipment (e.g., isokinetic and handgrip dynamometers),[5,6,] which makes it attractive for performance in different settings. Isometric wall squat training has been prescribed as a percentage of the heart rate peak (95% HR_{peak}) achieved during an incremental isometric exercise test.[2,4,7] Recently, Lea et al.[8] also demonstrated that prescribing isometric wall squat training based on the rating of perceived exertion (RPE) had a comparable effect on blood pressure as when prescribed based on 95% HR_{peak}. Both methodologies demonstrated a low coefficient of variation (CV) during an isometric wall squat incremental test,[9-12] suggesting good agreement between the measurements.

Despite these favorable agreement indicators, robust metrics, including standard error of measurement (SEM) and the limits of agreement of Bland-Altman plots[13, 14] remain unknown. Furthermore, no study has demonstrated the intraclass correlation coefficient (ICC) for HR and RPE during the test. Therefore, despite being widely used[15], it is still unknown whether the isometric wall squat incremental test is reliable.

OBJECTIVE

This study aimed to analyze the indicators of reliability and agreement of HR and RPE during the isometric wall squat incremental test.

METHODS

Participants

Healthy adults of both sexes, including those who had not been performing recreational resistance training, were recruited via social media and flyers distributed near the university. Participants were eligible if they met the following criteria: a) no history of cardiovascular disease or diabetes, b) absence of osteo-articular injuries or conditions that would hinder the performance of squat exercises, c) nonsmokers, and d) not taking medications or supplements that could alter hemodynamic variables. Participants who did not complete both tests were excluded.

All the participants provided written informed consent to participate in the study, which the Institutional Review Board approved (#3.558.606) on September 6, 2019, per the Brazilian National Research Ethics System Guidelines.

Protocol

All participants who consented to participate in the study attended two laboratory visits. Demographic information, medical history, and medication use details were collected during the initial visit. Additionally, height and weight were measured following standardized protocols, and body mass index was calculated. Subsequently, the participants were familiarized with the testing procedures and underwent an isometric wall squat incremental test. On the second assessment day, after at least 48 hours, participants repeated the isometric wall squat incremental test at the same time as on the first day.

For the incremental isometric wall squat test, the participants remained upright with their backs against a wall, feet parallel and shoulder-width apart, and hands by their sides. A clinical goniometer (Trident, Brazil) with a protractor divided into degrees was attached to each participant's knee using an elastic Velcro strap to control the angle of movement.

The test has five progressive stages.[7,9] The first stage began at 135° of knee flexion, and the participants were instructed to hold this position for 2 min. Once each stage was completed, the knee joint angle decreased by 10°. Stage progression passes without intervals through the following angles: 125°, 115°, 105°, and 95° (**Figure 1**). The test was considered complete when the participant concluded the 5th stage or could not maintain the knee joint angle for 2 min. During the test, the evaluator provided verbal encouragement and instructions on maintaining normal breathing and avoiding the Valsalva maneuver.

During the test, HR was continuously measured using a cardio monitor (Polar Vantage M2, Polar Electro Oy, Finland). HR data were extracted from the cardiac monitor and synchronized using Polar Flow syn*c software.* The average HR of the final 30 s in each stage[12] was considered and the highest HR value was considered HR_{max}.

RPE was recorded using the Isometric Exercise Scale.[10,11] Standardized scaling and anchoring instructions were given to each participant before the test, as previously described.[10,11] Participants were asked to report the RPE in their active muscles in the final 10 seconds of each stage of the isometric wall squat incremental test. Participants were cued to give their ratings using the standardized question, "How hard do you feel your muscles are working?" The scale was positioned in the full view of the participants for the entire test. The RPE_{max} was defined as the highest value obtained during the test.

Statistical analysis

Data were stored in Microsoft Excel (Microsoft, Redmond, Washington, United States, 2016) and analyzed using SPSS for Windows version 25 (IBM Inc., Chicago, Illinois, USA). The normality of the data distribution was analyzed using the Shapiro-Wilk test. Parametric data are presented as mean ± standard deviation (SD), and non-parametric data are presented as medians (interquartile ranges).

The paired t-test and Wilcoxon test were used to compare the HR and RPE responses on the two days of the isometric wall squat incremental test. The reliability of the isometric wall squat incremental test was analyzed by ICC (3, K) based on the average rating, absolute agreement, and two-way mixed effects model as suggested[16-18]. Agreement measures were calculated using CV, Bland-Altman plot, and SEM. A P value of < 0.05 was used to establish statistical significance.

HR = heart rate; RPE = rating of perceived exertion.
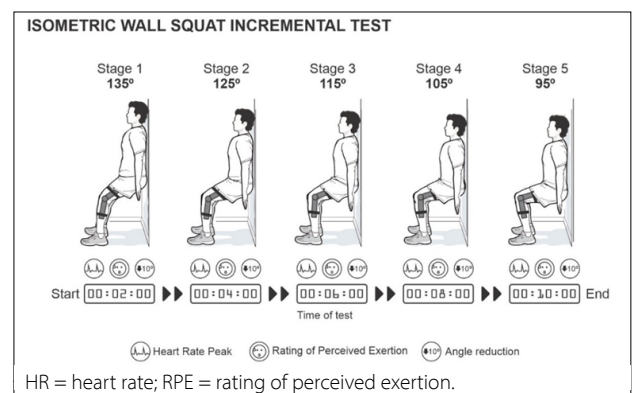
Figure 1. Knee joint angles used for the five consecutive 2-min stages of the isometric wall squat incremental test.

RESULTS

Thirty participants were enrolled in this study. Two participants completed only one day of testing and were excluded from the study. Thus, 28 healthy individuals (15 male and 13 female) were included in the analysis. Nine participants performed resistance exercises recreationally. Participants' characteristics are presented in **Table 1**.

Fifteen participants completed the test in the same stages on both days, and three participants finished the test in the final stage (95º angle) on both days. The reliability values of HR_{max} and RPE_{max} during the isometric wall squat incremental tests are listed in **Table 2**. No significant differences were observed between Tests 1 and 2 for HR_{max} and RPE_{max}.

Figure 2 illustrates the agreement between Tests 1 and 2 for HR_{max} and RPE_{max}. The Bland–Altman plots indicated good agreement for both HR_{max} and RPE_{max}.

The reliability and agreement indicators of HR and RPE during the isometric wall squat incremental tests are shown in **Table 3**. No significant differences (P > 0.05) were observed between tests 1 and 2 in the isometric wall squat incremental test.

DISCUSSION

The results of the current study demonstrated that both the HR and RPE presented comparable reliability and agreement in monitoring the intensity of isometric wall squat exercises in healthy adults. We did not observe any statistically significant differences between the two days of the incremental wall squat test for either HR_{max} or RPE_{max}. In addition, no differences were found for either RPE or HR at any stage, consistent with findings from previous studies,[10-12] suggesting no systematic bias.[14]

The ICC has been considered the primary reliability measure for continuous outcomes.[13,14] In the current study, the ICC values were 0.695 for HR_{max} and 0.525 for RPE_{max}. Although previous studies[10,11] have assessed the ICC for HR and RPE during exercise sessions at various angles, none have evaluated the isometric wall squat test, the main parameter used for wall squat exercise prescription. In addition, the ICC values during each test stage showed a high proportion of actual variance, suggesting that the data presented good reliability for HR and that the variability was due to

HR$_{max}$ = The highest heart rate during the isometric wall squat incremental test; RPE$_{max}$ = the highest rating of perceived exertion value during the isometric wall squat incremental test.
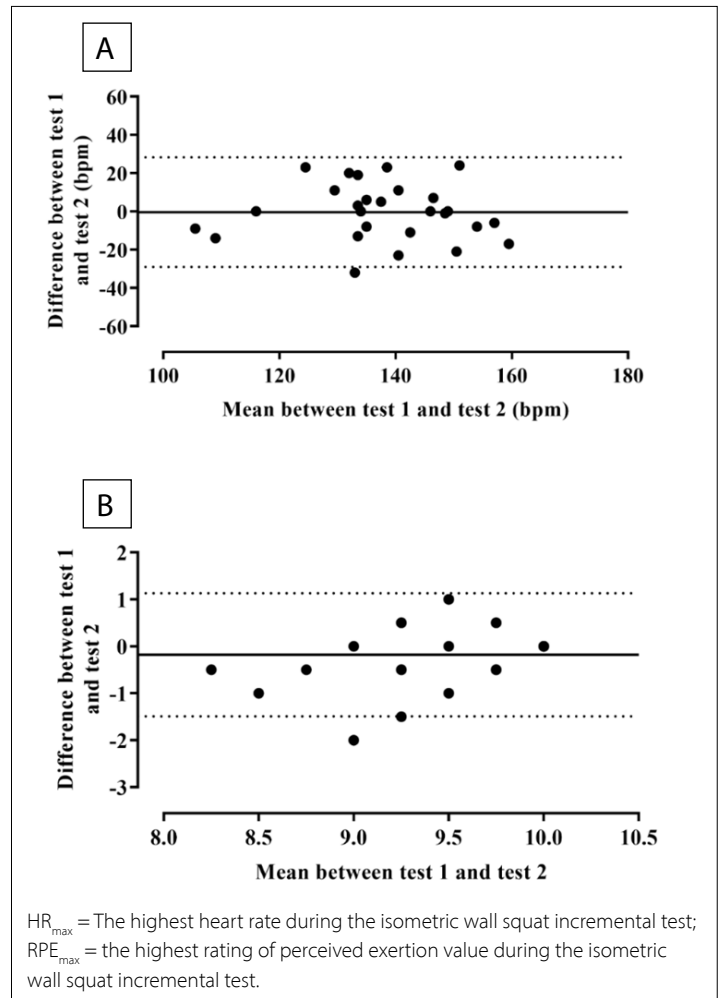
Figure 2. Bland – Altman plots for HR$_{max}$ (Panel A) and RPE$_{max}$ (Panel B) between Test 1 and Test 2 during the isometric wall squat incremental test.

Table 1. Sociodemographic characteristics of the participants (n = 28)

	Values
Male, %	53.6
Physically active, yes %	32.1
Age, years	26.0 ± 4.8
Height, cm	67.0 ± 13.7
Weight, kg	1.70 ± 0.1
BMI, kg/m²	23.2 ± 3.5

Values are presented as frequency or mean ± standard deviation

Table 2. Intraclass correlation coefficient, standard error of measurement, coefficient of variation, and minimum detected difference of heart rate and rating of perceived exertion in the isometric wall squat incremental test

	Test 1	Test 2	P	ICC	P	SEM	CV	Bias ± SD	95%LoA
HR$_{max}$	139 (17)	137 (24)	0.867	0.695	0.002	8.1	5.8	-0.39 ± 14.6	-29.0 to 28.3
RPE$_{max}$	9.5 (1.0)	10.0 (1.0)	0.212	0.525	0.036	0.4	3.6	-0.18 ± 0.67	-1.49 to 1.13

Data are presented as median (interquartile range); SD = standard-deviation; HR$_{max}$ = the highest heart rate value during the isometric wall squat incremental test; RPE$_{max}$ = the highest rating of perceived exertion value during the isometric wall squat incremental test; ICC = intraclass correlation coefficient; SEM = standard error of measurement, CV = coefficient of variation; 95%LoA = 95% limit of agreement.

Table 3. Intraclass correlation coefficient, standard error of measurement, coefficient of variation and minimum detected difference of heart rate and rating of perceived exertion in each stage of the isometric wall squat incremental test

Stages	n	Test1	Test2	P	ICC	P	SEM	CV	Bias ± SD	Number of outliers	95%LoA
Heart rate											
1st	28	102 ± 14	107 ± 11	0.067	0.659	0.002	7.2	7.2	-4.46 ± 12.39	1	-28.74 to 19.81
2nd	28	115 ± 13	117 ± 11	0.496	0.594	0.012	8.4	6.8	-1.71 ± 13.15	1	-27.49 to 24.06
3rd	27	131 ± 15	131 ± 12	0.988	0.766	< 0.001	6.0	5.4	0.04 ± 12.36	1	-24.19 to 24.27
4th	12	134 ± 13	134 ± 16	0.638	0.682	0.041	5.8	5.3	-2.00 ± 14.30	1	-30.03 to 26.03
Rating of perceived exertion											
1st	28	2.0 (2.0)	1.3 (1.0)	0.135	0.879	< 0.001	0.3	41.1	0.28 ± 0.92	1	-1.53 to 2.08
2nd	28	5.3 (3.4)	4.5 (3.5)	0.750	0.754	< 0.001	1.0	25.8	-0.16 ± 2.03	1	-4.14 to 3.82
3rd	27	8.5 (3.0)	8.5 (2.5)	0.914	0.831	< 0.001	0.5	9.3	0.04 ± 1.3 1	1	-2.54 to 2.62
4th	12	9.3 (1.4)	9.8 (1.4)	0.729	0.922	< 0.001	0.2	3.5	-0.08 ± 0.60	0	-1.25 to 1.09

Data presented as mean ± standard deviation or median (interquartile range); HR = The average the HR of the last 30 seconds in each stage; RPE = Rating of perceived exertion in the previous 10 seconds of each stage; ICC = intraclass correlation coefficient; 95%CI = confidence interval 95%; SEM = standard error of measurement, CV = coefficient of variation, 95%LoA = 95% Limits of Agreements.

individual differences. This indicated that the measurements were relatively reliable and replicable[14].

The CV of HR_{max} values obtained in this study (5.8%) were in line with previous studies that report results ranging from 3.6%[9] to 6.3%.[12] Conversely, none of these studies assessed the CV for RPE during the isometric wall squat test. The only data referred to the RPE during the different stages of the exercise sessions, ranging from 54% (angle of 135º) to 4.5% (angle of 95º). This is consistent with our findings of 41.1% (angle of 135º) to 3.5% (angle of 105º), indicating lower CVs at lower angles.

SEM has also been inadequately explored during isometric wall squat tests. Only Lea et al.[10] presented SEM data for HR and RPE during an exercise session and observed values of 2.4 bpm and 0.65, respectively. We observed an HR_{max} of 8.1 bpm and an RPE_{max} of 0.4. These results suggest that the SEM for both the HR and RPE across tests and sessions is acceptable.

The current study is the first to describe the Bland-Altman limits of agreement during the isometric wall squat test. The results revealed consistent and adequate agreement between measurements, demonstrating differences characterized by low variability and the absence of systematic patterns for both HR and RPE. One outlier was observed in both methods, indicating that, in a few cases, wide variability in HR and RPE can occur between tests.

The present study has some limitations that should be considered when interpreting the results. Some participants did not complete the final stages of the incremental test, limiting their responses or data analysis. Furthermore, the participants self-reported regular physical activity, which could have led to a memory bias. Finally, the training histories of those undergoing recreational resistance training (32% of the participants) were not assessed. It is worth noting that the incremental test results may not fully represent a complete exercise session, and our study sample comprised exclusively of healthy young adults. Therefore, caution should be exercised when generalizing these findings to other clinical populations. However, the present study adds significant information to the scientific community regarding the reliability and agreement of HR and RPE during the isometric wall squat incremental test, which is an intensity-determining method.

CONCLUSION

The reliability and agreement of the HR and RPE were similar, indicating that both methods presented similar psychometric properties for monitoring intensity in isometric wall squat training.

REFERENCES

1. Zhou Y, Xie G, Wang J, Yang S. Cardiovascular risk factors significantly correlate with autonomic nervous system activity in children. Can J Cardiol. 2012;28(4):477-82. PMID: 22560462; https://doi.org/10.1016/j.cjca.2012.02.003.

2. Edwards JJ, Deenmamode AHP, Griffiths M, et al. Exercise training and resting blood pressure: a large-scale pairwise and network meta-analysis of randomised controlled trials. Br J Sports Med. 2023;57(20):1317-26. PMID: 37491419; https://doi.org/10.1136/bjsports-2022-106503.

3. Baffour-Awuah B, Pearson MJ, Dieberg G, Smart NA. Isometric Resistance Training to Manage Hypertension: Systematic Review and Meta-analysis. Curr Hypertens Rep. 2023;25(4):35-49. PMID: 36853479; https://doi.org/10.1007/s11906-023-01232-w.

4. Edwards JJ, Wiles J, O'Driscoll J. Mechanisms for blood pressure reduction following isometric exercise training: a systematic review and meta-analysis. J Hypertens. 2022;40(11):2299-306. PMID: 35950976; https://doi.org/10.1097/hjh.0000000000003261.

5. Farah BQ, Germano-Soares AH, Rodrigues SLC, et al. Acute and chronic effects of isometric handgrip exercise on cardiovascular variables in hypertensive patients: a systematic review. Sports. 2017;5(3):55. PMID: 29910415; https://doi.org/10.3390/sports5030055.

6. Millar PJ, McGowan CL, Cornelissen VA, Araujo CG, Swaine IL. Evidence for the role of isometric exercise training in reducing blood pressure: potential mechanisms and future directions. Sports Med. 2014;44(3):345-56. PMID: 24174307; https://doi.org/10.1007/s40279-013-0118-x.

7. Taylor KA, Wiles JD, Coleman DA, et al. Neurohumoral and ambulatory haemodynamic adaptations following isometric exercise training in unmedicated hypertensive patients. J Hypertens. 2019;37(4):827-36. PMID: 30817465; https://doi.org/10.1097/hjh.0000000000001922.

8. Lea JWD, O'Driscoll JM, Wiles JD. The implementation of a home-based isometric wall squat intervention using ratings of perceived exertion to select and control exercise intensity: a pilot study in normotensive and pre-hypertensive adults. Eur J Appl Physiol. 2024;124(1):281-93. PMID: 37458822; https://doi.org/10.1007/s00421-023-05269-2.

9. Goldring N, Wiles JD, Coleman D. The effects of isometric wall squat exercise on heart rate and blood pressure in a normotensive population. J Sports Sci. 2014;32(2):129-36. PMID: 23879248; https://doi.org/10.1080/02640414.2013.809471.

10. Lea JWD, O'Driscoll JM, Coleman DA, Wiles JD. Validity and reliability of RPE as a measure of intensity during isometric wall squat exercise. J Clin Transl Res. 2021;7(2):248-56. PMID: 34104828.

11. Lea JWD, O'Driscoll JM, Coleman DA, Wiles JD. Validity and reliability of the 'Isometric Exercise Scale' (IES) for measuring ratings of perceived exertion during continuous isometric exercise. Sci Rep. 2021;11(1):5334. PMID: 33674722; https://doi.org/10.1038/s41598-021-84803-8.

12. Wiles JD, Goldring N, O'Driscoll JM, Taylor KA, Coleman DA. An alternative approach to isometric exercise training prescription for cardiovascular health. Transl J Am Coll Sports Med. 2018;3(2):10-8. Available from: https://www.researchgate.net/publication/322540153_An_Alternative_Approach_to_Isometric_Exercise_Training_Prescription_for_Cardiovascular_Health. Accesses in 2024 (March 14).

13. Kottner J, Audige L, Brorson S, et al. Guidelines for Reporting Reliability and Agreement Studies (GRRAS) were proposed. Int J Nurs Stud. 2011;48(6): 661-71. PMID: 21514934; https://doi.org/10.1016/j.ijnurstu.2011.01.016.

14. Atkinson G, Nevill AM. Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. Sports Med. 1998;26(4):217-38. PMID: 9820922; https://doi.org/10.2165/00007256-199826040-00002.

15. Edwards JJ, Coleman DA, Ritti-Dias RM, et al. Isometric Exercise Training and Arterial Hypertension: An Updated Review. Sports Med. 2024. PMID: 38762832; https://doi.org/10.1007/s40279-024-02036-x.

16. Koo TK, Li MY. A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. J Chiropr Med. 2016;15(2):155-63. PMID: 27330520; https://doi.org/10.1016/j.jcm.2016.02.012.

17. McGraw KO, Wong SP. Forming Inferences about Some Intraclass Correlation Coefficients. Psychological Methods. 1996;1(1):30-46. https://doi.org/10.2165/ 10.1037/1082-989X.1.1.30.

18. Weir JP. Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. J Strength Cond Res. 2005;19(1):231-40. PMID: 15705040; https://doi.org/10.1519/15184.1.

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Frequency of scapular dyskinesis and its relationship with disease parameters in patients with ankylosing spondylitis: a cross-sectional study

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ABSTRACT

BACKGROUND: Scapular dyskinesis (SD) is a condition associated with impaired scapular movement caused by cervical, shoulder, and postural abnormalities.

OBJECTIVE: The aim of this study was to determine the frequency of SD in patients with ankylosing spondylitis (AS).

DESIGN AND SETTING: A cross-sectional study was conducted at Ondokuz Mayıs University, Samsun, Turkey.

METHODS: One hundred patients with AS but without shoulder involvement (74 males and 26 females) and 50 healthy controls (35 males and 15 females) were included in the study. The patients were divided into two groups: patients with and without SD. SD was assessed using the Scapular Dyskinesis Test and Lateral Scapular Slide Test. Disease activity, spinal mobility, and chest expansion were also measured. The severity of enthesitis was evaluated using the Spondyloarthritis Research Consortium of Canada index.

RESULTS: There were significant differences between the two groups of patients with AS, those with SD, and those without SD in terms of age, chest expansion, and the Bath Ankylosing Spondylitis Metrology Index (BASMI) scores ($P < 0.05$). The groups differed significantly in terms of hip, thoracic, and lumbar involvement ($P < 0.05$). The BASMI score was a significant variable affecting SD ($P < 0.05$). No cases of SD were observed in the control group.

CONCLUSION: While there were no significant differences in disease activity and enthesitis scores between patients with and without SD, differences were detected in mobility parameters. Since shoulder examinations of the patients were normal, it can be inferred that SD occurred because of the involvement of the scapulothoracic joints and thoracic spine.

INTRODUCTION

Ankylosing Spondylitis (AS) is a chronic inflammatory disease primarily affecting the spine and peripheral joints. The course of AS may be progressive, starting at the sacroiliac joints and leading to ankylosis throughout the spine, including the cervical region. The development of ankylosis can restrict joint mobility, causing significant disability and deterioration in the quality of life. In cases of extra-spinal involvement, one of the target joints is the shoulder joint, where inflammation can cause severe pain and restrict shoulder movement.[1] Previous studies have reported that the frequency of shoulder involvement in patients with AS varies between 3.5% and 33%.[2]

Coordinated movement of the glenohumeral joint and scapula is crucial for proper shoulder function. The scapula plays an important role in the stability of the shoulder joint.[3] Changes in scapular position and problems in scapulothoracic joint movement can lead to shoulder pathologies.[4] Therefore, the examination of scapular functions is crucial in the evaluation of patients with shoulder complaints.

Scapular dyskinesis (SD) is defined as the deviation of the scapula from its normal position at rest and/or during movement.[5] Previous studies have demonstrated a high prevalence of SD in individuals with shoulder pathologies such as rotator cuff problems and impingement syndrome, as well as in elite athletes who frequently use their shoulders.[6] Any pathology affecting the glenohumeral or scapulothoracic joint is likely to be associated with SD. In patients with AS, kyphosis, shoulder involvement with arthritis, and enthesitis can impair scapulothoracic movements. To our knowledge, the presence of SD in patients with AS has not been previously evaluated.

OBJECTIVE

This study aimed to investigate the frequency of SD in patients with AS, particularly in those without shoulder involvement. In addition, possible associations between SD and disease activity, spinal mobility, enthesitis, and chest expansion were assessed.

METHODS

A total of 112 consecutive patients with axial spondyloarthritis (ax-SpA) who were treated at the Rheumatology Clinic of Ondokuz Mayıs University Faculty of Medicine fulfilled the Assessment of SpondyloArthritis International Society (ASAS) classification criteria for ax-SpA, and had current sacroiliac and spinal radiographs revealing radiological sacroiliitis consistent with AS were enrolled in the study. Patients with scoliosis or shoulder and neck pathologies that could cause SD were excluded from the study. Patients with a history of psychiatric or rheumatological diseases other than AS were also excluded. All participants underwent shoulder ultrasonography to identify shoulder pathologies, such as arthritis, enthesitis, shoulder impingement syndrome, or rotator cuff tears. Although these findings did not result in obvious clinical symptoms, the patients with sonographic findings were excluded. After applying these criteria, 12 patients were excluded, and the study was conducted on the remaining 100 patients.

The control group included 50 healthy individuals aged > 18 years, consisting of relatives of patients from outpatient clinics, university employees, and volunteers from the general population.

This study was performed in accordance with the Declaration of Helsinki, and the protocol was approved on December 23, 2023, by the Medical Research Ethics Committee at Ondokuz Mayıs University (No:289/2023). The patients and controls were informed of the study, and written consent was obtained. Detailed physical examinations of the patients and control subjects were performed by the same PMR specialist with more than 20 years of experience. (DD).

A priori power analysis was performed, and the minimum sample size was determined to be 26 for each group.[7] Demographic data (including age, sex, marital status, and disease duration) were also recorded.

Clinical assessments

Socio-demographic characteristics

Age, sex, disease duration, age at diagnosis, drug usage (disease-modifying anti-rheumatic drugs and biological agents), history of peripheral arthritis, and extra-articular manifestations such as uveitis, inflammatory bowel disease, and psoriasis were noted for each patient.

All patients underwent standard physical examinations and anthropometric measurements. Only patients with radiographic sacroiliitis were included. Involvement of the lumbar, thoracic, and cervical spines was assessed by examining current radiographs for the presence of syndesmophytes, erosions, or ankylosis. The decision regarding the radiographic findings was obtained via consensus of two rheumatologists (SK and KC).

Disease Activity

Clinical disease activity was evaluated using the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Ankylosing Spondylitis Disease Activity Score-C-Reactive Protein (ASDAS-CRP), and ASDAS-Erythrocyte Sedimentation Rate (ASDAS-ESR):[8-10]

Mobility

Patient mobility was evaluated using the Bath Ankylosing Spondylitis Metrology Index (BASMI), which includes measurements of wall-to-tragus distance, lumbar flexion, cervical rotation, lumbar lateral flexion, and intermalleolar distance. Chest expansion was measured with a tape measure placed circumferentially around the chest wall in the fourth intercostal space.[11-13]

Enthesitis score

The severity of enthesitis was assessed via the Spondyloarthritis Research Consortium of Canada (SPARCC) enthesitis index evaluating tenderness in a total of 16 enthesitis sites: the greater trochanter (right/left [R/L]), quadriceps tendon insertion to the patella (R/L), patellar ligament insertion into the patella and tibial tuberosity (R/L), Achilles tendon insertion (R/L), plantar fascia insertion (R/L), medial and lateral epicondyles (R/L), and the supraspinatus insertion (R/L). Tenderness at each site was quantified on a dichotomous basis as follows: 0 = non-tender and 1 = tender. All parameters were evaluated by the same physician.[14]

Evaluation of scapular dyskinesia

In the observational SD assessment using the Scapular Dyskinesia test (SDT), the patients were instructed to perform bilateral shoulder elevation movements consecutively 3–5 times in the sagittal plane. The medial border of the scapula was observed throughout the movement. The presence of a distinct prominence of the inferomedial, entire medial, or superior scapular border during movement was noted as SD. If none of these were observed, the presence of SD was ruled out. As shown in the literature, the test demonstrates high inter-rater agreement and sensitivity in the evaluation of SD.[15]

The Lateral Scapular Slide Test (LSST) was performed with the patient in an upright position. Three different arm positions

were examined: a) arms at the sides of the body (**Figure 1a**), b) hands on top of the hips (**Figure 1b**), and c) arms at 90º abduction (**Figure 1c**). The distance between the spinous processes of the vertebrae at the same level as the lower scapular angle was measured bilaterally using calipers. If the difference between measurements in the same position was greater than 1.5 cm, it was recorded as SD.[16] Patients with positive results in both observational SDT and LSST assessments were recorded as having SD.

Based on the LSST results, the side farther from the center was the asymmetric side, and the opposite side was the symmetric side.

Statistical analyses

Statistical analyses were performed using SPSS software (version 21.0; IBM, Armonk, New York, United States). An a priori power analysis was performed, and the minimum sample size was determined to be 26 for each group. Descriptive statistics are presented as mean ± standard deviation, minimum-maximum, frequency distribution, and percentage. The Kolmogorov-Smirnov test was used to analyze the normal distribution assumption of the quantitative outcomes. Student's t-test, Mann–Whitney U-test, and chi-square test were used to compare the clinical scores and demographic characteristics of the two groups. Intergroup comparison of the lateral scapular shift test was performed using Kruskal-Wallis analysis and Mann-Whitney U tests. Binary logistic regression analysis was performed to determine whether age, disease duration, sex, BASMI score, chest expansion, enthesitis score, ASDAS-ESR, ASDAS-CRP level, thoracic involvement, lumbar involvement, and sacroiliitis were associated with SD. P values less than 0.05 were considered statistically significant.

RESULTS

Initially, 112 consecutive patients with AS but without known shoulder involvement were included in this study. After a detailed examination, 12 patients were excluded from the study (six had impingement syndrome, three had cervical disc herniation, one had a history of labral tear, one had a previous humerus fracture, and one was a basketball player prone to shoulder trauma). One hundred patients with AS and 50 healthy controls were included in this study. The age of those in the AS and control groups was 47.00 ± 11.84 (range: 21-63) and 44.00 ± 7.24 (range: 28-58), respectively, with no significant difference between the two groups (P = 0.062). The patient group comprised 74 males and 26 females, whereas the control group consisted of 35 males and 15 females, with no significant sex differences between the two groups (P = 0.604).

All participants underwent SDT and LSST. No participant in the control group had SD. Based on the test results, 26 patients with SD were categorized into Group 1, 74 patients without SD into Group 2, and healthy individuals into Group 3. The side farther from the center was considered asymmetric, and the opposite side was regarded as the symmetric side in the LSST assessment. In the comparison of the LSST results among the three groups, a significant difference was found on the asymmetric side in the three arm positions (P < 0.05). For the pairwise comparison of the groups, the LSST results for Group 1 and Group 2 are summarized in **Table 1**. A significant difference was observed in the asymmetric side between the two groups (P < 0.05). Although a significant difference was found between Groups 1 and 3 on the asymmetric side (P < 0.05), no significant difference was detected between Groups 2 and 3 for all measurements (P > 0.05).
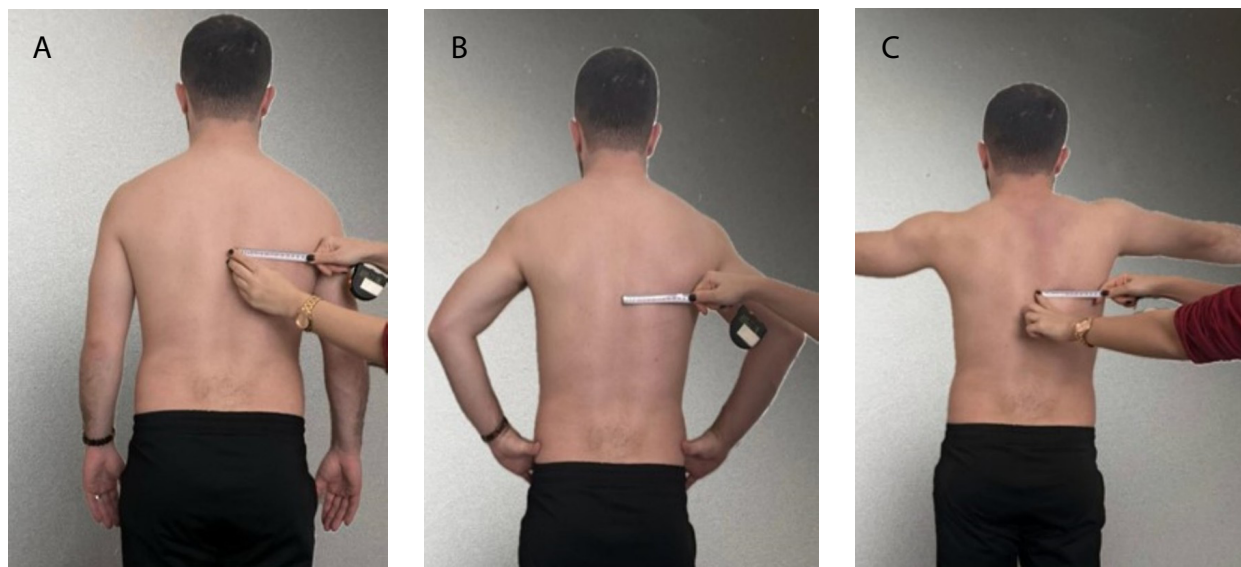
a) With arms resting at the sides, b) with hands placed on the hips, and c) with arms in 90º abduction.

Figure 1. Measurement of the scapular position in the Lateral Scapular Slide Test.

Upon examining other patient data, it was found that the age of the patients in Group 1 was significantly higher (P < 0.05). However, there was no significant difference in disease duration between Groups 1 and 2 (P > 0.05) (**Table 2**). The BASMI scores were higher in Group 1, and the frequency of lumbar and thoracic involvement was significantly higher. Additionally, chest expansion was more restricted, and the percentage of hip involvement was higher in Group 1 (P < 0.05) (**Table 2** and **Table 3**).

In the assessments based on radiographs, when patients were categorized into mild stages (≤ 2) or advanced stages (3 or 4) of sacroiliitis, it was observed that in Group 1, sacroiliac involvement was in a more advanced stage. There were no significant differences between the two groups in terms of disease activity scores or medications used at the time of evaluation (P > 0.05). Detailed findings are provided in **Table 2** and **Table 3**.

The relationships between clinical parameters and SD, as determined by binary logistic regression analysis, are presented in **Table 3**. The BASMI score was identified as a significant variable affecting SD (P < 0.05) (**Table 4**).

DISCUSSION

Our study revealed a significant prevalence of SD in patients with AS through the implementation of SDT and LSST. Another noteworthy aspect of this study was the absence of shoulder involvement related to AS in all the participants. Our data support the notion that a substantial portion of SD can be observed in patients with AS but without arthritis and is solely associated with axial involvement.

Various pathologies have been implicated in the development of SD. Primarily, neck problems, shoulder-related factors, posture-related factors, and peripheral nerve damage can give rise to SD, as highlighted by Panagiotopoulos et al.[17] Among those, a closer examination should particularly focus on shoulder joint pathologies, peripheral nerve damage innervating shoulder muscles, and pathologies related to cervical roots innervating shoulder muscles.[18]

Studies have demonstrated an increased frequency of SD in individuals with neck pain.[19] Additionally, long thoracic nerve injury has been identified as another significant cause of SD and medial scapular winging, particularly resulting from overhead

Table 1. Comparison of demographic and clinical data of patients according to scapular dyskinesis

	Group 1 (n = 26) Mean ± SD (range)	Group 2 (n = 74) Mean ± SD (range)	P
Age (years)	51.30 ± 7.87 (37-63)	45.48 ± 12.65 (21-70)	**0.028***
Disease duration (years)	15.03 ± 9.34 (2-34)	11.38 ± 8.91 (1-45)	0.081
Age at diagnosis (years)	33.30 ± 16.35 (12-59)	32.73 ± 12.50 (7-55)	0.436
Enthesitis score	1.07 ± 0.98 (0-6)	0.50 ± 0.33 (0-2)	0.763
BASMI	7.12 ± 5.12 (0.9-32)	2.48 ± 1.21 (0.5-6)	**0.001***
Chest expansion (cm)	3.11 ± 1.13 (1-4.5)	4.27 ± 1.42 (2-6)	**0.001***
ASDAS-ESR	1.96 ± 0.93 (1-4)	2.57 ± 1.18 (0-5)	0.259
ASDAS-CRP	1.71 ± 1.11 (0-3.6)	2.28 ± 1.17 (0-4.4)	0.336
BASDAI (n)			
≥ 4	3 (11.5)	18 (24.3)	0.169
4 >	23 (88.5)	56 (75.5)	
Gender			
Female	1 (3.9)	25 (33.8)	**0.003***
Male	25 (96.1)	49 (66.2)	

*P < 0.05 significant; BASMI = Bath Ankylosing Spondylitis Metrology Index; ASDAS-CRP = Ankylosing Spondylitis Disease Activity Score-C-Reactive Protein; ASDAS-ESH = Ankylosing Spondylitis Disease Activity Score – Erythrocyte Sedimentation Rate; BASDAI = Bath Ankylosing Spondylitis Disease Activity Index; Group 1 = patients with scapular dyskinesis; Group 2 = patients without scapular dyskinesis.

Table 2. Results of the Lateral Scapular Slide Test

	Group 1 (n = 26) Mean ± SD (min-max)	Group 2 (n = 74) Mean ± SD (min-max)	P
Position 1 Other side	9.20 ± 0.98 (6.7-11)	8.23 ± 2.55 (3.4-11.8)	0.571
Position 1 Asymmetrical side	10.42 ± 0.97 (8.2-12)	8.46 ± 2.53 (3.6-11.8)	**0.002***
Position 2 Other side	9.34 ± 0.78 (7.4-10.5)	8.78 ± 2.43 (4-12.8)	0.634
Position 2 Asymmetrical side	10.76 ± 1.20 (7.8-12)	9.02 ± 2.37 (4.1-12.8)	**0.001***
Position 3 Other side	10.03 ± 1.44 (6.9-13)	9.39 ± 2.38 (4.8-13.6)	0.939
Position 3 Asymmetrical side	10.92 ± 1.15 (8.5-13)	9.59 ± 2.35 (4.9-13.8)	**0.033***

Position 1 = arms next to the body; Position 2 = hands on the hips; Position 3 = arms in 90º abduction; Group 1 = Patients with scapular dyskinesis; Group 2 = Patients without scapular dyskinesis.

weightlifting.[20] In our study, patients with neck pathologies were excluded. Physical examination of all patients was conducted for signs suggestive of root compression. While obtaining magnetic resonance imaging (MRI) to completely rule out cervical root compression could be suggested for thorough exclusion, it is important to note that the underlying mechanisms leading to SD in cervical pathologies often involve muscle spasms or weakness due to root compression. Patients were thoroughly questioned and evaluated through physical examinations in this regard. Therefore, we did not consider an underlying cervical mechanism or peripheral nerve damage as the cause of SD in our patient group.

Table 3. Comparisons of patients' clinical parameters

		Group 1 (n = 26) Mean ± SD (min-max)	Group 2 (n = 74) Mean ± SD (min-max)	P
Lumbar involvement	Yes	8 (30.7)	9 (12.2)	0.030*
	No	18 (69.3)	65 (87.8)	
Thoracal involvement	Yes	7 (26.9)	7 (9.5)	0.036*
	No	19 (73.1)	67 (90.5)	
Cervical involvement	Yes	4 (15.4)	4 (5.4)	0.107
	No	22 (84.6)	70 (94.6)	
Hip involvement	Yes	10 (38.5)	7 (9.5)	0.001*
	No	16 (61.5)	67 (90.5)	
Heel enthesitis	Yes	4 (15.4)	11 (14.9)	0.949
	No	22 (84.6)	63 (85.1)	
Sacroiliitis (n%) Early stage (I-II)		12 (46.2)	51 (68.9)	0.039*
Late stage (III-IV)		14 (53.8)	23 (31.1)	
Uveitis (n%)	Yes	3 (11.5)	11 (14.9)	0.674
	No	23 (88.5)	63 (85.1)	
DMARDs (n%)	Yes	2 (15.4)	5 (13.2)	0.840
	No	11 (84.6)	33 (86.8)	
Biological agents (n%)	Yes	13 (100)	36 (94.7)	0.399
	No	0	2 (5.3)	

DMARDs = Disease-modifying anti-rheumatic drugs; Group 1 = Patients with scapular dyskinesis; Group 2 = Patients without scapular dyskinesis.

Other pathologies that contribute to SD are shoulder-related. Acromioclavicular joint disorders, impingement syndrome, rotator cuff and glenoid labrum pathologies, and clavicle fractures are the main shoulder pathologies associated with SD.[3,17] In a study by Christiansen et al. involving 40 patients with impingement syndrome, they demonstrated the presence of SD in nearly half of the patients before treatment.[21] In their study, Keshavarz et al. noted that patients with shoulder impingement syndrome exhibited increased scapular protraction at rest, increased posterior tilt during abduction, and increased internal rotation during elevation.[22] Similarly, in a study involving patients with a history of shoulder fractures, Suphakitchanusan et al. found the frequency of SD to be 50%.[23] Therefore, in our study, shoulder pathologies that could cause SD were excluded through medical history, examination, and ultrasonographic evaluation.

It is worth noting that SD can be observed in individuals with excessive use of the upper extremities, even in the absence of any shoulder pathology, particularly in athletes with frequent overhead movements.[24] Even in the absence of shoulder pathology, fatigue-related weakness in the rotator cuff, scapula stabilizers, and latissimus dorsi muscles due to chronic use appears to be the main underlying mechanism. In a study by Zago et al., an isokinetic fatigue protocol was applied to 24 healthy professional overhead athletes, and measurements were performed before and after the protocol. When evaluating the pre-post fatigue range of motion, they observed a significant decrease in shoulder elevation and a significant increase in scapular tilt. Computer-assisted measurements revealed a significant delay in initiating humeroscapular movement after fatigue, indicating that fatigue leads to significant changes in scapulohumeral rhythm.[25] None of the patients were engaged in professional sports, and when occupations involving overhead limb usage were queried, none of the patients reported such activities. Furthermore, as all potential shoulder pathologies were ruled out through physical examination and ultrasonographic

Table 4. Binary logistic regression analysis of factors associated with scapular dyskinesis

	B	Std. error	Wald	P	Exp (B)	95%CI for EXP(B) Lower	95%CI for EXP(B) Upper
Age	0.056	0.033	2.947	0.086	0.946	0.887	1.008
Sex	-2.469	1.319	3.506	0.061	0.085	0.006	1.122
Disease duration	0.046	0.037	1.544	0.214	1.047	0.974	1.125
Lumbar involvement	0.455	0.982	0.214	0.643	1.576	0.230	10.805
Thoracal involvement	1.055	1.101	0.918	0.338	2.871	0.332	24.833
Sacroiliitis	0.718	0.630	1.297	0.255	2.050	0.596	7.052
Enthesitis score	0.078	0.373	0.044	0.833	0.925	0.446	1.919
BASMI score	0.821	0.272	9.083	**0.003***	0.440	0.258	0.750
Chest expansion	-0.124	0.079	2.439	0.118	0.883	0.756	1.032
ASDAS-ESR	0.343	0.646	0.283	0.595	1.410	0.397	5.002
ASDAS-CRP	0.009	0.561	0.000	0.987	0.991	0.330	2.974

*P < 0.05 significant; BASMI = Bath Ankylosing Spondylitis Metrology Index; ASDAS-CRP = Ankylosing Spondylitis Disease Activity Score-C-Reactive Protein; ASDAS-ESH = Ankylosing Spondylitis Disease Activity Score-Erythrocyte Sedimentation Rate; CI = confidence interval; Exp(B) = exponential of the B coefficient.

assessment, we did not consider SD to be primarily associated with shoulder joint dysfunction.

Postural abnormalities are implicated in the emergence of SD in individuals, excluding cervical or shoulder-related pathologies.[17] Prolonged postures that place excessive strain on the shoulder girdle may exacerbate these biomechanical issues, further promoting the development of SD. The scapulothoracic joint is involved in shoulder movement. SD can arise in any condition affecting the scapula and the thoracic part of the scapulothoracic surface. For a normal movement pattern, it is necessary for the thorax to have a normal ellipsoid structure and the kyphosis angle to be within normal limits.[26] Especially in situations where thoracic kyphosis increases, which can be a contributing factor to the occurrence of SD. In a study conducted by Telli et al. on patients with myofascial pain syndrome, SD was significantly more prevalent in individuals with increased kyphosis.[27] In another study conducted by Otoshi et al., an increased prevalence of subacromial impingement syndrome was detected in individuals with increased kyphosis. This study demonstrated that increased kyphosis leads to decreased shoulder elevation and SD, resulting in impingement.[28] that increased thoracic kyphosis causes the scapula to become more protracted and rotate downward. Excessive scapular protraction alters the role of the scapula in shoulder function, leading to potential compression under the acromion and subacromial tissues, including the subacromial bursa and rotator cuff.[16,28] During AS, lumbar lordosis is decreased and thoracic kyphosis is increased, resulting in typical postural deterioration. We believe that in our patients, the fundamental cause of SD was postural changes that developed during the course of AS.

AS is a chronic inflammatory rheumatic disease characterized by axial involvement, with the sacroiliac joint being the initial affected area in all patients.[29] Over time, the disease can progress upwards, sequentially affecting the lumbar, thoracic, and cervical spine. Progression of spinal involvement is also an indicator of disease severity. Inflammation and subsequent ankylosis lead to a decrease in spinal movements.[30] Lumbar spine involvement may result in reduced measurements in the Schober test, whereas thoracic spine, costovertebral, and sternocostal joint involvement can restrict chest expansion. As kyphosis increases, the occiput-to-wall distance progressively increases.[31] The current study demonstrated that in patients with AS and SD, radiological involvement in the lumbar and thoracic vertebrae was more prominent than in those without SD. In addition, chest expansion was significantly reduced in this group. Regression analysis revealed a significant correlation between the BASMI scores and SD. The BASMI score is an index used to assess the impact on spinal mobility in patients with AS, incorporating measurements such as lateral flexion, lumbar flexion, and tragus-to-wall distance in its subcomponents to detect reduced spinal mobility as a result of advanced disease.[32] a high BASMI

score indicates a more advanced stage of the disease. Therefore, a high BASMI score in participants with SD implies the presence of advanced disease, with expected lumbar and thoracic involvement and advanced sacroiliitis.[33] During which the costovertebral joints participate in movement. In patients with AS, due to thoracic involvement, the chest expansion is usually limited.[34] The observed limitation of chest expansion in the SD group may be explained by the higher thoracic involvement in this group. Moreover, as there was no significant difference in the total disease duration, the higher prevalence of thoracic involvement in the SD group indicated that patients in this group had a more severe disease. This was further supported by the higher prevalence of hip involvement, which is a poor prognostic indicator in the SD group. The sacroiliitis observed in the SD group was also more advanced, indicating the role of disease severity in the occurrence of SD. In Otoshi et al.'s study, an increase in the occiput-wall distance, an indirect indicator of kyphosis, was more pronounced in the impingement syndrome group.[28] The tragus-wall distance, another indirect indicator of kyphosis, holds significant importance in the BASMI score. The high BASMI score in the SD group may be related to increased kyphosis, indicating advanced and severe disease.

We believe that our study will make a significant contribution to the literature, as it is the first study to investigate the presence of SD in patients with AS and to determine the factors associated with the occurrence of SD. Concerning the limitations of our study, cervical and shoulder pathologies in patients were ruled out through anamnesis, physical examination and ultrasonography. MRI could not be used to exclude cervical and shoulder pathologies because of the absence of complaints in the participants. Additionally, the lack of measurement of the radiological kyphosis angle in patients and the investigation of its relationship with SD can be considered another limitation.

CONCLUSION

This study revealed the presence of SD in patients with AS and isolated axial involvement without shoulder or cervical pathology. Indicators of poor prognosis and advanced disease, such as sacroiliac radiographic findings and BASMI scores, were identified in the SD group. Therefore, investigating the presence of SD in patients with AS is important. If SD is present in these patients, the risk of developing shoulder pathologies increases, and early preventive rehabilitation measures should be implemented for appropriate treatment.

REFERENCES

1. Ou Alla SA, Bahiri R, Amine H, et al. Ultrasound features of shoulder involvement in patients with ankylosing spondylitis: a case-control study. BMC Musculoskelet Disord. 2013;14(1):272. PMID: 24053556; https://doi.org/10.1186/1471-2474-14-272.

2. Lambert RG, Dhillon SS, Jhangri GS, et al. High prevalence of symptomatic enthesopathy of the shoulder in ankylosing spondylitis: deltoid origin involvement constitutes a hallmark of disease. Arthritis Rheum. 2004;51(5):681-90. PMID: 15478149; https://doi.org/10.1002/art.20681.

3. Kibler WB, Sciascia A. Current concepts: scapular dyskinesis. Br J Sports Med. 2010;44(5):300-5. PMID: 19996329; https://doi.org/10.1136/bjsm.2009.058834.

4. Kim E, Jang T, Park HJ, Ikemoto S, Murase T, Sugamoto K, Hong SW. In vivo three- dimensional scapular kinematic alterations after reverse total shoulder arthroplasty. J Orthop Surg. 2020;28(2):2309499020921979. PMID: 32390500; https://doi.org/10.1177/2309499020921979.

5. Kibler WB, Sciascia A, Wilkes T. Scapular dyskinesis and its relation to shoulder injury. J Am Acad Orthop Surg. 2012;20(6):364-72. PMID: 22661566; https://doi.org/10.5435/jaaos-20-06-364.

6. Burn MB, McCulloch PC, Lintner DM, Liberman SR, Harris JD. Prevalence of scapular dyskinesis in overhead and nonoverhead athletes: a systematic review. Orthop J Sports Med. 2016;4(2):2325967115627608. PMID: 26962539; https://doi.org/10.1177/2325967115627608.

7. Delen M, Oskay D, Baglan S, et al. Effect of scapular dyskinesis on disease activity, quality of life, level of disability in female patients with rheumatoid arthritis. Ergoterapi ve Rehabilitasyon Dergisi. 2018;6(2):125-34. https://doi.org/10.30720/ered.463651.

8. Akkoc Y., Karatepe AG, Akar S, Kirazli Y, Akkoc N. A Turkish version of the Bath Ankylosing Spondylitis Disease Activity Index: reliability and validity. Rheumatol Int. 2005;25(4):280-4. PMID: 14730386; https://doi.org/10.1007/s00296-003-0432-y.

9. Garrett S, Jenkinson T, Kennedy LG, et al. A new approach to defining disease status in ankylosing spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index. J Rheumatol. 1994;21(12):2286-91. PMID: 7699630.

10. Kilic E, Kilic G, Akgul O, Ozgocmen S. Discriminant validity of the Ankylosing Spondylitis Disease Activity Score (ASDAS) in patients with non-radiographic axial spondyloarthritis and ankylosing spondylitis: a cohort study. Rheumatol Int. 2015;35(6):981-9. PMID: 25366469; https://doi.org/10.1007/s00296-014-3168-y.

11. Jenkinson TR, Mallorie PA, Whitelock HC, et al. Defining spinal mobility in ankylosing spondylitis (AS). The Bath AS Metrology Index. J Rheumatology. 1994;21(9):1694-8. PMID: 7799351.

12. Guenther V, Locher E, Falkenbach A, et al. Body image in patients with ankylosing spondylitis. Clin Exp Rheumatology. 2010;28(3):341-7. PMID: 20460037.

13. Durmuş D, Alayli G, Uzun O, et al. Effects of two exercise interventions on pulmonary functions in the patients with ankylosing spondylitis. Joint Bone Spine; 2009;76(2):150-5. PMID: 19084457; https://doi.org/10.1016/j.jbspin.2008.06.013.

14. Zahiroglu Y, Ulus Y, Akyol Y, et al. Spondyloarthritis Research Consortium of Canada (SPARCC) enthesitis index in Turkish patients with ankylosing spondylitis: relationship with disease activity and quality of life. Int J Rheum Dis. 2014;17(2):173-80. PMID: 24576273; https://doi.org/10.1111/1756-185x.12067.

15. Uhl TL, Kibler WB, Gecewich B, Tripp BL. Evaluation of clinical assessment methods for scapular dyskinesis. Arthroscopy. 2009;25(11):1240-8. PMID: 19896045; https://doi.org/10.1016/j.arthro.2009.06.007.

16. Kibler WB. The role of the scapula in athletic shoulder function. Am J Sports Med. 1998;26(2):325-37. PMID: 9548131; https://doi.org/10.1177/03635465980260022801.

17. Panagiotopoulos AC, Crowther IM. Scapular Dyskinesia, the forgotten culprit of shoulder pain and how to rehabilitate. SICOT J. 2019;5:29. PMID: 31430250; https://doi.org/10.1051/sicotj/2019029.

18. Roche SJ, Funk L, Sciascia A, Kibler WB. Scapular dyskinesis: the surgeon's perspective. Shoulder Elbow. 2015;7(4):289-97. PMID: 27582990; https://doi.org/10.1177/1758573215595949.

19. Sağlam G, Telli H. The prevalence of scapular dyskinesia in patients with back, neck, and shoulder pain and the effect of this combination on pain and muscle shortness. Agri. 2022;34(2):100-8. PMID: 35848815; https://doi.org/10.14744/agri.2022.87059.

20. Berthold JB, Burg TM, Nussbaum RP. Long thoracic nerve injury caused by overhead weight lifting leading to scapular dyskinesis and medial scapular winging. J Am Osteopath Assoc. 2017;117(2):133-7. PMID: 28134956; https://doi.org/10.7556/jaoa.2017.025.

21. Christiansen DH, Møller AD, Vestergaard JM, Mose S, Maribo T. The scapular dyskinesis test: Reliability, agreement, and predictive value in patients with subacromial impingement syndrome. J Hand Ther. 2017;30(2):208-13. PMID: 28571725; https://doi.org/10.1016/j.jht.2017.04.002.

22. Keshavarz R, Bashardoust Tajali S, Mir SM, Ashrafi H. The role of scapular kinematics in patients with different shoulder musculoskeletal disorders: A systematic review approach. J Bodyw Mov Ther. 2017;21(2):386-400. PMID: 28532884; https://doi.org/10.1016/j.jbmt.2016.09.002.

23. Suphakitchanusan W, Kerdsomnuek P, Jamkrajang P, et al. Scapular dyskinesis after treatment of proximal humerus fracture, a 3-dimensional motion analysis and clinical outcomes. J Shoulder Elbow Surg. 2023;32(10):e504-15. PMID: 37285953; https://doi.org/10.1016/j.jse.2023.04.035.

24. Saini SS, Shah SS, Curtis AS. Scapular Dyskinesis and the Kinetic Chain: Recognizing Dysfunction and Treating Injury in the Tennis Athlete. Curr Rev Musculoskelet Med. 2020;13(6):748-56. PMID: 32827302; https://doi.org/10.1007/s12178-020-09672-6.

25. Zago M, Kawczyński A, Klich S, et al. Fatigue-Induced Scapular Dyskinesis in Healthy Overhead Athletes. Front Bioeng Biotechnol. 2020;8:302. PMID: 32373599; https://doi.org/10.3389/fbioe.2020.00302.

26. Sciascia A, Kibler WB. Current Views of Scapular Dyskinesis and its Possible Clinical Relevance. Int J Sports Phys Ther. 2022;17(2):117-30. PMID: 35136680; https://doi.org/10.26603/001c.31727.

27. Telli H, Sağlam G. Scapular dyskinesis and loss of cervical lordosis in myofascial pain syndrome and its effects on pain and posture disorders. Turk J Phys Med Rehabil. 2022;69(2):188-99. PMID: 37671383; https://doi.org/10.5606/tftrd.2023.10652.

28. Otoshi K, Takegami M, Sekiguchi M, et al. Association between kyphosis and subacromial impingement syndrome: LOHAS study. J Shoulder Elbow Surg. 2014;23(12):e300-7. PMID: 25107600; https://doi.org/10.1016/j.jse.2014.04.010.

29. Sieper J, Braun J, Rudwaleit M, Boonen A, Zink A. Ankylosing spondylitis: an overview. Ann Rheum Dis. 2002;61(Suppl 3):iii8-18. PMID: 12381506; https://doi.org/10.1136/ard.61.suppl_3.iii8.

30. Hoh DJ, Khoueir P, Wang MY. Management of cervical deformity in ankylosing spondylitis. Neurosurg Focus. 2008;24(1):E9. PMID: 18290747; https://doi.org/10.3171/foc/2008/24/1/e9.

31. Viitanen JV, Kokko ML, Lehtinen K, Suni J, Kautiainen H. Correlation between mobility restrictions and radiologic changes in ankylosing spondylitis. Spine. 1995;20(4):492-6. PMID: 7747236; https://doi.org/10.1097/00007632-199502001-00015.

32. Sari IF, Tatli S, Ilhanli I, et al. Spinal Mobility Limitation Can Be the Main Reason of Kinesiophobia in Ankylosing Spondylitis. Cureus. 2023;15(7):e42528. PMID: 37637649; https://doi.org/10.7759/cureus.42528.

33. Kennedy LG, Jenkinson TR, Mallorie PA, et al. Ankylosing spondylitis: the correlation between a new metrology score and radiology. Br J Rheumatol. 1995;34(8):767-70. PMID: 7551663; https://doi.org/10.1093/rheumatology/34.8.767.

34. Berdal G, Halvorsen S, van der Heijde D, Mowe M, Dagfinrud H. Restrictive pulmonary function is more prevalent in patients with ankylosing spondylitis than in matched population controls and is associated with impaired spinal mobility: a comparative study. Arthritis Res Ther. 2012;14(1):R19. PMID: 22277377; https://doi.org/10.1186/ar3699.

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Effects of depression on patients suffering from ankylosing spondylitis: a comparative study

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ABSTRACT

BACKGROUND: Ankylosing spondylitis (AS) is a sustained inflammatory pathology that manifests as increasing rigidity and a continuous decline in spinal flexibility, leading to increasing lumbar pain during rest.
OBJECTIVES: This study primarily aimed to evaluate depression assessments using the Beck Depression Inventory (BDI) and delineate depressive symptomatology in patients diagnosed with AS compared to those without this condition.
DESIGN AND SETTING: A comparative study was conducted in Medical Centers in Málaga, Spain.
METHODS: A cohort of 102 participants, with a mean age of 46,80 ± 10,54 years, was divided into two sets: 51 individuals diagnosed with AS (cases) and another 51 without AS (controls), each harmonized across variables such as body mass index, age, and sex. Demographic variables were systematically gathered from each participant, and the BDI responses were accurately recorded and subsequently analyzed for comparison.
RESULTS: Of the total sample, the sex distribution was 29.4% male and 70.6% female. BDI scores were higher for the AS group (19.25 ± 15.5) than for the control group (5.33 ± 7). Notably, there were clear statistical differences (P < 0.01) in the BDI categories, with elevated levels observed in participants with AS.
CONCLUSIONS: Individuals with AS experienced higher levels of depression than those without AS. Furthermore, there were sex differences within the case group, with a higher percentage of women than men at any level of depression. Notably, there was a moderate inverse correlation between the number of years since diagnosis and depression level.

INTRODUCTION

Ankylosing spondylitis (AS) is a persistent inflammatory disorder predominantly affecting the axial skeleton, marked by symptoms such as inflammatory back pain, rigidity, and gradual reduction in spinal flexibility.[1,2] The prevalence of AS in Spain is estimated to be 0.26%, similar to that found in other European Union countries, although, globally, there is considerable variation between countries.[3]

AS more commonly affects men than women, with a ratio of approximately 2-3:1 in radiographic AS.[4] The epidemiology of AS varies by geographic region, with a prevalence ranging from 0.1% to 1.4% in Europe, and is higher in populations with a high prevalence of HLA-B27, such as in Northern Europe and certain ethnic groups.[1] In addition, it has been observed that women with AS receive more diagnostic codes than men, including a higher coding of peripheral symptoms and a higher prevalence of diagnostic codes for depression.[5]

Depression in AS has been studied in various ways, as a symptom of the disease[6,7] or as a cause of it.[8] Considering that AS affects the axial skeleton, causing pain in the spine and leading to lumbar pain, mobility restriction, and even sleep problems,[9,10] depression is acknowledged as a significant comorbid factor in patients with AS, exerting a detrimental influence on both the quality of life and clinical trajectory of the disease.[11]

Subjects with AS demonstrate a significantly higher prevalence of depression compared to the healthy population, which substantially degrades their quality of life and aggravates the severity of their clinical outcomes.[12] Moreover, significant sleep disruptions are frequently identified in patients with AS, potentially correlated with pain and additional symptomatic expressions of the disease.[13] The incidence of depression diagnosed in those with AS is approximately 80% greater in females and 50% greater in males than in the general population.[14] Another study in

Korea revealed that post-diagnosis depression risk among individuals with AS was 2.21 times higher than in a control group, with a higher risk in female patients, older patients, those with low socioeconomic status, and those with chronic comorbidities.[15]

Currently, there is a lack of research in Spain that analyzes depression severity considering its multifaceted nature, including affective, behavioral, and cognitive dimensions, as well as anxiety, in patients with AS.

Fatigue, a common multidimensional symptom in AS, is significantly associated with disease activity and depression, highlighting the need to address psychogenic elements, particularly depression, in the treatment of AS.[16] Additionally, considerable sleep alteration has been reported in these patients, which could be strongly linked to pain and other symptoms of the disease.[13] Consequently, the review of the presented literature has identified the lack of existing data on the comprehensive assessment of depression between AS-diagnosed and non-diagnosed respondents in comparative studies in the Spanish context. Therefore, this study aims to contribute to the improvement of AS-affected individuals' health and quality of life by comparing depression risk between patients with AS and healthy controls and establishing a case-control study design.

It is hypothesized that patients diagnosed with AS will exhibit significantly higher levels of depression, as measured by the Beck Depression Inventory (BDI), than a control group without AS and that this depression will have a detrimental impact on their overall quality of life.

OBJECTIVES

The principal aim of this study was to evaluate depression assessments using the BDI to delineate depressive symptomatology in patients diagnosed with ankylosing spondylitis (AS) compared to those without this condition.

METHODS

Sample Design

A sample of 102 individuals was selected using a voluntary, systematic, and non-random sampling approach. This methodology was selected because of the voluntary nature of participant recruitment. This approach ensured the inclusion of patients with AS.

The study cohort was divided into two groups: 51 patients with AS diagnosed via X-ray confirmation by a rheumatologist and 51 control participants without AS. Recruitment was conducted between December 2022 and June 2023. Patients with AS were recruited through patient organizations in Sevilla and Córdoba, Spain, while control participants were sourced from the podiatry departments of the Policlínica Lacibis and Alhaurín Torre Salud medical centers.

The inclusion criteria required participants to be legal adults, capable of providing informed consent, and clearly distinguished as AS or non-AS. Control participants were matched to the AS group based on age and sex. Those who failed to meet these criteria and were unable to independently undertake activities of daily living or something similar were excluded.[17] Specifically, three control participants were excluded for not meeting the matching criteria, one individual was excluded for failing to indicate their sex, and two were excluded due to significant age differences compared to the AS group. This study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).[18]

Sample Size Calculation

To determine the appropriate sample size for this case-control study, Epidat software 4.2 was employed. This tool was developed by the Consellería de Sanidade of Xunta de Galicia, Spain, in collaboration with the Pan-American Health Organization (PAHO-WHO) and Universidad CES of Colombia. The sample size was estimated based on an assumed confidence level of 75%, statistical power of 0.80, odds ratio of 2.0, and anticipated exposure proportions of 50% in the cases and 33.333% in the controls. Consequently, the study had a sample size of 102 participants, with an equal distribution of 51 individuals in each group.

Procedure

In research on the relationship between AS and depression, data collection included sociodemographic variables such as sex, age, height, weight, body mass index (BMI), comorbidities, employment status, educational level, and marital status.

The study participants, diagnosed with AS, completed the BDI, a validated questionnaire[19,20] and translated into Spanish; the BDI is recognized for its effectiveness in assessing depression symptoms.[21,22] This instrument consists of 21 items, each with a score of 0 to 3 points, with a total possible score of 63 points. Outcomes are classified into multiple ranges: absence of depression (0-9 points), mild depression (10-15 points), moderate (16-23 points), and severe (24-63 points).

The BDI is notable for its high reliability, demonstrated by a Cronbach's alpha coefficient of 0.85 to 0.889, and is suitable for both psychiatric and non-psychiatric patients, distinguishing between subtypes of depression and depression from anxiety.[21] This interculturally applied questionnaire evaluates a wide range of symptoms, including mood disorders, loss of hope, feelings of guilt, and fatigue, among others. The BDI score is a valuable indicator of the need for professional intervention, especially for scores above 17.[19-24]

This study offers a comprehensive view of the mental state of patients with AS and contributes to our understanding of the interactions between this chronic disease and mental health.

Ethical Considerations

This study was approved by the Ethics Committee for Experimental Research at the University of Málaga, Spain, and was assigned identification number 122-2022-H on February 2, 2023. All the methods and procedures were conducted in strict accordance with the ethical guidelines of the Declaration of Helsinki.[25]

Statistical Analysis

Sociodemographic data were analyzed, including variables such as sex, age, height, weight, and BMI, along with other independent variables. These are expressed as the mean and standard deviation (SD), and the maximum and minimum values are provided. To assess the normality of the data, we employed the Kolmogorov-Smirnov test, considering data distributions as normal if P-values exceeded 0.05. The results indicated non-normal distributions for the study variables, as demonstrated by P values less than 0.05, prompting us to apply the Mann-Whitney U test to detect statistically significant differences between groups.

Frequencies and percentages were calculated for categorical data. We used the chi-square test to compare the differences between the two groups in the BDI category. The relationship between the number of years since diagnosis and the degree of depression was evaluated using Spearman's correlation.

All statistical evaluations were performed using SPSS software version 27.0.1.0 (IBM-Corporation, Armonk, NY, United States).

RESULTS

Description and Comparison Data

The data revealed a non-normal distribution (P < 0.05) for all analyzed variables (age, weight, height, BMI, and BDI scores). The study was conducted with a sample of 102 subjects divided into two groups of 51 each: a case group (AS) and a control group. Participants from both cohorts were matched based on sex, age, and BMI. As shown in **Table 1**, no statistically significant differences were observed (P > 0.05), except at the time of diagnosis because the control group did not have AS. All participants exhibited the characteristics outlined in **Table 1**. The mean duration since the diagnosis of AS was considerably high (11.46 years), although the data demonstrated notable variation as shown by the SD (± 11.51 years) with a range of 0.3 to 50 years.

Comorbidities were assessed among the participants. Various comorbidities were identified, including hypertension, diabetes, multiple sclerosis, heart disease, fibromyalgia, and vascular insufficiency, each represented by an individual case within the sample. This corresponds to 1% of the participants in each condition. Because of the diversity and low frequency of these specific comorbidities, they were not incorporated in detail in the main analysis.

Furthermore, a higher proportion of the total sample (16.66%) was obese. Specifically, in the case group, a higher prevalence of obesity was noted (15.68%) than in the control group (11.76%). The data on obesity in patients with AS were similar to those of other studies that have specifically investigated obesity.[26]

Table 2 shows the results of the educational level analysis. A varied distribution of educational levels was observed in both the entire sample and in the specific case and control groups. The most represented category in the total sample was the third level of study, accounting for 36.27% of the participants, followed by individuals with higher education (24.51%). When analyzing the groups separately, 39.22% of participants in the AS group and 33.33% in the healthy group were categorized as third-level studies. Furthermore, in both the case and control groups, individuals with higher education represented approximately a quarter of each group, with 23.53% and 25.49%, respectively. The primary and secondary levels were similar in

Table 1. Descriptive and comparative data (Spain, 2023)

Descriptive data		Total (n = 102)	AS (n = 51)	Control (n = 51)	P value*
		Mean (SD)	Mean (SD)	Mean (SD)	
Age (years)		46.80 ± 10.54 (24-70)	46.45 ± 11.38 (24-70)	45.88 ± 9.73 (28-68)	0.683[†]
Weight (kg)		70.70 ± 15.09 (44-115)	71.61 ± 17.01 (44-115)	69.79 ± 13 (52-102)	0.886[†]
Height (m)		1.67 ± 0.08 (1.5-1.88)	1.67 ± 0.08 (1.5-1.86)	1.67 ± 0.09 (1.52-1.88)	0.644[†]
BMI (kg/m²)		25.37 ± 5.05 (17.04-44.44)	25.67 ± 5.74 (17.04-44.44)	25.08 ± 4.28 (19.33-39.84)	0.776[†]
Sex (%)	Male (%)	30 (29.4%)	15 (29.4%)	15 (29.4%)	1[‡]
	Female (%)	72 (70.6%)	36 (70.6%)	36 (70.6%)	
Time since AS diagnosis (years)		N/A	11.43 ± 11.51 (0.3-50)	N/A	< 0.01[†]

BMI = body mass index; SD = standard deviation; AS = ankylosing spondylitis.

*In all analyses, P < 0.05 (95% confidence interval) was considered statistically significant.

†The Mann-Whitney U test was applied.

‡ Frequencies (percentages) and the chi-square (X²) test were employed.

both groups. It is noteworthy that the chi-square test demonstrated a lack of statistically significant discrepancies in the distribution patterns of educational attainment levels when comparing the case and control cohorts.

Outcome Measurements

Table 3 presents the statistically significant differences in the BDI scores between the two groups. Subjects with AS exhibited higher scores (BDI = 19.25 ± 15.50), in contrast to the lower scores of the control group (BDI = 5.33 ± 7). Statistically significant differences were observed in the BDI categories between the AS and control groups, as indicated in the same table. Notably, severe depression was exclusively observed in the AS cohort.

Table 4 displays the correlation between the duration since AS diagnosis and BDI scores. Since the BDI Score data did not show a normal distribution and the relationship between the two variables may not be linear, the correlation was assessed using the Spearman coefficient (-0.331). This moderate negative correlation indicated an inverse relationship between the two variables.

DISCUSSION

The main objective of this study was to compare BDI scores to categorize depression severity in subjects diagnosed with AS and an unaffected group in Spain.

This case-control study was conducted to examine the impact of depression in individuals with AS and healthy individuals. After reviewing the scientific literature, we found insufficient studies measuring the influence of anxiety and depression on these patients in Spain.

The results indicate that the majority of subjects with AS in this study experienced depression (82.35%) at one of its three levels, compared to the control group (17.65%), data that are in line with levels similar to other studies conducted with the BDI,[27,28] and higher than studies that used other tools to assess depression.[29,30]

A recent study aimed to evaluate depression in patients with AS with a gender focus, determining that, in relation to depression, there were factors that affected depression differently; for example, pain was a greater determinant in women than in men.[31] In our study, approximately 46.67% of men and 97.22% of women with AS showed some degree of depression, values very similar to those

Table 4. Correlation between time since diagnosis and degree of depression

	Time since AS diagnosis (years)	P value
BDI* Scores	-0.331†	**0.018**

*BDI = Beck Depression Inventory; AS = ankylosing spondylitis.
†Spearman's rho. In all analyses, P < 0.05 (within a 95% confidence interval) was regarded as statistically significant (in bold).

Table 2. Descriptive and comparative of education levels (Spain, 2023)

Education Level	Total (n = 102)	AS (n = 51)	Control (n = 51)	P value*
Incomplete Primary Level	37 (36.3%)	20 (39.2%)	17 (33.3)	‡0.983407
Primary Level	19 (18.6%)	9 (17.6%)	10 (19.6%)	‡0.983407
Secondary Level (High School)	19 (18.6%)	9 (17.6%)	10 (19.6%)	‡0.983407
Third level (3-years university studies)	37 (36.3%)	20 (39.2%)	17 (33.3)	‡0.983407
Higher Studies (university studies of 5 years or more)	25 (24.5%)	12 (23.5%)	13 (25.5%)	‡0.983407

‡ Chi-square (X²) test was utilized. AS = ankylosing spondylitis.

Table 3. Relationship between Beck Depression Inventory scores and categories among patients with ankylosing spondylitis and the control group

Outcome Measurements		Total group Mean ± SD (range) n = 102	AS group Mean ± SD (range) n = 51	Control group Mean ± SD (range) n = 51	P value (Cases vs. Controls)
BDI category*	No Depression	51 (50%)	9 (17.65%)	42 (82.35%)	**0.002‡** **0.67**
	Mild	18 (17.65%)	13 (25.49%)	5 (9.8%)	
	Moderate	16 (15.69%)	12 (23.53)	4 (7.84%)	
	Severe	17 (16.67%)	17 (33.33%)	0 (0%)	
BDI scores		12.29 ± 14.75 (0-40)	19.25 ± 15.50 (0-40)	5.33 ± 7 (0-18)	**< 0.001†**

*BDI = Beck Depression Inventory; SD = standard deviation; AS = ankylosing spondylitis. Frequency, percentage (%), and the chi-squared test (‡) were employed. The BDI domains are categorized as follows:
(1) 0-9 points indicate no depression, (2) 10-15 points indicate mild depression, (3) 16-23 points indicate moderate depression, and (4) 24-63 points indicate severe depression. † BDI scores, median, interquartile range, range (min–max) and Mann–Whitney U test applied. For all analyses, P < 0.05 (within a 95% confidence interval) was considered statistically significant (in bold).

obtained by Meesters et al., although it was concluded that the rate of depression was higher in women in the general population.[14]

Depression has also been analyzed in patients with AS, considering their level of education or occupational status, with varying results. In the study conducted by Karetekin et al., these two parameters were not considered statistically significant.[7] However, Kilic et al. considered the educational level to be a determining factor associated with depression, noting that lower levels had a higher probability of depression.[32] In the analysis of the relationship between the level of education and the prevalence of different degrees of depression in the case group of our study, no clear trend is identified, suggesting that a higher educational level leads to a lower probability of suffering from depression. For instance, participants with incomplete primary education showed a 100% prevalence of mild depression, whereas those with higher education exhibited a 41.67% prevalence of severe depression, which was considerably higher than those with other educational levels. Moreover, in the tertiary education category, the percentage of depression was more evenly distributed across different degrees and did not show a significant decrease in severe depression with increasing educational level. These findings suggest that the relationship between educational level and depression might be influenced by multiple factors and that education alone is not a clear predictor of the risk of depression in individuals with AS.

Because AS is a chronic disease,[1] the evolution of depression over the years was analyzed in this study, obtaining results that suggest that, on average, the longer the duration of the disease, the lower the level of depression (**Table 3**). These results are similar to those obtained in a previous study that evaluated depression levels over 15 years and found that depression decreased over time in patients with AS.[7]

In our study, the range of depression was assessed using the BDI questionnaire. This document was validated in Spanish by other authors,[21,22] and utilized to assess depression in patients with AS.[12,33,34] Previous research on depression in chronic diseases has supported the use of the BDI as an effective self-assessment tool for the detection and monitoring of depression in patients with multiple sclerosis[35] or Parkinson's disease,[36] the latter demonstrating that patients with Parkinson's disease matched healthy subjects and found that depression constitutes a significant risk for increased symptoms and adverse effects on their health. It has also been used in musculoskeletal pathologies such as subacute back pain,[37] which is a frequent symptom in patients with AS.[1,2] Our study is in line with previous research that examined special population groups related to depressive symptoms in chronic illnesses.[38,39] Populations such as those with rheumatic diseases and chronic pain syndromes exhibit a high prevalence of depressive symptoms,[39] emphasizing the need to assess and address depression in chronic inflammatory conditions such as AS.[11]

This study had several limitations. First, it was not a randomized controlled trial. Future studies could have a more diverse sample size, including subjects from other regions or countries, to improve the robustness of the study, as differences have been evidenced according to origin.[30] Additionally, in relation to depression, it would have been interesting to consider more factors to assess depression, such as the disease activity index (BASDAI) or sports practice; the latter has shown a decrease in depression levels in patients with AS.[34,40]

Considering the findings of this study, it would be valuable to develop new avenues of interventional research to address depression as an additional AS symptom. Among these, Mindfulness-Based Stress Reduction therapies are promising alternatives. These therapies have already shown significant improvements in anxiety and depression levels in individuals with chronic diseases, particularly during the COVID-19 pandemic.[41] Integrating such interventions into the treatment of AS could positively impact patients' quality of life and should be explored in future studies.

CONCLUSIONS

Higher scores and ranges of depression were observed in subjects with AS matched with healthy subjects; therefore, we can affirm that they have a higher risk of depression and should be monitored. The degree of depression in subjects with AS decreases with time.

REFERENCES

1. Braun J, Sieper J. Ankylosing spondylitis. Lancet. 2007;369(9570):1379-90. PMID: 17448825; https://doi.org/10.1016/s0140-6736(07)60635-7.

2. Khanna I, Tassiulas I. Ankylosing Spondylitis. In Ali Y. (eds). Rheumatology for Primary Care Providers: A Clinical Casebook. Cham: Springer; 2022. https://doi.org/10.1007/978-3-030-80699-6_15.

3. Quilis N, Sivera F, Seoane-Mato D, et al. Prevalence of ankylosing spondylitis in Spain: EPISER2016 Study. Scand J Rheumatol. 2020;49(3):210-3. PMID: 31682163; https://doi.org/10.1080/03009742.2019.1669704.

4. Sieper J, Poddubnyy D. Axial spondyloarthritis. Lancet. 2017;390(10089):73-84. PMID: 28110981; https://doi.org/10.1016/s0140-6736(16)31591-4.

5. Hwang MC, Rozycki M, Kauffman D, et al. Does Gender Impact a Diagnosis of Ankylosing Spondylitis? ACR Open Rheumatol. 2022;4(6):540-546. PMID: 35352497; https://doi.org/10.1002/acr2.11428.

6. Xu X, Shen B, Zhang A, et al. Anxiety and depression correlate with disease and quality-of-life parameters in Chinese patients with ankylosing spondylitis. Patient Prefer Adherence. 2016;10:879-85. PMID: 27284241; https://doi.org/10.2147/ppa.s86612.

7. Karatekin BD, Icagasioglu A, Oguz FM, Bayindir SN, Pasin O. Trajectory of anxiety, depression and quality of life in ankylosing spondylitis: a

descriptive study. J Coll Physicians Surg Pak. 2023;33(3):314-8. PMID: 36945163; https://doi.org/10.29271/jcpsp.2023.03.314.

8. Zhang N, Song C, Ji C, et al. Causality between depression and ankylosing spondylitis in a European population: Results from a Mendelian randomization analysis. Medicine. 2023;102(38):e35127. PMID: 37746958; https://doi.org/10.1097/md.0000000000035127.

9. Dagfinrud H, Kjeken I, Mowinckel P, Hagen KB, Kvien TK. Impact of functional impairment in ankylosing spondylitis: impairment, activity limitation, and participation restrictions. J Rheumatol. 2005;32(3):516-23. PMID: 15742446.

10. Jamieson AH, Alford CA, Bird HA, Hindmarch I, Wright V. The effect of sleep and nocturnal movement on stiffness, pain, and psychomotor performance in ankylosing spondylitis. Clin Exp Rheumatol. 1995;13(1):73-8. PMID: 7774107.

11. Park JY, Howren AM, Zusman EZ, Esdaile JM, De Vera MA. The incidence of depression and anxiety in patients with ankylosing spondylitis: a systematic review and meta-analysis. BMC Rheumatol. 2020;4(1):12. PMID: 32159073; https://doi.org/10.1186/s41927-019-0111-6.

12. Öksüz E, Cinar FI, Cinar M, Tekgoz E, Yilmaz S. Assessment of the effects of loneliness, perceived social support, and depression on medication adherence in patients with ankylosing spondylitis. Perspect Psychiatr Care. 2021;57(2):517-23. PMID: 32614084; https://doi.org/10.1111/ppc.12570.

13. Li Y, Zhang S, Zhu J, Du X, Huang F. Sleep disturbances are associated with increased pain, disease activity, depression, and anxiety in ankylosing spondylitis: a case-control study. Arthritis Res Ther. 2012;14(5):R215. PMID: 23058191; https://doi.org/10.1186/ar4054.

14. Meesters JJL, Bremander A, Bergman S, et al. The risk for depression in patients with ankylosing spondylitis: a population-based cohort study. Arthritis Res Ther. 2014;16(5):418. PMID: 25209603; https://doi.org/10.1186/s13075-014-0418-z.

15. Park JS, Jang HD, Hong JY, et al. Impact of ankylosing spondylitis on depression: a nationwide cohort study. Sci Rep. 2019;9(1):6736. PMID: 31043656; https://doi.org/10.1038/s41598-019-43155-0.

16. Günaydin R, Göksel Karatepe A, Ceşmeli N, Kaya T. Fatigue in patients with ankylosing spondylitis: relationships with disease-specific variables, depression, and sleep disturbance. Clin Rheumatol. 2009;28(9):1045-51. PMID: 19504231; https://doi.org/10.1007/s10067-009-1204-1.

17. Cortes-Rodríguez A, Alves-Gomes L, Losa-Iglesias ME, et al. Impact of ankylosing spondylitis on foot health and quality of life: an observational case–control study. Front Med. 2024;11:1355803. PMID: 38737760; https://doi.org/10.3389/fmed.2024.1355803.

18. White RG, Hakim AJ, Salganik MJ, et al. Strengthening the Reporting of Observational Studies in Epidemiology for respondent-driven sampling studies: "STROBE-RDS" statement. J Clin Epidemiol. 2015;68(12):1463-71. PMID: 26112433; https://doi.org/10.1016/j.jclinepi.2015.04.002.

19. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. Arch Gen Psychiatry. 1961;4(6):561-71. PMID: 13688369; https://doi.org/10.1001/archpsyc.1961.01710120031004.

20. Richter P, Werner J, Heerlein A, Kraus A, Sauer H. On the validity of the Beck Depression Inventory. A review. Psychopathology. 1998;31(3):160-8. PMID: 9636945; https://doi.org/10.1159/000066239.

21. Vázquez C, Sanz J. Fiabilidad y valores normativos de la versión española del inventario para la depresión de Beck de 1978. Clinical and Health. 1997;8(3):403-22. Available from: https://journals.copmadrid.org/clysa/art/38af86134b65d0f10fe33d30dd76442e. Accessed in 2025 (Jan. 21).

22. Wiebe JS, Penley JA. A psychometric comparison of the Beck Depression Inventory-II in English and Spanish. Psychol Assess. 2005;17(4):481-5. PMID: 16393015; https://doi.org/10.1037/1040-3590.17.4.481.

23. Penley JA, Wiebe JS, Nwosu A. Psychometric Properties of the Spanish Beck Depression Inventory-II in a Medical Sample. Psychol Assess. 2003;15(4):569-77. PMID: 14692850; https://doi.org/10.1037/1040-3590.15.4.569.

24. Toledano-Toledano F, Contreras-Valdez JA. Validity and reliability of the Beck Depression Inventory II (BDI-II) in family caregivers of children with chronic diseases. PLoS One. 2018;13(11):e0206917. PMID: 30485299; https://doi.org/10.1371/journal.pone.0206917.

25. Manzini JL. Declaración de Helsinki: principios éticos para la investigación médica sobre sujetos humanos. Acta Bioeth. 2000;6(2):321-34. http://dx.doi.org/10.4067/S1726-569X2000000200010.

26. Hu L, Ji X, Wang Y, et al. Underweight and obesity are strong predictors of clinical outcomes in patients with ankylosing spondylitis: data from the smart-phone spondylarthritis management system. Ther Adv Musculoskelet Dis. 2021;13:1759720X211030792. PMID: 34345253; https://doi.org/10.1177/1759720x211030792.

27. Yüce E, Şentürk E, Sağaltıcı E, Şentürk İA, Aytekin E. Sleep quality and depression in patients with ankylosing spondylitis and their associations with clinical parameters: a cross-sectional, case-control study. Agri. 2023;35(1):1-9. PMID: 36625190; https://doi.org/10.14744/agri.2021.46514.

28. Yurdakul FG, Çimen YG, Ulucaköy RK, et al. Impulsivity and ankylosing spondylitis: Is there a relationship? Turk J Phys Med Rehabil. 2018;65(1):51-8. PMID: 31485579; https://doi.org/10.5606/tftrd.2019.2580.

29. Webers C, Vanhoof L, Leue C, Boonen A, Köhler S. Depression in ankylosing spondylitis and the role of disease-related and contextual factors: a cross-sectional study. Arthritis Res Ther. 2019;21(1):215. PMID: 31639012; https://doi.org/10.1186/s13075-019-1995-7.

30. Zhang L, Wu Y, Liu S, Zhu W. Prevalence of depression in ankylosing spondylitis: a systematic review and meta-analysis. Psychiatry Investig. 2019;16(8):565-74. PMID: 31446684; https://doi.org/10.30773/pi.2019.06.05.

31. Nam B, Koo BS, Nam SW, et al. Gender differences in factors associated with low quality of life and depression in Korean patients with ankylosing spondylitis. Qual Life Res. 2021;30(8):2299-310. PMID: 33689133; https://doi.org/10.1007/s11136-021-02800-w.

32. Kilic G, Kilic E, Ozgocmen S. Relationship between psychiatric status, self-reported outcome measures, and clinical parameters in axial spondyloarthritis. Medicine. 2014;93(29):e337. PMID: 25546683; https://doi.org/10.1097/md.0000000000000337.

33. Oskay D, Tuna Z, Düzgün İ, et al. Relationship between kinesiophobia and pain, quality of life, functional status, disease activity, mobility, and depression in patients with ankylosing spondylitis. Turk J Med Sci. 2017;47(5):1340-7. PMID: 29151302; https://doi.org/10.3906/sag-1702-93.

34. Durmus D, Alayli G, Cil E, Canturk F. Effects of a home-based exercise program on quality of life, fatigue, and depression in patients with ankylosing spondylitis. Rheumatol Int. 2009;29(6):673-7. PMID: 18985351; https://doi.org/10.1007/s00296-008-0756-8.

35. Ruiz-Sánchez FJ, do Rosário Martins M, Soares S, et al. Impact of multiple sclerosis and its association with depression: an analytical case-control investigation. Healthcare. 2022;10(11):2218. PMID: 36360559; https://doi.org/10.3390/healthcare10112218.

36. Jiménez-Cebrián AM, Becerro-De-Bengoa-Vallejo R, Losa-Iglesias ME, et al. The impact of depression symptoms in patients with Parkinson's disease: a novel case-control investigation. Int J Environ Res Public Health. 2021;18(5):2369. PMID: 33804349; https://doi.org/10.3390/ijerph18052369.

37. López-López D, Vilar-Fernández JM, Calvo-Lobo C, et al. Evaluation of depression in subacute low back pain: a case control study. Pain Physician. 2017;20(4):e499-505. PMID: 28535558.

38. Moussavi S, Chatterji S, Verdes E, et al. Depression, chronic diseases, and decrements in health: results from the World Health Surveys. Lancet. 2007;370(9590):851-8. PMID: 17826170; https://doi.org/10.1016/s0140-6736(07)61415-9.

39. Matcham F, Rayner L, Steer S, Hotopf M. The prevalence of depression in rheumatoid arthritis: a systematic review and meta-analysis. Rheumatology. 2013;52(12):2136-48. PMID: 24003249; https://doi.org/10.1093/rheumatology/ket169.

40. Lim HJ, Moon YI, Lee MS. Effects of home-based daily exercise therapy on joint mobility, daily activity, pain, and depression in patients with ankylosing spondylitis. Rheumatol Int. 2005;25(3):225-9. PMID: 15650833; https://doi.org/10.1007/s00296-004-0536-z.

41. Osama H, Rabea HM, Abdelrahman MA. The impact of mindfulness-based stress reduction on psychological health among patients with chronic diseases during COVID-19 outbreak lockdown. Beni Suef Univ J Basic Appl Sci. 2023;12(1):50. PMID: 37251428; https://doi.org/10.1186/s43088-023-00389-2.

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The burden of healthcare-associated infections in Brazil: multi-hospital point prevalence using a matched case-control study

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ABSTRACT

BACKGROUND: Healthcare-associated infections (HAIs) have a significant impact on patient care worldwide and have serious implications for the Brazilian healthcare system.

OBJECTIVES: This study aimed to describe the trends in HAIs in adult intensive care units (ICUs) using data from a national point-prevalence survey.

DESIGN AND SETTING: A point-prevalence study was conducted in 2019 across adult intensive ICUs in large acute care hospitals in Brazil.

METHODS: A matched case-control study was performed to assess the risk factors associated with the development of infection.

RESULTS: A total of 386 patients from 15 hospitals were studied, of whom 102 (26.4%; 102/386) were infected, and 76.5% had at least one ICU-acquired infection. In clinical-surgical ICUs (CSU), the prevalence of infections acquired in the unit was 77.9%, whereas in Coronary ICUs (COU), it was 68.7%. There was a predominance of pneumonia (51.0%), mainly caused by Gram-negative non-fermenters, and bloodstream infections (34.4%), predominantly caused by coagulase-negative *Staphylococcus* (CoNS). In the risk factor analysis, cancer and general antimicrobial use were independently associated.

CONCLUSION: This study found a high burden of HAIs in adult ICUs in Brazil, mainly associated with the high use of antibiotics for infections and a worse prognosis.

INTRODUCTION

Healthcare-associated infections (HAIs) and antimicrobial resistance are growing global public health concerns, with particular significance in intensive care units (ICUs).[1] In Brazilian ICUs, estimates of HAI prevalence in tertiary hospitals range from 44.3% to 79.4%.[2-4]

Comprehensive data on infection types, pathogenic microorganisms, risk factors, and antimicrobial use across Brazil are essential for developing policies that prioritize the prevention and treatment of HAIs. Such data can help optimize patient care and efficiently allocate financial resources.[5,6] In 2016, a multicenter study was conducted in Brazil to determine the one-day point prevalence of infections in 28 ICUs in the state of Minas Gerais. The study included 303 patients, of whom 155 (51.2%) were found to be infected, and 123 (79.4%) had at least one infection acquired in the ICU.[4]

The current study was conducted in 2019 using a design similar to that previously described but including additional Brazilian states. We hypothesized that the prevalence of HAIs and associated microorganisms would vary significantly among geographical regions. To gain a broad understanding of the magnitude of HAIs in ICUs and the associated burden of disease in Brazil, we estimated the prevalence of HAIs using data from multicenter studies.

OBJECTIVE

This article aimed to describe trends in HAIs in adult intensive care units (ICUs) using data from a national point-prevalence survey.

METHODS

Survey design and participating hospitals

This matched case-control study was conducted in 17 clinical-surgical ICUs (CSUs) and five coronary ICUs (COUs) across the five main geographic regions of Brazil (North, Northeast, Midwest, Southeast, and South) in 2019. Fifteen hospitals, comprising both public and private institutions, participated in the study with the consent of their administrations. This study included 386 patients hospitalized in the ICUs on the corresponding day. The prevalence of HAIs and episodes of infection were determined for each region, along with the overall frequency of microorganisms diagnosed in each type of ICU. For the microorganisms evaluated in this study, data were provided by the respective hospitals at the time of microbiological diagnosis. This case-control study was based on a one-day point prevalence survey to determine the demographic characteristics and risk factors between groups. The analyzed variables included age, length of hospital stay, underlying diseases, hospital risk factors, and antimicrobial therapy. This study was approved on August 25, 2018, by the Research Ethics Committee of the Federal University of Uberlandia under the protocol number CAAE: 88387817.0.0000.5152.

The co-participating centers were randomly selected. A survey of hospitals with ICU beds was conducted in the main cities of each region, and the managers of these institutions were contacted to complete the project. The executing team applied the same methodology to all centers for data collection and surveys in the visited ICUs.

Definitions

HAIs were defined according to the guidelines of the Agência Nacional de Vigilância Sanitária (ANVISA, Brazil),[7] which were largely based on definitions from the National Healthcare Safety Network (NHSN).[8] However, ANVISA's guidelines expand the definition of bloodstream infections (BSIs) to include patients with clinically defined sepsis without laboratory confirmation. Treatment administered during the period between the suspicion of infection and obtaining susceptibility results was defined as empirical.[9]

Selection of cases

Cases were defined as patients who had a confirmed HAI acquired in the ICU up to the corresponding day in each hospital, as defined by physicians according to the Diagnostic Criteria for Infection Related to Health Care established in each institution, according to ANVISA. At least one case was selected from each ICU included in the prevalence survey. Patient pairing was performed in a 1:1 ratio for patients who met the established criteria.

Selection of controls

Controls were patients without HAI who met the following predetermined criteria: they needed to be hospitalized in the same unit as the patient and should not have acquired an infection until the corresponding day. Controls were matched according to sex, age, reason for hospitalization (clinical, surgical, or traumatic), and the total length of hospital stay before infection (risk time).

To eliminate time bias, the total hospitalization time for controls until the corresponding day should be greater than or equal to the interval between the admission and infection dates of the cases.[10] In addition, controls had to be in the same age group as the case patients, with a maximum age difference of ± 10 years.

Statistical analysis

Comparisons between groups were made using Student's t-test for variables with a normal distribution (evaluated using the D'Agostino and Lilliefors tests) and the Mann-Whitney U test for variables with a non-normal distribution. Chi-squared and Fisher's exact tests were used to assess the relationships between categorical variables. Multiple regression models were used for multivariate analysis. A significance level of 5% ($P < 0.05$) was considered significant. All analyses were performed using BioEstat 5.0 software (Instituto de Desenvolvimento Sustentável Mamirauá, Tefé, AM, Brazil).

RESULTS

This study included 15 hospitals located in the five regions of Brazil. The institutions had 4,204 beds, of which 337 (8.0%) were CSUs and 99 (2.3%) were COUs. **Table 1** shows the prevalence of

Table 1. Prevalence of healthcare-associated infections in adult clinical-surgical and coronary intensive care units in different regions in Brazil

Regions	Number of Hospitals	Patients admitted to the ICU*		Patients with HAI§ (%)		Patients with HAI acquired in the ICU (%)	
		CSU¥	COU♦	CSU	COU	CSU	COU
North	3	45	13	16 (35.5)	5 (38.5)	13 (81.2)	4 (80.0)
Northeast	5	99	24	19 (19.2)	3 (12.5)	13 (68.4)	2 (66.7)
Midwest	2	60	0	14 (23.3)	0	13 (92.8)	0
Southwest	4	83	49	33 (39.7)	8 (16.3)	24 (72.7)	5 (62.5)
South	1	13	0	4 (30.8)	0	4 (100.0)	0
Total	15	300	86	86 (28.7)	16 (18.6)	67 (77.9)	11 (68.7)

*ICU = intensive care unit; §HAI = healthcare-associated infection; ¥CSU = clinical-surgical unit; ♦COU = coronary unit.

HAIs in ICUs on the day of the study. Among the CSUs, 86/300 (28.7%) patients had HAIs, and 77.9% of these infections were acquired within the unit. In addition, when the frequency was examined by region, the Southwestern (39.7%) and Northern (35.5%) regions had the highest rates. Regarding the prevalence in the COUs, 16/86 (18.6%) patients had at least one infectious episode, and 68.7% of these infections were acquired in the unit.

Table 2 shows the frequency of infectious episodes identified according to the site of infection in HAIs acquired exclusively in the ICUs. A total of 84 episodes were identified in 67 infected patients in CSUs, with 12 episodes observed in 11 infected patients in COUs. Pneumonia episodes were the most prevalent infections in both units, accounting for 50.0% of CSUs and 58.3% of COUs, followed by BSIs (34.5% and 33.3 %, respectively). The frequency of episodes by region followed the same pattern, except in the southeastern region, where pneumonia and BSIs had the same frequency.

The microorganisms responsible for HAIs are shown in **Table 3**. A total of 45 microorganisms were identified in 96 episodes (46.9%) of HAI acquired in the ICUs. The most common microorganisms were Gram-negative bacilli, accounting for 34.4% (n = 33/96 episodes) of the total documented pathogens. In CSUs, the most common bacteria were *Pseudomonas aeruginosa*, Coagulase-Negative

Table 2. Prevalence of healthcare-associated infection episodes in adult clinical-surgical and coronary intensive care units in different regions of Brazil

Regions	Total number of HAI[*] episodes acquired in the ICU		Pneumonia (%)		Bloodstream infection (%)		Urinary tract infection (%)	
	CSU[§]	COU[¥]	CSU	COU	CSU	COU	CSU	COU
North	17	5	8 (47.0)	4 (80.0)	6 (35.3)	0	2 (11.8)	0
Northeast	17	2	8 (47.0)	0	7 (41.2)	2 (100.0)	2 (11.8)	0
Midwest	14	0	9 (64.3)	0	5 (35.7)	0	0	0
Southwest	26	5	10 (38.5)	3 (60.0)	10 (38.5)	2 (40.0)	4 (15.4)	0
South	10	0	7 (70.0)	0	1 (10.0)	0	1	0
Total	84	12	42 (50.0)	7 (58.3)	29 (34.5)	4 (33.3)	9 (10.7)	0

[*]HAI = healthcare-associated infection; [§]CSU = clinical-surgical unit; [¥]COU = coronary unit; Other infections – CSU = surgical site (2); skin (1).

Table 3. Microorganism frequency by common healthcare-associated infections acquired in adult clinical-surgical and coronary intensive care units in Brazil

	Total HAI[*]	Bloodstream infection	Pneumonia
Clinical-surgical ICU[§]			
Patients with HAI; N	67	29	40
Number of microorganisms identified; n	41	14	21
Microorganisms (N; %)	*Pseudomonas aeruginosa* (7; 18.9%)	CoNS[¥] (6; 42.8%)	*Acinetobacter baumannii* (4; 22.2%)
	CoNS[¥] (7; 18.9%)	*Pseudomonas aeruginosa* (2; 14.3%)	*Pseudomonas aeruginosa* (4; 22.2%)
	Klebsiella pneumoniae (7; 18.9%)	*Klebsiella pneumoniae* (2; 14.3%)	*Klebsiella pneumoniae* (3; 16.7%)
	Acinetobacter baumannii (5; 13.5%)	*Enterobacter cloacae* (1; 7.1%)	*Enterobacter cloacae* (2; 11.1%)
	Other Gram-negative bacilli[♦] (5; 13.5%)	*Klebsiella oxytoca* (1; 7.1%)	*Staphylococcus aureus* (2; 11.1%)
	Enterobacter cloacae (4; 10.8%)	*Pseudomonas stutzeri* (1; 7.1%)	CoNS[¥] (1; 5.5%)
	Escherichia coli (2; 5.4%)	*Escherichia coli* (1; 7.1%)	*Proteus mirabilis* (1; 5.5%)
	Staphylococcus aureus (2; 5.4%)		*Raoultella ornithinolytica* (1; 5.5%)
	Candida albicans (1; 2.7%)		*Citrobacter freundii* complex (1; 5.5%)
	Streptococcus pneumoniae (1; 2.7%)		*Candida tropicalis* (1; 5.5%)
			Streptococcus pneumoniae (1; 5.5%)
Coronary ICU			
Patients with HAI[*]; N	11	6	8
Number of microorganisms identified; n	4	2	2
Microorganisms (frequency)	*Klebsiella pneumoniae* (2; 50.0%)	*Klebsiella pneumoniae* (1; 50.0%)	*Klebsiella pneumoniae* (1; 50.0%)
	Staphylococcus aureus (1; 25.0%)	*Acinetobacter baumannii* (1; 50.0%)	*Staphylococcus aureus* (1; 50.0%)
	Acinetobacter baumannii (1; 25.0%)		

[*]HAI = healthcare-associated infection; [§]ICU = intensive care unit; [¥]CoNS = Coagulase-Negative *Staphylococcus: Staphylococcus epidermidis* (3), *Staphylococcus hominis* (2), *Staphylococcus haemolyticus* (1), *Staphylococcus capitis* (1); [♦]*Pseudomonas stutzeri* (1), *Klebsiella oxytoca* (1)**,** *Proteus mirabilis* (1), *Raoultella ornithinolytica* (1), *Citrobacter freundii* complex (1)**.**

Staphylococcus (CoNS), and *Klebsiella pneumoniae*, all having the same proportions (18.9%), followed by *Acinetobacter baumannii* (13.5%) and *Enterobacter cloacae* (10.8%). The most common agents causing pneumonia in these units were *A. baumannii* (22.2%) and *P. aeruginosa* (22.2%). In BSIs, the most prevalent microorganism was CoNS, accounting for approximately half of all cases. Furthermore, we observed a low frequency (48.8%; data not provided) of infections based on the microbiological diagnostic criteria.

Risk factor analysis was performed using a matched case-control study, and 50 pairs were selected for analysis. The matching criteria were selected to ensure that there were no significant differences between the groups. Success rates ranged from 56.0% to 86.0% (**Table 4**).

In general, the patients were relatively young, with 57.0% younger than 65 years, and the majority (78.3%) used three or more invasive devices. Approximately 59.3% of the patients were treated with broad-spectrum antibiotics, such as β-lactams with inhibitors (24.1%) and carbapenems (19.0%) (data not shown). Among all patients, 59.8% used antimicrobials, whereas only 24% of the control patients received such treatment. **Table 5** compares the cases and controls, revealing significant differences between patients with cancer and those using a central venous catheter, mechanical ventilation, tracheostomy, and enteral nutrition. Patients who used antimicrobials for initial empirical therapy, infection treatment, or prophylaxis exhibited significant differences between the groups, along with variations in the average number of prescribed antimicrobials.

According to the logistic regression model presented in Table 5, cancer was identified as an independent risk factor for HAIs (odds ratio [OR] = 13.9559; 95% confidence interval [CI] = 1.07-182.80; P = 0.0446), whereas prophylactic use of antibiotics was identified as a protective factor in the control group (OR = 0.0296; 95%CI = 0.00-0.38; P = 0.0071).

DISCUSSION

The lack of surveillance data and comprehensive prevalence surveys in low- and middle-income countries is concerning.[11] While several countries are making efforts to quantify the burden and determinants of Healthcare-Associated Infections (HAIs), ensuring data adherence and reliability remains a significant challenge in developing countries.[6,12,13]

In this 24-hour point-prevalence study conducted at 15 participating centers in Brazil, the overall rate of suspected or confirmed HAIs was 26.4% (102/386). This rate exceeded those reported in previous studies conducted in Europe (ranging from 3.0% to 30.7%)[13-16] and the United States (ranging from 4.0% to 11.9%).[17,18] Our results suggest a remarkably high prevalence of HAIs acquired in Brazilian ICUs, regardless of geographic region, consistent with the findings reported by Braga et al.[4] Although most participating centers were located in the Northern and Southeastern regions, the proportion of patients admitted to the ICU with HAI did not significantly differ across geographic regions.

Considering only the public hospitals evaluated in this study, an extremely high rate of HAIs was observed in adult CSUs (82.5%; data not shown). This finding aligns with previous studies reporting elevated rates of HAIs in Brazilian ICUs.[4,19,20] Furthermore, due to the COVID-19 pandemic, recent literature has indicated an increase in infection rates associated with healthcare in countries with limited resources, with a reported prevalence increase of up to 15.0%.[21,22]

Another aspect analyzed in this study was the incidence of infection. Our findings confirm that pneumonia (50.0%) and BSI (34.5%) were the most prevalent infections, which is consistent with similar studies conducted in Brazil.[3,4,20,23] These results reinforce the notion that infections at these anatomical sites are associated with a worse prognosis and higher mortality rates among hospitalized patients in low- and middle-income countries.[24-26] Notably, the etiology of infections, as determined by positive cultures, is an important finding. Our results are consistent with the current literature, with Gram-negative bacilli being the most frequently isolated pathogens in developing countries, including Brazil.[27-29]

A concerning aspect to be emphasized in this regard is that only 48.8% of the infectious episodes had microbiological diagnostic criteria, which may contribute to inappropriately high consumption of antimicrobials, either due to the lack of medication de-escalation or the in vitro resistance of microorganisms to the administered antibiotic.[30] As a result of the absence or delay in microbiological diagnosis, we identified a high rate of initial empirical therapy (54.1%) among the total number of patients using antimicrobials, which are determinant factors for the increase in adverse events in the patient's clinical course.[31,32]

While multivariate analysis indicated that cancer was an independent risk factor for HAIs, traditional factors such as the use of central venous catheters, mechanical ventilation, tracheostomy, enteral nutrition, and general antimicrobial use were found to be more significant in the group of infected patients.

The excessive use of antimicrobials in Brazil is a healthcare issue that affects all critically hospitalized patients. Studies conducted by researchers in Latin America have reported high prevalence

Table 4. Success rate of paired variables for risk factors in patients with healthcare-related infections through a case-control study paired in intensive care units in Brazil

Variables	Total of pairs; n	No. of pairs reached; n	Success achieved (%)	P value
Reason for hospitalization	50	41	82.0	0.3284*
Sex	50	43	86.0	0.6787*
Age	50	29	58.0	0.4969♦
Risk time	50	28	56.0	0.6439§

*Chi-square test; §Student's t-test; ♦Mann-Whitney test.

Table 5. Characteristics and risk factors of matched case-control patients in the point-prevalence study of healthcare-associated infections in adult intensive care units in Brazil

Variables	Total patients	Total matched patients	Matched case	Matched control	Statistical analysis	
	n = 386 (%)	n = 100 (%)	n = 50 (%)	n = 50 (%)	Univariate, P value	Multivariate, P value, OR (95%IC)
Age						
18 - 64 years	210 (54.4)	57 (57.0)	28 (56.0)	29 (58.0)	1.0000	
≥ 65 years	176 (45.6)	43 (43.0)	22 (44.0)	21 (42.0)		
Length of hospital stay, mean days	14.5	19.6	22.9	16.3	0.0929	
Underlying conditions						
Heart disease	106 (27.5)	13 (13.0)	3 (6.0)	10 (20.0)	0.0744	
Systemic arterial hypertension	187 (48.4)	38 (38.0)	21 (42.0)	17 (34.0)	0.5365	
COPD*	40 (10.4)	7 (7.0)	4 (8.0)	3 (6.0)	0.7180	
Diabetes	113 (29.3)	31 (31.0)	15 (30.0)	16 (32.0)	1.0000	
Cancer	50 (12.9)	8 (8.0)	7 (14.0)	1 (2.0)	**0.0326**	**0.0446, 13.9559 (1.07-182.80)**
Stroke	52 (13.5)	16 (16.0)	7 (14.0)	9 (18.0)	0.7850	
Kidney disease	52 (13.5)	13 (13.0)	7 (14.0)	6 (12.0)	1.0000	
Liver disease	10 (2.6)	3 (3.0)	2 (4.0)	1 (2.0)	1.0000	
Polytrauma	46 (11.9)	18 (18.0)	9 (18.0)	9 (18.0)	0.7948	
HIV§	9 (2.3)	4 (4.0)	1 (2.0)	3 (6.0)	0.6173	
Hospital and clinical risk factors						
Surgery	169 (43.8)	42 (42.0)	18 (36.0)	24 (48.0)	0.3110	
Central venous catheter	231 (59.8)	62 (62.0)	34 (68.0)	28 (56.0)	**0.0027**	0.4599, 1.4681 (0.53-4.07)
Peripheral venous catheter	49 (12.7)	7 (7.0)	2 (4.0)	5 (10.0)	0.4360	
Urinary catheter	217 (56.2)	63 (63.0)	36 (72.0)	27 (54.0)	0.0975	
Mechanical ventilation	202 (52.3)	64 (64.0)	39 (78.0)	25 (50.0)	**0.0068**	0.2180, 1.1968 (0.34-4.22)
Tracheostomy	72 (18.6)	27 (27.0)	19 (38.0)	8 (16.0)	**0.0243**	0.7801, 1.1968 (0.34-4.22)
Surgical drain	50 (12.9)	14 (14.0)	5 (10.0)	9 (18.0)	0.3873	
Hemodialysis	34 (8.8)	7 (7.0)	4 (8.0)	3 (6.0)	0.7180	
Enteral nutrition	199 (51.5)	58 (58.0)	35 (70.0)	23 (46.0)	**0.0258**	0.1422, 2.2363 (0.76-6.55)
Parenteral nutrition	8 (2.1)	0	0	0		
Antimicrobial therapy						
Use of antimicrobials	231 (59.8)	62 (62.0)	50 (100.0)	12 (24.0)	**< 0.0001**	N/A
Mean of antimicrobials prescribed	1.0	1.1	1.9	0.5	**< 0.0001**	N/A
Empirical use	125 (32.1)	28 (28.0)	28 (56.0)	0	**< 0.0001**	N/A
Infection treatment	55 (14.2)	21 (21.0)	21 (42.0)	0	**< 0.0001**	N/A
Prophylactic use	51 (13.2)	13 (13.0)	1 (2.0)	12 (24.0)	**0.0029**	**0.0071, 0.0296 (0.00-0.38)**

*COPD = chronic obstructive pulmonary disease; §HIV = human immunodeficiency virus.

rates of antimicrobial use, particularly of broad-spectrum antibiotics, as we have also demonstrated.[33-36] Two primary factors may be associated with this issue: delayed microbiological diagnosis, as previously mentioned, and a lack of diversity in available drugs.[37] Therefore, the indiscriminate use of antimicrobials is becoming increasingly concerning because it applies selective pressure on microorganisms that progressively restricts the existing therapeutic options through acquired resistance mechanisms.[37-39]

Another aspect analyzed, in addition to the previously discussed CSUs, were the findings found in the COUs. Eight ICUs were included, revealing a prevalence of infection of 18.6% (n = 16/86), which is significantly higher than the rates found in developed countries, which typically range from 4.0% to 10.0%.[40-42] Thus,

HAIs are a significant complication of cardiovascular procedures, with high morbidity and mortality in affected patients.[40,43] Similar to data reported in the literature,[40,42,43] pneumonia was the most common infection in these units.

Acknowledging the limitations of this study in terms of design, time, and resource availability, we believe that the results are well represented and emphasize the importance of conducting similar studies to estimate the burden of HAIs in Brazil. This is particularly relevant given the restricted geographic coverage, data availability, and low participation of centers in this type of surveillance. It is worth noting that such studies can aid in planning and strengthening HAI prevention and control strategies, even in resource-limited settings, particularly for public health in Brazil.

CONCLUSION

This multicenter study of the prevalence of HAI revealed alarming rates across different regions of the country. Pneumonia and sepsis associated with Gram-negative bacilli are the most significant infections. This group of microorganisms poses a considerable challenge to public health authorities in terms of their content and control. Our findings suggest that the microbiological diagnosis of HAIs falls short of expectations, likely because of the high rates of antibiotic use and empirical treatments.

REFERENCES

1. Alp E, Damani N. Healthcare-associated infections in intensive care units: Epidemiology and infection control in low-to-middle income countries. J Infect Dev Ctries. 2015;9(10):1040-5. PMID: 26517477; https://doi.org/10.3855/jidc.6832.

2. Salomao R, Rosenthal VD, Grimberg G, et al. Device-associated infection rates in intensive care units of Brazilian hospitals: Findings of the International Nosocomial Infection Control Consortium. Rev Panam Salud Publica. 2008;24(3):195-202. PMID: 19115547; https://doi.org/10.1590/s1020-49892008000900006.

3. Silva E, Dalfior Junior L, Da Silveira Fernandes H, Moreno R, Vincent JL. Prevalence and outcomes of infections in Brazilian ICUs: a subanalysis of EPIC II study. Rev Bras Ter Intensiva. 2012;24(2):143-50. PMID: 23917761; https://doi.org/10.1590/S0103-507X2012000200008.

4. Braga IA, Campos PA, Gontijo-Filho PP, Ribas RM. Multi-hospital point prevalence study of healthcare-associated infections in 28 adult intensive care units in Brazil. J Hosp Infect. 2018;99(3):318-24. PMID: 29522784; https://doi.org/10.1016/j.jhin.2018.03.003.

5. Nogueira-Jr C, Padoveze MC. Public policies on healthcare associated infections: a case study of three countries. Health Policy. 2018;122(9):991-1000. PMID: 30037567; https://doi.org/10.1016/j.healthpol.2018.07.006.

6. Nogueira Junior C, Mello DS, Padoveze MC, et al. Characterization of epidemiological surveillance systems for healthcare-associated infections (HAI) in the world and challenges for Brazil. Cad Saude Publica. 2014;30(1):11-20. PMID: 24627009; https://doi.org/10.1590/0102-311x00044113.

7. Agência Nacional de Vigilância Sanitária. Critérios Diagnósticos de Infecção Relacionada à Assistência à Saúde. Segurança do Paciente e Qualidade em Serviços de Saúde. Brasilia: ANVISA; 2013. Available from: https://www.gov.br/anvisa/pt-br/centraisdeconteudo/publicacoes/servicosdesaude/publicacoes/caderno-2-criterios-diagnosticos-de-infeccao-relacionada-a-assistencia-a-saude.pdf/view. Accessed in 2025 (Feb. 19).

8. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control. 2008;36(5):309-32. PMID: 18538699; https://doi.org/10.1016/j.ajic.2008.03.002.

9. Daikos GL, Tsaousi S, Tzouvelekis LS, et al. Carbapenemase-producing Klebsiella pneumoniae bloodstream infections: Lowering mortality by antibiotic combination schemes and the role of carbapenems. Antimicrob Agents Chemother. 2014;58(4):2322-8. PMID: 24514083; https://doi.org/10.1128/AAC.02166-13.

10. Lü Y, Cai MH, Cheng J, Zou K, Xiang Q, et al. A multi-center nested case-control study on hospitalization costs and length of stay due to healthcare-associated infection. Antimicrob Resist Infect Control. 2018;7:99. PMID: 30116526; https://doi.org/10.1186/s13756-018-0386-1.

11. World Health Organization. Report on the Burden of Endemic Health Care-Associated Infection Worldwide. Geneva: WHO; 2011. Available from: http://who.int/publications/i/item/report-on-the-burden-of-endemic-health-care-associated-infection-worldwide. Accessed in 2025 (Feb. 19).

12. Allegranzi B, Bagheri Nejad S, Combescure C, Graafmans W, Attar H, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2011;377(9761):228-41. PMID: 21146207; https://doi.org/10.1016/S0140-6736(10)61458-4.

13. Smiddy MP, Murphy OM. The use of point prevalence surveys of healthcare-associated infection to identify risk factors and facilitate infection prevention and control planning. Healthc Infect. 2013;18(4):162-67. https://doi.org/10.1071/HI13022.

14. Suetens C, Latour K, Kärki T, et al. Prevalence of healthcare-associated infections, estimated incidence and composite antimicrobial resistance index in acute care hospitals and long-term care facilities: Results from two European point prevalence surveys, 2016 to 2017. Euro Surveill. 2018;23(46):1800516. PMID: 30458912. https://doi.org/10.2807/1560-7917.ES.2018.23.46.1800516.

15. European Centre for Disease Prevention and Control. Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals – ECDC PPS validation protocol version 3.1.2. Stockholm: ECDC; 2019. Available from: https://www.ecdc.europa.eu/sites/default/files/documents/PPS-HAI-AMR-protocol.pdf. Accessed in 2025 (Feb. 19).

16. Erdem H, Inan A, Altındis S, et al. Surveillance, control and management of infections in intensive care units in Southern Europe, Turkey and Iran - A prospective multicenter point prevalence study. J Infect. 2014;68(2):131-40. PMID: 24269951; https://doi.org/10.1016/j.jinf.2013.11.001.

17. Magill SS, Edwards JR, Bamberg W, et al. Multistate point-prevalence survey of health care-associated infections. N Engl J Med. 2014;370(13):1198-208. PMID: 24670166. https://doi.org/10.1056/NEJMoa1306801.

18. Grohskopf LA, Sinkowitz-Cochran RL, Garrett DO, et al. A national point-prevalence survey of pediatric intensive care unit-acquired infections in the United States. J Pediatr. 2002;140(4):432-8. PMID: 12006957; https://doi.org/10.1067/mpd.2002.122499.

19. Melo LSW, Estevão TM, Chaves JSC, et al. Success factors of a collaborative project to reduce healthcare-associated infections in intensive care units in Northeastern Brazil. Rev Bras Ter Intensiva. 2022;34(3):327-34. PMID: 36197370; https://doi.org/10.5935/0103-507x.20220070-pt.

20. Lisboa T, Faria M, Hoher JA, et al. The prevalence of nosocomial infection in intensive care units in the State of Rio Grande do Sul. Rev Bras Ter Intensiva. 2007;19(4):414-20. PMID: 25310156; https://doi.org/10.1590/S0103-507X2007000400002.

21. Ghali H, Ben Cheikh A, Bhiri S, et al. Trends of healthcare-associated infections in a Tunisian University Hospital and impact of COVID-19 pandemic. Inquiry. 2021;58:469580211067930. PMID: 34910605; https://doi.org/10.1177/00469580211067930.

22. Rosenthal VD, Myatra SN, Divatia JV, et al. The impact of COVID-19 on health care–associated infections in intensive care units in low- and middle-income countries: International Nosocomial Infection Control Consortium (INICC) findings. Int J Infect Dis. 2022;118:83-8. PMID: 35218928; https://doi.org/10.1016/j.ijid.2022.02.041.

23. Fortaleza CMCB, Padoveze MC, Kiffer CRV, et al. Multi-state survey of healthcare-associated infections in acute care hospitals in Brazil. J Hosp Infect. 2017;96(2):139-44. PMID: 28433398; https://doi.org/10.1016/j.jhin.2017.03.024.

24. Vincent JL, Bihari DJ, Suter PM, et al. The prevalence of nosocomial infection in intensive care units in Europe: Results of the European prevalence of infection in intensive care (EPIC) study. JAMA. 1995;274(8):639-44. PMID: 7637145; https://doi.org/10.1001/jama.1995.03530080055041.

25. Ponce de León-Rosales SP, Molinar-Ramos F, Domínguez-Cherit G, Rangel-Frausto MS, Vázquez-Ramos VG. Prevalence of infections in intensive care units in Mexico: A multicenter study. Crit Care Med. 2000;28(5):1316-21. PMID: 10834672; https://doi.org/10.1097/00003246-200005000-00010.

26. Cairns S, Reilly J, Booth M. Prevalence of healthcare-associated infection in Scottish intensive care units. J Hosp Infect. 2010;76(4):308-10. PMID: 20970880; https://doi.org/10.1016/j.jhin.2010.05.010.

27. Dias VMCH, Silva DMWD, Burger M, et al. Active surveillance of carbapenem-resistant Gram-negative healthcare-associated infections in a low-middle-income country city. Braz J Infect Dis. 2021;25(2):101540. PMID: 33592171; https://doi.org/10.1016/j.bjid.2021.101540.

28. Iskandar K, Molinier L, Hallit S, et al. Surveillance of antimicrobial resistance in low- and middle-income countries: a scattered picture. Antimicrob Resist Infect Control. 2021;10(1):63. PMID: 33789754; https://doi.org/10.1186/s13756-021-00931-w.

29. Sands K, Carvalho MJ, Portal E, et al. Characterization of antimicrobial-resistant Gram-negative bacteria that cause neonatal sepsis in seven low- and middle-income countries. Nat Microbiol. 2021;6(4):512-23. PMID: 33782558; https://doi.org/10.1038/s41564-021-00870-7.

30. Fair RJ, Tor Y. Antibiotics and bacterial resistance in the 21st Century. Perspect Medicin Chem. 2014;6:25-64. PMID: 25232278; https://doi.org/10.4137/PMC.S14459.

31. Gupta A, Kapil A, Kabra SK, et al. Prospective study estimating healthcare associated infections in a paediatric hemato-oncology unit of a tertiary care hospital in north India. Indian J Med Res. 2013;138(6):944-9. PMID: 24521640.

32. Rosa RG, Goldani LZ. Factors associated with hospital length of stay among cancer patients with febrile neutropenia. PLOS One. 2014;9(10):e108969. PMID: 25285790; https://doi.org/10.1371/journal.pone.0108969.

33. Wirtz VJ, Dreser A, Gonzales R. Trends in antibiotic utilization in eight Latin American countries, 1997-2007. Rev Panam Salud Publica. 2010;27(3):219-25. PMID: 20414511; https://doi.org/10.1590/s1020-49892010000300009.

34. Wolff MJ. Use and misuse of antibiotics in Latin America. Clin Infect Dis. 1993;17(Supplement 2):S346-51. PMID: 8274599; https://doi.org/10.1093/clinids/17.supplement_2.s346.

35. Levy Hara G, Rojas-Cortés R, Molina León HF, et al. Point prevalence survey of antibiotic use in hospitals in Latin American countries. J Antimicrob Chemother. 2022;77(3):807-15. PMID: 34957520; https://doi.org/10.1093/jac/dkab459.

36. Huerta-Gutiérrez R, Braga L, Camacho-Ortiz A, et al. One-day point prevalence of healthcare-associated infections and antimicrobial use in four countries in Latin America. Int J Infect Dis. 2019;86:157-66. PMID: 31229613; https://doi.org/10.1016/j.ijid.2019.06.016.

37. Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global multifaceted phenomenon. Pathog Glob Health. 2015;109(7):309-18. PMID: 26343252; https://doi.org/10.1179/2047773215Y.0000000030.

38. Levin ASS. Quais os princípios gerais da profilaxia antibiótica antes de intervenção cirúrgica? Rev Assoc Med Bras. 2002;48(4):282. https://doi.org/10.1590/S0104-42302002000400013.

39. Martinez-Sobalvarro JV, Júnior AAP, Pereira LB, et al. Antimicrobial stewardship for surgical antibiotic prophylaxis and surgical site infections: a systematic review. Int J Clin Pharm. 2022;44(2):301-19. PMID: 34843035; https://doi.org/10.1007/s11096-021-01358-4.

40. Michalopoulos A, Geroulanos S, Rosmarakis ES, Falagas ME. Frequency, characteristics, and predictors of microbiologically documented nosocomial infections after cardiac surgery. Eur J Cardiothorac Surg. 2006;29(4):456-60. PMID: 16481186; https://doi.org/10.1016/j.ejcts.2005.12.035.

41. Bouza E, Hortal J, Muñoz P, et al. Postoperative infections after major heart surgery and prevention of ventilator-associated pneumonia: a one-day European prevalence study (ESGNI-008). J Hosp Infect. 2006;64(3):224-30. PMID: 16930769; https://doi.org/10.1016/j.jhin.2006.06.019.

42. Liu Z, Zhang X, Zhai Q. Clinical investigation of nosocomial infections in adult patients after cardiac surgery. Medicine. 2021;100(4):e24162. PMID: 33530207; https://doi.org/10.1097/MD.0000000000024162.

43. De Santo LS, Bancone C, Santarpino G, et al. Microbiologically documented nosocomial infections after cardiac surgery: an 18-month prospective tertiary care centre report. Eur J Cardiothorac Surg. 2008;33(4):666-72. PMID: 18261917; https://doi.org/10.1016/j.ejcts.2007.12.046.

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Cluster of factors related to metabolic changes in older individuals: a cross-sectional study

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ABSTRACT

BACKGROUND: Exposure to multiple risk factors related to metabolic changes can negatively affect the health status of older individuals.

OBJECTIVE: To investigate the clustering of factors related to metabolic changes in older individuals.

DESIGN AND SETTING: This was a cross-sectional study involving 287 older individuals (≥ 60 years old) enrolled in the Family Health Strategy in the municipality of Ibicuí, state of Bahia.

METHODS: Factors associated with metabolic changes were abdominal obesity, self-reported diabetes, high blood pressure, sedentary behavior, and physical inactivity. Clustering was defined by an observed-to-expected prevalence (O/E) ratio greater than 1.20. The association between these factors was analyzed using multiple logistic regression.

RESULTS: A total of seven clusters were identified with a predominance of diabetes, hypertension, sedentary behavior, and abdominal obesity (O/E = 2.28). Older adults were more likely to present with physical inactivity, diabetes, blood pressure, and sedentary behavior simultaneously (Odds Ratio [OR] = 7.78; 95% confidence interval [CI] = 1.25–48.42). Negative health perception was associated with the combination of high blood pressure, sedentary behavior, and abdominal obesity (OR = 0.23; 95%CI = 0.25–0.92); female sex with the cluster of physical inactivity and abdominal obesity (OR = 0.12; 95%CI = 0.04–0.35); and the occurrence of physical inactivity without the presence of other factors (OR = 3.87; 95%CI = 1.66–8.99).

CONCLUSIONS: The combination of risk factors related to metabolic changes represents a greater probability of health problems than individual factors. Therefore, investigating the association between these factors will help in planning targeted interventions.

INTRODUCTION

Metabolic changes, including abdominal obesity, hyperglycemia, dyslipidemia, and high blood pressure, are associated with an increased risk of diseases such as type 2 diabetes and cardiovascular disease, as well as an increase in overall mortality.[1,2] In addition, these changes can lead to the progression of other clinical complications, such as cancer, gout, nonalcoholic fatty liver disease, polycystic ovary syndrome, sleep apnea syndrome, and dementia.[3]

The simultaneous occurrence of some of these alterations is referred to as metabolic syndrome (MS). This has been described as one of the main public health problems involving a cluster of visceral adiposity and a high risk of developing diabetes, cardiovascular disease, and mortality.[4] One of the main contributors to its increasing prevalence is population aging, given that older individuals are routinely the most affected by the cardiovascular and metabolic risk factors that characterize MS.[5]

Studies have identified physical and functional decline,[6] sedentary lifestyle,[7] and physical inactivity[8,9] as risk factors for MS and explained how these factors alter the body's metabolic responses. Both sedentary behavior and physical inactivity contribute to deleterious metabolic effects, such as increased insulin resistance, changes in adipose tissue lipolysis, and mitochondrial pathway dysfunction. Moreover, these factors are correlated with the accumulation of visceral and hepatic fat in individuals at high risk of type 2 diabetes.[8,10]

Assuming that MS is a group of clinical changes influenced by lifestyle, sedentary lifestyle, unhealthy eating habits, stress and genetic factors and that their co-occurrence may be associated with an increased risk of developing diseases, cluster-type combinatorial analysis has emerged as an important tool for examining the relationship between multiple risk factors[11]. This type

of analysis allows the identification of coexisting and aggregated different risk factors, enabling the evaluation of the most prevalent clusters.

Therefore, understanding common clusters of metabolic risk factors is relevant for the primary prevention of a specific target and the promotion of broader health policies,[12,13] to apply more appropriate strategies for the management and prevention of health risks in a population.[14,15] However, research on the clustering of metabolic risk factors among the Brazilian population is still incipient.

OBJECTIVE

This study aimed to investigate the aggregation of factors related to metabolic changes in older individuals.

METHODS

Study design and sample

This cross-sectional study, based on data from the project titled "Monitoring the Health Conditions of the Elderly in a Small Municipality (MONIDI)," was conducted in the municipality of Ibicuí, state of Bahia, in 2014.

The target population of the current study was comprised of randomly selected older people of both sexes, aged 60 years or older, who were enrolled in the Family Health Strategy (FHS) of the municipality. The sample size was determined based on criteria for finite populations,[16] adopting a significance level of 5%, 95% confidence interval (CI), and tolerable error of 3%. An additional 10% of individuals were included in the sample to compensate for possible losses and refusals, resulting in a total sample of 310 older individuals.

The exclusion criteria included being bedridden, having Alzheimer's disease or other neurological and cognitive disorders, being diagnosed and reported by FHS professionals, the absence of any body segment, and conditions that would prevent participation in the physical fitness assessment or their ability to answer the questionnaire. Individuals who lacked information on any factors related to the metabolic changes used for the cluster

analysis were excluded. After applying the eligibility criteria, 287 older adults were included in the final sample.

Data collection and study variables

Data were collected using the Elderly Health Assessment Instrument tool.[17] This instrument was used in the Family Health Units, along with a physical assessment conducted by a previously trained team. Older individuals were invited to visit the units on the day of data collection and were informed about the relevance and objectives of the study. Face-to-face interviews, physical tests, and anthropometric assessments were conducted.

For the current study, sociodemographic information and perceptions of health status were used as independent variables. These included sex (female or male), age (dichotomized into 60–79 years and ≥ 80 years), race/color (self-reported and categorized as white and non-white [black, brown, yellow, and indigenous]), marital status (with a partner or without a partner), income (< 1 minimum wage or ≥ 1 minimum wage), schooling (in completed years of study, categorized as literate and illiterate), and perceived health (dichotomized into positive [excellent, very good, and good] and negative [fair and poor]).

The five factors related to metabolic changes, which were used in the cluster analysis, are listed in **Table 1**.

Data analysis

Descriptive statistics, including absolute and relative frequencies, were used in the data analysis to characterize behaviors related to metabolic changes based on the described variables. For the cluster analysis, the joint probability of these behaviors was calculated. The presence of clustering was verified by the ratio of observed (O) to expected (E) prevalence, with clusters defined as combinations where the O/E ratio was greater than 1.20.[22]

Logistic regression analysis was used to examine the associations between each combination of behaviors and independent variables. Combinations with the highest observed prevalence and O/E ratios greater than 1.20 were included in the adjustment models.

Table 1. Description of the factors used in this study

Factors	Evaluation in research	Definition applied
Abdominal obesity (AO)	Anthropometric measurements of waist circumference (WC) were used to assess abdominal obesity (males ≥ 94; females ≥ 80).	Classified based on WHO recommended values for females and males.[18]
Self-reported diabetes (D)	Noted by the following question: Do you have any of the health problems listed below? Diabetes (yes or no)	Verified by an affirmative answer to the question.[19]
High blood pressure (BP)	Noted by the following question: Do you have any of the health problems listed below? High blood pressure (yes or no).	Verified by an affirmative answer to the question.[19]
Sedentary behavior (SB)	Assessed through questions taken from the International Physical Activity Questionnaire (IPAQ), a version adapted for older Brazilians.	Verified by calculating the average time spent in sedentary behavior.[20]
Physical inactivity (PI)	Assessed through the question: How would you rate your leisure-time physical activity?	Those who reported not practicing physical activity (light, moderate, or intense) in their free time were considered insufficiently active in their leisure time.[21]

WHO = World Health Organization.

To identify the variables associated with each group, the odds ratio (OR) was adopted as an effect measure, with a 95%CI obtained through logistic regression analysis. All variables with a significance level of less than 0.20 in the bivariate analysis were included in the adjusted models. The multiple logistic regression analysis was conducted using models that included all preselected independent variables with a backward stepwise selection method. Analyses were performed using STATA software (version 14.0; StataCorp LLC, College Station, Texas, United States).

Ethical aspects

This study adhered to the ethical principles of the Declaration of Helsinki by the World Medical Association and Resolution 466/2012 of the National Health Council. The research protocols were evaluated and approved on April 11, 2024, by the Human Research Ethics Committee of the Universidade Estadual do Sudoeste da Bahia (UESB) (CAAE: 22969013.0.0000.0055). All participants provided written informed consent before participation.

RESULTS

The sociodemographic profiles of the participants and the prevalence of factors related to metabolic changes are shown in **Table 2**. The sample primarily consisted of older people aged 60 to 79 years (83.62%), females (54.01%), and those living without a partner (50.1%). Non-white races/colors were the most prevalent (69.3%) among the participants, and the majority were literate (56.1%).

The most common risk factors identified were physical inactivity (68.2%) and abdominal obesity (55.4%). Regarding the associations between isolated risk factors and sociodemographic characteristics, older individuals who were illiterate were significantly more inactive (P = 0.042), those who lived without a partner reported more time spent in sedentary behavior (P = 0.036), and females had a higher prevalence of abdominal obesity (P < 0.001). Additionally, there was a greater prevalence of negative health perceptions among participants with diabetes (P = 0.047) (**Table 2**).

Overall, seven combinations were observed with an O/E value greater than 1.20. The combination of diabetes (D), high blood pressure (BP), sedentary behavior (SB), and abdominal obesity (AO) was most prevalent (O/E = 2.28; 95%CI = 2.14–2.41) (**Table 3**).

The prevalence of the most frequent groups based on sociodemographic characteristics and health perceptions of older adults is shown in **Table 4**.

When analyzing the combination of three simultaneous risk factors, a larger cluster was observed for the combination of physical inactivity, diabetes, and sedentary behavior (O/E = 1.61; 95%CI = 1.43–1.79). Among the combinations of two factors, the highest score was identified for the combination of physical inactivity and abdominal obesity (O/E = 1.22; 95%CI = 1.11–1.33). In the evaluation of the presence of only one of the factors without the presence of the others, physical inactivity had the highest prevalence (O/E = 1.27; 95%CI = 1.13–1.40) (**Table 3**).

In the multivariate analysis, associations were observed between the oldest age group and a combination of physical inactivity, diabetes, high blood pressure, and sedentary behavior (OR = 7.78;

Table 2. Prevalence of factors related to metabolic changes according to sociodemographic variables. MONIDI, Ibicuí/BA, 2014

Variables	Total	Physical inactivity		Diabetes		High blood pressure		Sedentary behavior		Abdominal obesity	
	n (%)	n (%)	P value	n (%)	P value	n (%)	P value	n (%)	P value	n (%)	P value
Total	287 (100%)	196 (68.29)		41 (14.29)		122 (42.51)		124 (43.21)		159 (55.40)	
Age (years)											
60–79	240 (83.62)	164 (68,33)	0.973	31 (12.92)	0.134	101 (42.08)	0.742	102 (42.50)	0.586	138 (57.50)	0.106
≥80	47 (16.38)	32 (69.09)		10 (21.28)		21 (44.68)		22 (46.81)		21 (44.68)	
Sex											
Female	155 (54.01)	110 (70.97)	0.291	18 (11.61)	0.161	67 (43.23)	0.790	64 (41.29)	0.478	120 (77.42)	**<0.001**
Male	132 (45.99)	86 (65.15)		23 (17.42)		55 (41.67)		60 (45.45)		39 (29.55)	
Race/color (271)											
White	83 (30.63)	51 (61.45)	0.131	15 (18.07)	0.202	31 (37.35)	0.260	35 (42.17)	0.762	49 (59.04)	0.569
Non-white	188 (69.37)	133 (70.74)		23 (12.23)		84 (44.68)		83 (44.15)		114 (55.32)	
Marital status											
Without a partner	144 (50.17)	92 (63.89)	0.108	19 (13.19)	0.596	65 (45.14)	0.366	71 (49.31)	**0.036**	80 (55.56)	0.958
With a partner	143 (49.83)	104 (72.73)		22 (15.38)		57 (39.86)		53 (37.06)		79 (55.24)	
Schooling											
Literate	161 (56.10)	102 (63.35)	**0.042**	18 (11.18)	0.089	64 (39.75)	0.285	71 (44.10)	0.730	97 (60.25)	0.062
Illiterate	126 (43.90)	94 (74.60)		23 (18.25)		58 (46.03)		53 (42.06)		62 (49.21)	
Perceived health											
Positive	110 (38.33)	71 (64.55)	0.282	10 (9.09)	**0.047**	45 (40.91)	0.666	49 (44.55)	0.718	67 (60.91)	0.139
Negative	177 (61.67)	125 (70.62)		31 (17.51)		77 (43.50)		75 (42.37)		92 (51.98)	

n = number of individuals per variable; % = Percentage; P value = Pearson's chi-square test.

95%CI = 1.25–48.42); negative perception of health was associated with a combination of high blood pressure, sedentary behavior, and abdominal obesity (OR = 0.23; 95%CI = 0.25–0.92); female sex was associated with a combination of physical inactivity and abdominal obesity (OR = 0.12; 95%CI = 0.04–0.35); and male sex was associated with a combination of physical inactivity without the presence of other risk factors (OR = 3.87; 95%CI = 1.66–8.99). These associations remained significant even after adjustments (**Table 5**).

DISCUSSION

This study investigated the clustering of factors related to metabolic changes in older individuals. Of the 32 possible combinations identified in the cluster analysis, seven clusters whose risk factors did not occur independently in the population were verified. The co-occurrence of risk factors related to metabolic changes represents a greater probability of future cardiovascular complications than any single risk factor in isolation.[23]

Among the five factors related to metabolic changes, physical inactivity was present in five of the seven combinations with the highest observed-to-expected prevalence ratio. This result aligns with studies showing a consistent relationship between the increase in the prevalence of MS and insufficient levels of physical activity in Western populations.[7,24,25] In older Brazilians, an increase in the level of physical activity was associated with a 33% lower chance of developing MS than inactivity.[26]

When analyzing the association between the groups with the highest prevalence and independent variables, the oldest individuals were seven times more likely to simultaneously present four of the five factors related to metabolic changes: physical inactivity, diabetes, arterial hypertension, and sedentary behavior. Previous findings reinforce this result and demonstrate how physical inactivity and sedentary behavior (both strongly related to obesity) are associated with an increased risk of several chronic diseases, including heart disease, diabetes, hypertension, osteoporosis, depression, and several types of cancers.[27,28]

Table 3. Prevalence of cluster of factors related to metabolic changes in older individuals. MONIDI, Ibicuí/BA, 2014

Risk factors	PI	D	BP	SB	AO	O(%)	O/E	95%CI
5	+	+	+	+	+	1.05	1.06	(0.88–1.23)
4	-	+	+	+	+	1.05	**2.28**	(2.14–2.41)
4	+	-	+	+	+	6.97	1.17	(1.01–1.33)
4	+	+	-	+	+	1.05	0.78	(0.60–0.96)
4	+	+	+	-	+	1.74	**1.33**	(1.15–1.51)
4	+	+	+	+	-	1.74	**2.18**	(2.01–2.34)
3	-	-	+	+	+	3.48	**1.26**	(1.08–1.44)
3	-	+	-	+	+	0.0	0.0	(-0.16–0.16)
3	-	+	+	-	+	0.70	1.16	(1.00–1.31)
3	-	+	+	+	-	0.35	0.94	(0.83–1.06)
3	+	-	-	+	+	7.32	0.91	(0.77–1.05)
3	+	-	+	-	+	5.57	0.71	(0.57–0.85)
3	+	-	+	+	-	4.88	1.02	(0.85–1.19)
3	+	+	-	-	+	1.38	0.78	(0.60–0.96)
3	+	+	-	+	-	1.74	**1.61**	(1.43–1.79)
3	+	+	+	-	-	0.70	0.67	(0.49–0.84)
2	-	-	-	+	+	2.79	0.75	(0.57–0.92)
2	-	-	+	-	+	3.83	1.05	(0.88–1.23)
2	-	-	+	+	-	2.44	1.10	(0.91–1.28)
2	+	-	-	-	+	12.89	**1.22**	(1.11–1.33)
2	+	-	-	+	-	5.77	0.89	(0.73–1.05)
2	+	-	+	-	-	5.18	0.82	(0.67–0.98)
2	+	+	-	-	-	0.70	0.49	(0.31–0.67)
2	-	+	-	-	+	0.70	0.85	(0.68–1.02)
2	-	+	-	+	-	0.35	0.70	(0.56–0.84)
2	-	+	+	-	-	0.35	0.72	(0.58–0.86)
1	-	-	-	-	+	4.88	0.99	(0.82–1.16)
1	-	-	-	+	-	2.44	0.81	(0.63–0.99)
1	-	-	+	-	-	3.49	1.19	(1.01–1.37)
1	+	-	-	-	-	10.80	**1.27**	(1.13–1.40)
1	-	+	-	-	-	0.70	1.06	(0.90–1.22)
0	-	-	-	-	-	4.18	1.06	(0.88–1.23)

CI = confidence interval; + = presence of risk behavior; - = absence of risk behavior; O = observed prevalence; O/E = relationship between observed and expected prevalence; PI = physical inactivity; D = diabetes; BP = high blood pressure; SB = sedentary behavior; AO = abdominal obesity.

Research involving 1,606 older participants in the baseline of the Bambuí Project showed a high prevalence of the primary diseases associated with MS, where 77.5% of the participants were solely hypertensive, 6.6% were solely diabetic, and 15.9% were both hypertensive and diabetic.[29] This high prevalence can be attributed to increased exposure to risk factors such as physical inactivity, sedentary behavior, and obesity with aging, representing an important public health problem in Brazil.

Table 4. Prevalence of groupings of factors related to metabolic changes according to sociodemographic characteristics and health perception of older individuals. MONIDI, Ibicuí/BA, 2014

Variables	D_BP_SB_AO (Cluster 1) n (%)	PI_D_BP_AO (Cluster 2) n (%)	PI_D_BP_SB (Cluster 3) n (%)	BP_SB_AO (Cluster 4) n (%)	PI_D_SB (Cluster 5) n (%)	PI_AO (Cluster 6) n (%)	PI (Cluster 7) n (%)
Age (years)							
60–79	3 (100.0)	5 (100.00)	2 (40.00)*	10 (100.0)	4 (80.00)	34 (91.89)	26 (83.87)
≥ 80	-	-	3 (60.00)	-	1 (20.00)	3 (8.11)	5 (16.13)
Sex							
Female	2 (66.67)	3 (60.00)	2 (40.00)	8 (80.00)	1 (20.00)	33 (89.9)*	8 (25.81)*
Male	1 (33.33)	2 (40.00)	3 (60.00)	2 (20.00)	4 (80.00)	4 (10.81)	23 (74.19)
Race/color (282)							
White	1 (33.33)	3 (60.00)	2 (66.67)	2 (20.00)	1 (20.00)	6 (17.14)	10 (34.48)
Non-white	2 (66.67)	2 (40.00)	1 (33.33)	8 (80.00)	4 (80.00)	29 (82.86)	19 (65.52)
Marital status							
Without a partner	2 (66.67)	1 (20.00)	4 (80.00)	7 (70.00)	2 (40.00)	18 (48.65)	13 (41.94)
With a partner	1 (33.33)	4 (80.00)	1 (20.00)	3 (30.00)	3 (60.00)	19 (51.35)	18 (58.06)
Schooling							
Literate	1 (33.33)	3 (60.00)	2 (40.00)	7 (70.00)	3 (60.00)	19 (51.35)	15 (48.39)
Illiterate	2 (66.67)	2 (40.00)	3 (60.00)	3 (30.00)	2 (40.00)	18 (48.65)	16 (51.61)
Perceived health							
Positive	-	1 (20.00)	2 (40.00)	7 (70.00)*	2 (40.00)	12 (32.43)	13 (41.94)
Negative	3 (100.00)	4 (80.00)	3 (60.00)	3 (30.00)	3 (60.00)	25 (67.57)	18 (58.06)

N = number of individuals per variable; % = Percentage; *P value = < 0.05; PI = physical inactivity; D = diabetes; BP = high blood pressure; SB = sedentary behavior; AO = abdominal obesity.

Table 5. Results of multiple logistic regression between groups of factors related to metabolic changes and independent variables. MONIDI, Ibicuí/BA, 2014

Variables	PI_D_BP_SB OR (95%CI)	BP_SB_AO OR (95%CI)	PI_AO OR (95%CI)	PI OR (95%CI)
Age (years)				
60–79	1	-	-	-
≥ 80	**7.78 (1.25–48.42)**	-	-	-
Sex				
Female	1	1	1	1
Male	1.47 (0.23–9.25)	0.25 (0.05–1.22)	**0.12 (0.04–0.36)**	**3.87 (1.66–8.99)**
Race/color (282)				
White	-	-	1	-
Non-white	-	-	1.34 (0.97–1.84)	-
Marital status				
Without partner	-	-	-	-
With partner	-	-	1.69 (0.79–3.61)	-
Schooling				
Literate	-	-	-	1
Illiterate	-	-	-	1.40 (0.65–3.01)
Perceived health				
Positive	-	1	-	-
Negative	-	**0.23 (0.25–0.92)**	-	-

CI = confidence interval; OR = odds ratio; PI = physical inactivity; D = diabetes; BP = high blood pressure; SB = sedentary behavior; AO = abdominal obesity.

Sedentary behavior establishes a positive relationship between risks and the health of older individuals. Time spent watching television and total sitting time greater than 2 h/day were associated with an increased relative risk of MS[30] and increased risk of obesity.[31] Individuals who spend more time in a sitting and/or inclined position (> 5 h/day) were 4.5 and 2.9 times more likely to have diabetes mellitus and dyslipidemia, respectively, compared with those with lower levels of sedentary behavior.[32]

The prevalence of the concomitant occurrence of multiple factors related to metabolic changes in the older population has rarely been described in national literature. A study involving patients with diabetes and hypertension monitored by the FHS in the state of Pernambuco reported that older adults (> 60 years) were more likely to spend 6 h/day or more sitting compared with those in the younger age group (20–59 years old).[33]

In this study, older adults with a negative perception of their health were more likely to present with high blood pressure, sedentary behavior, and abdominal obesity. These results align with findings from a previous study conducted on the Chilean national population, which indicated that a combination of physical activity and minimal time spent on behaviors related to sitting proved to be beneficial as a marker of adiposity and cardiometabolic health. Data from this study suggest that increased physical activity in people categorized as highly sedentary can help mitigate cardiometabolic risk.[34]

Both high blood pressure and abdominal obesity are associated with a higher risk of mortality from cardiovascular diseases.[26,35] In Brazil, high BP affects more than 60% of the older population, contributing directly or indirectly to 50% of deaths from cardiovascular diseases, and shows a direct and linear association with aging.[26]

Studies have indicated a statistically significant association between sedentary behavior and abdominal obesity.[36,37] A possible hypothesis for this association is that sedentary behavior promotes lower energy expenditure, replaces daily activities—even light intensity—and stimulates the consumption of high-calorie foods, which can result in greater adiposity.[38,39] However, the combined association between these two factors and high blood pressure requires further investigation.

A survey conducted among climacteric females showed that abdominal obesity was associated with a sedentary lifestyle, elevated total cholesterol levels, and high blood pressure.[40] The association between hypertension and abdominal obesity was observed in a 22-year Chinese cohort study, which demonstrated that body mass index and waist circumference significantly predicted the development of hypertension.[41]

However, the mechanism underlying the association between abdominal obesity and hypertension remains unclear. Nevertheless, the increase in adipose tissue likely leads to the release of a variety of adipokines linked to decreased production and utilization of nitric oxide, which plays important roles in regulating vascular tone and suppressing vascular smooth muscle cell proliferation. Therefore, a reduction in the effects of nitric oxide is associated with endothelial dysfunction and high blood pressure.[41-43]

In the current study, the simultaneous occurrence of physical inactivity and abdominal obesity was higher in females than in males. However, when evaluating the behavior of physical inactivity alone, males exhibited a 3.87 times greater probability of being physically inactive than females. These results suggest that females had a lower probability of being physically inactive when considered independently.

Physical inactivity and abdominal adiposity are associated with persistent low-grade systemic inflammation. A previous study highlights a probable link between these factors and a "sedentary-vicious cycle," where physical inactivity leads to chronic inflammation induced by the accumulation of visceral fat and is commonly accompanied by fatigue and loss of muscle mass, which proportionally affects the ability to engage in physical activity.[44]

Our results reinforce the concept of distinguishing the clinical expression of metabolic changes according to sex, where the higher prevalence of physical inactivity and abdominal obesity among females may be related to postmenopausal status.[40,45] A study conducted with climacteric females strengthened this relationship, demonstrating a higher prevalence of abdominal obesity in physically inactive females.[40]

Changes in menopause-related sex hormone levels have an additional negative impact on metabolic health.[46] These changes are associated with changes in fat distribution patterns, visceral accumulation, and increased waist circumference[47,48] and changes in metabolic biomarkers[49] and decreased muscle mass.[50] Consequently, menopause has a strong potential to contribute to the development or worsening of MS in females.[51]

A study showed that females have a higher percentage of barriers to engaging in physical activity than males.[52] The barriers are socially constructed sex roles, the burden of managing the home, difficulty in accessing physical activity spaces and leisure opportunities, violence in public spaces, and the higher prevalence of comorbidities in females. These factors may explain the higher prevalence of physical inactivity in this group.[53-56]

The limitation of this study is that the information on self-reported sedentary behavior and physical activity, although a widely used strategy in epidemiological investigations, may be susceptible to memory bias. However, this study evaluated many older adults living in a region characterized by low education and income and insufficient access to health services. To the best of our knowledge, this is the first study to investigate the combined effects of multiple factors related to metabolic changes in a sample of older individuals from Bahia.

CONCLUSION

The grouping of risk factors related to metabolic changes was associated with a greater risk of future cardiovascular problems

than any individual risk factor. Therefore, this study is important, as its findings will help in planning interventions targeting the most prevalent combinations. Further studies using the same methodological approach could enhance the knowledge of common risk clusters in this population. Additionally, this study emphasizes the importance of promoting increased physical activity among the older population and reducing sedentary time through public health policies as strategies for reducing cardiometabolic risk.

REFERENCES

1. Ma A, Fang K, Dong J, Dong Z. Prevalence and related factors of metabolic syndrome in Beijing, China (Year 2017). Obes Facts. 2020;13(6):538-47. PMID: 33232966; https://doi.org/10.1159/000508842.

2. França SL, Lima SS, Vieira JRS. Metabolic syndrome and associated factors in adults of the Amazon region. PLoS One. 2016;11(12):e0167320. PMID: 27936021; https://doi.org/10.1371/journal.pone.0167320.

3. Beck-Nielsen H. The metabolic syndrome: Pharmacology and clinical aspects. 1ª ed. Vienna: Springer Vienna; 2013. https://doi.org/10.1007/978-3-7091-1331-8.

4. Monserrat-Mesquida M, Quetglas-Llabrés M, Capó X, et al. Metabolic syndrome is associated with oxidative stress and proinflammatory state. Antioxidants 2020;9:236. PMID: 32178436; https://doi.org/10.3390/antiox9030236.

5. Dominguez LJ, Barbagallo M. The biology of the metabolic syndrome and aging. Curr Opin Clin Nutr Metab Care. 2016;19(1):5-11. PMID: 26560521; https://doi.org/10.1097/MCO.0000000000000243.

6. Shur NF, Creedon L, Skirrow S, et al. Age-related changes in muscle architecture and metabolism in humans: The likely contribution of physical inactivity to age-related functional decline. Ageing Res Rev. 2021;68:101344. PMID: 33872778; https://doi.org/10.1016/j.arr.2021.101344.

7. Myers J, Kokkinos P, Nyelin E. Physical activity, cardiorespiratory fitness, and the metabolic syndrome. Nutrients. 2019;11(7):1652. PMID: 31331009; https://doi.org/10.3390/nu11071652.

8. Bowden Davies KA, Pickles S, Sprung VS, et al. Reduced physical activity in young and older adults: metabolic and musculoskeletal implications. Ther Adv Endocrinol Metab. 2019;10:2042018819888824. PMID: 31803464; https://doi.org/10.1177/2042018819888824.

9. Gallardo-Alfaro L, Bibiloni MDM, Mateos D, Ugarriza L, Tur JA. Leisure-time physical activity and metabolic syndrome in older adults. Int J Environ Res Public Health. 2019;16(18):3358. PMID: 31514471; https://doi.org/10.3390/ijerph16183358.

10. Ekblom-Bak E, Halldin M, Vikstrom M, et al. Physical activity attenuates cardiovascular risk and mortality in men and women with and without the metabolic syndrome - A 20-year follow-up of a population-based cohort of 60-year-olds. Eur J Prev Cardiol. 2021;28(12):1376-85. PMID: 34647588; https://doi.org/10.1177/2047487320916596.

11. Austregésilo SC, Goes PSA, Sena Júnior MR, Pazos CTC. Clustering of oral and general health risk behaviors among adolescents. Prev Med Rep. 2019;15:100936. PMID: 31372328; https://doi.org/10.1016/j.pmedr.2019.100936.

12. Rabel M, Laxy M, Thorand B, et al. Clustering of health-related behavior patterns and demographics. Results from the population-based KORA S4/F4 cohort study. Front Public Health. 2019;6:387. PMID: 30723712; https://doi.org/10.3389/fpubh.2018.00387.

13. Matias TS, Silva KS, Silva JA, Mello GT, Salmon J. Clustering of diet, physical activity and sedentary behavior among Brazilian adolescents in the national school - Based health survey (PeNSE 2015). BMC Public Health. 2018;18:1283. https://doi.org/10.1186/s12889-018-6203-1.

14. Yoshimitanaka O, Drumond M, Cristo EB, Spedo SM, Pinto NRS. Uso da análise de clusters como ferramenta de apoio à gestão no SUS. Saude Soc. 2015;24(1):34-45. https://doi.org/10.1590/S0104-12902015000100003.

15. Busch V, Van Stel HF, Schrijvers AJ, Leeuw JR. Clustering of health-related behaviors, health outcomes and demographics in Dutch adolescents: A cross-sectional study. BMC Public Health. 2013;13:1118. PMID: 24305509; https://doi.org/10.1186/1471-2458-13-1118.

16. Luiz RR, Magnanini MMF. A lógica da determinação do tamanho da amostra em investigações epidemiológicas. Cad Saude Colet. 2000;8(2):9-28. Available from: https://ediscipinas.usp.br/pluginfile.php/4116370/mod_resource/content/1/Determinac%CC%A7a%CC%83oamostraRonir2000_2.pdf. Accessed in 2023 (Oct. 30)

17. Pedreira RBS, Rocha SV, Santos CA, Vasconcelos LRC, Reis MC. Content validity of the Geriatric Health Assessment Instrument. Einstein. 2016;14(2):158-77. PMID: 27462889; https://doi.org/10.1590/S1679-45082016AO3455.

18. WHO. Consultation on Obesity (1999: Geneva, Switzerland) & World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO consultation. World Health Organization. 2000. Available from: https://apps.who.int/iris/handle/10665/42330. Accessed in 2023 (Oct. 30)

19. Damião JM, Vasconcelos LRC, Rocha SV, Coutinho APP. Associação entre comportamento sedentário e diabetes em idosos de baixa renda na cidade de Ibicuí-BA: pesquisa populacional brasileira. Rev Med. 2020;99(5):442-7. https://doi.org/10.11606/issn.1679-9836.v99i5p442-447.

20. Benedetti TRB, Rodriguez-Añez CR, Mazo GZ, Petroski ÉL, Antunes PDC. Reprodutibilidade e validade do Questionário Internacional de Atividade Física (IPAQ) em homens idosos. Rev Bras Med Esporte. 2007;13(1):11-6. https://doi.org/10.1590/S1517-86922007000100004.

21. Pitanga FJG, Lessa I. Prevalência e fatores associados ao sedentarismo no lazer em adultos. Cad Saude Publica. 2005;21(3):870-7. PMID: 15868045; https://doi.org/10.1590/S0102-311X2005000300021.

22. Jordão LMR, Malta DC, Freire MCM. Clustering patterns of oral and general health-risk behaviours in Brazilian adolescents: Findings from a national survey. Community Dent Oral Epidemiol. 2018;46(2):194-202. PMID: 29168590; https://doi.org/10.1111/cdoe.12354.

23. Rey HCV. A importância de reconhecer a co-ocorrência de fatores de risco cardiometabólico na população para estabelecer prioridades em políticas públicas. Arq Bras Cardiol. 2021;117(1):49-50. PMID: 34320067; https://doi.org/10.36660/abc.20210511.

24. Chau J, Chey T, Burks-Young S, Engelen L, Bauman A. Trends in prevalence of leisure time physical activity and inactivity: results from Australian National Health Surveys 1989 to 2011. Aust NZJ Public Health. 2017;41(6):617-624. PMID: 28749561; https://doi.org/10.1111/1753-6405.12699.

25. Pucci G, Alcidi R, Tap L, et al. Sex- and gender-related prevalence, cardiovascular risk and therapeutic approach in metabolic syndrome: A review of the literature. Pharmacol Res. 2017;120:34-42. PMID: 28300617; https://doi.org/10.1016/j.phrs.2017.03.008.

26. Costa ACO, Duarte YAO, Andrade FB. Metabolic syndrome: Physical inactivity and socioeconomic inequalities among non-institutionalized Brazilian elderly. Rev Bras Epidemiol. 2020;23:e200046. PMID: 32491048; https://doi.org/10.1590/1980-549720200046.

27. Silveira EA, Mendonça CR, Delpino FM, et al. Sedentary behavior, physical inactivity, abdominal obesity and obesity in adults and older adults: A systematic review and meta-analysis. Clin Nutr ESPEN. 2022;50:63-73. PMID: 35871953; https://doi.org/10.1016/j.clnesp.2022.06.001.

28. Cunningham C, O' Sullivan R, Caserotti P, Tully MA. Consequences of physical inactivity in older adults: A systematic review of reviews and meta-analyses.Scand J Med Sci Sports. 2020;30(5):816-27. PMID: 32020713; https://doi.org/10.1111/sms.13616.

29. Loyola Filho AI, Firmo JOA, Uchôa E, Lima-Costa MF. Fatores associados à autoavaliação negativa da saúde entre idosos hipertensos e/ou diabéticos: Resultados do projeto Bambuí. Rev Bras Epidemiol. 2013;16(3):559-71. https://doi.org/10.1590/S1415-790X2013000300001.

30. Rezende LFM, Lopes MR, Rey-López JP, Matsudo VKR, Luiz ODC. Sedentary behavior and health outcomes: An overview of systematic reviews. PLoS One. 2014;9(8):e105620. PMID: 25144686; https://doi.org/10.1371/journal.pone.0105620.

31. Gardiner PA, Healy GN, Eakin EG, et al. Associations between television viewing time and overall sitting time with the metabolic syndrome in older men and women: The Australian diabetes obesity and lifestyle study. J Am Geriatr Soc. 2011;59(5):788-96. PMID: 21568949; https://doi.org/10.1111/j.1532-5415.2011.03390.x.

32. Mazo GZ, Virtuoso JF, Krug RDR, Menezes EC, Lopes MA. Association between sitting time and major diseases in Brazilian octogenarians. Arq Ciencias Saude UNIPAR. 2018;22(1):3-9. https://doi.org/10.25110/arqsaude.v22i1.2018.6033.

33. Oliveira RC, Barbosa JMV, Fontbonne A, Cesse E, Souza WV. Factors associated with the sedentary behavior of diabetics and hypertensives in primary care in Pernambuco: RedeNut study. Motricidade. 2020;16(2):212-24. https://doi.org/10.6063/motricidade.18947.

34. Cristi-Montero C, Steell L, Petermann F, et al. Joint effect of physical activity and sedentary behaviour on cardiovascular risk factors in Chilean adults. J Public Health (Oxf). 2018;40(3):485-92. PMID: 29045709; https://doi.org/10.1093/pubmed/fdx134.

35. Moura LAN, Pagotto V, Pereira CC, Oliveira C, Silveira EA. Does abdominal obesity increase all-cause, cardiovascular disease, and cancer mortality risks in older adults? A 10-Year Follow-Up Analysis. Nutrients. 2022;14(20):4315. PMID: 36296999; https://doi.org/10.3390/nu14204315.

36. Delfino LD, Tebar WR, Tebar FCSG, et al. Association between sedentary behavior, obesity and hypertension in public school teachers. Ind Health. 2020;58(4):345-53. PMID: 32009026; https://doi.org/10.2486/indhealth.2019-0170.

37. Guerra PH, Mielke GI, Garcia LMT. Comportamento Sedentário. Corpoconsciência 2014;18(1):23-36. Available from: https://periodicoscientificos.ufmt.br/ojs/index.php/corpoconsciencia/article/view/3568. Accessed in 2023 (Oct. 30).

38. Calegari, K. Association between food compulsion and sedentary: factors that lead to obesity. Revista Brasileira de Obesidade, Nutrição e Emagrecimento. 2012;6(35):242. Available from: http://www.rbone.com.br/index.php/rbone/article/view/279. Accessed in 2023 (Oct. 30).

39. Hruby A, Hu FB. The Epidemiology of Obesity: A big picture. PharmacoEconomics. 2015;33(7):673-689. PMID: 25471927; https://doi.org/10.1007/s40273-014-0243-x.

40. Pimenta WC, Rocha JSB, Caldeira AP, et al. Abdominal obesity and association with sociodemographic, behavioral and clinical data in climacteric women assisted in primary care. PLoS One. 2020;15(8):e0237336. PMID: 32790774; https://doi.org/10.1371/journal.pone.0237336.

41. Chen Y, Liang X, Zheng S, Wang Y, Lu W. Association of body fat mass and fat distribution with the incidence of hypertension in a population-based Chinese cohort: A 22-year follow-up. J Am Heart Assoc. 2018;7(6):e007153. PMID: 29745366; https://doi.org/10.1161/JAHA.117.007153.

42. Powell-Wiley TM, Poirier P, Burke LE, et al. Obesity and cardiovascular disease a scientific statement from the American Heart Association. Circulation. 2021;143(21):e984-1010. PMID: 33882682; https://doi.org/10.1161/CIR.0000000000000973.

43. Koenen M, Hill MA, Cohen P, Sowers JR. Obesity, adipose tissue and vascular dysfunction. Circ Res. 2021;128(7):951-68. PMID: 33793327. https://doi.org/10.1161/circresaha.121.318093.

44. Burini RC, Anderson E, Durstine JL, Carson JA. Inflammation, physical activity, and chronic disease: An evolutionary perspective. Sports Med Health Sci. 2020;2(1):1-6. PMID: 35783338; https://doi.org/10.1016/j.smhs.2020.03.004.

45. Feng GS, Li HL, Shen QM, et al. Population attributable risk of excess weight, abdominal obesity and physical inactivity for type 2 diabetes in Chinese men and women. Ann Transl Med. 2021;9(4):326. PMID: 33708953; https://doi.org/10.21037/atm-20-6121.

46. Hyvärinen M, Juppi HK, Taskinen S, et al. Metabolic health, menopause, and physical activity—a 4-year follow-up study. Int J Obes. 2022;46(3):544-54. PMID: 34802032; https://doi.org/10.1038/s41366-021-01022-x.

47. Ko SH, Kim HS. Menopause-associated lipid metabolic disorders and foods beneficial for postmenopausal women. Nutrients. 2020;12(1):202. PMID: 31941004; https://doi.org/10.3390/nu12010202.

48. Faulkner JL, Chantemèle EJB. Sex hormones, aging and cardiometabolic syndrome. Biol Sex Differ. 2019;10(1):30. PMID: 31262349; https://doi.org/10.1186/s13293-019-0246-6.

49. Wang Q, Ferreira DLS, Nelson SM, et al. Metabolic characterization of menopause: Cross-sectional and longitudinal evidence. BMC Med. 2018;16(1):17. PMID: 29402284; https://doi.org/10.1186/s12916-018-1008-8.

50. Juppi HK, Sipilä S, Cronin NJ, et al. Role of menopausal transition and physical activity in loss of lean and muscle mass: A follow-up study in middle-aged finnish women. J Clin Med. 2020;9(5):1588. PMID: 32456169; https://doi.org/10.3390/jcm9051588.

51. Nair AR, Pillai AJ, Nair N. Cardiovascular changes in menopause. Curr Cardiol Rev. 2020;17(4):e230421187681. PMID: 33155924; https://doi.org/10.2174/1573403X16666201106141811.

52. Peixoto SV, Mambrini JVM, Firmo JOA, et al. Physical activity practice among older adults: Results of the ELSI-Brazil. Rev Saude Publica. 2018;52(Suppl 2):5s. PMID: 30379280; https://doi.org/10.11606/S1518-8787.2018052000605.

53. Socoloski TS, Rech CR, Correa Junior JA, et al. Barreiras para a prática de atividade física em idosos: revisão de escopo de estudos brasileiros. Rev Bras Ativ Fis Saude. 2021;26:1-8. https://doi.org/10.12820/rbafs.26e0208.

54. Kretschmer AC, Dumith SC. Physical activity in leisure-time and perceived environment: A population-based study with adults and the elderly from southern Brazil. Rev Bras Epidemiol. 2020;23:e200043. PMID: 32428192; https://doi.org/10.1590/1980-549720200043.

55. Cunha UC, Dias CMSB. A recoabitação dos filhos e netos na perspectiva de idosas chefes de família. Contextos Clinic. 2019;12(2):599-616. https://doi.org/10.4013/ctc.2019.122.10.

56. Silva PAB, Sacramento AJ, Carmo CID, et al. Factors associated with metabolic syndrome in older adults: a population-based study. Rev Bras Enferm. 2019;72(Suppl 2):221-8. https://doi.org/10.1590/0034-7167-2018-0620.

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The Latin American Integration Route and infectious diseases

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An intricate relationship between growing trade, population migration, and mobility has emerged as a significant force shaping the dynamics of infectious disease spread.[1] In today's globalized world, the intensification of international connectivity and advancements in transportation technologies have opened unprecedented avenues for pathogens to cross borders swiftly.[2] The recent coronavirus disease pandemic vividly illustrates how extensive transportation networks and heightened interconnectivity facilitate the rapid global dissemination of pathogens.[3]

In this scenario, the Latin American Integration Route (RILA), also known as the Bioceanic Corridor, represents a strategic logistical integration project aimed at establishing a direct connection between the Atlantic and Pacific Oceans, thus promoting efficient interconnections among different countries in South America. This ambitious corridor connecting Brazil, Paraguay, Argentina, and Chile holds the potential to boost trade, reduce distances, and strengthen economic ties among the involved nations.[4] Its history traces back to regional integration initiatives in South America, especially among Mercosur countries, aiming to create a land Route facilitating the transportation of goods and stimulating economic development in the traversed regions.[5]

In Brazil, the RILA begins in the state of Mato Grosso do Sul and passes through strategic cities, such as Campo Grande and Porto Murtinho. Upon entering Paraguay, it traverses localities, such as Carmelo Peralta, Mariscal José Félix Estigarribia, Boquerón, and Pozo Hondo. In Argentina, the Corridor covers Misión La Paz, Tartagal, Jujuy, and Salta before reaching Chile and connecting to the ports of Mejillones and Iquique.[6]

With respect to the RILA, the state of Mato Grosso do Sul has gained attention for grappling with endemic arboviruses and infectious diseases. The intricate interplay of macro-environmental and cultural factors, involving the expansion of railway infrastructure, deforestation of natural habitats, and environmental alterations, has significantly amplified the influx of individuals, including workers, travelers, and migrants, who are eagerly pursuing economic opportunities. The establishment of settlements in close proximity to railway lines and unbridled urban expansion compounds the challenges, as evidenced by the heightened prevalence of diseases such as leishmaniasis and dengue.[7,8] Furthermore, municipalities near the RILA in the state of Mato Grosso do Sul have shown a higher incidence of tuberculosis than the Brazilian average.[9] This unfavorable situation may be further exacerbated by the continuous flow of people through the Bioceanic Corridor.

Directing attention to the health of travelers within this region is important and demands collaborative efforts among the nations along the RILA.[10] The concept of "traveler health" takes center stage, emphasizing not only the well-being of individuals on the move but also the potential impact on the global public health. Educational initiatives are of utmost significance, aiming to raise awareness about the risks associated with arboviruses and emphasize preventive measures.[11] This includes immunization as well as an understanding of the environmental factors contributing to disease transmission.[12]

Notably, since 2022, the governments of Brazil, Paraguay, Argentina, and Chile have been meeting at the "Subnational Territories Forum of the Bioceanic Capricorn Corridor" event. In 2024, the forum held its 5th meet, focusing on issues such as economic development, governance, logistics, transportation, and tourism.[13-15] However, despite the critical health challenges posed by increased mobility, the topic of health has yet to gain significant visibility on the forum's agenda or in international agreements. This oversight underscores the need for a greater emphasis on health strategies to

address the emerging risks associated with the Bioceanic Corridor and ensure a more comprehensive approach to regional integration. The project for constructing the Bioceanic Corridor must go beyond the economic benefits,[16] and its effects on the health and quality of life of the population should be investigated.

Limitations

This paper offers a critical and forward-looking perspective on the health challenges associated with the RILA. However, it is important to acknowledge that this analysis is preliminary and is based on current data and scenarios that may evolve over time. The discussion presented here is limited by the data availability and the inherent complexity of the global health phenomena, which involve numerous variables and dynamic factors.

Future directions

We have determined that health policies should be directed towards the RILA. Preventive strategies should address the root causes of disease spread, focusing on sustainable development practices that consider public health implications. Initiatives advocating responsible urbanization and reforestation play a fundamental role in mitigating the environmental factors that contribute to disease propagation. As the RILA becomes a focal point of regional integration, a comprehensive approach to global health strategies must be the public policy.

Ensuring accessible and quality healthcare services along the Corridor is the cornerstone of disease control. The strategic establishment of healthcare facilities along the RILA and ensuring the availability of necessary medical resources contribute significantly to the effective management of health risks.

Moreover, we emphasize the importance of research in understanding the intricate relationship between the RILA and health dynamics. Research initiatives should explore the specific health challenges faced by travelers along the Corridor, focusing on the prevalence of arboviruses, infectious disease transmission patterns, and socio-environmental factors influencing health outcomes. Collaborative research initiatives across the involved countries can provide valuable insights into formulating evidence-based strategies for health protection.

Formulation of cross-border agreements and protocols among the countries involved is imperative. These agreements should outline joint efforts to monitor and manage the health risks associated with the RILA. Information-exchange mechanisms, early warning systems, and coordinated responses to disease outbreaks are essential components of such agreements.

CONCLUSION

Transnational collaboration plays a pivotal role in addressing the health challenges posed by the RILA. Comprehensive strategies encompassing education, prevention, and healthcare, supported by robust international cooperation and research endeavors, are essential to minimize the impact of population mobility on disease transmission. The conclusion of this monumental project slated for the year 2027 raises some questions. Are we truly prepared for the potential impact of RILA on Brazil and the world? Are we adequately considering the ramifications of disease spread and traveler health? The intricate interplay between increased connectivity and disease dynamics necessitates a proactive and vigilant approach to ensure the well-being of both the local and transient populations along the Corridor. As a global community, are we adept to meet this challenge and prepare for the health implications that come with such transformative endeavors?

REFERENCES

1. Relman DA, Choffnes ER, Mack A. Infectious disease movement in a borderless world: workshop summary. Washington, D.C.: National Academies Press; 2010.

2. Jean-Paul Rodrigue. The Geography of Transport Systems. Vol. 5. New York: Routledge; 2020. Available from: https://transportgeography.org/. Accessed in 2024 (Feb. 07).

3. Baker RE, Mahmud AS, Miller IF, et al. Infectious disease in an era of global change. Nat Rev Microbiol. 2022;20(4):193-205. PMID: 34646006; https://doi.org/10.1038/s41579-021-00639-z.

4. Castro JCP de. Analytical Studies about the Bioceanic Corridor. Interações. 2021;22(4):1061-76. https://doi.org/10.20435/inter.v22i4.3484.

5. Abrita MB, Vignandi RS, Centurião DAS, et al. Dynamics of local productive arrangements in the municipalities of Mato Grosso do Sul considering the transformations of the Bioceanic Corridor. PLoS One. 2023;18(4):e0284023. PMID: 37027370; https://doi.org/10.1371/journal.pone.0284023.

6. Ferreira ML, Castilho MA, Oliveira EM. Brasil, Paraguai, Argentina e Chile / Rota Bioceânica: relações culturais no território vivido. Interações. 2019;20(spe):69-89. https://doi.org/10.20435/inter.v20iespecial.2299.

7. Castilho de Arruda LD, Giovanetti M, Fonseca V, et al. Dengue fever surveillance in Mato Grosso do Sul: insights from genomic analysis and implications for public health strategies. Viruses. 2023;15(9):1790. PMID: 37766197; https://doi.org/10.3390/v15091790.

8. Neitzke-Abreu HC, Andrade GMC, Almeida PS, et al. Natural infection of Lutzomyia longipalpis (Lutz & Neiva, 1912) by Leishmania infantum in a municipality with a high incidence of visceral leishmaniasis in the Brazilian Midwest. Rev Soc Bras Med Trop. 2023;56:e02592023. PMID: 37792832; https://doi.org/10.1590%2F0037-8682-0259-2023.

9. Cunha JPA, Campos RV, Maciel RF, Marques AMC. Magnitude of tuberculosis on the Bioceanic Route: an epidemiological description. Interações. 2021;22(4):1385-95. https://doi.org/10.20435/inter.v22i4.3475.

10. Mehendale AM, Vaishnav L, Joshi SH, Joshi A. Public health importance of emporiatrics: a review. Cureus. 2023;15(3):e36343. PMID: 37082503; https://doi.org/10.7759/cureus.36343.

11. Wendt S, Beier D, Paquet D, et al. Medical Advice for Travelers. Dtsch Arztebl Int. 2021;118(21):349-56. PMID: 33597073; https://doi.org/10.3238/arztebl.m2021.0127.

12. Mouchtouri VA, Christoforidou EP, An der Heiden M, et al. Exit and entry screening practices for infectious diseases among travelers at points of entry: looking for evidence on public health impact. Int J Environ Res Public Health. 2019;16(23):4638. PMID: 31766548; https://doi.org/10.3390/ijerph16234638.

13. Brasil. No Chile, MTur participa da 2ª edição do Fórum do Corredor Bioceânico. Ministério do Turismo, 11/22/2022. Available from: https://www.gov.br/turismo/pt-br/assuntos/noticias/no-chile-mtur-participa-da-2o-edicao-do-forum-do-corredor-bioceanico. Accessed in 2025 (Jan. 22).

14. Instituto de Pesquisa Econômica Aplicada. Ipea apresenta modelo de governança do corredor bioceânico em fórum na Argentina. IPEA, 04/14/2023. Available from: https://www.ipea.gov.br/portal/categorias/45-todas-as-noticias/noticias/13676-ipea-apresenta-modelo-de-governanca-do-corredor-bioceanico-em-forum-na-argentina. Accessed in 2025 (Jan. 22).

15. Rota Bioceânica. 5º Fórum do Corredor Rodoviário Bioceânico: uma obra que poderá ser licitada por ordem do então ministro Santiago Peña. Rota Bioceânica, 06/21/2024. Available from: https://rotabioceanica.com.br/2024/06/5o-forum-do-corredor-rodoviario-bioceanico-uma-obra-que-podera-ser-licitada-por-ordem-do-entao-ministro-santiago-pena/. Accessed in 2025 (Jan. 22).

16. Fernandes TADS, Urquiza AHA, Cruz RL. O trabalho frente à implementação do Corredor Bioceânico em Mato Grosso do Sul. Interações. 2024;25(1):e2514218. https://doi.org/10.20435/inter.v25i1.4218.

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INSTRUCTIONS FOR AUTHORS

Scope and indexing

São Paulo Medical Journal (formerly Revista Paulista de Medicina) was founded in 1932 and is published bimonthly by Associação Paulista de Medicina, a regional medical association in Brazil.

The Journal accepts articles in English in the fields of evidence-based health, including internal medicine, epidemiology and public health, specialized medicine (gynecology & obstetrics, mental health, surgery, pediatrics, urology, neurology and many others), and also physical therapy, speech therapy, psychology, nursing and healthcare management/administration.

São Paulo Medical Journal's articles are indexed in MEDLINE, LILACS, SciELO, Science Citation Index Expanded, Journal Citation Reports/Science Edition (ISI) and EBSCO Publishing.

Editorial policy

Papers with a commercial objective will not be accepted: please review the Journal's conflicts of interest policy below.

São Paulo Medical Journal accepts manuscripts previously deposited in a trusted preprint server.

São Paulo Medical Journal supports Open Science practices. It invites reviewers to join Open Peer Review practices through acceptance that their identities can be revealed to the authors of articles. However, this is purely an invitation: reviewers may also continue to provide their input anonymously.

São Paulo Medical Journal is an open-access publication. This means that it publishes full texts online with free access for readers.

São Paulo Medical Journal applies a publication fee in the form of an article processing charge (APC) for all studies conducted outside of Brazil. This rate will be charged to the corresponding author when the study has been accepted on the grounds of its scientific merit. This fee is US$ 500.00 and is independent of the length of the text. The corresponding author should wait to receive the journal's invoice before making the payment. The article will only be published after presentation of the proof of payment. Submission is free for all. Associação Paulista de Medicina provides financial support for the Journal.

Articles accepted for publication become the Journal's property for copyright purposes, in accordance with Creative Commons attribution type BY.

Transparency and integrity: guidelines for writing

The Journal recommends that all articles submitted should comply with the editorial quality standards established in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals,[1] as updated in the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals. These standards were created and published by the International Committee of Medical Journal Editors (ICMJE) as a step towards integrity and transparency in science reporting and they were updated in December 2018.[1]

All studies published in *São Paulo Medical Journal* must be described in accordance with the specific guidelines for papers reporting on clinical trials (CONSORT),[2] systematic reviews and meta-analyses (PRISMA),[3,4] observational studies (STROBE),[5,6] case reports (CARE)[7] and accuracy studies on diagnostic tests (STARD).[8,9] These guidelines ensure that all methodological procedures have been described, and that no result has been omitted. If none of the above reporting guidelines are adequate for the study design, authors are encouraged to visit the EQUATOR Network website (http://www.equator-network.org/) to search for appropriate tools.

Conflicts of interest

Authors are required to describe any conflicts of interest that may exist regarding the research or the publication of the article. Failure to disclose any conflicts of interest is a form of misconduct.

Conflicts of interest may be financial or non-financial. The Journal recommends that the item "Conflicts of interest" at http://www.icmje.org should be read to obtain clarifications regarding what may or may not be considered to be a conflict of interest. The existence and declaration of conflicts of interest is not an impediment to publication at all.

Acknowledgements and funding

Grants, bursaries and any other financial support for studies must be mentioned separately, after the references, in a section named "Acknowledgements." Any financial support should be acknowledged, always with the funding agency name, and with the protocol number whenever possible. Donation of materials used in the research can and should be acknowledged too.

This section should also be used to acknowledge any other contributions from individuals or professionals who have helped in producing or reviewing the study, and whose contributions to the publication do not constitute authorship.

Authorship

The Journal supports the position taken by the ICMJE (http://www.icmje.org) regarding authorship. All authors should read ICMJE's recommendations to obtain clarifications regarding the criteria for authorship and to verify whether all of them have made enough contributions to be considered authors.[10]

All authors of articles published in *São Paulo Medical Journal* need to have contributed actively to the discussion of the study results and should review and approve the final version that is to be released. If one author has not contributed enough or has not approved the final version of the manuscript, he/she must be transferred to the Acknowledgement section.

The corresponding author is the primary guarantor of all ethical issues relating to the manuscript, before, during and after its

publication. However, *São Paulo Medical Journal* and ICMJE consider that all authors are held fully responsible for the study, regarding the accuracy or integrity of data and data interpretation in the text. Contributions such as data collection only do not constitute authorship.

The addition or deletion of authors' names in the manuscript byline is possible only if the corresponding author provides the reason for the rearrangement and a written signed agreement from all authors. Modifications to the order of the authors are possible, but also need to be justified. Authors whose names are removed or inserted must agree with this in writing. Publication of the article cannot proceed without a declaration of authorship contributions signed by all authors.

São Paulo Medical Journal supports the ORCID initiative. All authors should create an ORCID identification (ID) record (in www.orcid.org) before submitting their article and should link the submission to their existing ORCID ID in the electronic submission system. ORCID identifications help to distinguish researchers with similar names, give credit to contributors and link authors to their professional affiliations. In addition, this may increase the ability of search engines to retrieve articles.

São Paulo Medical Journal supports Open Science practices. Authors must therefore complete an open science compliance form, which is available from: https://wp.scielo.org/wp-content/uploads/Open-Science-Compliance-Form_en.docx.

Redundant or duplicate publication

São Paulo Medical Journal will avoid publishing redundant or duplicate articles. The Journal agrees with the ICMJE definition of redundant publication,[11] i.e. an attempt to report or publish the same results from a study twice. This includes but is not limited to publication of patient cohort data that has already been published, without clear reference to the previous publication. In situations in which authors are making a secondary analysis on data that has already published elsewhere, they must state this clearly. Moreover, the outcomes assessed in each analysis should be clearly differentiated.

The Journal's peer review policy and procedures

After receipt of the article through the electronic submission system, it will be read by the editorial team, who will check whether the text complies with the Journal's Instructions for Authors regarding format. The Journal has adopted the *CrossRef Similarity Check* system for identifying plagiarism and any text that has been plagiarized, in whole or in part, will be promptly rejected. Self-plagiarism will also be monitored.

When the general format of the manuscript is deemed acceptable and fully compliant with these Instructions for Authors, and only then, the editorial team will submit the article to the Editor-in-Chief, who will firstly evaluate its scope. If the editor finds that the topic is of interest for publication, he will assign at least two reviewers/referees with expertise in the theme, to evaluate the quality of the study. After a period varying from one to several weeks, the authors will then receive the reviewers' evaluations and will be required to provide all further information requested and the corrections that may be necessary for publication. These reviewers, as well as the Editorial Team and the Editor-in-Chief, may also deem the article to be unsuitable for publication by *São Paulo Medical Journal* at this point.

At the time of manuscript submission, the authors will be asked to indicate the names of three to five referees. All of them should be from outside the institution where the authors work and at least two should preferably be from outside Brazil. The Editor-in-Chief is free to choose them to review the paper or to rely on the *São Paulo Medical Journal's* Editorial Board alone.

Articles will be rejected without peer review if:
- they do not present Ethics Committee approval (or a justification for the absence of this);
- they fail to adhere to the format for text and figures described here.

After peer review

Peer reviewers, associated editors and the Editor-in-Chief may ask for clarifications or changes to be made to the manuscript. The authors should then send their article back to the Journal, with the modifications made as requested. Changes to the text should be highlighted (in a different color or using a text editor tool to track changes). Failure to show the changes clearly might result in the paper being returned to the authors.

The modified article must be accompanied by a letter answering the referees' comments, point by point. The modified article and the response letter are presented to the editorial team and reviewers, who will verify whether the problems have been resolved adequately. The text and the reviewers' final evaluations, along with the response letter, will then be sent to the Editor-in-Chief for a decision.

Manuscripts that are found to be suitable for publication through their scientific merit will be considered "provisionally accepted". However, all articles will subsequently be scrutinized to check for any problems regarding the reporting, i.e. sentence construction, spelling, grammar, numerical/statistical problems, bibliographical references and other matters that may arise, especially in the Methods section. The adherence to reporting guidelines will be checked at this point, and the staff will point out any information regarding methodology or results that the authors should provide. This is done in order to ensure transparency and integrity of publication, and to allow reproducibility.

The editorial team will then provide page proofs for the authors to review and approve. No article is published without this final author approval. All authors should review the proof, although the Journal asks the corresponding author to give final approval.

Submission

Articles should be submitted only after they have been formatted as described below. Texts must be submitted exclusively through the Internet, using the Journal's electronic submission system, which is available at http://mc04.manuscriptcentral.com/spmj-scielo. Submissions sent by e-mail or through the post will not be accepted.

The manuscript should be divided into two files. The first of these, the main document ("blinded"), should contain the article title, article type, keywords and abstract, article text, references and tables, but must omit all information about the authors. The second of these, the "title page", should contain all the information about the authors.

To format these documents, use Times New Roman font, font size 12, line spacing 1.5, justified text and numbered pages.

The corresponding author is responsible for the submission. However, all authors should approve the final version of the manuscript that is to be submitted and should be aware of and approve any changes that might be made after peer review.

Covering letter

All manuscripts must be submitted with a covering letter signed at least by the corresponding author. The letter must contain the following five essential items relating to the manuscript:

1. a declaration that the manuscript is original and that the text is not under consideration by any other journal;
2. a statement that the manuscript has been approved by all authors, who agree to cede the copyrights to the Journal, disclose all sources of funding and declare all potential conflicts of interest;
3. a statement that the study protocol was endorsed by an Internal Review Board (Ethics Committee), including the date and number of the approval (in the case of original articles). This is required for absolutely all studies involving human subjects or patient data (such as medical records), in accordance with the Committee on Publication Ethics (COPE) guidelines, and even for case reports. A copy of the approval document must be submitted to the Journal;
4. each author should indicate a valid, up-to-date email address for contact;
5. a list of a minimum of five potential referees outside of the authors' institutions, who could be invited, at the Editor-in-Chief's discretion, to evaluate the manuscript.

General guidelines for original articles

The following are considered to be full-text original articles: clinical trials; cohort, case-control, prevalence, incidence, accuracy and cost-effectiveness studies; case series (i.e. case reports on more than three patients analyzed together); and systematic reviews with or without meta-analysis. These types of article should be written with a maximum of 3,500 words (from the introduction to the end of the conclusion).

Typical main headings in the text include Introduction, Methods, Results, Discussion and Conclusion. The authors can and should use short subheadings too, especially those concerning the reporting guideline items.

Trial and systematic review registration policy

São Paulo Medical Journal supports the clinical trial registration policies of the World Health Organization (WHO) and the International Committee of Medical Journal Editors (ICMJE) and recognizes the importance of these initiatives for registration and international dissemination of information on randomized clinical trials, with open access. Thus, since 2008, manuscripts on clinical trials are accepted for publication if they have received an identification number from one of the public clinical trial registration database (such as ClinicalTrials.gov and/or REBEC and/or the World Health Organization; the options are stated at http://www.icmje.org). The identification number should be declared at the end of the abstract. Articles describing systematic reviews must provide the protocol registration number from a reliable database, such as PROSPERO, Open Science Framework, Cochrane, Joanna Briggs and others. Articles presenting clinical trials or systematic reviews without registration protocols will be promptly rejected without peer review.

Results from cases with DNA sequences must be deposited in appropriate public databases. The protocol number or URL can be requested at any time during the editorial review. Publication of other research data in public repositories is also recommended, since it contributes towards replicability of research, increases article visibility and possibly improves access to health information.

Sample size

All studies published in SPMJ must present a description of how the sample size was arrived at. If it was a convenience or purposive sample, the authors must declare so and explain the characteristics of this sample and recruitment method. For clinical trials, for instance, it is mandatory to inform each of the three main values used to calculate sample size:

- power (usually 80% or more);
- level of significance (usually 0.05 or lower);
- clinically meaningful difference (effect size targeted), according to the main outcome measurement.

Regardless of study results (if "positive" or "negative"), the journal will probably reject articles of trials using underpowered samples, when sample size has not been properly calculated or the calculation has not been fully described as indicated above.

Abbreviations, acronyms and products

Abbreviations and acronyms must not be used, even those in everyday use, unless they are defined when first used in the text. However, authors should avoid them for clarity whenever possible. Drugs or medications must be referred to using their generic names (without capital letters), with avoidance of casual mention of commercial or brand names.

Interventions

All drugs, including anesthetics, should be followed by the dosage and posology used.

Any product cited in the Methods section, such as diagnostic or therapeutic equipment, tests, reagents, instruments, utensils, prostheses, orthoses and intraoperative devices, must be described together with the manufacturer's name and place (city and country) of manufacture in parentheses. The version of the software used should be mentioned.

Any other interventions, such as exercises, psychological assessments or educational sessions, should be described in enough details to allow reproducibility. The Journal recommends that the TIDieR reporting guidelines should be used to describe interventions, both in clinical trials and in observational studies.[13]

Supplementary material

Because supplementary material comprises documents that do not form part of the text of the manuscript, São Paulo Medical Journal will not publish it. The authors should cite an access link that allows readers to view the supplementary material.

Short communications

Short communications are reports on the results from ongoing studies or studies that have recently been concluded for which urgent publication is important. They should be structured in the same way as original articles. The authors of this kind of communication should explain, in the covering letter, why they believe that publication is urgent. Short communications and case reports must be limited to 1,000 words (from the introduction to the end of the conclusion).

Case reports, case series, narrative reviews and letters to the editor

Starting in June 2018, only individual case reports dealing with situations of public health emergencies will be accepted by *São Paulo Medical Journal*. Case reports that had already been accepted for publication up to May 2018 will still be published in a timely manner.

After initial evaluation of scope by the editor-in-chief, case reports, case series and narrative reviews will be considered for peer-review evaluation only when accompanied by a systematic search of the literature, in which relevant studies found (based on their level of evidence) are presented and discussed.[12] The search strategy for each database and the number of articles obtained from each database should be shown in a table. This is mandatory for all case reports, case series and narrative reviews submitted for publication. Failure to provide the search description will lead to rejection before peer review.

The access route to the electronic databases used should be stated (for example, PubMed, OVID, Elsevier or Bireme). For the search strategies, MeSH terms must be used for Medline, LILACS, and Cochrane Library. DeCS terms must be used for LILACS. EMTREE terms must be used for Embase. Also, for LILACS, the search strategy must be conducted using English (MeSH), Spanish (DeCS) and Portuguese (DeCS) terms concomitantly. The search strategies must be presented exactly as they were used during the search, including parentheses, quotation marks and Boolean operators (AND, OR, and NOT). The search dates should be indicated in the text or in the table.

Patients have the right to privacy. Submission of case reports and case series must contain a declaration that all patients gave their consent to have their cases reported (even for patients cared for in public institutions), in text and images (photographs or imaging examination reproductions). The Journal will take care to cover any anatomical part or examination section that might allow patient identification. For deceased patients whose relatives cannot be contacted, the authors should consult the Editor-in-Chief. All case reports and case series must be evaluated and approved by an ethics committee.

Case reports should be reported in accordance with the CARE Statement,[7] including a timeline of interventions. They should be structured in the same way as original articles.

Case reports must not be submitted as letters. Letters to the editor address articles that have been published in the *São Paulo Medical Journal* or may deal with health issues of interest. In the category of letters to the editor, the text has a free format, but must not exceed 500 words and five references.

FORMAT: FOR ALL TYPES OF ARTICLES

Title page

The title page must contain the following items:

1. Type of paper (original article, review or updating article, short communication or letter to the editor);
2. Title of the paper in English, which should be brief but informative, and should mention the study design.[14] Clinical trial, cohort, cross-sectional or case-control study, and systematic review are the most common study designs. Note: the study design declared in the title should be the same in the methods and in the abstract;
3. Full name of each author. The editorial policy of the *São Paulo Medical Journal* is that abbreviations of authors' names must not be used; therefore, we ask that names be stated in full, without using abbreviations;
4. Place or institution where the work was developed, city and country;
5. Each author should indicate the way his/her name should be used in indexing. For example: for "João Costa Andrade", the indexed name could be "Costa-Andrade J." or "Andrade JC", as preferred;
6. The author's professional background (Physician, Pharmacist, Nurse, Dietitian or another professional description, or Undergraduate Student); and his/her position currently held (for example, Master's or Doctoral Student, Assistant Professor, Associate Professor or Professor), in the department and institution where he/she works, and the city and country (affiliations);

7. Each author should present his/her ORCID identification number (as obtained from HYPERLINK "http://www.orcid.org/" www.orcid.org);

8. Each author must inform his contribution, preferably following the CRediT system (see above in Authorship);

9. Date and venue of the event at which the paper was presented, if applicable, such as congresses, seminars or dissertation or thesis presentations.

10. Sources of financial support for the study, bursaries or funding for purchasing or donation of equipment or drugs. The protocol number for the funding must be presented with the name of the issuing institution. For Brazilian authors, all grants that can be considered to be related to production of the study must be declared, such as fellowships for undergraduate, master's and doctoral students; along with possible support for postgraduate programs (such as CAPES) and for the authors individually, such as awards for established investigators (productivity; CNPq), accompanied by the respective grant numbers.

11. Description of any conflicts of interest held by the authors (see above).

12. Complete postal address, e-mail address and telephone number of the author to be contacted about the publication process in the Journal (the "corresponding author"). This author should also indicate a postal address, e-mail address and telephone number that can be published together with the article. *São Paulo Medical Journal* recommends that an office address (rather than a residential address) should be informed for publication.

Second page: abstract and keywords

The second page must include the title and a structured abstract in English with a maximum of 250 words. References must not be cited in the abstract.

The following headings must be used in the structured abstract:

- Background – Describe the context and rationale for the study;
- Objectives - Describe the study aims. These aims need to be concordant with the study objectives in the main text of the article, and with the conclusions;
- Design and setting – Declare the study design correctly, and the setting (type of institution or center and geographical location);
- Methods – Describe the methods briefly. It is not necessary to give all the details on statistics in the abstract;
- Results – Report the primary results;
- Conclusions – Make a succinct statement about data interpretation, answering the research question presented previously. Check that this is concordant with the conclusions in the main text of the article;
- Clinical Trial or Systematic Review Registration – Mandatory for clinical trials and systematic reviews; optional for observational studies. List the URL, as well as the Unique Identifier, on the publicly accessible website on which the trial is registered.

- MeSH Terms - Three to five keywords in English must be chosen from the Medical Subject Headings (MeSH) list of Index Medicus, which is available at http://www.ncbi.nlm.nih.gov/sites/entrez?db=mesh. These terms will help librarians to quickly index the article.

- Author keywords - The authors should also add three to six "author keywords" that they think express the main article themes. These keywords should be different from the MeSH terms and preferably different from words already used in the title and abstract, so as to improve the discoverability of the article by readers doing a search in PubMed. They provide an additional chance for the article to be retrieved, read and cited. Combinations of words and variations (different wording or plurals, for example) are encouraged.

References

For any manuscript, all statements in the text that do not result from the study presented for publication in the *São Paulo Medical Journal* but from other studies must be accompanied by a quotation of the source of the data. All statements regarding health statistics and epidemiological data should generally be followed by references to the sources that generated this information, even if the data are only available electronically.

São Paulo Medical Journal uses the reference style known as the "Vancouver style," as recommended by the International Committee of Medical Journal Editors (ICMJE). Follow the instructions and examples at www.icmje.org, item "References", for the format.

In the text, the references must be numbered in the order of citation. The citation numbers must be inserted after periods/full stops or commas in sentences, and in superscript (without parentheses or square brackets). References cited in the legends of tables and figures must maintain sequence with the references mentioned in the text.

In the list of references, all the authors must be listed if there are up to and including five authors; if there are six or more, the first three should be cited, followed by the expression "et al." For books, the city of publication and the name of the publishing house are mandatory. For texts published on the internet, the complete uniform resource locator (URL) or address is necessary (not only the main home page of a website or link), so that by copying the complete address into a computer internet browser, the Journal's readers will be taken to the exact document cited, and not to a general website.

At the end of each reference, please insert the "PMID" number (for papers indexed in PubMed) and the link to the "DOI" number if available.

Authors are responsible for providing a complete and accurate list of references. All references cited in the text must appear in the reference list, and every item in the reference list must be cited in the text. Also, citations must be in the correct sequence.

Manuscripts that do not follow these guidelines for references will be returned to the authors for adjustments.

The reference list should be inserted after the conclusions and before the tables and figures.

Figures and tables

Images must be submitted at a minimum size that is reproducible in the printed edition. Figures should be sent at a resolution of 300 DPI and minimum size of 2,500 pixels (width) and be recorded in ".jpg" or ".tif" format. Images submitted in inadequate formats will not be accepted.

Images must not be embedded inside Microsoft PowerPoint or Microsoft Word documents, because this reduces the image size. Authors must send the images separately, outside of .doc or .ppt documents. Failure to send the original images at appropriate sizes leads to paper rejection before peer review.

Flowcharts are an exception: these must be drawn in an editable document (such as Microsoft Word or PowerPoint), and should not be sent as an image that can't be changed.

Figures such as bars of line graphs should be accompanied by the tables of data from which they have been generated (for example, sending them in the Microsoft Excel spreadsheets, and not as image files). This allows the Journal to correct legends and titles if necessary, and to format the graphs according to the Journal's style. Graphs generated from software such as SPSS or RevMan must be generated at the appropriate size, so that they can be printed (see above). Authors must provide internal legends/captions in correct English.

All the figures and tables should be cited in the text. All figures and tables must contain legends or titles that precisely describe their content and the context or sample from which the information was obtained (i.e. what the results presented are and what the kind of sample or setting was). The reader should be able to understand the content of the figures and tables simply by reading the titles (without the need to consult the text), i.e. titles should be complete. Acronyms or abbreviations in figure and table titles are not acceptable. If it is necessary to use acronyms or abbreviations inside a table or figure (for better formatting), they must be spelled out in a legend below the table or figure.

For figures relating to microscopic findings (i.e. histopathological results), a scale must be embedded in the image to indicate the magnification used (just like in a map scale). The staining agents (in histology or immunohistochemistry evaluations) should be specified in the figure legend.

DOCUMENTS CITED

1. Internal Committee of Medical Journal Editors. Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals. Available from: http://www.icmje.org/recommendations/. Accessed in 2019 (March 11).

2. The CONSORT Statement. Available from: http://www.consort-statement.org/. Accessed in 2018 (May 3).

3. Moher D, Cook DJ, Eastwood S, et al. Improving the quality of reports of meta-analyses of randomised controlled trials: the QUOROM statement. Br J Surg 2002. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1046/j.1365-2168.2000.01610.x. Accessed in 2019 (April 4).

4. PRISMA. Transparent Reporting of Systematic Reviews and Meta-Analyses. Available from: www.prisma-statement.org. Accessed in 2019 (April 4).

5. STROBE Statement. Strengthening the reporting of observational studies in epidemiology. What is strobe? Available from: http://www.strobe-statement.org/. Accessed in 2018 (May 3).

6. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008;61(4):344-9. PMID: 18313558. doi: 10.1016/j.jclinepi.2007.11.008.

7. The CARE Guidelines: Consensus-based Clinical Case Reporting Guideline Development. Enhancing the QUAlity and Transparency Of health Research. Available from: https://www.equator-network.org/reporting-guidelines/care/. Accessed in 2018 (May 3).

8. STARD Statement. STAndards for the Reporting of Diagnostic accuracy studies. Available from: http://www.equator-network.org/reporting-guidelines/stard/. Accessed in 2018 (May 3).

9. Rennie D. Improving reports of studies of diagnostic tests: the STARD initiative. JAMA. 2003;289(1):89-90. doi:10.1001/jama.289.1.89.

10. International Committee of Medical Journal Editors (ICMJE). Defining the Role of Authors and Contributors. Available from: http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html. Accessed in 2019 (March 11).

11. International Committee of Medical Journal Editors. Overlapping Publications. Available from: http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/overlapping-publications.html. Accessed in 2018 (Feb 18).

12. Phillips B, Ball C, Sackett D, et al. Oxford Centre for Evidence-based Medicine Levels of Evidence (March 2009). Available from: https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/. Accessed in 2018 (May 3).

13. Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. BMJ. 2014;348:g1687. PMID: 24609605; doi: 10.1136/bmj.g1687.

14. Non-randomised controlled study (NRS) designs. Available from: http://childhoodcancer.cochrane.org/non-randomised-controlled-study-nrs-designs. Accessed in 2018 (May 3).

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