VOLUME 29

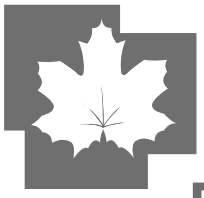
Revista Brasileira de Geriatria e Gerontologia

Brazilian Journal of Geriatrics and Gerontology

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ISSN 1981-2256



Revista Brasileira de Geriatria e Gerontologia

Brazilian Journal of Geriatrics and Gerontology

VOLUME 29, 2026

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Knowledge and attitudes regarding sexuality according to sociodemographic and economic characteristics of older adults

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Lígia de Fátima Machado[2]
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Abstract

Objective: To evaluate the knowledge and attitudes of older adults regarding sexuality according to sociodemographic and economic factors. *Methods:* This quantitative, observational, cross-sectional study was conducted with 219 older adults in Uberaba, Minas Gerais, Brazil, through telephone contact between October 2020 and May 2021. Data were analyzed using statistical software. *Results:* Among all respondents, the mean age was 74.5 years, with a predominance of women; individuals who were married or living with a spouse or partner; those with incomplete primary education; Catholics; White individuals; and those with a household income below two minimum wages. Knowledge and attitudes regarding sexuality were associated with sex, marital status, and educational level. Male participants, those who were single, and those with higher levels of education demonstrated greater knowledge about sexuality. Regarding attitudes, women, widowed individuals, and those with lower educational levels exhibited a more conservative stance. *Conclusion:* The findings indicate that older adults' knowledge and attitudes regarding sexuality are associated with their sociodemographic characteristics. Healthcare professionals should be attentive to factors such as sex, marital status, and educational level, considering group differences related to sexuality. Health education initiatives and multidisciplinary, holistic approaches, free from stigma and prejudice, may contribute to the advancement of health policies directed at older adults, including the right to discuss the topic and experience sexuality with quality across different stages of life.

Keywords: Health of the Elderly. Sexuality. Sexual Health. Health Knowledge, Attitudes, Practice. Older Adults.

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Funding: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). Financing Code: APQ 420399/2018-6.

The authors declare that there is no conflict in the conception of this work.

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Received: July 24, 2025
Approved: November 24, 2025

http://dx.doi.org/10.1590/1981-22562026029.250118.en

INTRODUCTION

Certain physiological changes that naturally occur with advancing age, such as weight changes, reduced skin elasticity, and slowed metabolism, are commonly associated with a negative connotation of old age within the social context[1].

Although sexuality in later life can promote well-being and improve quality of life, it is often viewed solely as an attribute associated with youth and fertility, which leads to the neglect of the sexual needs of older adults[2,3].

When addressing this complex and challenging topic, it is essential to deconstruct the prejudices and stereotypes surrounding expressions of sexuality, recognizing them as a human right regardless of age group[3].

However, due to limited understanding of the physiological changes that occur during this stage of life, many older adults may withdraw from maintaining an active sexual life. The lack of understanding of these changes can result in misinterpretations regarding their capabilities[4].

Moreover, beyond biological factors, psychological, cultural, and social elements may influence how older adults experience and perceive sexuality[4]. Understanding these determinants contributes to the development of health actions aimed at reducing the negative impacts related to sexuality and encouraging older adults to discuss the topic, thereby demystifying existing taboos[4].

Conversely, limited knowledge about sexuality may lead to more negative attitudes and conservative views[5].

From this perspective, studies assessing the knowledge and attitudes of older adults regarding sexuality have predominantly focused on sexually transmitted infections (STIs) and their impact on health[5,6]. However, there is a scarcity of studies addressing sexuality while considering the sociodemographic and economic characteristics of older adults. These aspects are relevant because they may directly affect self-esteem, relationship quality, and sexual satisfaction[7].

Therefore, addressing this gap in the scientific literature may provide insights into how older adults experience sexuality, contributing to a broader understanding within this group, society, and healthcare professionals regarding sexual aptitude and desire during this stage of development[8]. This will enable healthcare professionals to better equip themselves to meet the needs of this age group more comprehensively, rather than limiting their focus solely to biological changes[9].

Thus, the present study aims to describe the sociodemographic and economic characteristics of the participants and to assess the knowledge and attitudes of older adults regarding sexuality according to sociodemographic and economic factors.

METHODS

This was a quantitative, observational, cross-sectional study. Data were collected in the urban area of Uberaba, Minas Gerais, Brazil, between October 2020 and May 2021.

The sample is part of a larger project titled "Survey on sexuality in older adults – ISI Project." A preexisting list was used from the project "Active Aging, Global Functionality, and Quality of Life among Older Adults in the Uberaba (MG) Health Microregion," conducted between May 2017 and June 2018, which provided contact information for 803 older adults who were able to answer telephone calls and respond to questions.

Individuals of both sexes aged 60 years or older were included in the study. In total, 219 older adults participated. The reasons for exclusions and losses were: 31 individuals had died; 45 were not in condition or were unable to respond by telephone due to illness, hearing impairment, or inability to verbalize; 98 chose not to participate; 195 could not be contacted due to phone number changes or invalid numbers; and 215 were not reached after at least six attempts made by interviewers on different days and at different times, even though the phone number existed and belonged to the individual.

Data were obtained through telephone contact conducted by 10 trained interviewers, and responses

were recorded directly on an online electronic form. After data collection, the information was transferred to an electronic spreadsheet. The questionnaire, which included sociodemographic and economic variables (sex, age, marital status, educational level, household income, number of individuals dependent on the income, race/ethnicity, and religion or belief), was developed by the researchers.

The Aging Sexual Knowledge and Attitudes Scale (ASKAS) is an instrument designed to better understand how older adults perceive and experience sexuality based on physiological and sociopsychological aspects. It contains 28 statements with response options structured on a Likert-type scale. Of these, 20 statements refer to the "knowledge" domain (true = 1, false = 2, do not know = 3), and the remaining eight statements correspond to "attitudes" (responses ranging from strongly disagree = 1 to strongly agree = 7). Lower scores indicate a higher level of knowledge on the subject. Regarding attitudes, lower scores suggest a more liberal perspective, whereas higher scores indicate a tendency toward more conservative views. The scale does not aim to identify the sexual profile of the older adult but to assess knowledge and attitudes toward sexuality at this stage of life.[10]

The study considered sociodemographic and economic variables, including sex (classified as female and male); age in years; and marital status (with or without a partner). Educational level was assessed based on formal schooling, including those who had never attended school, those with incomplete primary education, and those with complete primary education or higher.

Household income was expressed in minimum wages (MW) and categorized as less than two, two to three, and four or more. Self-reported race/ethnicity included the following options: Black and mixed-race ("Pardo") population, White, Asian, and Indigenous. Religion or belief included the categories Catholic, Spiritist and Kardecist, other religions or beliefs, no religion/belief, or agnostic. For all variables, the option "not reported" was available when the older adult preferred not to answer, with occurrences in marital status, educational level, number of individuals dependent on income, and religion/belief (n = 1), and in household income (n = 2).

Knowledge and attitudes were measured using the total score obtained on the ASKAS, allowing the evaluation of participants' level of information and whether their views were conservative or liberal.

For data analysis, categorical variables were presented using absolute and relative frequencies. Numerical variables were analyzed using measures of central tendency and dispersion with R software, version 4.0.0. Considering a finite population of 803 individuals and a 5% margin of error, a minimum of 261 participants was estimated to ensure statistically reliable estimates. However, due to restrictions imposed by the COVID-19 pandemic, responses were obtained from 219 individuals. With this sample size, the margin of error increased to 5.66%, as determined by statistical calculation.

Statistical analyses were conducted in R (RStudio). After assessing data normality through statistical tests and visual inspection of Q-Q plots, the Mann-Whitney test (or Wilcoxon test for independent samples) and the Kruskal-Wallis test were applied for comparisons between two or more groups, respectively. For multiple comparisons following the Kruskal-Wallis test, Dunn's post hoc test was used to identify which groups differed from one another. To control Type I error due to multiple comparisons, p-values were adjusted using the Bonferroni method. Effect size for the Mann-Whitney test was calculated as r (wilcox_effsize(), rstatix package) and converted to Cohen's ($d=2r/\sqrt{1-r^2}$) to estimate test power using pwr.t2n.test() (pwr package). For the Kruskal-Wallis test, effect size was estimated using eta-squared ($\eta^2=(H-k+1)/(n-k)$), where H is the test statistic, k is the number of groups, and is the sample size. Test power was estimated by approximation to an ANOVA using the effect size converted to f ($f=\sqrt{\eta^2/(1-\eta^2)}$) and the function pwr.anova.test() (pwr package). Effect size r for the Mann-Whitney test was interpreted as small ($r \approx 0.10$), moderate ($r \approx 0.30$), and large ($r \geq 0.30$). For the Kruskal-Wallis test, eta-squared values were interpreted as small ($\eta^2 \approx 0.01$), moderate ($\eta^2 \approx 0.06$), and large ($\eta^2 \approx 0.14$). A significance level of 5% was adopted, and tests with power greater than 80% were considered capable of detecting true differences between groups.

The project was approved by the Human Research Ethics Committee of the Universidade Federal do Triângulo Mineiro (UFTM), CAAE 07786819.2.0000.5154, under ruling no. 4,342,951. It complied with the recommendations set forth in Resolutions No. 466/2012 and No. 510/2016 of the National Health Council. The informed consent statement was read and subsequently sent via email or WhatsApp. At the time of the initial contact, the telephone number and email address of the principal investigator were also provided. Participants received prior information regarding the study objectives and procedures, data confidentiality, and the anonymity of their participation. Any questions raised were then addressed. Interviews began only after verbal consent was obtained from the participants.

DATA AVAILABILITY

The dataset supporting the findings of this study is available upon request from the corresponding author.

RESULTS AND DISCUSSION

Among the 219 participants, females predominated (62.1%) (Table 1), corroborating studies conducted in Brazilian cities[11,12]. The higher participation of older women may be related to their greater life expectancy, resulting from behavioral differences between sexes, considering that men often exhibit higher-risk behaviors such as alcohol and drug use, involvement in traffic accidents, and lower attention to health care[13].

The mean age was 74.5 years, with SD = ±7.9 years, median = 73 years, CV = 11%, Q1 = 69 years, and Q3 = 80 years, consistent with the increased longevity of Brazilians over recent decades, achieved through advances in health promotion policies, which include protective, preventive, and early disease detection measures[14].

Regarding marital status, most participants (53.7%) reported not having a partner (Table 1), diverging from studies conducted in Brazil with older adults[7,12]. This finding may be explained by the fact that, in the present study, participants without partners included individuals who had never married or cohabited, single individuals, widowed, separated, legally separated, or divorced. When assessed separately, following national trends, there is typically a predominance of married individuals. A literature review identified that partnership is associated with the experience of sexuality among older adults. Among older women, the lack or loss of a partner, such as in widowhood, appears to negatively affect engagement in sexual practices[15].

Participants had a low educational level, with the highest percentage reporting incomplete primary education (64.7%) (Table 1), similar to findings from studies conducted in Brazil[7,12]. The low educational level among older adults may be attributed to cultural influences prevalent during their childhood and youth. At that time, education was often undervalued in comparison with priorities such as marriage, family formation, early entry into the labor market, and limited access to educational institutions[16].

A total of 65.6% of respondents identified as Catholic (Table 1), a profile similarly observed in the Brazilian Northeast.[17] Older adults who follow Catholicism may often hold more traditionalist views about sexuality, reflecting principles that guide conservative attitudes among these adherents[5,15]. In this sense, religion may act as a guiding authority, as it establishes norms that define what is considered acceptable or unacceptable behavior and shapes individuals according to predetermined rules[18], which may influence, although not investigated in this study, their perspectives on sexuality.

Analysis of the race/ethnicity variable showed that 55.7% of participants self-identified as White. Regarding household income, most respondents reported an income below two minimum wages (43.1%). In addition, 42.5% of the participants belonged to families in which two individuals depended on the primary income (Table 1). It is worth noting that socioeconomic status influences the degree of knowledge about sexuality. Individuals with lower incomes have fewer opportunities and resources to acquire in-depth knowledge on the subject, and this limited access to appropriate information results in reduced understanding of sexual matters[19].

Table 1. Sociodemographic and economic profile of older adults participating in the study. Uberaba, Minas Gerais, Brazil, 2020–2021.

Variables	n (%)	95% CI*
Sex		
Female	136(62.1)	56.4 - 67.8
Male	83(37.9)	32.2 - 43.6
Marital status		
Without partner	117(53.7)	48.0 - 59.3
With partner	101(46.3)	40.7 - 52.0
Educational level		
No formal education	16(7.3)	1.7 - 13.0
Incomplete primary education	141(64.7)	59.0 - 70.3
Complete primary education or higher	61(28.0)	22.3 - 33.6
Household income (in minimum wages)		
< 2	93(43.1)	37.4 - 48.7
2 - 4	87(40.3)	34.6 - 45.9
4 or more	36(16.7)	11.0 - 22.3
Number of people who depend on the household income		
1	47(21.6)	15.9 - 27.2
2	93(42.5)	36.8 - 48.2
3	44(20.2)	14.5 - 25.8
4 or more	34(15.6)	9.9 - 21.3
Race/ethnicity		
Black population (Black and Mixed-race)	84(38.4)	32.7 - 44.0
White	122(55.7)	50.0 - 61.4
Asian and Indigenous	13(5.9)	0.3 - 11.6
Religion or belief		
Catholic	143(65.6)	59.9 - 71.3
Spiritist / Kardecist	34(15.6)	9.9 - 21.3
Other religions/beliefs	30(13.8)	8.1 - 19.4
No religion/belief or Agnostic	11(5.0)	0.0 - 10.7

*CI: Confidence interval. **Source:** Survey data.

The Mann–Whitney U test showed a significant difference in knowledge scores between sexes ($W = 7734$, $p < 0.001$). The effect size, calculated as r, was 0.31, classified as moderate. When converted to Cohen's d, the effect corresponded to $d \approx 0.65$, reinforcing that the magnitude of the difference is of moderate intensity. Specifically, female participants had significantly higher knowledge scores compared with male participants. Considering that lower scores indicate greater knowledge about sexuality, older men demonstrated greater knowledge than older women (Table 2). This finding aligns with the literature, showing that cultural and social norms have historically allowed men greater freedom to discuss and express issues related to sexuality and sex[7].

The way parents address sexuality varies according to the child's gender. Women receive more restrictive messages surrounding this topic, often conveyed through euphemisms, vague terms, and risk-based narratives such as pregnancy, and are subjected to stricter moral standards than men. Consequently,

differentiated communication can significantly affect the level of knowledge on the topic, leading to a reduced understanding of their own bodies and a limited repertoire of knowledge about pleasure, consent, and other important aspects of sexuality[20].

In contrast, men, who receive more positive and informative messages, are more likely to develop a broader and more balanced understanding of sexual matters. Promoting equitable and informative communication for both genders may help reduce these disparities and contribute to a more robust and equitable understanding of sexuality among men and women[20].

Regarding older adults' attitudes toward sexuality, there was a significant difference in scores when comparing sexes ($W = 7254$, $p < 0.001$). The effect size was small ($r = 0.24$), indicating that although statistically significant, the difference had limited magnitude. When converted to Cohen's d, the effect corresponded to $d \approx 0.49$, reinforcing that the difference is small to moderate. Older women had slightly higher attitude scores than men. In other words, older men demonstrated a more liberal attitude toward sexuality than older women (Table 2), consistent with findings from a study conducted in Montenegro[21].

This discrepancy may be attributed to inconsistent social norms applied to genders, in which female sexuality is considerably more repressed than male sexuality. As a result, women may be reluctant to express their attitudes toward sexuality in order to avoid judgments based on cultural stigmas[21].

There was a significant difference in knowledge scores between participants with and without partners ($W = 4136$, $p < 0.001$), with a small effect size ($r = 0.26$), indicating limited magnitude. When converted to Cohen's d, the effect was $d \approx 0.53$, suggesting a small to moderate difference. Older adults without partners had slightly higher knowledge scores than those with partners, indicating lower knowledge about sexuality (Table 2).

A significant difference was also observed in attitude scores between participants with and without partners ($W = 4459.5$, $p = 0.002$). The effect size ($r = 0.21$; $d \approx 0.44$) indicates a small to moderate difference, suggesting that participants without partners had slightly higher attitude scores than those with partners, demonstrating more conservative attitudes.

A study conducted in Germany showed that widowed men are more likely to remarry than widowed women[22]. Older widowed women may experience reduced sexual activity and demonstrate disinterest in issues related to sexuality, mainly due to the absence of a steady partner after the loss of their spouse[23].

After the death of their husband, many older women choose not to engage in new relationships. For cultural, religious, and social reasons, they are not encouraged to have other partners. Considering that, for many older women, sex is predominantly understood as a marital union associated with reproductive function, once they become widowed and do not have a steady partner, sexual activity is often eliminated from daily life[15]. Therefore, resistance to establishing new sexual relationships influences the development of more conservative attitudes among women without a partner, due to cultural expectations imposed on their behavior[24].

A significant difference was found in median knowledge scores among educational-level groups ($H = 8.29$, $df = 2$, $p = 0.016$). The effect size of 0.03, estimated by eta-squared ($\eta^2 = 0.03$), was small, and the test power, estimated at 62%, indicates a moderate probability of detecting a true difference among groups with the sample used. The Dunn post hoc test, adjusted by the Bonferroni method, showed that participants with incomplete primary education had lower knowledge about sexuality than those with complete primary education or higher (adjusted $p = 0.020$) (Table 2), consistent with a study conducted with older adults in Northeastern Brazil[5].

Individuals with fewer years of schooling tend to have limited access to basic healthcare services and, consequently, may not sufficiently acquire technically grounded information that could be obtained in these settings. Additionally, they face greater challenges in correctly understanding the guidance provided by the healthcare team[25].

Educational level and gaps in knowledge regarding the modes of transmission, prevention, and treatment of sexually transmitted infections (STIs), for example, emerge as contributing factors to increased vulnerability in this population. Thus, insufficient educational measures may result in a greater propensity for risk behaviors and delays in seeking medical care, considering that in this age group unsafe sexual health practices are often adopted, increasing the likelihood of acquiring diseases[26,27].

Significant differences were also observed in attitude scores among educational-level groups ($H = 19.22$, $df = 2$, $p < 0.001$). The effect size ($\eta^2 = 0.08$) suggests a medium effect, indicating that approximately 8% of the variability in attitude scores can be attributed to educational level. The Dunn post-hoc test, adjusted using the Bonferroni method, showed that those with higher levels of education also demonstrated a more liberal attitude toward sexuality (adjusted $p < 0.001$) (Table 2).

In this regard, knowledge about the aging process, its particularities, and strategies to maintain healthy sexuality in this stage of life tends to foster more permissive attitudes[5,28]. A liberal orientation is characterized by critical and independent thinking, flexibility in considering divergent perspectives, and willingness to question traditions or norms established by society. It also involves valuing inclusion and diversity, as well as respecting cultural and individual differences, aligned with principles of equality and inclusion[29].

This can be explained by the fact that, when exposed to a greater amount of reliable information acquired in educational settings, individuals encounter diverse ideas and perspectives that may help develop critical thinking, which in turn can reduce misconceptions and misunderstandings regarding the possibility of sexual satisfaction in older age[30]. Such knowledge is crucial to demystify the stereotypical belief that sexuality is unimportant in old age and to influence the adoption of less conservative attitudes[7].

Household income was not associated with knowledge about sexuality ($H = 1.48$, $df = 2$, $p = 0.476$), but differences were observed among income groups regarding attitudes ($H = 8.36$, $df = 2$, $p = 0.015$). The effect size ($eta^2 = 0.03$) indicates a small difference, and test power was limited (44%), suggesting a low probability of detecting true differences with the sample used. The Dunn post-hoc test, adjusted by the Bonferroni method, showed that participants with household income between two and less than four minimum wages had significantly higher attitude scores than those with income below two minimum wages (adjusted $p = 0.040$), reflecting a more conservative stance (Table 2). This finding is consistent with a national study conducted with older adults ($p < 0.002$)[5] and with a study conducted in Minas Gerais, which identified that higher income among older women was associated with the continuation of sexual activity[31].

Table 2. Knowledge and attitude scores of older adults regarding sexuality, according to sociodemographic and economic factors. Uberaba, Minas Gerais, Brazil, 2020–2021.

Variables	Attitudes and Knowledge about Sexuality in Aging (ASKAS)			
	Knowledge***	p / effect size	Attitudes	p / effect size
Sex		<0.001*		<0.001*
Female (n=136)	35 (30; 45)	r=0.31 (moderate)	22 (17; 25)	r=0.24 (small)
Male (n=83)	30 (26; 36)		18 (14; 21)	
Marital status		<0.001*		0.012*
Without partner (n=117)	35 (30; 45)	r=0.260 (small)	22 (18; 25)	r=0.210 (small)
With partner (n=101)	30 (28; 36)		19 (15; 23)	
Educational level		0.016**		<0.001**
No formal education (n=16)	35 (28; 47)	h^2=0.030 (small)	22 (15; 25)	h^2 = 0.080 (moderate)
Incomplete primary education (n=141)	34 (29; 42)		22 (17; 25)	
Complete primary education or higher (n=61)	31 (26; 37)		17 (12; 21)	
Household income (in minimum wages)		0.476 **		0.015**
Less than 2 (n=93)	34 (29; 39)	-	22 (17; 26)	h^2 = 0.030 (small)
Between 2 and < 4 (n=87)	32 (28; 39)		19 (15; 24)	
4 or more (n=36)	33 (27; 41)		20 (16; 22)	
Number of individuals dependent on household income		0.324**		0.669**
1 (n=47)	32 (27; 39)	-	19 (15; 24)	-
2 (n=93)	33 (28; 40)		19 (15; 24)	
3 (n=44)	36 (30; 43)		21 (17; 24)	
4 or more (n=34)	30 (27; 38)		21 (17; 24)	
Race/ethnicity		>0.900**		0.523**
Black and Mixed-race (n=84)	33 (29; 29)	-	21 (16; 25)	-
White (n=122)	33 (28; 41)		21 (15; 24)	
Asian and Indigenous (n=13)	36 (30; 38)		19 (18; 25)	
Religion or belief		0.382**		0.182**
Catholic (n=143)	34 (28; 40)	-	20 (16; 24)	-
Spiritist / Kardecist (n=34)	31 (28; 38)		21 (15; 24)	
Other religions/beliefs (n=30)	32 (28; 41)		24 (17; 26)	

*Mann–Whitney U test; **Kruskal–Wallis test; ***Median (1st quartile, 3rd quartile). **Source:** Study data.

Given the accelerated population aging, research is essential to enhance care and to emphasize actions aimed at preventing diseases and injuries, as well as promoting and maintaining health. A study conducted with older adults in Mexico found that participants wished for the topic of sexuality to be addressed by the healthcare team during consultations. They recognized the importance of receiving guidance from reliable and specialized sources that demonstrate an empathetic understanding of issues involving sexuality in later life and that are capable of providing advice on ways to experience it with quality[18].

In another study conducted with 411 older adults, 71.29% agreed that having knowledge about sexuality was relevant, and 61.07% reported being sexually active. These findings indicate that, despite the particularities of this phase of life, such as menopause, hormonal changes, and metabolic alterations, older adults are fully capable of engaging in sexual relations

and experiencing pleasure[32]. However, healthcare professionals do not always discuss these topics with individuals in this age group, either due to reluctance to introduce the subject or because of the stereotype that sexuality is no longer part of older adults' lives[33,34].

Strategies can be developed to make conversations about sexuality more natural, for example by providing specific instructions that highlight the use of routine, confidential questions and encourage individuals to feel comfortable sharing information[35]. By offering appropriate support, healthcare professionals can help reduce stigma and promote a holistic, inclusive, and humanized approach[26].

This study presents limitations related to the data collection method, which relied on telephone contact and resulted in reduced sample representativeness due to several factors, such as refusals to participate and difficulties in reaching potential participants. However, this was the feasible approach adopted to conduct the study, in order to comply with safety measures imposed during the COVID-19 pandemic and to safeguard the integrity of the collected data. Regarding refusals, most older adults stated that they declined due to the time required to participate by telephone or because of other difficulties, such as hearing problems. The topic itself does not appear to have been a barrier to participation. This contrasts with the ASKAS scale validation study, in which respondents demonstrated difficulty and embarrassment in speaking openly about the subject[10]. It is inferred that telephone-based data collection may have had a positive influence, since participants did not need to be face to face with the interviewer, which may have facilitated dialogue and the expression of responses.

CONCLUSIONS

The findings indicate that older women, individuals without a steady partner, and those with incomplete primary education had lower levels of knowledge about sexuality than the other groups. In addition, female sex, lower educational level, and higher income were associated with more conservative attitudes.

This study has limitations related to the high number of refusals and other losses, such as difficulties reaching part of the older population by telephone, which may affect the generalizability and interpretation of the findings. These factors reinforce the exploratory nature of the results, which should be interpreted in light of the participating population. Nonetheless, methodological rigor was maintained, following ethical principles and the recommendations in place at the time for conducting research with older adults during the COVID-19 pandemic.

Despite these limitations, the study advances knowledge in the field of Public Health by bringing to light specific data on socioeconomic and demographic factors related to the knowledge and attitudes of older adults regarding sexuality in later life. The findings are also aligned with the Sustainable Development Goals: Good Health and Well-Being, target 3.8, which calls for access to essential and high-quality health services, and Gender Equality, target 5.1, which aims to end all forms of discrimination against women, and target 5.6, which seeks to ensure universal access to sexual health.

In this regard, it is important that multiprofessional teams implement sexual health education practices, especially within the scope of primary health care (PHC), in order to promote dialogue and qualified listening, understand older adults' level of knowledge and attitudes about sexuality and the multiple factors surrounding it, and foster health care while reducing situations of vulnerability. This is fundamental to ensuring the implementation of health policies.

For future research, studies with larger samples are recommended, with emphasis on investigating the social determinants of health related to older adults' knowledge and attitudes about sexuality in different cultural and regional contexts.

AUTHORSHIP

- Regiane L. Takaoka – Formal analysis; interpretation of results; writing and review.
- Lígia F. Machado – Interpretation of results; writing and review.

- Ana Paula Fernandes – Data analysis and interpretation; review; approval of the final version for publication.
- Pollyana C. S. Ferreira – Study conception and design; writing; review; critical revision; funding acquisition; approval of the final version for publication.

ACKNOWLEDGMENTS

We thank the Public Health Research Group of the Universidade Federal e do Triângulo Mineiro and Professor Darlene Mara dos Santos Tavares for their support in the development of this research, as well as the older adults who participated in the study.

Edited by: Marcos Felipe Silva de Lima

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Most prevalent morbidities among older Brazilian adults according to sex, age groups, and major regions

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Abstract

Objective: To identify the most prevalent morbidities among older Brazilian adults in 2013 and 2019 and their percentage variation according to sex and age groups in the country's major regions. *Method:* This cross-sectional study used data from the 2013 and 2019 National Health Survey, including older adults aged 60 years or over who answered the selected resident questionnaire (2013: n=11,177; 2019: n=22,728). Complex sample analyses with sampling weights were performed, estimating prevalences and confidence intervals to ensure the representativeness of the results. Percentage variation was calculated using the formula [(value at the later time ÷ value at the earlier time) − 1] × 100. Associations between variables were assessed using Pearson's chi-square test ($p<0.05$). *Results:* The most prevalent morbidities in both years were hypertension, chronic back problems, hypercholesterolemia, diabetes mellitus, and arthritis or rheumatism. These conditions were more prevalent among younger older adults, females, and residents of the Southeast region. Overall, an increase in the percentage variation of morbidities among older adults was observed across the years analyzed, according to the Brazilian regions, although with important disparities by sex and age groups. *Conclusion:* The distribution of morbidities revealed inequalities according to sex, age groups, and regions, reflecting disparities in the aging process of the Brazilian population. These findings enhance the understanding of regional inequalities and support managers and healthcare professionals in organizing equitable care for older adults, guiding the development of public policies and clinical practice in geriatrics and gerontology.

Keywords: Morbidity. Chronic Disease. Aging. Health of the Elderly. Geriatrics.

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There was no funding for the execution of this work.
The authors declare that there is no conflict in the conception of this work.

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Received: September 2, 2025
Approved: November 25, 2025

http://dx.doi.org/10.1590/1981-22562026029.250145.en

INTRODUCTION

An increase in noncommunicable chronic diseases (NCDs) has been observed among the older population, concurrently with population aging and the epidemiological transition[1]. Noncommunicable chronic diseases are among the leading causes of disability and premature mortality worldwide, accounting for approximately 71% of all deaths. In this context, older adults are the most affected, resulting in significant impacts on their quality of life and generating substantial costs for healthcare systems[2]. In Brazil, in 2019, noncommunicable chronic diseases accounted for more than 734,000 deaths, representing approximately 55% of all deaths in the country[1].

Previous studies have highlighted the importance of investigating the health of older adults, particularly regarding the most prevalent morbidities[3-6]. International[3,4] and national[5,6] research has shown differences according to sex and age groups, with the oldest old (80 years of age or older) women exhibiting higher prevalence of multimorbidity (two or more morbidities in the same individual) when up to 25 diseases and greater life expectancy are considered.

Within the context of Brazil's demographic transition, the older population has increased markedly, especially among those aged 80 years or over, compared with other age groups[7]. This phenomenon has triggered significant changes in morbidity and mortality patterns, with substantial regional diversity influenced by socioeconomic, cultural, and racial disparities, access to healthcare services, urbanization, and other factors[7].

Clarifying potential regional differences is essential for improving understanding and for developing effective strategies aimed at preventing health conditions and organizing healthcare delivery. This enables the recognition of specificities that are often rendered invisible by regional inequalities, contributing to the promotion of health and quality of life among older adults[6].

Few studies have examined the epidemiology of the most prevalent morbidities among older Brazilian adults within a regional framework, particularly considering sex, age groups, and temporal comparisons. This study seeks to address this gap in the literature, as understanding such diversity is essential for formulating more equitable public health policies and for delivering comprehensive healthcare to this population, especially considering Primary Health Care (PHC) as the main entry point into the Unified Health System (SUS)[5,6].

Thus, comparative analysis enables healthcare professionals to identify the most relevant aspects to be addressed in the assessment and monitoring of older adults' health, while also supporting decision-makers in developing or adjusting public policies. Therefore, this study aims to identify the most prevalent morbidities among older Brazilian adults in 2013 and 2019 according to sex and age groups across the country's major regions.

METHODS

This was a cross-sectional study using individual data from the Brazilian National Health Survey (PNS). This is the most comprehensive health survey conducted in Brazil and consists of a nationally representative household-based survey carried out in 2013 and 2019 across the country's major regions. It was developed by the Brazilian Institute of Geography and Statistics (IBGE) in partnership with the Ministry of Health. The methodology of the National Health Survey is internationally validated and allows for statistically rigorous comparison of regional realities in Brazil[8]. This study followed the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting observational studies.

The study population consisted of older adults aged 60 years or older residing in all Brazilian states. The sample included older adults who completed the selected resident questionnaire (2013: 11,177; 2019: 22,728). In both editions of the National Health Survey, sampling followed a three-stage cluster design. In the first stage, the primary sampling units were census tracts randomly selected. In the second stage, a random number of households was selected

within each tract, and in the third stage, one resident was randomly selected in each sampled household[8].

Publicly available data were obtained between April and June 2023 from the 2013 and 2019 National Health Survey databases, accessible on the IBGE website.

To assess the most prevalent morbidities, 14 noncommunicable chronic diseases included in both editions of the National Health Survey were considered, according to the survey's specific modules. Morbidities were identified using Module H on noncommunicable chronic diseases. The questions and their respective codes were: hypertension (Q002), diabetes mellitus (Q030), hypercholesterolemia (Q060), heart disease (Q063), cerebrovascular disease (Q068), asthma (Q074), arthritis/rheumatism (Q079), chronic back problem (Q084), work-related musculoskeletal disorder (Q088), depression (Q092), lung disease (Q116), cancer (Q120), and chronic kidney failure (Q124).

The identification of noncommunicable chronic diseases was based on the question: "Has any physician ever given you a diagnosis for this disease?", with dichotomous response options (yes/no). For chronic back pain, the survey relied on participants' self-reports, whereas for depression and mental health, previous diagnoses made by a mental health professional (psychiatrist or psychologist) were considered.

Based on a ranking derived from the prevalence analysis of all morbidities included in both editions of the National Health Survey, the five most prevalent morbidities in Brazil were selected for analysis (hypertension, chronic back problem, hypercholesterolemia, diabetes mellitus, and arthritis or rheumatism), as these accounted for more than 50% of all morbidities among older Brazilian adults.

Sociodemographic variables were drawn from different modules of the National Health Survey. Sex was identified in Module A – General Characteristics of Household Residents, question Q001: "What is your sex?" (male; female). Age was obtained from question Q002 of the same module: "How old are you in completed years?", and categorized into three age groups (60–69, 70–79, and ≥80 years). The region of residence was derived from the geographic location of the household, recorded in the identification and territorial classification block of the questionnaire, following the official IBGE division into five major regions: North, Northeast, Southeast, South, and Central-West. Educational level was obtained from Module C – Education Characteristics, question Q025: "What is the highest level of schooling you attended and completed?", categorized as no schooling, primary education, secondary education, and higher education. Perceived health status was extracted from Module J – Lifestyle and Health Perception, question Q001: "In general, how would you rate your health?" The response options were very good, good, fair, poor, and very poor; for analysis, categories were grouped as very good/good, fair, and poor/very poor.

For sample characterization, two groups of older adults were considered: a younger group (60–79 years) and an older group (80 years or over), following previous research on aging and morbidity distribution[9-13]. Variables were analyzed by sex and age group within the regional context. Considering the complex sampling design, sampling weights for the primary sampling unit, individual, and stratum were applied in all analyses, ensuring the representativeness of data for older Brazilian adults. For sample characterization, categorical variables were presented using relative frequencies (%) and 95% confidence intervals (95% CI). Morbidity prevalences and their respective 95% CIs were estimated according to survey year, sex, and age group across Brazil's major regions.

Associations between variables were analyzed using Pearson's Chi-square test with a 95% confidence level. Associations were considered statistically significant when the p-value was <0.05. Percentage variation was calculated as follows: $[(\text{value at the later time} \div \text{value at the earlier time}) - 1] \times 100$, in accordance with a previous study comparing percentages across the two editions of the National Health Survey[14].

This study used only secondary, public, and anonymized data from the National Health Survey, whose data collection was approved by the National

Research Ethics Commission (CONEP) under opinions Nº 328,159/2013 and Nº 3,529,376/2019, in compliance with National Health Council Resolution Nº 466/12. The present analysis, involving public data with no possibility of participant identification, also complies with the guidelines of National Health Council Resolution Nº 510/2016.

DATA AVAILABILITY

The full dataset supporting the results of this study is publicly available on the National Health Survey website and can be accessed at https://www.pns.icict.fiocruz.br/bases-de-dados/

RESULTS

Table 1 presents the proportional distribution of the relative frequencies of sociodemographic and health-related variables of older adults in 2013 and 2019, as well as the percentage variation for Brazil and its major regions. In both years, higher proportions of women, individuals aged 60-79 years, and those with incomplete primary education were observed in Brazil and in its regions. A greater proportion of very good/good perceived health status was found in the Southeast, South, and Central-West regions, whereas fair perceived health was more prevalent in the North and Northeast regions.

Table 1. Characteristics of older adults in 2013 (N = 11,177) and 2019 (N = 22,728), in percentages and 95% Confidence Intervals (95% CI). National Health Survey, Brazil, 2013 and 2019.

Variables	2013 % (95% CI)	2019 % (95% CI)	Percentage variation
BRAZIL			
Sex			
Female	56.4 (54.8-57.9)	56.7 (55.6-57.7)	0.5
Male	43.6 (42.1-45.2)	43.3 (42.3-44.4)	0.6
Age			
60–79 years	86.4 (87.2-89.5)	86.4 (85.7-87.2)	0
80 years or over	13.6 (12.6-14.7)	13.6 (12.8-14.3)	0
Educational Attainment			
No formal education	22.7 (21.4-24)	16.8 (16-17.7)	-35.1
Incomplete primary education	48 (46.3-49.7)	46.5 (45.3-47.6)	-3.2
Complete primary education or higher	29.3 (26-33.2)	36.7 (34-39.7)	25.2
Self-rated Health Status			
Very good/good	44.4 (42.1-46.8)	47 (45.4-48.9)	5.8
Fair	43.5 (42-45)	41.7 (40.6-42.9)	-4.3
Poor/very poor	12.1 (10.8-13.6)	11.3 (10.3-12.2)	-8
NORTH REGION	4.9 (4.5-5.3)	6.1 (5.8-6.4)	24.4
Sex			
Female	53 (47.3-58.6)	53.7 (51-56.4)	1.3
Male	47 (41.4-52.7)	46.3 (43.6-49)	-1.5
Age			
60–79 years	90.4 (87.5-92.8)	87.2 (85.2-88.9)	-3.6
80 years or over	9.6 (7.2-12.5)	12.8 (11.1-14.8)	33.3

to be continued

Continuation of Table 1

Variables	2013 % (95% CI)	2019 % (95% CI)	Percentage variation
Educational Attainment			
No formal education	27.4 (23.8-31.5)	25 (22.4-27.8)	10
Incomplete primary education	48.6 (43.9-53.2)	46.5 (43.7-49.3)	4.5
Complete primary education or higher	24 (17.5-33.1)	28.5 (23.3-34.9)	18.7
Self-rated Health Status			
Very good/good	35.6 (30-41.7)	39.7 (36.2-43.4)	11.5
Fair	48.2 (43.6-52.8)	47.4 (44.7-50.1)	-1.6
Poor/very poor	16.2 (12.3-21.4)	12.9 (10.9-15.6)	-26.3
NORTHEAST REGION	25.2 (24.1-26.4)	25.4 (24.6-26.2)	0.7
Sex			
Female	55.9 (53.1-58.6)	56.5 (54.7-58.3)	1
Male	44.1 (41.4-46.9)	43.5 (41.7-45.3)	-1.3
Age			
60–79 years	85.1 (83-87.1)	84.2 (82.7-85.6)	-1
80 years or over	14.9 (12.9-17)	15.8 (14.4-17.3)	6
Educational Attainment			
No formal education	39.2 (36.5-42)	34.5 (32.6-36.5)	-13.6
Incomplete primary education	41.6 (38.8-44.5)	40.9 (39-42.8)	-1.7
Complete primary education or higher	19.2 (15.4-23.7)	24.6 (21.5-28.2)	28.7
Self-rated Health Status			
Very good/good	34.7 (31.7-38)	35.1 (32.9-37.5)	1.1
Fair	48.3 (45.7-50.8)	48.8 (47-50.6)	1.2
Poor/very poor	17 (14.6-19.9)	16.1 (14.5-18)	-5.5
SOUTHEAST REGION	48.3 (46.8-49.8)	46.4 (45.4-47.5)	-4
Sex			
Female	57.1 (54.6-59.6)	57.6 (55.7-59.5)	0.8
Male	42.9 (40.4-45.4)	42.4 (40.5-44.3)	-1.1
Age			
60–79 years	85.6 (83.8-87.3)	86.6 (85.3-87.9)	1.1
80 years or over	14.4 (12.7-16.2)	13.4 (12.1-14.7)	-7.4
Educational Attainment			
No formal education	15.5 (13.6-17.5)	9 (7.9-10.2)	-72.2
Incomplete primary education	48.9 (46.1-51.8)	46.4 (44.4-48.3)	-5.3
Complete primary education or higher	35.6 (23-33.1)	44.6 (39.7-50.3)	25.2
Self-rated Health Status			
Very good/good	50.3 (46.3-54.5)	53.5 (50.3-56.7)	0.4
Fair	40.9 (38.5-43.4)	37.5 (35.5-39.5)	-9
Poor/very poor	8.8 (6.9-11.3)	9 (7.5-10.9)	2.2
SOUTH REGION	15.1 (14.2-16)	15.7 (15.1-16.4)	3.9
Sex			
Female	56.8 (52.8-60.7)	55.8 (53.7-57.9)	-1.7
Male	43.2 (39.3-47.2)	44.2 (42.1-46.3)	2.3

to be continued

Continuation of Table 1

Variables	2013 % (95% CI)	2019 % (95% CI)	Percentage variation
Age			
60–79 years	88.6 (86-90.8)	88.2 (86.7-89.6)	-0.4
80 years or over	11.4 (9.2-14)	11.8 (10.4-13.3)	3.5
Educational Attainment			
No formal education	14.7 (12.3-17.6)	8.3 (7-9.8)	-77.1
Incomplete primary education	56.7 (52.7-60.5)	55.3 (52.9-57.7)	-2.5
Complete primary education or higher	28.6 (22.5-36.5)	36.4 (31.1-42.5)	27.1
Self-rated Health Status			
Very good/good	45.6 (40.8-51)	50.5 (47.1-54.3)	10.7
Fair	42.2 (38.8-45.6)	40.2 (37.8-42.6)	-4.9
Poor/very poor	12.2 (9.2-16.2)	9.3 (7.5-11.3)	-31.1
CENTRAL-WEST REGION	6.5 (6-6.9)	6.4 (6-6.7)	-1.5
Sex			
Female	55.1 (51.3-58.9)	55.4 (52.2-58.6)	-0.5
Male	44.9 (41.1-48.7)	44.6 (41.4-47.8)	-0.6
Age			
60–79 years	89.1 (86.8-91.1)	88.9 (86.8-90.7)	-0.2
80 years or over	10.9 (8.9-13.2)	11.1 (9.3-13.2)	1.8
Educational Attainment			
No formal education	25.5 (22.5-28.7)	17 (14.9-19.4)	-50
Incomplete primary education	45.4 (41.7-49.1)	47.3 (44.1-50.4)	3.9
Complete primary education or higher	29.1 (22.6-37.8)	35.7 (29.5-43.3)	22.6
Self-rated Health Status			
Very good/good	43.3 (38.2-49.1)	46.5 (42.1-51.3)	7.3
Fair	43.4 (39.9-47)	42.9 (40-46)	-1.1
Poor/very poor	13.3 (10-17.4)	10.6 (8.5-13.3)	- 24.5

Percentages estimated using sampling weights; V: percentage variation between 2013 and 2019 [(value at the later time ÷ value at the earlier time) − 1] × 100. **Source:** National Health Survey, 2013 and 2019.

Figure 1 shows the proportional distribution of morbidity prevalences among older adults in the major Brazilian regions in 2013 and 2019. The most prevalent morbidities were, respectively: hypertension, chronic back problem, hypercholesterolemia, diabetes mellitus, and arthritis or rheumatism. Morbidities were consistently more prevalent in the Southeast, Northeast, and South regions. Hypertension was the leading chronic condition nationwide, with the highest percentage observed in the Southeast.

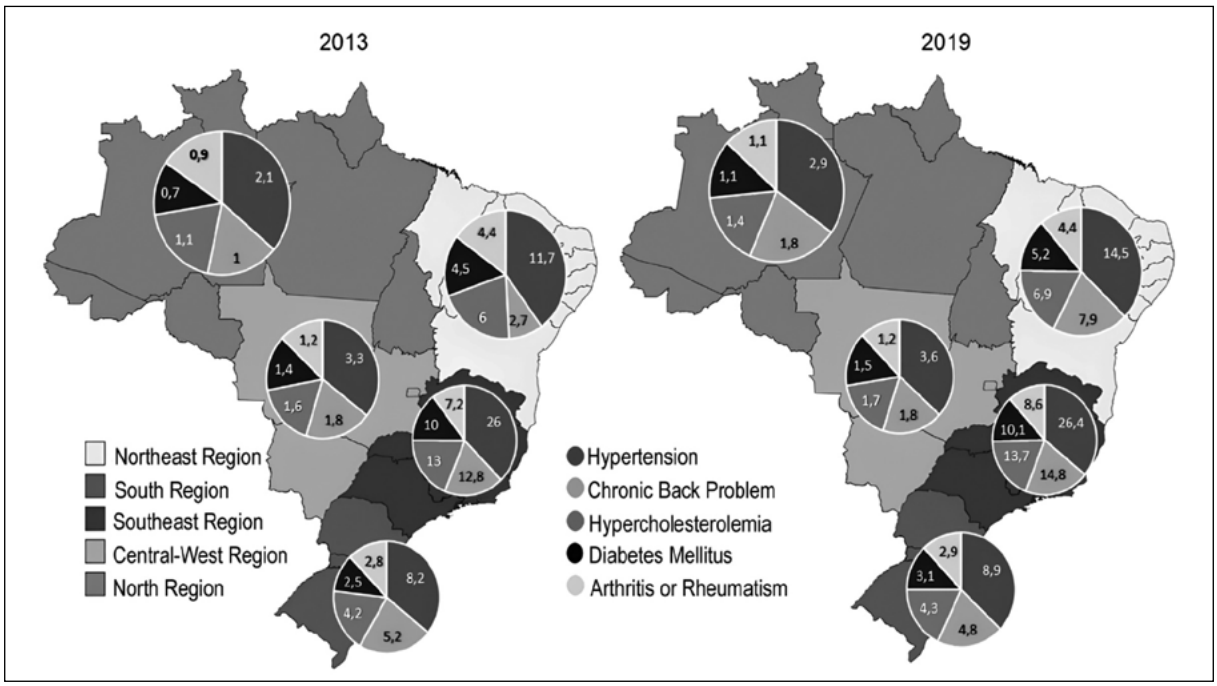


Figure 1. Distribution of morbidity prevalences among older adults in the major Brazilian regions. National Health Survey (2013: n = 11,177; 2019: n = 22,728), Brazil.

According to Table 2, hypercholesterolemia and diabetes mellitus showed significant percentage increases among men, whereas arthritis or rheumatism showed a percentage decrease in Brazil (-19.4%) and across all regions, especially in the Northeast (-40.6%). Conversely, among women, a significant increase in arthritis or rheumatism was observed, followed by chronic back problem and hypertension.

Important differences in percentage variation of morbidities between sexes were observed: in the North, the largest difference was the increase in chronic back problem among men; in the Northeast, hypercholesterolemia increased mainly among men; in the Southeast, arthritis or rheumatism increased among women and decreased among men; in the South, diabetes mellitus increased primarily among women; and in the Central-West, hypertension increased substantially among men. Furthermore, the Southeast and South regions presented percentages of hypertension higher than those observed in Brazil overall, according to sex, in both years.

Regarding age groups (Table 3), the Central-West region showed morbidity percentages higher than those identified in Brazil in both 2013 and 2019, whereas the Southeast and South regions showed higher percentages only in 2013. The greatest percentage variations were found in the increase in chronic back problem among younger older adults and in hypercholesterolemia among the oldest old in the North region. In the Northeast region, a substantial increase in chronic back problem was observed among the oldest old. 60-79 years.

Table 2. Distribution of prevalences and 95% Confidence Intervals (95% CI) of morbidities among older Brazilian adults according to sex and percentage variation between the years 2013 (n = 11,177) and 2019 (n = 22,728) in the major Brazilian regions. National Health Survey, Brazil, 2013 and 2019.

Variables	Male 2013 % (95% CI)	Male 2019 % (95% CI)	V*	Female 2013 % (95% CI)	Female 2019 % (95% CI)	V*	p* 2013	p* 2019
BRAZIL								
Hypertension	19.9 (18.6-21.2)	21.5 (20.6-22.4)	8	31.3 (29.8-32.8)	34.9 (33.9-36)	11.5	<0.001	<0.001
Chronic Back Problem	10.5 (9.5-11.6)	11.1 (10.4-11.7)	5.7	17.6 (15.5-18.9)	20 (19.1-21)	136	<0.001	<0.001
Hypercholesterolemia	7.7 (6.8-8.7)	8.9 (8.2-9.5)	15.5	18.2 (16.9-19.5)	19.1 (18.2-20.1)	4.9	<0.001	<0.001
Diabetes Mellitus	7.4 (6.5-8.4)	8.4 (7.8-9)	13.5	11.8 (10.7-12.9)	12.4 (11.7-13.2)	5	0.021	0.022
Arthritis or Rheumatism	4.3 (3.6-5.1)	3.6 (3.2-4)	-19.4	12.2 (11.2-13.3)	14.6 (13.7-15.5)	19.6	<0.001	<0.001
NORTH REGION								
Hypertension	17 (13.6-21)	19 (17-21.2)	11.7	26.7 (22.3-31.6)	29.3 (26.9-31.9)	9.7	0.013	<0.001
Chronic Back Problem	8.4 (5.9-11.9)	12.8 (11.2-14.6)	52.3	11.6 (8.4-15.7)	16 (14.1-18)	37.9	0.385	0.379
Hypercholesterolemia	7 (5-9.9)	7.3 (6.1-8.7)	4.2	15.6 (11.9-20.1)	16.9 (15-19)	8.3	0.008	<0.001
Diabetes Mellitus	5.2 (3.2-8.3)	7 (5.8-8.5)	34.6	10.6 (7.7-14.4)	10.7 (9.2-12.5)	0.9	0.049	0.072
Arthritis or Rheumatism	6 (3.7-9.7)	5 (4-6.4)	-20	13.2 (10.2-17)	13.7 (12.1-15.5)	3.7	0.006	<0.001
NORTHEAST REGION								
Hypertension	16.1 (14.2-18.1)	21.4 (20-22.9)	32.9	30.5 (28-33.1)	35.9 (34.2-37.5)	17.7	<0.001	<0.001
Chronic Back Problem	11.2 (9.6-13.2)	11.6 (10.5-12.8)	3.5	17.4 (15.4-19.7)	19.4 (17.9-21.1)	11.4	0.036	<0.001
Hypercholesterolemia	5.4 (4.3-6.6)	7.8 (6.8-8.9)	44.4	19.7 (17.7-21.9)	19.9 (18.5-21.3)	1	<0.001	<0.001
Diabetes Mellitus	5.7 (4.5-7.2)	7.4 (6.6-8.4)	29.8	12.9 (10.9-15.2)	13.2 (12.1-14.5)	2.3	0.001	<0.001
Arthritis or Rheumatism	4.5 (3.4-5.9)	3.2 (2.7-3.9)	-40.6	13 (11.2-15)	14.1 (12.9-15.5)	8.4	<0.001	<0.001
SOUTHEAST REGION								
Hypertension	21.7 (19.5-24.1)	21.6 (20-23.2)	-0.4	31.8 (29.4-31.4)	35.1 (33.3-37)	10.3	0.052	<0.001
Chronic Back Problem	9.5 (7.9-11.4)	10.6 (9.5-11.8)	11.5	17 (15-19.1)	21.2 (19.6-23)	24.7	0.005	<0.001
Hypercholesterolemia	8.5 (7-10.4)	9.3 (8.2-10.5)	9.4	17.7 (15.7-20)	19.8 (18.2-21.5)	11.8	<0.001	<0.001
Diabetes Mellitus	8.4 (6.9-10.1)	9.1 (8-10.3)	8.3	11.8 (10.2-13.8)	12.4 (11.2-13.7)	5	0.654	0.930
Arthritis or Rheumatism	4 (2.9-5.5)	3.5 (2.8-4.2)	-14.2	10.9 (9.4-12.6)	15 (13.4-16.8)	37.6	<0.001	<0.001

to be continued

Continuation of Table 2

Variables	Male 2013 % (95% CI)	Male 2019 % (95% CI)	V*	Female 2013 % (95% CI)	Female 2019 % (95% CI)	V*	p* 2013	p* 2019
SOUTH REGION								
Hypertension	21.5 (18.4-24.8)	22 (20.2-23.8)	2.3	32.6 (29.1-36.3)	35 (32.8-37.4)	7.4	0.049	<0.001
Chronic Back Problem	13.2 (10.7-16)	11.1 (9.9-12.4)	-18.9	21.5 (18.8-24.4)	19.7 (17.7-21.8)	-9.1	0.021	<0.001
Hypercholesterolemia	8.7 (6.6-11.3)	9.7 (8.5-11)	11.5	18.2 (15.6-21.1)	17.7 (15.9-19.6)	-2.8	0.001	<0.001
Diabetes Mellitus	7.2 (5.2-9.9)	8.2 (7.1-9.4)	13.9	9.4 (7.5-11.6)	11.3 (9.8-13)	20.2	0.703	0.425
Arthritis or Rheumatism	4.1 (2.8-6)	3.9 (3.2-4.7)	-5.1	14.6 (12.4-17.1)	14.4 (12.8-16.2)	-1.4	<0.001	<0.001
CENTRAL-WEST REGION								
Hypertension	19.1 (16.4-22.2)	22.2 (19.7-25)	16.2	31.6 (28.1-35.4)	34.7(31.9-37.7)	9.8	0.001	<0.001
Chronic Back Problem	9.9 (7.8-12.6)	10.5 (8.9-12.4)	6.1	18.6 (15.9-21.6)	17.9 (15.6-20.5)	-3.9	0.001	0.002
Hypercholesterolemia	8.2 (6.1-10.9)	9.1 (7.4-11.1)	11.0	17.6 (14.9-20.7)	17.1 (14.9-19.6)	-2.9	0.002	0.001
Diabetes Mellitus	7.9 (6-10.5)	8.7 (7-10.8)	10.1	13.2 (10.7-16.2)	14.4 (12.3-16.8)	9.1	0.150	0.024
Arthritis or Rheumatism	4.7 (3.3-6.6)	4 (3-5.4)	-17.5	13.3 (11.3-15.5)	14.1 (12.1-16.2)	6	<0.001	<0.001

Estimated percentages using sampling weights. V: percentage variation in prevalences between 2013 and 2019 [(value at later time ÷ value at earlier time)–1] × 100. *Chi-square test for the association between sexes.
Source: National Health Survey, 2013 and 2019.

Table 3. Distribution of prevalences and 95% Confidence Intervals (95% CI) of morbidities among older Brazilian adults according to age groups and percentage variation between the years 2013 (n = 11,177) and 2019 (n = 22,728) in the major Brazilian regions. National Health Survey, Brazil, 2013 and 2019.

Variables	60–79 years 2013 % (95% CI)	60–79 years 2019 % (95% CI)	V	80 years or over 2013 % (95% CI)	80 years or over 2019 % (95% CI)	V	p* 2013	p* 2019
BRAZIL								
Hypertension	43.8 (42.1-45.5)	48.1 (47-49.2)	9.8	7.4(6.6-8.3)	8.3 (7.7-8.9)	12.2	0.135	<0.001
Chronic Back Problem	24.4 (23-25.8)	27.1 (26.1-28.2)	11.1	3.8 (3.2-4.5)	3.9 (3.5-4.4)	2.6	0.840	0.139
Hypercholesterolemia	23.3 (21.9-24.7)	25.1 (24.1-26.1)	7.7	2.6 (2.1-3.1)	2.9 (2.5-3.3)	11.5	<0.001	<0.001
Diabetes Mellitus	16.6 (15.4-17.9)	18.1 (17.3-19)	9.0	2.5 (2.1-3.1)	2.7 (2.4-3.1)	8.0	0.702	0.630
Arthritis or Rheumatism	13.7 (12.7-14.8)	15.6 (14.7-16.5)	13.9	2.8 (2.3-3.3)	2.6 (2.3-3)	-7.7	0.007	0.329
NORTH REGION								
Hypertension	17.2 (13.4-21.9)	15.6 (13.9-17.6)	-10.3	2 (1.2-3.4)	3.1 (2.4-4.1)	55.0	0.712	0.023
Chronic Back Problem	18.4 (14.5-23.1)	25.8 (23.3-28.4)	40.2	1.6 (0.9-2.6)	3 (2.3-3.9)	87.5	0.445	0.067
Hypercholesterolemia	21.9 (17.9-26.5)	21.5 (19.4-23.7)	-1.9	0.7 (0.3-1.5)	2.7 (1.9-3.7)	285.7	0.001	0.236
Diabetes Mellitus	14.4 (10.8-19)	16.1 (14.1-18.2)	11.8	1.4 (0.8-2.4)	1.7 (1.2-2.4)	21.4	0.790	0.046
Arthritis or Rheumatism	17.2 (13.4-21.9)	15.6 (13.9-17.6)	-10.3	2 (1.2-3.4)	3.1 (2.4-4.1)	55.0	0.712	0.023
NORTHEAST REGION								
Hypertension	40 (37.3-42.7)	48 (46.2-49.8)	20.0	6.6 (5.4-8)	9.3 (8.2-10.5)	40.9	0.552	0.476
Chronic Back Problem	24.4 (21.9-27.1)	27.1 (25.3-28.9)	11.1	1.3 (3.2-5.6)	4 (3.2-4.9)	207.7	0.978	0.007
Hypercholesterolemia	22.5 (20.4-24.8)	24.2 (22.6-25.8)	7.6	2.6 (1.8-3.7)	3.5 (2.9-4.3)	34.6	0.018	0.009
Diabetes Mellitus	15.7 (13.8-17.8)	17.4 (16.2-18.7)	10.8	2.9 (2.1-4.1)	3.2 (2.5-4.1)	10.3	0.819	0.878
Arthritis or Rheumatism	14.3 (12.4-16.4)	14.5 (13.3-15.8)	1.4	3.2 (2.3-4.4)	2.8 (2.3-3.5)	-14.3	0.142	0.690
CENTRAL-WEST REGION								
Hypertension	45 (42.2-48)	48.6(46.6-50.5)	8.0	8.5 (7.2-10.1)	8.2 (7.2-9.3)	-3.7	0.113	0.068
Chronic Back Problem	22.5 (20.3-24.9)	27.5 (25.7-29.4)	22.2	4 (3-5.2)	4.3 (3.6-5.1)	7.5	0.690	0.945
Hypercholesterolemia	23.4 (21.1-25.8)	26.4 (24.5-28.3)	12.8	2.9 (2.2-3.8)	2.7 (2.2-3.3)	-7.4	0.023	<0.001
Diabetes Mellitus	17.4 (15.5-19.5)	18.7 (17.2-20.3)	7.5	2.9 (2.1-3.8)	2.7 (2.2-3.4)	-7.4	0.847	0.685
Arthritis or Rheumatism	12.1 (10.5-13.9)	15.9 (14.3-17.6)	31.4	2.8 (2-3.8)	2.6 (2-3.3)	-7.7	0.045	0.654

to be continued

Continuation of Table 3

Variables	60–79 years 2013 % (95% CI)	60–79 years 2019 % (95% CI)	V	80 years or over 2013 % (95% CI)	80 years or over 2019 % (95% CI)	V	p* 2013	p* 2019
SOUTHEAST REGION								
Hypertension	47.5 (43.9-51.2)	48.9 (46.4-51.3)	2.9	6.6 (4.9-8.8)	8.1 (7-9.5)	22.7	0.650	<0.001
Chronic Back Problem	31 (27.6-34.6)	27.1 (25-29.2)	14.4	3.6 (2.5-5.2)	3.7 (2.9-4.8)	2.8	0.565	0.778
Hypercholesterolemia	24.5 (21.5-27.8)	24.8 (22.9-26.8)	1.2	2.4 (1.4-3.9)	2.5 (1.9-3.3)	4.2	0.212	0.032
Diabetes Mellitus	15.3 (12.5-18.4)	17 (15.2-18.8)	11.1	1.3(0.7-2.3)	2.5 (1.9-3.4)	92.3	0.357	0.463
Arthritis or Rheumatism	16.2 (13.8-19)	16.1 (14.5-17.9)	0.6	2.4 (1.6-3.5)	2.2 (1.6-3)	9.1	0.515	0.965
SOUTH REGION								
Hypertension	44.8 (40.9-48.7)	49.8 (46.9-52.8)	11.2	6 (4.5-7.9)	7.1 (5.6-9)	18.3	0.731	0.066
Chronic Back Problem	26.3 (23-29.8)	25.6 (23.1-28.4)	2.7	2.2 (1.5-3.3)	2.8 (2-3.9)	27.3	0.068	0.431
Hypercholesterolemia	23.6 (20.4-27.2)	23.3 (20.8-26)	1.3	2.1 (1.4-3.3)	2.9 (2-4)	38.1	0.126	0.858
Diabetes Mellitus	18.9 (15.8-22.5)	20.7 (18.2-23.5)	9.5	2.2 (1.4-3.4)	2.4 (1.4-4)	9.1	0.897	0.750
Arthritis or Rheumatism	15.2 (12.7-18.1)	15.7 (13.6-17.9)	3.3	2.7 (1.9-3.9)	2.4 (1.7-3.4)	12.5	0.048	0.278

Estimated percentages using sampling weights. V: percentage variation in prevalences between 2013 and 2019 [(value at later time ÷ value at earlier time)–1] × 100. *Chi-square test for the association between age groups. **Source:** National Health Survey, 2013 and 2019.

DISCUSSION

The present study provides a comprehensive and representative analysis of the most prevalent morbidities among older Brazilian adults across regions. The analysis of proportional distributions according to sex and age groups at two distinct time points offers a broad understanding of the complexities of aging and contributes to advancing knowledge in geriatrics and gerontology.

Accelerated population aging in Brazil and its regions is evident, with the Southeast, Northeast, and South presenting the highest proportions of older adults in both years analyzed. The highest proportion of younger older adults was identified in the North region in 2013 and in the Central-West region in 2019, whereas the highest proportion of the oldest old was observed in the Northeast region in both years. This study reaffirms the country's regional disparities, especially in health, underscoring the need for regionally tailored actions[7].

Although chronic diseases have increased in the population, the perception of "very good/good" health also increased across all regions (especially in the North and South), whereas the perception of "poor/very poor" health decreased (except in the Southeast). However, studies show that the presence of chronic diseases is associated with worse self-rated health among older adults, particularly women, suggesting that this indicator remains highly subjective[15,16].

Corroborating the results of this study, a cross-sectional study conducted in Minas Gerais with 1,691 older adults aged 60 years and over, considering 25 noncommunicable chronic diseases, found the most prevalent morbidities to be hypertension (61.9%), followed by chronic back problem (48.6%)[17]. In the present study, these two morbidities were proportionally more prevalent in most Brazilian regions in both years, except in the North and Southeast regions in 2013, where hypertension and hypercholesterolemia were more prevalent.

Hypertension was also identified as the morbidity with the highest percentage of self-report among older adults in national[17,18] and international[19,20] studies. A time-series study using data from the Brazilian Surveillance System of Risk and Protective Factors for Chronic Diseases showed that self-reported hypertension increased significantly among older adults according to sex and age groups[21].

Cardiovascular diseases are the leading causes of death in Brazil and worldwide, with hypertension, diabetes mellitus, and hypercholesterolemia being the main risk factors[21]. Significant differences were observed in the prevalence of diabetes mellitus across regions and between sexes, with higher prevalence among men in the Southeast region and among women in the Central-West region in both years. Hypercholesterolemia showed the greatest percentage increase between the years in the oldest old in the North region, although this is the region with the lowest overall proportion of older adults[22].

These regional differences may be influenced by sociocultural specificities, which should be considered in the planning of public policies and health actions[8,11]. These morbidities require continuous control to prevent cardiovascular complications, which is directly related to patient adherence to treatment. In this regard, healthcare professionals must understand the factors that hinder adequate treatment, particularly among the oldest old, and develop health education strategies for correct medication use, educational groups that promote healthy lifestyles, and longitudinal and multidimensional follow-up of morbidities[23].

Chronic back problem showed the largest increase from 2013 to 2019 in the North region among both sexes and in the younger older adult age group. According to the IBGE, in 2019, spine-related diseases were the most common among residents of Rondônia and may be related to work activities characteristic of the North region, such as extractivism and agriculture/livestock[24]. This morbidity is highly prevalent and is associated with demographic, socioeconomic, and lifestyle factors[17]. It results in negative impacts on health conditions and requires intensified prevention, especially among younger age groups, as the severity of this problem increases with advancing age[17].

Arthritis or rheumatism showed a substantial reduction between the years among men, both nationwide and across all regions, whereas an increase

was observed among women, except in the South region. Although no other studies with this specific focus were identified, it is important to consider that the occurrence of this condition in older adults may be influenced by several factors, such as genetics, obesity, diet, and activities/occupation, which differ across sexes, age groups, and regions and may lead to decreased functional capacity[25].

The Southeast region presented the highest prevalence of morbidities. It stands out as the most populous and urbanized region, with the greatest population density in the country, in addition to being considered the region with the highest Gross Domestic Product (GDP)[26]. Aging in large urban centers is heterogeneous and shaped by factors such as average income and urban development processes, which demand distinct public policies. Furthermore, there is a feminization of aging in urban settings, marked by greater female migration from rural to urban areas, combined with women's greater longevity[27].

Brazilian regions present significant sociocultural disparities that may influence the different prevalence of morbidities among sex and age subgroups. The literature indicates that territorial, social, economic, and cultural inequalities significantly affect the socioeconomic and demographic conditions of the older population, reinforcing its heterogeneous distribution in Brazil[11]. Moreover, longevity is associated with social inequalities, resulting in distinct patterns of population growth and aging across Brazilian regions[28].

The morbidities investigated were more prevalent among older women, who also represent the majority of the population assessed. In general, women show greater concern with health conditions than men, resulting in more frequent use of healthcare services, which may partially explain the higher percentage of diagnoses of noncommunicable chronic diseases. However, according to studies using public data, women experience higher life expectancy with functional disability compared with men, across all ages and regions of Brazil[29].

Additionally, the distribution of morbidities was proportionally higher among younger older adults, as this group is considerably larger. This result may also be partially explained by the fact that most diagnoses of noncommunicable chronic diseases occur in the younger older adult age group. This may be due to the earlier onset of several chronic conditions and improved access to healthcare in this group, whereas monitoring and treatment levels tend to be lower among the oldest old[30]. Other studies assessing the presence of morbidities across older adult age groups have also found higher prevalence in the oldest age group[11].

It is important to consider the remarkable heterogeneity of biological age among individuals within the same age category. Furthermore, social disparities, which are already evident among older adults in Brazil, become even more pronounced among individuals aged 80 years and over[12]. These findings reinforce the importance of health promotion strategies adapted by sex and age group, while addressing social inequalities.

One limitation of this study relates to potential recall bias due to the use of self-reported information, as well as disparities in educational levels across regions, which may have influenced morbidity estimates. Another limitation concerns the absence of objective clinical measures to confirm diagnoses and other variables. Additionally, it was not possible to directly control the quality and standardization of data collection procedures or variable categorization, as previously collected secondary data were used. The exclusion of socioeconomic status from the main analyses may also have restricted the understanding of socioeconomic inequalities associated with morbidities.

Nevertheless, this study provides relevant data on the morbidity profile of older Brazilian adults, stratified by sex, age groups, and regions, based on a nationally representative sample. The findings contribute to the planning of actions aimed at preventing and managing chronic diseases, particularly within the context of Primary Health Care. The comparative analysis between 2013 and 2019 enables the identification of trends and the prioritization of strategies adapted to the epidemiological and regional context of the country, promoting greater equity.

CONCLUSION

The most prevalent morbidities were, respectively, hypertension, chronic back problem, hypercholesterolemia, diabetes mellitus, and arthritis or rheumatism, both in Brazil and across its regions. The distribution of morbidities was more prevalent among younger older adults, women, and residents of the Southeast region, despite notable differences across subgroups. Overall, we observed an upward trend in the percentage variation of morbidities among older adults between 2013 and 2019 across the Brazilian regions.

This study makes an important contribution to public health research, particularly in geriatrics and gerontology, by providing data on the distribution of morbidities among older Brazilian adults according to sex- and age-specific subgroups, as well as regional disparities. Identifying regional patterns and inequalities highlights the need for more tailored and integrated public health strategies to address the health challenges faced by this population.

For future studies, the monitoring and follow-up of these morbidities within regional contexts is recommended, considering their specific characteristics, to obtain a longitudinal understanding of the health profile of older adults in Brazil, given the importance of identifying health needs to promote quality of life and equitable healthy aging.

AUTHORSHIP

- Emily da Silva Eberhardt — conception, design, data analysis and interpretation; drafting and critical revision; final approval of the version; responsibility for all aspects of the work; project administration; formal analysis; conceptualization; data curation; writing – original draft; writing – review and editing; investigation; methodology; resources; approval of the version to be published.

- Sara Calumbi Nachipindo Kawalende — data analysis and interpretation; drafting and critical revision; final approval of the version; responsibility for all aspects of the work; formal analysis; conceptualization; writing – original draft; writing – review and editing; approval of the version to be published.

- Idiane Rosset — conception, design, data analysis and interpretation; drafting and critical revision; final approval of the version; responsibility for all aspects of the work; project administration; formal analysis; conceptualization; writing – original draft; writing – review and editing; investigation; methodology; resources; supervision; approval of the version to be published.

Edited by: Andressa Coelho Gomes

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Self-perceived health among older adults at risk of clinical-functional vulnerability in an Open University

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Abstract

Objective: To identify and understand the self-perceived health of older adults at risk of clinical-functional vulnerability who participate in an Open University within a public higher education institution in Northeastern Brazil. *Method:* This analytical, qualitative study was based on secondary data from the project titled "Assessment of Frailty in Older Adults Participating in the Open University for Maturity." Inclusion criteria were being an older adult, participating in the university, presenting no cognitive impairment, and presenting vulnerability risk according to the Clinical-Functional Vulnerability Index (CFVI-20). Thus, of the 102 participants, 34 were included and 68 were excluded from the sample. Data were analyzed using thematic categorical analysis, and categories were established inductively. *Results:* Three thematic categories were identified: Health as the absence of disease; Health as a state of biopsychosocial and spiritual well-being; and Health as the ability to overcome clinical-functional vulnerabilities and how the Open University contributes to this process. *Conclusion:* Continuous clinical-functional assessment of older adults is essential for the early detection of vulnerabilities and the implementation of educational interventions. In Open University programs, the social interaction promoted by institutional initiatives fosters discussion on quality of life and contributes to self-awareness in health promotion and maintenance during aging.

Keywords: Aging. Health of the Elderly. Health Promotion. Self-Perception.

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Funding: This work was supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Funding Code 001.

The authors declare no conflicts of interest in the conception of this work.

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Received: September 1, 2025
Approved: November 24, 2025

http://dx.doi.org/10.1590/1981-22562026029.250140.en

INTRODUCTION

Aging is a gradual and dynamic process that occurs universally among all human beings and is accompanied by biological, functional, biochemical, psychological, and sociocultural changes that result in a significant loss of an individual's ability to adapt to the environment over time. Functional decline increases the risk of frailty, which may arise from the aging process itself or from disabling diseases or falls that may ultimately lead to death[1].

As age advances, the disabilities accumulated over the years contribute to increased vulnerability among older adults. Geriatric syndromes (iatrogenesis, cognitive impairment, family insufficiency, sphincter insufficiency, immobility, communication impairment, and postural instability), together with the loss of social roles and experiences of loneliness, pose potential risks to active or healthy aging[2-4]. Within the context of demographic transition, studying functional profiles and the extent to which they affect the health of older adults becomes an essential parameter for guiding healthcare practices in response to population aging[5,6].

Positive self-perceived health among older adults is directly related to social determinants and health behaviors, which substantially shape the orientation of care. Self-perception is recognized as an important indicator of well-being and can guide prevention and health promotion strategies in accordance with the guidelines of the National Policy for the Health of Older Adults (PNSPI). By considering both organic and non-organic factors that affect functionality, findings from previous studies reinforce the importance of integrated multiprofessional interventions focused on quality of life[6].

Thus, the well-being of older adults is understood to be determined by the maintenance of autonomy and independence, including the potential for social engagement and participation[7,8]. To this end, assessing activities of daily living (ADLs) and instrumental activities of daily living (IADLs) and using validated scales that evaluate functionality and the risk of frailty and vulnerability constitute essential prerequisites for planning care-oriented actions within older adult health programs[9].

Frailty in aging is a multidimensional condition associated with multiple factors and is characterized by reduced energy reserves and decreased resilience to stressors, which increase vulnerability and the risk of adverse clinical outcomes such as functional decline, falls, institutionalization, hospitalization, and mortality[10]. Recognizing that older adults have the right to access higher education institutions and participate in lifelong educational activities is a crucial component for advancing the guidelines of healthy aging. One notable example is that of Open Universities, which promote greater social interaction and shared experiences within academic environments, providing opportunities for diverse experiences, skill development, and settings that foster intergenerational encounters[2,11-14].

The Open University fulfills its social role by developing educational activities for older adults, guided by the fundamental principle of promoting intergenerational exchange among academics (professors and students) and older participants, fostering dialogue between academic knowledge and the lived experiences of those involved. In this context, it seeks to promote discussions that emphasize the value of knowledge, the preservation and improvement of communication, and the encouragement of the active integration of aging individuals into society[12-14].

The main justification for the present study was based on the observation that academic programs within Open Universities must also incorporate clinical-functional assessment, particularly in institutions that provide training in the health sciences. Furthermore, when considering older adults who participate in such programs and are at risk of frailty, it becomes necessary to understand how they perceive their own health and how these academic environments may contribute to promoting healthy aging. Thus, the general objective was to identify and understand the self-perceived health of older adults at risk of clinical-functional vulnerability who participate in an Open University within a public higher education institution in Northeastern Brazil.

METHOD

The study was submitted to and approved by the Ethics and Research Committee of the

Universidade Estadual da Paraíba (UEPB), under opinion number 6.297.534 and Certificate of Ethical Review Submission (CAAE): 73350323.6.0000.5187. All ethical procedures followed Resolution No. 510/2016[15] of the National Health Council of the Ministry of Health. Accordingly, the Informed Consent Form (ICF) and the Authorization Form for the use of secondary data were used in this study.

This is an analytical, qualitative, cross-sectional study based on secondary data from a larger umbrella project conducted between September 2023 and September 2024, titled "Assessment of Frailty in Older Adults Participating in the Open University for Maturity." The study was conducted in two stages. In Stage I, participants were recruited, and a sociodemographic questionnaire was administered for participant characterization, followed by the Mini-Mental State Examination (MMSE) and the Clinical-Functional Vulnerability Index (CFVI-20). In Stage II, interviews were conducted using an established qualitative interview technique.

The study was carried out at the Open University for Maturity (UAMA). UAMA/UEPB is an institutional program headquartered on Campus I of the Universidade Estadual da Paraíba, located in the municipality of Campina Grande, Paraíba, in Northeastern Brazil. Data collection occurred from November 2023 to April 2024 during sessions held throughout the program's regular academic period.

UAMA aims to address the educational needs of older adults without requiring previous academic degrees. Its institutional mission is to contribute to the improvement of personal, functional, and sociocultural capacities through educational and social activities that enhance quality of life. The initiative also seeks to promote academic integration among older adults, enabling them to deepen their knowledge in various areas, including health, leisure, general knowledge, culture, aging studies, law, and quality of life. Upon completing the course, participants submit a final assignment titled "Life History Narrative" and receive a certificate in Education for Human Aging.

The study population consisted of older adults regularly enrolled in UAMA who attended classes and participated in all activities developed during the study period, totaling 102 regular morning participants at the time.

Inclusion criteria were being an older adult, participating in the university, not presenting cognitive impairment, and being at risk of vulnerability according to the Clinical-Functional Vulnerability Index (CFVI-20). Exclusion criteria were older adults who self-perceived their health positively in comparison to others of the same age, that is, those who answered excellent, very good, or good based on the CFVI-20.

Thus, of the 102 participants, 34 were included in the sample and 68 were excluded. This exclusion was necessary to understand the phenomenon of self-perceived health among those at risk of vulnerability who did not self-perceive their health as positive. It is important to note that self-perceived health is a subjective health indicator among older adults and is related to social determination[6,14]. Therefore, the analytical focus resulted in a sample of 34 older adults at risk of vulnerability with negative self-perceived health. Based on this sample, the following guiding questions were analyzed: How do you self-perceive your health? How does the Open University influence your health perception?

The Mini-Mental State Examination (MMSE) is a widely used screening scale for cognitive impairment among different populations, including adults and older adults. It proposes different scoring thresholds according to the individual's years of schooling. Cut-off points between 19 and 20 are recommended for older adults with no formal education, and between 23 and 24 for those with prior schooling, such that scores below these thresholds indicate cognitive impairment[16].

The Clinical-Functional Vulnerability Index (CFVI-20) is a Brazilian rapid screening tool that identifies clinical-functional vulnerability among older adults and may be administered by any trained healthcare professional. It contains 20 items addressing different health domains, with a total possible score of 40 points. Scores from 0 to 6 indicate a robust older adult, scores from 7 to 14 indicate moderate risk of frailty, and scores above 15 indicate high frailty, classifying the individual as frail[11].

Interviews were audio-recorded using an Android smartphone and transcribed verbatim with the support of pre-tested headphones. Three rounds of transcript revision were conducted based on repeated listening to the recordings. Narrative identification was performed through a coded organization of the interviews, using the letter "i" (older adult) followed by the ordinal code of each transcript. Thus, the participant labeled as i.1 refers to the transcript of the first interviewee. This procedure enabled the construction of the interview *corpus*.

The narratives were organized and methodologically assessed using thematic categorical analysis. Bardin (2009)[17] defines a set of content analysis techniques comprising the following stages: (1) pre-analysis, involving initial reading and corpus organization; (2) exploration of the material, categorization, and coding; and (3) treatment of the results, inference, and interpretation. The thematic categories were established inductively.

DATA AVAILABILITY

All datasets supporting the findings of this study are available upon request to the corresponding author, given that they contain information that could compromise the privacy of the research participants.

RESULTS AND DISCUSSION

A total of 34 older adults were analyzed, classified as being at risk of clinical-functional vulnerability according to the CFVI-20 and who self-perceived their health as poor or very poor. This characterization highlights the need to deepen the understanding of how they perceive their own health, as well as how participation in the Open University influences their well-being. Three thematic categories were identified: Category I, Health as the absence of disease; Category II, Health as a biopsychosocial and spiritual state of well-being; and Category III, Health as the ability to overcome clinical-functional vulnerabilities and how the Open University supports this process.

The category identified as "Health as the absence of disease" was recognized in the statements of seven participants, whose self-perceived health was described by directly associating health with the absence of illness. When health is defined as the absence of disease, a limited awareness emerges regarding the possibilities of managing aging based on the pillars of health promotion, prevention of health conditions, stabilization, supported self-care, and continuous assessment of potential risk stratification, as recommended in the guideline for older adult care[11].

The narratives in this thematic category highlight the predominance of the hegemonic biomedical model, which fragments care and hinders a comprehensive health approach. This perspective reflects long-standing challenges in healthcare systems regarding the management of chronic conditions and reinforces the need to broaden debate and incorporate this topic into the agendas of the health sciences. Representative statements include:

> "Health is being well cared for when illness appears; it is not feeling pain, not needing to take so much medication, and not having diseases. It is going to the physician and being attended; it is going to the clinic and having physicians and medications for our problems, and we do not have that. Health is being treated and undergoing treatment; for this reason, my health is poor as an older adult." (i.1)

> "I think health is everything as a whole, right? It is having a physician to provide care; it is not having disease. Health is living without illness, without having many types of diseases like I do. There is hypertension, taking medication, diabetes, osteoporosis, so many ailments." (i.17)

There is a clear need to expand health-education spaces that include older adults, with the purpose of promoting new conceptions that guide individuals toward understanding healthy aging. Similarly, there is a need for gerontological and geriatric training in healthcare, considering that many curricula still do not include mandatory components focused on older adult care[18].

Open Universities expand discussions on topics such as health education; however, there remains a need for educational spaces that enable the general population to understand self-perceived health

not merely as the absence of disease and curative pharmacological treatments, but as an integral perspective of well-being and maintenance of functional capacity, even when illness is present.

The World Health Organization (WHO) defines health as a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity[6]. This supports the current debate highlighting the need to contextualize aging within the framework of the chronic disease care model, demystifying aging from the perspective of being treated as a disease[11].

The health of older adults must be understood broadly, considering not only the absence of disease but also the physiological and mental changes, the environmental and cultural contexts of aging, the social determinants of health, and the role of healthcare training in the quality of care provided[18].

Health conditions in aging are shaped by multiple health indicators, particularly physical, cognitive, and muscular strength deficits. Thus, the onset of disease is understood as a form of wear that may occur in various ways and at different points in the human lifespan, not only among those who grow old. However, confronting these conditions is inherent to the physiological changes attributed to the aging process itself[19,20].

Considering this thematic category analyzed in an open university setting, where health promotion is grounded in dialogue with older adults, it became evident that there is a need for further advancement in strategies to reach the aging population, with the aim of optimizing effective health practices according to the guidelines for healthy aging. Such resources may support lifestyle changes, strengthen self-perceived self-care, and contribute to disease prevention, thereby optimizing active aging and enhancing longevity and quality of life among older adults[19-22]. Therefore, the open university is recognized as an educational space for the promotion of health among older adults, as well as a setting for the exchange of experiences among academics (faculty and students), older participants, and the broader community.

In the second thematic category, "Health as biopsychosocial and spiritual well-being," 17 participants referred to health as a balance of biopsychosocial and spiritual dimensions. In this context, findings indicate that these individuals cultivate healthy lifestyle practices, even while perceiving their health as fair or poor. Examples include the following statements:

> "Health is living with tranquility, having love, having peace, always receiving a hug that cures any illness. That, for me, is health. Even today, I am not feeling very well because I woke up with knee pain, but even so, I feel balanced; I just wish the pain would improve a little more." (i.9)

> "In my view, health is peace of mind. I think health has no price, right? It is the most important thing you must have in your life—first health, and then peace. Because when you do not have these two things, you have nothing. Everything you try to do, if you have a problem, you cannot manage it. I, thank God […] have my ailments, and although today I feel a little shaken in terms of my health, I am seeking balance each day, following my diets, praying daily, and also following the recommendations of the regimens." (i.32)

In this category, it is possible to observe that even in the presence of health complaints and situations initially classified as poor or very poor, health is understood as well-being and as biopsychosocial and spiritual balance. This understanding emerges in the context of confronting challenges through resilience and lifestyle reorganization, within the limitations inherent to aging. Therefore, health is recognized as a path of ongoing pursuit of balance, even amid the complaints resulting from the human aging process and its trajectory of risks for vulnerability and frailty.

Health is understood as a state of well-being that must be continuously constructed, requiring willingness, self-care, self-knowledge, and adequate socioeconomic conditions, as well as access to essential services. Thus, there is a need to foster new perspectives on health aimed at more comprehensive models of care that restore autonomy and independence in care practices, together with incentives for disease prevention and health promotion.

In this regard, when examining the self-perceived health of participants at risk of vulnerability in health, it becomes evident that quality of life remains a reference point for the basic health needs of the group analyzed. It is also noteworthy that education, cultural factors, basic sanitation, and spiritual, physical, mental, psychological, and emotional well-being, across various domains including existential, personal fulfillment, family, environmental, social, and professional spheres, are essential for a resilient view of healthy aging with quality of life[20-22].

Thus, quality of life in aging requires an empowered understanding of health among this population with regard to health promotion, enabling social participation, recognition, and social support. For this reason, health policies and initiatives that encourage active aging, with attention to the biopsychosocial and spiritual dimensions of the individual, become essential[20].

In the third thematic category, titled "Health is being able to overcome clinical-functional vulnerabilities and how the open university helps in this process," ten participants mentioned in their responses that the open university serves as a collaborative space for coping with clinical-functional vulnerability. The open university promotes social interaction and health education, contributing to a realistic and positive view of health and of overcoming challenges, as expressed in the statements below, in which participants describe their efforts to overcome difficulties and seek knowledge to face the human aging process:

> "I consider my health poor because I have diabetes and hypertension, but UAMA has brought me better quality of life through learning. At this stage of life, being able to study and meet committed professors from whom I have learned a great deal is invaluable. Even though I think my health is poor, what saves me is having friendships that I will carry throughout my life. Seeking to improve my self-esteem, this is what happens to us here at UAMA." (i.7)

> "I do not consider my health good because I have a lot of pain and fatigue, but I overcome all of this with faith in God by coming to UAMA. That is what matters, sharing with friends the pains of aging. Here at UAMA it is very good. We learn a lot, and that helps me overcome my problems." (i.8)

> "For me, health is taking care of myself. For example, I need several treatments, and one of them is urgent, physical therapy, which I have not been able to do because of a fall I had, and this arm no longer lifts. I also have balance problems, so I really need assistance. Even so, I overcome all of this with my knowledge. I always seek improvement and never give up. I learned from life, but UAMA also helps us gain more understanding about overcoming age-related challenges." (i.10)

Although the statements refer to negative aspects that corroborate the problems experienced, they are framed from a positive perspective, since these older adults participate in a space that provides health education, opportunities for socialization, and support from a professional team in carrying out activities. Group-based practices for older adults foster continuity of autonomy and independence and also contribute to reducing the risks of loneliness and social isolation[22,23].

In this sense, the narratives of older adults help elucidate how they perceive changes in their daily lives and in their own life trajectories when they are included in an educational environment for older learners. Open Universities are thus understood as fundamental institutions that influence improved self-esteem, self-knowledge, the establishment of affective bonds, and the sharing of experiences. Through these processes, they justify how essential such programs are for empowering this population and fostering satisfaction in acquiring new knowledge[4,12,13].

Self-perceived health, as well as the aging process, are intrinsically interconnected and reflect the ongoing pursuit of understanding quality of life, thereby expanding the continuity of efforts to promote and implement actions that benefit this age group. In this perspective, previous studies indicate that older adults participating in an Open University for Mature Adults seek to remain up to date, engage in memory exercises, reduce anxiety, and take an active role in decision-making related to health matters, pursuing meaningful engagement that promotes active aging[12,13,22,23].

Accordingly, open universities bear the responsibility of reframing actions related to aging and ensuring that older adults remain actively integrated into their communities and society. This enables them to feel useful and valued, allows their knowledge to be recognized in enriching environments, and promotes well-being and satisfaction. Moreover, it respects their life experiences and diversity of perspectives while supporting the maintenance of functional capacity and cognitive abilities[11,12].

It is important to emphasize that the role of professionals in these environments includes providing assistance and care to older adults, assessing their health, establishing humanized care plans, and fostering relevant themes for shared discussion. Such professionals and their socioeducational interventions offer encouragement and contribute to modifying life habits, with the aim of promoting functional independence and autonomy[20].

The study also identified that a minority, seven participants, perceived their health as fair or poor, associating their self-perceived health exclusively with the presence of diseases. Divergent paradigms emerged, as seventeen participants understood health as well-being rather than the mere absence of disease, recognizing that physical, social, mental, and spiritual well-being are essential components for feeling well throughout the human aging process. Given the heterogeneity of the group, expanding spaces for dialogue on health within the open university may stimulate creative and targeted initiatives that support healthy aging.

Considering the benefits observed among older adults participating in UAMA, the importance of such environments for human development and for understanding this stage of life becomes clear. This underscores the urgent need for effective public policies that promote the creation of similar initiatives aimed at meeting the needs of this population. These spaces not only provide new knowledge but also ensure the promotion of health.

The bonds, learning experiences, and social interactions fostered by UAMA gave new meaning to the lives of the participants, including those facing adversities inherent to aging, contributing to a more fulfilling older age. The expansion of open university programs, understood as spaces that promote social interaction, health, and intergenerational encounters, represents significant progress for gerontological discussions in both academia and society.

A limitation of this study was its conduct in only one open university unit, highlighting the need for further investigations that broaden the discussion of self-perceived health in other academic and geographic contexts to deepen understanding of this topic.

CONCLUSION

It was observed that some participants perceived health as the absence of disease, while most associated it with biopsychosocial and spiritual well-being. It was also evident that the open university contributes to health discussions within the context of social interaction among older adult participants, as well as to the training of students, and serves as a platform for promoting health education for the aging community.

Accordingly, self-perception may vary among individuals, while the construction of knowledge and the ongoing pursuit of independence aim to broaden understanding, preventing self-perceived health from being limited to a single, isolated definition. Continued research on this topic is necessary to strengthen scientific knowledge and to support the robustness of functional capacity, given the evident growth of this population.

It is essential to continuously assess the health of older adults to prevent vulnerabilities and promote educational actions, especially in environments such as open universities, which foster care and self-awareness in the aging process.

AUTHORSHIP

- Santos, N. A. – initial drafting, conceptualization, data curation, writing, investigation, methodology.
- Silva, J. R. L. – formal analysis, investigation, visualization, review and writing.

- Medeiros, A. C. T. – review and editing, visualization.
- Silva, J. – review and editing, funding acquisition, visualization.
- Medeiros, F. A. L. – formal analysis, project administration, investigation, methodology, funding acquisition, review and editing, validation, and visualization.

ACKNOWLEDGMENTS

We thank all collaborators and participants of the Open University for Maturity (UAMA/UEPB) and the Graduate Program in Health Psychology (PPGPS/UEPB) for their support in conducting this research.

Edited by: Larissa Neves Quadros

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Retirement leisure: association of loneliness and social support network with depression in older adults – a cross-sectional study

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Abstract

Objective: To determine whether loneliness and social support network characteristics are associated with depression among retired older adults. *Method*: An observational, cross-sectional, analytical study was conducted. The sample comprised 144 older adults. The inclusion criterion was being an older adult with preserved communication ability and cognition, assessed using the Kahn Mental Status Questionnaire. Participants not meeting the criteria established by this instrument were excluded. The instruments used were the UCLA Loneliness Scale (UCLA-BR), the Geriatric Depression Scale (GDS-15), and the Medical Outcomes Study Social Support Scale (MOS-SSS). Sociodemographic variables included age, sex, religion, education, monthly income, marital status, falls in past month, polypharmacy, comorbidities, length of retirement, and self-rated health. *Results*: Mild-to-moderate levels of loneliness ($p<0.001$), low emotional support ($p<0.003$), low affective support ($p<0.002$), and low positive social interaction ($p<0.001$), as well as the predictors presence of comorbidities ($p<0.021$), fair or poor perceived health ($p<0.001$), monthly income below the minimum wage ($p<0.022$), and being single ($p<0.041$), were significantly associated with depressive symptoms. *Conclusion*: The study revealed that loneliness, low emotional, affective and positive social interaction support, as well as comorbidities, poor perceived health, low income, and being single, increased vulnerability to depression among the retired older adults.

Keywords: Older Adults. Loneliness. Depression. Social Support.

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No funding was received to support this study.
The authors declare no conflicts of interest in the conception of this work.

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Received: November 3, 2025
Approved: February 10, 2026

http://dx.doi.org/10.1590/1981-22562026029.250186.en

INTRODUCTION

The most marked growth in the Brazilian population has occurred among the stratum of older adults, which showed an annual growth of over 4% between 2012 and 2022. The national population aged 60 years or older, estimated at 14.2 million in 2000, is projected to reach 73.5 million by 2060. Over the next 10 years, an annual increase of over 1 million older adults is expected[1].

The demographic change seen today has a significant impact on society, raising concerns about the sustainability of health and social welfare systems, while also posing new challenges for the development of public policies[2]. In this scenario, understanding the determinants that influence rate of cognitive decline and ways of preserving cognitive performance during late life has become increasingly relevant[3].

The "use it or lose it" theory suggests that cognitive performance tends to deteriorate when the individual is not mentally challenged or stimulated. Thus, retirement may increase the risk of more rapid cognitive decline due to the reduction in cognitively demanding activities after stopping working. However, this negative effect of retirement can vary among different occupational groups. People in professions with high intellectual demands are expected to experience less age-related decline while still working, compared to those in occupations with lower mental demands[3,4].

Retirement typically causes people to lose access to social contacts, lifestyles and daily routines, as well as potential stimuli, activities and purpose, which may lead to depressive symptoms such as loneliness and hopelessness[5]. In addition to these aspects, given the value that work holds in contemporary society as a means of achieving recognition and social status[6], the post-retirement period directly impacts the social valorization of older adults, as well as their self-esteem, which may also contribute to the development of depression.

Leisure, in this context, becomes a relevant factor to be considered. Although it may represent an opportunity for rest and recreation, excessive leisure without meaningful activities can intensify the feelings of loneliness and isolation already present in the post-retirement period. The loss of routine and social contacts, coupled with a lack of engagement in activities that promote interaction and purpose, can make free time a negative experience, increasing the risk of psychological distress and depression. Therefore, it is crucial that leisure be balanced with social and recreational activities that promote belonging, thereby helping to preserve the mental health of older adults[7].

Given that loneliness, weakening of the social support network and depression are common in older adults, the rationale behind this study was to address a prevalent problem that significantly compromises quality of life and also increases the risk of comorbidities and mortality. In this context, strategies that promote social engagement, cognitive stimulation and maintenance of life purpose after retirement, become fundamental for mitigating the negative effects of cognitive decline and depressive disorders in this population. Understanding these factors is essential to inform public policies and support the development of effective interventions to foster healthy aging and improve quality of life of older adults.

Against this backdrop, the objective of the present study was to determine whether loneliness and social support network characteristics are associated with depression in retired older adults.

METHOD

An observational, cross-sectional, analytical study, involving older adults from a city in the interior of Minas Gerais state, was conducted. The sample size calculation was based on an estimated prevalence of depression of 6% in older adults, an alpha error of 5%, one-tailed test, normal distribution, and a minimum statistical power of 80%, giving an estimated sample of 144 participants. The reference rate adopted for the calculation was based on data from the World Health Organization, which estimates that depression affects 4.8% of the world population and 5.8% of the Brazilian population.

Mental status assessment was used as an inclusion criterion. Thus, retired older adults with preserved communication and cognitive abilities were

included, as measured by the Kahn Mental Status Questionnaire, a validated instrument adapted for use in Brazil. Individuals scoring below the cutoff point, indicating the presence of signs of cognitive impairment, as well as those who could not read, a requirement for understanding the scales applied, were excluded.

Given the cross-sectional design of the study, the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[8] were followed.

Data collection was carried out between March and April 2025 by a previously trained team, ensuring standardization of procedures and uniformity in the application of the instruments. The training consisted of theoretical alignment activities and interview simulations, in order to minimize disparities among evaluators. Individual interviews were conducted in community locations with high circulation, such as squares, parks, and bus stops. The cognitive assessment did not involve clinical examinations or specialized medical evaluation, being based solely on the validated instrument, an aspect taken into account as a study limitation.

The cognitive assessment was the first procedure, entailing application of the Kahn Mental Status Questionnaire, originally developed by Kahn et al. in 1960 in "Brief Objective Measures for the Determination of Status in the Aged" and culturally adapted and validated for Brazil[9]. This abbreviated 10-item questionnaire assesses temporal-spatial orientation and memory for remote facts. Participants had to answer at least 7 questions correctly to meet the basic criteria of temporal-spatial orientation for inclusion in the study[10].

Subsequently, sociodemographic and clinical information was collected using a structured questionnaire devised by the authors for the purposes of this study, containing closed items probing sex, age, religion, education, monthly income, marital status, history of falls in last month, use of multiple medications (polypharmacy), self-reported comorbidities, length of retirement, and perceived health.

Depression among the retired older adults was measured using the Geriatric Depression Scale (GDS-15)[11]. The GDS is a widely used validated diagnostic instrument for depression in older adults[12]. This scale has 15 negative affirmative questions, scoring 1 or 0 points. A total sum of scores of 0-5 is deemed normal; 6-10 indicates mild-to-moderate depression, and 11-15 severe depression.

Loneliness was assessed using the UCLA-BR Loneliness Scale[13]. The scale, originally called the University of California Los Angeles (UCLA) Loneliness Scale, has been adapted and validated for use in Brazil. The UCLA-BR consists of 20 questions, probing social interaction (how the person relates) and isolation (withdrawal from social interaction); with responses scored as 0-3 for each item. Regarding scale scores: 0-22 points indicates minimal loneliness; 23-35, mild loneliness; 36-47, moderate loneliness; and 48-60, intense loneliness[14].

Social support network was assessed using the Portuguese version of the Medical Outcomes Study (MOS) Social Support Scale[15] validated for Brazil[9]. The questionnaire contains 19 items covering the following functional dimensions of social support: material, affective, positive social interaction, and emotional/informational. Participants must indicate their perceived frequency of each type of available support: never, rarely, sometimes, almost always, or always[9].

For each item, the participant must indicate how often they consider each type of support available: never, rarely, sometimes, almost always, or always, and the interpretive scores are[9]: Material support: ≤6: Low perception; 7-13: Medium perception; ≥14: High perception. Affective support: ≤4: Low perception; 5-10: Medium perception; ≥11: High perception. Emotional/informational support: ≤12: Low perception; 13-28: Medium perception; ≥29: High perception. Positive social interaction: ≤6: Low perception; 7-13: Medium perception; ≥14: High perception.

The project was approved by the Research Ethics Committee (CEP) of the Medical School of Itajubá (FMIT), under approval No. 7.416.538, and

complied with all recommendations of Resolution Nos. 466/2012[16] and 510/2016[17], which provide for ethics guidelines applicable to research involving humans in Brazil.

Descriptive statistics were employed for data analysis, with categorical variables expressed as frequency and percentage. The following statistical procedures were used for associations: chi-square, Cramer's V, and Wald test. An error measure of 5% (0.05) was adopted for statistical significance, with a 95% confidence interval.

Inferential analysis was performed using a multivariate logistic regression model. Parameter estimation of the model was based on the Maximum Likelihood Estimation (MLE) method, using the Newton-Raphson optimization algorithm to maximize the log-likelihood function and fit the logit link function to the data. For the selection of independent variables, an automated stepwise methodology (hybrid) was adopted. The decision criterion for iterative inclusion and exclusion of predictors was based on the Wald test statistic. Thus, the final model retained only variables that had statistically significant coefficients, ensuring a parsimonious and well-fitting multivariate model.

DATA AVAILABILITY

The full data set underpinning the study results is available from Figshare.com at https://doi.org/10.6084/m9.figshare.30924161.

RESULTS

The sociodemographic and health profile of the older adults evaluated, as well as the relationship of these variables with the presence of depressive symptoms, are presented in Table 1. The results show which characteristics were most strongly associated with depression in the group studied, highlighting the major differences across the categories analyzed.

Table 2 provides a summary of the distribution of loneliness levels among participants and their association with depressive symptoms. Increased loneliness shows an association with higher rate of depression, highlighting the role of this variable in the context analyzed.

The nature of the associations between the social support network domains and the presence of depressive symptoms are presented in Table 3. The data set reveals those social support dimensions which had the greatest influence on the mental health of the retired older adults.

The odds ratios of the predictors found to be statistically significant are shown in Table 4, allowing estimation of the magnitude of risk associated with each category analyzed in terms of depressive symptoms.

The multivariate model with the predictors that remained significant after adjustment are presented in Table 5. This shows the strength of association between each variable and depressive symptoms, identifying independent factors with the greatest impact.

Table 1. Sociodemographic and health characteristics and association with depression (N=144). Itajubá, Minas Gerais state, 2025.

	No depression		Mild/Moderate depression		Severe depression		Total		*p*-value
Predictor	AF	RF (%)	AF	RF (%)	AF	RF (%)	AF	RF (%)	
Sex									
Female	57	74.0	17	22.1	3	3.9	77	53.5	0.473
Male	53	79.1	14	20.9	0	0.0	67	46.5	
Age (years)									
60 - 69	41	73.2	12	21.4	3	5.4	56	38.9	0.380
70 - 79	50	82.0	11	18.0	0	0.0	61	42.4	
≥ 80	19	70.4	8	29.6	0	0.0	27	18.8	

to be continued

Continuation of Table 1

	No depression		Mild/Moderate depression		Severe depression		Total		*p*-value
Predictor	AF	RF (%)	AF	RF (%)	AF	RF (%)	AF	RF (%)	
Religion									
Catholic	85	79.4	20	18.7	2	1.9	107	74.3	
Catholic, Spiritist	1	100.0	0	0.0	0	0.0	1	0.7	
Spiritist	3	60.0	2	40.0	0	0.0	5	3.5	0.571
Evangelical	15	65.2	8	34.8	0	0.0	23	16.0	
Other	1	100.0	0	0.0	0	0.0	1	0.7	
No religion	5	71.4	1	14.3	1	14.3	7	4.9	
Education (years)									
1-4	15	93.8	1	6.2	0	0.0	16	11.1	
5-8	25	73.5	9	26.5	0	0.0	34	23.6	0.170
> 9	68	73.9	21	22.8	3	3.3	92	63.9	
No education	2	100.0	0	0.0	0	0.0	2	1.4	
Monthly income (MW)									
1-2 MW	55	73.3	18	24.0	2	2.7	75	52.1	0.647
> 3 MW	52	80.0	12	18.5	1	1.5	65	45.1	
< 1 MW	3	75.0	1	25.0	0	0.0	4	2.8	
Marital status									
Married	60	83.3	11	15.3	1	1.4	72	50.0	
Divorced	15	71.4	6	28.6	0	0.0	21	14.6	0.166
Single	12	60.0	7	35.0	1	5.0	20	13.9	
Widowed	23	74.2	7	22.6	1	3.2	31	21.5	
Falls in last month									
No	98	79.0	24	19.4	2	1.6	124	86.1	0.077
Yes	12	60.0	7	35.0	1	5.0	20	13.9	
Polypharmacy									
No	63	82.9	12	15.8	1	1.3	76	52.8	0.052
Yes	47	69.1	19	27.9	2	2.9	68	47.2	
Comorbidities									
No	29	90.6	3	9.4	0	0.0	32	22.2	**0.021**
Yes	81	72.3	28	25.0	3	2.7	112	77.8	
Length of retirement (years)									
2-5	19	73.1	7	26.9	0	0.0	26	18.1	0.707
> 6	80	76.2	23	21.9	2	1.9	105	72.9	
< 1	11	84.6	1	7.7	1	7.7	13	9.0	
Perceived health									
Poor	1	50.0	1	50.0	0	0.0	2	1.4	
Fair	13	40.6	17	53.1	2	6.2	32	22.2	**<0.001**
Good	65	85.5	10	13.2	1	1.3	76	52.8	
Excellent	31	91.2	3	8.8	0	0.0	34	23.6	

Source: Authors, 2025. N= Sample size, AF: Absolute Frequency, RF (%): Relative Frequency (percentage), *p*-value= Level of statistical significance (p<0.05), MW: minimum wage.

Table 2. Regression analysis of loneliness versus depression (N=144). Itajubá, Minas Gerais state, 2025.

	No depression		Mild/moderate depression		Severe depression		Total		*p*-value
Predictor	AF	RF (%)	AF	RF (%)	AF	RF (%)	AF	RF (%)	
Loneliness scale									
Minimal loneliness	103	85.1	17	14.0	1	0.8	121	84.0	**<0.001**
Mild loneliness	5	33.3	9	60.0	1	6.7	15	10.4	
Moderate loneliness	2	25.0	5	62.5	1	12.5	8	5.6	

Source: Authors, 2025. N= Sample size, AF: Absolute Frequency, RF (%): Relative Frequency (percentage), *p*-value= Level of statistical significance (p<0.05).

Table 3. Regression analysis of social support network domains versus depression (N=144). Itajubá, Minas Gerais state, 2025.

	No depression		Mild/moderate depression		Severe depression		Total		*p*-value
Predictor	AF	RF (%)	AF	RF (%)	AF	RF (%)	AF	RF (%)	
Emotional/informational support									
Perceived low	5	71.4	1	14.3	1	14.3	7	4.9	**0.003**
Perceived medium	23	57.5	15	37.5	2	5.0	40	27.8	
Perceived high	82	84.5	15	15.5	0	0.0	97	67.4	
Material support									
Perceived low	10	47.1	2	41.2	0	11.8	12	8.3	0.06
Perceived medium	23	80.3	12	18.9	2	0.8	37	25.7	
Perceived high	77	81.1	17	17.9	1	1.1	95	66	
Affective support									
Perceived low	3	42.9	4	57.1	0	0	7	4.9	**<0.002**
Perceived medium	32	69.6	11	23.9	3	6.5	46	31.9	
Perceived high	75	82.4	16	17.6	0	0	91	63.2	
Social interaction support									
Perceived low	4	57.1	3	42.9	0	0.0	7	4.9	**<0.001**
Perceived medium	15	50.0	12	40.0	3	10.0	30	20.8	
Perceived high	91	85.0	16	15.0	0	0.0	107	74.3	

Source: Authors, 2025. N= Sample size, AF: Absolute Frequency, RF (%): Relative Frequency (percentage), *p*-value= Level of statistical significance (p<0.05).

Table 4. Odds Ratio analysis, significant predictors for depression (N=144). Itajubá, Minas Gerais state, 2025.

Predictor	cat_A	cat_B	Odds (A/B)	Lower bound	Upper bound
Marital status	Divorced	Single	0.50	0.06	4.12
	Divorced		1.96	0.22	17.69
	Single	Widowed	3.93	0.47	32.88
Perceived health	Fair	Fair	-	-	-
	Fair	Excellent	7.22	5.51	59.13
	Poor	Excellent	-	-	-
Monthly income	> 3 MW	< 1 MW	0.68	0.01	48.99
Affective support	Perceived low	Perceived low	2.17	0.09	19.36
Emotional/informational support	Perceived low	Perceived medium	0.38	0.01	17.78
Loneliness scale	Moderate loneliness	Minimal loneliness	11.41	0.69	187.90

Source: Authors, 2025. cat-A: category A (reference for comparison); cat-B: category compared to category A, Odds (A/B): odds ratio between categories, lower bound: confidence interval lower limit (95%), Upper bound: confidence interval upper limit (95%). MW: minimum wage.

Table 5. Multivariate regression analysis, significant predictors versus depression (N=144). Itajubá, Minas Gerais state, 2025.

Predictor	Regression coefficient (β)	Confidence interval		*p*-value	Chi²	Cramer´s V
		Lower	Upper			
Monthly income (MW)						
1-2 MW	-	-	-	**0.022**	7.611	0.077
> 3 MW	1.60	-0.54	3.73			
< 1 MW	7.11	2.06	12.16			
Marital status						
Married	-	-	-	**0.041**	8.246	0.191
Divorced	0.5	-1.89	2.89			
Single	3.10	0.72	5.47			
Widowed	-1.12	-3.58	1.35			
Perceived health						
Good	-		-	**0.009**	11.662	0.465
Fair	3.96	1.54	6.38			
Poor	25.80	*	*			
Excellent	-1.41	-4.26	1.43			
Loneliness scale						
Minimal loneliness	-4.78	-7.93	-1.64	**0.001**	13.213	0.473
Mild loneliness	-	-	-			
Moderate loneliness	3.62	-0.54	7.78			
Emotional/ informational support						
Perceived low	-9.33	-15.81	-2.84	**0.018**	8.067	0.284
Perceived medium	-1.54	-3.86	0.78			
Perceived high	-	-	-			
Affective support						
Perceived low	3.87	0.14	7.59	**0.047**	7.38	0.194
Perceived medium	0.65	-1.35	2.65			
Perceived high	-	-	-			

Source: Authors, 2025. (β): Regression coefficient, *p*-value: Level of statistical significance (p<0.05); Chi²: chi-square test statistic; Cramer´s V: measure of association strength, MW: minimum wage.

DISCUSSION

The aim of this study was to determine whether loneliness and social support network characteristics are associated with the presence of depressive symptoms in retired older adults. The results confirm this initial hypothesis, showing that mild-to-moderate levels of loneliness, low emotional, affective and positive social interaction support, as well as the presence of comorbidities, negative perceived health and income below the minimum wage, exhibited a significant association with depressive symptoms. These findings reinforce the importance of construing aging not only as a biological process, but also as a social and relational phenomenon, marked by the quality of bonds with others and living conditions.

The relationship between loneliness and depression identified in this study corroborates robust evidence from the literature, showing that older adults who experience chronic loneliness tend to have a higher probability of developing mental disorders and physical conditions, such as hypertension and cardiovascular diseases[18]. Loneliness negatively impacts emotional health, reduces psychological resilience, and interferes with the maintenance of brain activity, as the absence of emotional support and low social interactions deprive the individual of essential relational stimuli. This scenario renders older adults more vulnerable to stress and adverse psychological outcomes, including depression[18]. In studies involving similar samples, higher levels of loneliness correlated with greater presence of depressive symptoms and lower perceived social support[13]. These previous results are consistent with the findings of the present investigation, showing that loneliness is a central variable in understanding emotional distress in retired older adults.

Broader scientific evidence on the topic reveals a consistent association of loneliness and social withdrawal with depressive symptoms in older adults[19]. In general, the more intense the feelings of isolation and lower the affective support network, the greater the incidence of depressive disorders. This relationship pervades different sociocultural contexts, indicating that human interaction, affection, and belonging are universal needs, whose deprivation contributes to psychological illness.

In the national scenario, a study conducted at a specialist clinic for older adults in São Paulo showed that users with high perceived emotional support and positive social interaction had higher levels of psychological well-being, while those reporting low support exhibited a higher rate of depressive symptoms[20]. This data directly converges with the results of this study, reinforcing the protective role of social support in aging.

In a complementary manner, during the COVID-19 pandemic, the American study "All of Us Research Program", involving over 69,000 adults, found that high levels of emotional support and positive social interaction were associated with lower levels of depressive symptoms[21]. The methodological consistency of these studies reinforces that, even under adverse conditions, social support has an attenuating effect on psychological distress.

In studies conducted in other countries, such as Jordan (Middle East), a negative correlation was found between affective support and depression among institutionalized older adults, demonstrating that the absence of affective support exacerbates emotional distress[22]. Similar findings show that emotional support has a robust protective effect against depression[21] and that psychosocial interventions focused on strengthening support networks can significantly reduce depressive symptoms in older adults[23].

Furthermore, longitudinal studies show that a greater number of confidants and the availability of practical help are associated with lower depressive symptoms, a relationship mediated by decreased loneliness[24]. This evidence supports the "buffering" theoretical model, according to which social support networks act as a psychological buffer that reduces the impact of stress through emotional protection, instrumental support, and strengthening of interpersonal bonds[25].

The humanistic perspective of psychiatrist Nise da Silveira offers an important conceptual contribution to understanding the findings of this

study. Contrary to the coercive and exclusionary practices of traditional psychiatry, Nise defends the centrality of affection, creativity, and human bonding as fundamental therapeutic elements[26]. In her experiences at Pedro II Hospital and the Museum of Images of the Unconscious[27], she showed that affective coexistence, symbolic expression, and engagement in creative activities favor social reintegration and emotional balance of people affected by psychological distress[27,28]. Thus, her vision converges with the results of this study by confirming that affection, human contact, and feelings of belonging are essential elements in preserving mental health[27], especially in periods marked by changes in identity and reorganization of daily life, as occurs with retirement.

In addition to loneliness and support network, this study found that other factors were significantly associated with depression, such as the presence of comorbidities. In a study of 22,728 Brazilian older adults, 11.8% had depressive symptoms and 8.46% multiple chronic diseases, and individuals with multimorbidities had up to double the risk of developing depression[29]. The authors also found that older adults with more restricted support networks and less involvement in community activities exhibited higher rates of depression. These results reaffirm that physical health and mental health are interdependent dimensions, especially in aging.

Another relevant aspect concerns perceived health. Studies show that older adults who rate their health as poor or very poor have a significantly higher risk of developing depressive symptoms[30]. A study of 185 older adults found that participants with negative perceived health had up to ten times greater chance of presenting depressive symptoms compared to those with positive perceived health[30]. Thus, the present study confirms this association, demonstrating that the way older adults perceive their health plays a determining role in the subjective experience of emotional well-being.

Socioeconomic status also stood out as a factor associated with depression. Older adults whose income was below the minimum wage had a higher rate of depressive symptoms, a relationship widely documented in the literature. In a study involving 133 older adults, 32.4% lived on insufficient income, a situation associated with a higher rate of depressive symptoms[20]. Similar results were found in the SABE Study, which showed that older adults whose income was insufficient to meet daily needs had a higher prevalence of depression[20]. Additionally, single marital status proved to be a factor associated with depression: among female older adults residing in rural areas of Mato Grosso do Sul state, 23.29% had depressive symptoms, especially among those who were single and had negative perceived health[31].

These findings align with the DSM-5 guidelines, which characterize depression as a multifactorial disorder, involving psychological, biological, genetic, and environmental aspects[24]. In the older population, depression has a major impact, being associated with a higher risk of disability, worsening chronic diseases, suicide, and mortality. Leisure resulting from retirement can negatively impact the social and emotional structure of older adults, reducing significant interactions and weakening support networks. In this sense, the social support network constitutes a central space of emotional support, representing the interface between the individual and society[32]. Such networks directly influence how older adults perceive their world, face adversities, and establish relationships, being potentiated by family, community, and affective bonds. These bonds, when strengthened, act as protective elements against the vulnerabilities inherent to the aging process.

This study has some limitations that should be noted. The cross-sectional design precludes any causal inference between the analyzed variables and limits the study to identifying associations. The use of self-report instruments may have introduced bias regarding individual perceptions, while the sample of retired older adults from a specific geographic context restricts the generalization of the study results. Future studies should adopt longitudinal designs and more diversified samples to further understanding on the role of loneliness, support networks, and perceived health in the development of depressive symptoms among retired older adults. Investigations should also explore community interventions, coexistence programs, and psychological strategies that promote social integration, affective strengthening, and positive perceived health.

CONCLUSION

The present study provides consistent evidence that the main factors associated with depression in retired older adults are mild-to-moderate loneliness, and low emotional, affective, and positive social interaction support. Furthermore, the presence of comorbidities, negative perceived health, monthly income below the minimum wage, and single marital status were found to increase vulnerability to depressive symptoms. This study is innovative in so far as it integrates both psychosocial and socioeconomic dimensions in elucidating emotional illness during retirement, a period marked by changes in identity and social bonds. The results underscore the role of interdisciplinary strategies for promoting mental health, especially through strengthening support networks and affective relationships, fundamental elements for preventing depression and enhancing quality of life in late adulthood.

AUTHOR CONTRIBUTIONS

- Miriam de Lima Mohallem – Conceptualization; study design; data analysis and interpretation; writing – original draft.
- Julia Brandão Vaz Cipriano – Conceptualization; study design; data analysis and interpretation; writing – original draft.
- Deruchette Danire Henriques Magalhães – Data analysis and interpretation; writing – review and editing; approval of the version to be published; responsibility for all aspects of the work.
- Rogério Donizeti Reis – Conceptualization; study design; data analysis and interpretation; data curation; writing – first review; writing – review and editing; final approval of the version to be published; responsibility for all aspects of the work.

Edited by: Camila Alves dos Santos

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Evolution of the Population Aging Index in Brazil (1991–2022): temporal analysis and sociodemographic determinants

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Abstract

Objective: To analyze the evolution of the Population Aging Index (PAI) in Brazil from 1991 to 2022 and to evaluate its association with selected demographic and socioeconomic indicators. *Methods:* This is an ecological time-series study using data from the Brazilian Demographic Censuses and intercensal estimates from the Brazilian Institute of Geography and Statistics (IBGE). The PAI was calculated as the number of individuals aged ≥60 per 100 aged 0–14. Annual percent change (APC) in PAI was estimated through Prais-Winsten regression. Selected variables included sex ratio, population density, population growth rate, life expectancy, fertility, infant mortality, urbanization, Palma ratio, Gini index, gross domestic product and Human Development Index. *Results:* The PAI increased from 16.7 in 1991 to 68.4 in 2022, constituting a 300% rise over 30 years. Higher values were concentrated in the South and Southeast, and lower values in the North. The fertility rate and Gini index were negatively associated with PAI-APC in the final model, while GDP showed a positive association. These factors explained 84% of PAI variation across states. *Conclusion:* Population aging in Brazil has rapidly and unevenly advanced, with faster growth in more developed states. The findings should be interpreted considering that some of the analyzed indicators constitute direct demographic determinants of population aging. Nevertheless, the results highlight the need for intersectoral and regionally tailored public policies to address the challenges posed by accelerated and unequal population aging.

Keywords: Aging. Population Dynamics. Socioeconomic Factors. Health Inequality Indicators. Brazil.

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There was no funding for the execution of this work.

The authors declare that there is no conflict in the conception of this work.

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Received: November 3, 2025
Approved: January 8, 2026

http://dx.doi.org/10.1590/1981-22562026029.250185.en

INTRODUCTION

Population aging is a demographic phenomenon characterized by an increase in the proportion of older adults in relation to younger age groups in the population's age structure[1]. This process has intensified particularly rapidly in recent decades in Brazil. The older adult population increased from approximately three million people in 1960 to about 20 million in 2008, corresponding to a growth of almost 700% in less than 50 years[2]. This movement occurred in line with the demographic transition, characterized by replacement of a regime of high fertility and mortality rates with another marked by the sustained reduction of these indicators[1,2]. From this perspective, the Brazilian demographic transition stood out for its speed and scope when compared to that observed in high-income countries[2], contributing to imbalances in the dynamics of the country's social and economic institutions.

This aging process reflects social and economic transformations that occurred throughout the 20th century, including the greater insertion of women into the labor market, associated with a reduction in fertility rates; an expansion of education, with increased average schooling and access to higher education; and advances in public health and technology, which improved living conditions and raised life expectancy at birth[3,4]. Together, these factors have shaped the country's current demographic profile characterized by low population growth and greater longevity, posing significant challenges to social and economic development.

The analysis of population aging can be operationalized through the Population Aging Index (PAI), defined as the ratio between the number of people aged 60 or older and the number of individuals aged between zero and 14 years. This indicator allows us to synthesize changes in the age structure and compare aging patterns between regions and over time, being particularly useful for territorial analyses in contexts of accelerated demographic transition.

Population aging in Brazil poses challenges to economic and social systems, with repercussions on the labor market, social security, consumption patterns, and the organization of health systems[3,5–8]. However, these impacts manifest themselves unevenly among the regions of the country, reflecting differences in demographic and socioeconomic profiles. In this sense, investigating the evolution of the PAI and its association with demographic and socioeconomic indicators allows us to understand how these inequalities are expressed in the dynamics of Brazilian population aging. Given this context, it becomes relevant to analyze the temporal evolution of the Population Aging Index in Brazil and its association with selected demographic and socioeconomic indicators in an integrated way considering the regional heterogeneity of the country. Despite the relevance of the topic, studies that explore these associations over extended periods, especially at the state level, are still limited.

Thus, the objective of this study was to analyze the evolution of the Population Aging Index in Brazil between 1991 and 2022 and to evaluate its association with selected demographic and socioeconomic indicators.

METHODS

This is an ecological time-series study. The data source was the Brazilian Institute of Geography and Statistics (*IBGE* – https://www.ibge.gov.br/en/home-eng.html). We collected data from the Brazilian Demographic Censuses conducted in the years 1991, 2000, 2010, and 2022, and from estimates for their intervals (1996, 2006, 2016).

The PAI in Brazil is measured as the number of older adults aged 60 or older per 100 children and adolescents aged 0 to 14. We calculated the PAI for each of the 27 Brazilian states for these seven years mentioned (1991, 1996, 2000, 2006, 2010, 2016, and 2022). Next, we used Prais-Winsten regression to estimate the variation in the PAI between 1991 and 2022 (32 years) considering the autocorrelation of the residuals. This analysis generates an annual percentage variation coefficient (APC) with its respective 95% confidence interval (95%CI). When the 95%CI does not include the value zero, it means that the APC is increasing (if positive) or decreasing (if negative); when the 95%CI includes the value zero, it means that the APC is stable during this period.

The contextual factors (covariates) included in the analysis were: sex ratio (number of men divided by the number of women); population density (number of inhabitants per square kilometer); geometric population growth rate (constant rate at which a population changes from one period to the next); life expectancy at birth (average number of years a newborn can expect to live); fertility rate (number of children per woman); infant mortality rate (number of deaths before one year of age divided by the total number of live births); urbanization index (percentage of the population living in urban areas); Palma ratio (ratio of income of the richest 10% to the poorest 40%); Gini coefficient (a statistical measure of dispersion designed to represent income inequality, wealth inequality, or consumption inequality); Gross Domestic Product (GDP – a standard measure of the value added created through the production of goods and services); and Human Development Index (HDI – a statistical index composed of indicators of life expectancy, education, and per capita income).

These covariates were analyzed for the most recent year for which they were available. Most were extracted from the latest *IBGE* Demographic Census (*IBGE*, 2022). Otherwise, if the variable was not available in the latest Census, it was extracted from the year 2016 (namely: life expectancy at birth, infant mortality rate, urbanization index, and Palma index).

The analyses were performed in the first half of 2025. Simple and multiple regressions were performed to test the association between each covariate and the variation in the PAI. We categorized each covariate into tertiles for analysis purposes and tested them in both forms (continuous and categorical). Next, we present only the significant association for the variables in tertiles in the Results section, as these explained the greatest variability (R^2 coefficient) of the outcome. Variables with a p-value less than 0.20 were kept in the final model, and those with a p-value less than 0.05 had statistical significance. Linear trend tests were also performed.

The study used exclusively secondary, aggregated, and publicly accessible data, without the possibility of individual identification. Therefore, it is exempt from review by a Research Ethics Committee, in accordance with Resolution No. 510 of the National Health Council, of April 7, 2016.

DATA AVAILABILITY

The entire dataset supporting the results of this study is available upon request from the corresponding author, Samuel C. Dumith.

RESULTS

The PAI in Brazil changed from 16.7 in 1991 (ranging from 8.5 in Roraima to 32.5 in Rio de Janeiro) to 68.4 in 2022 (ranging from 27.1 in Roraima to 115.4 in Rio Grande do Sul). This represents an absolute increase of 51.7 percentage points (pp) or a relative increase of 300% over 30 years (Table 1). Among the 27 Brazilian states, the average annual percentage change (APC) for the PAI from 1991 to 2022 was 1.8 (95%CI 1.6 to 2.1), ranging from 0.7 (in Roraima) to 3.2 (in Rio Grande do Sul).

Considering the Brazilian regions, the APC-PAI ranged from an average of 1.1 (SD=0.4) in the North region to 2.8 (SD=0.4) in the South region (Figure 1). It increased almost fourfold between 1991 and 2022 for all five regions, rising from 10 to 40 in the North region, and from 24 and 23 to 96 and 97 for the Southeast and South regions, respectively. This means that there is virtually one older adult (60 years or older) for every child or young person under 15 years old in the Southeast and South regions, as based on the last Census (2022). However, considering the North region (lowest PAI in Brazil), there are approximately two individuals under 15 years old for every individual 60 years or older.

Table 1. Description of the population aging index (PAI) and the annual percentage change (APC) for each Brazilian state (n=27), 1991 to 2022.

State	PAI _1991	PAI _1996	PAI _2000	PAI _2006	PAI _2010	PAI _2016	PAI _2022	APC (pp)	APC (95%CI)
Rondônia	9.4	12.1	15.2	20.3	26.6	35.3	56.4	1.7	0.8; 2.5
Acre	10.8	12.7	14.1	15.0	19.0	22.6	35.3	0.8	0.3; 1.3
Amazonas	9.6	11.4	12.5	15.0	18.2	22.8	33.3	0.8	0.4; 1.3
Roraima	8.5	9.3	10.5	13.1	16.6	21.7	27.1	0.7	0.4; 1.0
Pará	11.5	13.6	15.5	18.4	22.7	29.3	44.1	1.2	0.5; 1.9
Amapá	8.6	9.4	10.4	12.0	15.5	19.7	31.1	0.8	0.3; 1.4
Tocantins	13.5	16.3	19.3	23.5	29.5	37.7	53.9	1.5	0.7; 2.2
Maranhão	13.7	16.8	19.3	23.1	28.0	34.7	49.8	1.3	0.6; 1.9
Piauí	16.2	20.6	24.8	31.3	40.0	49.3	72.6	1.9	1.2; 2.7
Ceará	19.9	23.0	26.4	32.8	41.6	52.3	71.7	1.9	1.1; 2.8
Rio Grande do Norte	22.1	25.0	28.5	34.7	43.6	52.9	76.3	1.9	1.1; 2.8
Paraíba	23.9	27.8	32.4	38.6	47.4	57.1	74.5	1.8	1.2; 2.5
Pernambuco	21.3	25.1	28.6	33.8	41.6	50.3	70.3	1.7	0.9; 2.5
Alagoas	15.9	18.3	20.6	24.4	30.4	39.7	57.5	1.5	0.6; 2.4
Sergipe	17.3	19.7	22.0	26.9	33.4	42.9	62.7	1.7	0.7; 2.6
Bahia	17.3	21.5	25.8	32.3	40.4	52.2	75.7	2.1	1.1; 3.1
Minas Gerais	22.3	27.3	32.0	41.0	52.6	71.9	98.3	2.8	1.4; 4.2
Espírito Santo	19.3	23.8	29.1	35.3	44.9	58.9	85.5	2.4	1.2; 3.6
Rio de Janeiro	32.5	38.2	42.6	50.0	61.5	79.3	105.6	2.7	1.3; 4.1
São Paulo	25.1	29.6	34.0	42.5	53.9	68.1	95.6	2.6	1.4; 3.8
Paraná	20.5	24.9	29.5	38.0	49.0	65.5	85.9	2.4	1.4; 3.5
Santa Catarina	20.4	24.3	28.5	37.2	48.2	66.5	89.8	2.6	1.4; 3.9
Rio Grande do Sul	29.7	34.8	40.1	50.8	65.5	87.4	115.4	3.2	1.7; 4.7
Mato Grosso do Sul	16.5	20.5	24.7	31.1	39.1	49.6	64.5	1.8	1.1; 2.4
Mato Grosso	11.5	14.7	18.1	23.8	30.7	40.1	52.0	1.5	1.0; 2.0
Goiás	16.7	20.5	24.5	31.0	39.0	49.2	67.5	1.8	1.1; 2.6
Distrito Federal	11.8	15.1	14.2	24.6	32.5	45.2	68.4	2.1	1.2; 3.0
Brasil	16.7	20.5	24.7	24.5	39.1	49.3	68.4	1.9	0.9; 2.9

pp: percentage points; 95%CI: 95% confidence interval.

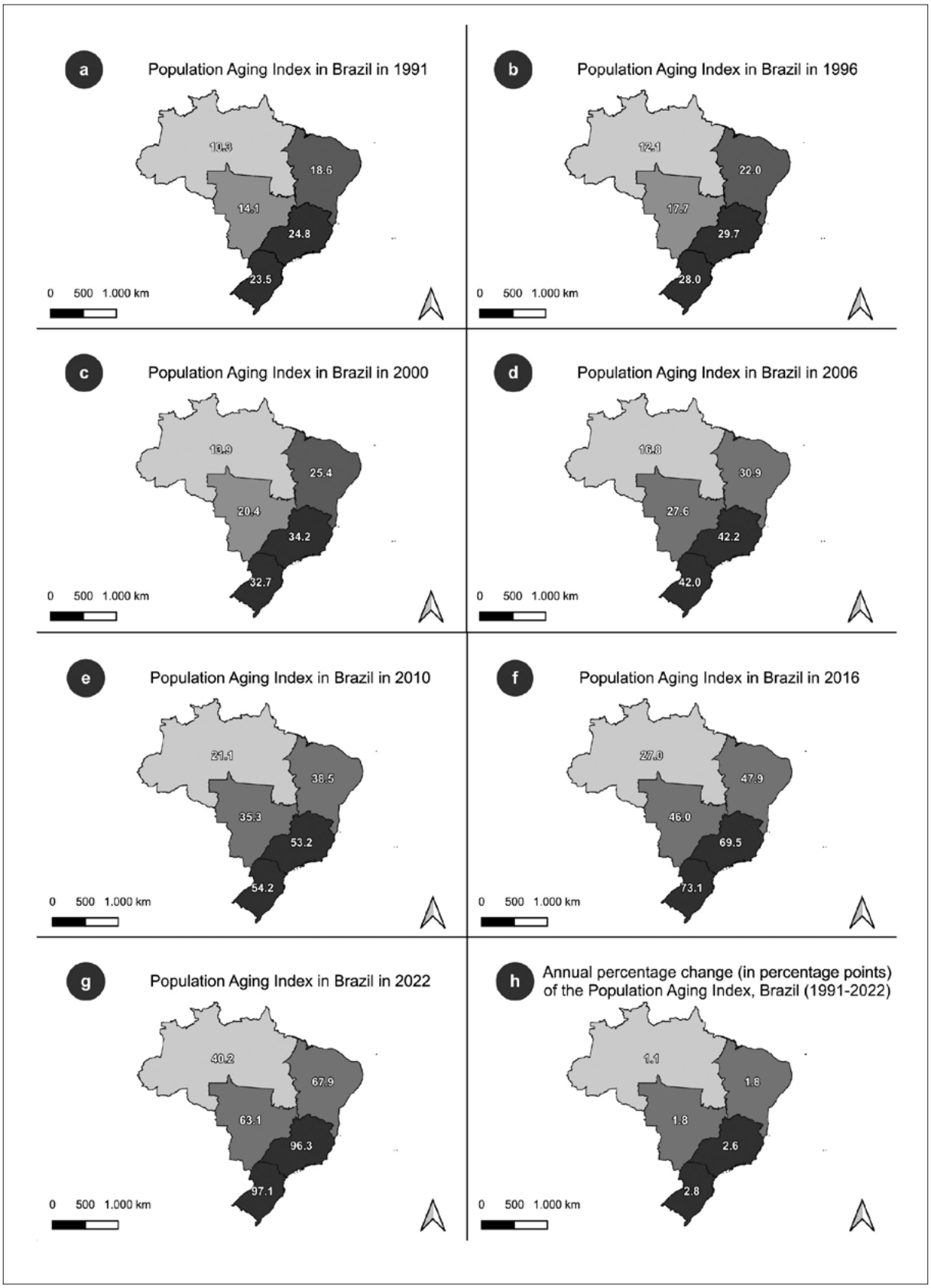


Figure 1. Description of the population aging index (PAI) according to the regional division of Brazil, 1991 to 2022.

The variables associated with the APC-PAI (Annual Percentage Change in the Population Aging Index) in the final statistical model were: fertility rate, Gini coefficient, and GDP (Table 2). We observed a negative association with the fertility rate and the Gini coefficient, meaning that an increase in their tertiles resulted in a lower APC-PAI. On the other hand, there was a positive association with GDP, meaning that each increase in its tertile resulted in a higher APC-PAI. Together, these variables explained 84% (adjusted R^2 coefficient) of the variability in the outcome (APC-PAI). The exposure variable most associated with the outcome was the fertility rate, meaning that states in the third tertile (highest fertility rate) showed an average of a 1.2 percentage point (pp) smaller increase in APC-PAI compared to the first tertile (states with the lowest fertility rate).

The other variables included in the statistical analyses (sex ratio, population density, geometric population growth rate, life expectancy at birth, infant mortality rate, urbanization index, Palma index, HDI) did not reach statistical significance (p-value >0.20) and were excluded from the final model.

Table 2. Crude and adjusted analyses of the annual percentage change (APC) in the population aging index (PAI) associated with contextual factors for the 27 federative units of Brazil – 1991 to 2022.

Contextual variables (tertiles)	Crude analysis		Adjusted analysis*	
	Beta (95%CI)	P-value**	Beta (95%CI)	P-value**
Fertility rate		<0.001		<0.001
1st (lower)	Reference (0)		Reference (0)	
2nd (intermediate)	-0.38 (-0.82; 0.07)		-0.47 (-0.77; -0.16)	
3rd (higher)	-1.14 (-1.58; -0.69)		-1.23 (-1.55; -0.92)	
Gini coefficient		0.2		<0.01
1st (lower)	Reference (0)		Reference (0)	
2nd (intermediate)	-0.87 (-1.42; -0.32)		-0.42 (-0.73; -0.11)	
3rd (higher)	-0.40 (-0.95; 0.15)		-0.56 (-0.91; -0.21)	
Gross Domestic Product (GDP)		0.01		0.01
1st (lower)	Reference (0)		Reference (0)	
2nd (intermediate)	-0.13 (-0.66; 0.40)		0.16 (-0.17; 0.49)	
3rd (higher)	0.74 (0.21; 1.27)		0.45 (0.10; 0.79)	

CI: confidence interval; * Adjusted for each of the other variables presented in this table; ** p-value for linear trend

DISCUSSION

This study provides a comprehensive analysis of trends in the PAI across all Brazilian states from 1991 to 2022, as well as its association with key contextual factors. Key findings reveal that the PAI quadrupled during this period (from 17% to 68%), reflecting an average increase of almost two percentage points (pp) per year. Furthermore, the PAI growth was inversely associated with the fertility rate and the Gini coefficient, and directly associated with GDP. Moreover, the distinct demographic stages of the states are reflected in the PAI of the state of Rio Grande do Sul (for example), which was already higher in 1991 (29.7) than the value presented in Roraima in 2022 (27.1). Taken together, these results highlight the demographic intensification of population aging in Brazil and emphasize the influence of reproductive patterns, social and economic factors on its progression. By identifying the contextual determinants of aging, this study provides evidence that can guide regional planning and formulation of equitable public policies for healthy aging.

A study[9] analyzing the period from 1970 to 2010 identified a 268% increase in PAI in Brazil, providing a different temporal perspective from our study, which also highlights the country's rapid population aging. The authors reported the highest PAI values in the South (54.9) and Southeast (54.6) regions in 2010, while the North had the lowest (21.8), with this regional pattern also being observed in the present study. Although the study did not directly examine variables associated with aging, the authors observed that more developed regions tend to have higher PAI values[9]. This was confirmed in our analysis, which found a direct relationship between PAI and GDP, and an inverse relationship with the Gini coefficient. The study also presents estimates from the United Nations Population Division, which projected that Brazil would reach a PAI of 68.3 by 2025, a threshold already surpassed in 2022 according to our data.

The fertility transition, one of the components of the demographic transition, represents the shift from a pattern of high and poorly controlled fertility levels to a scenario of birth planning, with a reduction in births and also in neonatal deaths. According to a Brazilian study[10], the fertility transition process occurred in different ways both intra- and inter-regionally, highlighting the uniqueness of the country's demographic dynamics. Some Brazilian states with greater urban and economic development, such as Rio de Janeiro, São Paulo, and Rio Grande do Sul, experienced a slow fertility transition, beginning in 1930 or earlier (given the lack of sufficient records), which is consistent with what occurred in European countries.

However, many states experienced the fertility transition phenomenon in an accelerated manner, starting in the 1960s or 1970s[10], when the reduction in the fertility rate was recorded throughout the national territory in a sustained and uninterrupted way. Furthermore, at the inter-regional level, this study[10] indicated that the state of Santa Catarina presented homogeneous variation in the fertility rate throughout its territory over the study period, while Minas Gerais was the state with the greatest heterogeneity in its municipalities, being divided into five parts. In other words, even in a socioeconomically developed state, demographic changes occur at different rates according to the microregion.

Another national study[1] which also presents an overview of the Brazilian demographic transition indicated that the national fertility rate began to decline from the end of the 1960s, reaching the replacement threshold (which produces zero population growth) in the 2000s. Furthermore, this same study[1] compared the decline in the fertility rate in Brazil with that of England: while in England it took 100 years to show a 58% decline (from 5.3 in 1870 to 2.2 in 1970), in Brazil there was a 60% reduction in 30 years (from 5.8 in 1970 to 2.3 in 2000). This study[1] reinforces how quickly this rate decreased in Brazil, a middle-income country which has seen rapid narrowing of the age pyramid compared to high-income countries, implying super-accelerated population aging.

Previous studies have shown that population aging in Brazil is more pronounced in states with higher socioeconomic development levels, which is reflected in indicators such as GDP per capita, urbanization, and access to health. In this context, a study[4] highlighted the geographically heterogeneous

nature of population aging in Brazil. Based on GDP, the most economically developed regions (South and Southeast) have the highest proportions of older adults, in contrast to the lower rates observed in the North and Northeast. A study published in 2021[11] examined the relationship between income inequality and aging in Brazil. Similarly, the authors identified regional heterogeneity in sociodemographic dynamics. Furthermore, their findings revealed an inverse association between income inequality and aging indicators, reinforcing that municipalities with greater income disparities tend to have less favorable aging profiles[11].

As reported, our APC-PAI data can be explained by about 80% by the inverse relationship between the fertility rate and the Gini coefficient and positively by GDP. These findings suggest and reinforce the secondary and paradoxical effects of successful economic advancement, such as increased education and economic inclusion of women, rising cost of living, loss of value as an economic reserve for children, and greater access to birth control.[12] A global study shows that improvements in female education and access to contraceptives, strongly linked to wealth, are the main drivers of declining birth rates, accelerating the relative aging of the population.[13] Thus, this process leads to a reduction in the birth rate across all social strata in wealthier regions with less income disparity, which, combined with better sanitation, urban infrastructure, nutrition, education, and access to healthcare, pulls the age pyramid into an "age rectangle"[14-16].

Furthermore, it is important to highlight that the public policies developed in the country were essential to leverage improvement in the quality of life throughout Brazil, serving as a basis for the increase in longevity and the demographic transition. From this perspective, it is crucial to emphasize projects such as the National Immunization Program of 1973, the Unified Health System (*Sistema Único de Saúde*) and the expansion of the Family Health Strategy (*Estratégia Saúde da Família*) since 1994, as well as the expansion of access to essential medicines through the National Pharmaceutical Assistance Policy and the Popular Pharmacy Program of Brazil (*Política Nacional de Assistência Farmacêutica e do Programa Farmácia Popular do Brasil*) created in 2004, given that they constituted fundamental pillars for improving health indicators, increasing longevity and the quality of life of the Brazilian population[17,18]. Furthermore, expansion and improvement in the education system, also supported by public policies, contributed to increasing human capital, reducing inequalities, and directly influencing demographic dynamics by acting on the determinants of fertility and age structure, postponing entry into the labor market and family formation, and promoting changes in reproductive patterns[19].

Alongside population aging, social assistance policies serve as a foundation for mitigating socioeconomic inequalities in advanced ages[20], highlighting the Organic Law of Social Assistance (*Lei Orgânica da Assistência Social* (*LOAS*) – Law No. 8,742/1993), which established the Continuous Benefit Payment (*Benefício de Prestação Continuada - BPC*) as a guarantee of minimum income for older adults in vulnerable situations, regardless of social security contributions. Furthermore, the Statute of Older Adults (*Estatuto do Idoso*) established by Law No. 10,741/2003, constitutes a landmark in the institutional adaptation of the Brazilian State to population aging resulting from the demographic transition by consolidating rights and social protection mechanisms for the population aged 60 or over[20].

To our knowledge, this is the first study to quantify the magnitude of variation in the PAI in the Brazilian population over the last three decades. Our estimates included data from all Brazilian states, revealing striking differences and disparities in the population aging process among geographic regions. Furthermore, we identified the contextual factors most strongly associated with population aging in the country. The Gini coefficient was no longer significant, and the association with the fertility rate was reversed. This reversal may reflect that the states with the greatest reductions in fertility were among the poorest, while the richest states experienced slower declines.

The present study suggests that if the APC-PAI (Annual Percentage Change in the Population

Aging Index) remains constant, the number of older adults in Brazil will exceed the number of children and adolescents (0 to 14 years) within the next 15 years, which is already observed in some states. These findings emphasize the importance of anticipating demographic transitions and adapting health and social systems to the new population profile. The World Health Organization (WHO)[21] defines healthy aging as the process of maintaining functional capacity which enables well-being in old age, highlighting that health systems must be reorganized to meet the needs of aging populations. In this context, population aging not only represents a demographic change, but also a structural challenge for public health planning.

A study using data from the National Health Survey (*Pesquisa Nacional de Saúde*, 2013) showed how strongly the accumulation of chronic diseases is associated with functional dependence among older adults, reinforcing the need for integrated prevention and care strategies[22]. Similarly, regional analyses in the Americas indicate that the rapid increase in the proportion of older adults substantially contributes to the burden of non-communicable diseases and to a greater demand for long-term care[8,13].

Taken together, these findings highlight that managing population aging requires coordinated measures focused on maintaining functionality and autonomy in old age. This includes strengthening primary healthcare, expanding rehabilitation and long-term care services, and developing community environments that support active and independent living. Viewing population aging from this perspective underscores the need for strategic planning to ensure that increased longevity is accompanied by improved quality of life and system sustainability.

Some limitations of this study should be considered. We did not assess annual changes in PAI over the entire period due to the use of demographic censuses and intercensal population estimates. Thus, we selected seven points in time to ensure more reliable accuracy for trend analysis[23]. Contextual factors were assessed at a single point in time at the end of the time series (2022), except for life expectancy at birth, infant mortality rate, urbanization index, and Palma index, which were not available in the 2022 census and were obtained from the 2016 census. Furthermore, we used the age of 60 as the cut-off age for calculating PAI, while high-income countries adopt 65, which may compromise the comparability of our estimates with these countries.

CONCLUSION

The results of this study demonstrate a demographic transition process occurring heterogeneously among Brazilian states given their respective singularities in development and urbanization marked by a generalized acceleration over the last few decades. These issues converge with the findings based on the almost 300% increase in the Population Aging Index (PAI) over just three decades, in addition to the disparity in values recorded among the states, reinforcing the existence of distinct scenarios occurring simultaneously in the country. Regarding the analyzed indicators, both the fertility rate and the Gini coefficient showed an inverse association with the PAI, while the Gross Domestic Product of each state showed a positive association. Therefore, it is crucial to understand the different sociodemographic dynamics to effectively meet the specific population demands of each region, uniting public policies and studies focused on the analysis of structural factors in the fields of health, education, and social assistance as a fundamental strategy to understand and respond to the challenges posed by the rapid aging of the Brazilian population.

AUTHORSHIP

- Samuel C. Dumith: study conception, data analysis and interpretation, article writing, approval of the final manuscript version.
- Eduarda C. Policarpo: data tabulation, article writing, approval of the final manuscript version.
- Letícia V.M.M. Pereira: data tabulation, article writing, approval of the final manuscript version.

- Marcos C.S. Monteiro: data tabulation, article writing, approval of the final manuscript version.
- Eduarda C. Costa: critical review of the article, approval of the final manuscript version.

ACKNOWLEDGEMENTS

We appreciate Allan de Lima Araújo' s collaboration in carrying out this work.

Edited by: Cristian Arnecke Schröder

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Estimation of glomerular filtration rate: an evaluation of the use of different equations in the clinical context of older patients

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Abstract

Objective: To verify the level of agreement between the Chronic Kidney Disease Epidemiology Collaboration 2021 (CKD-EPI 2021) and Cockcroft-Gault (CG) equations regarding medication dose adjustment for renal function in older patients, and to analyze whether these estimates imply changes in clinical management. *Methods:* Observational study with a longitudinal and prospective design, including individuals aged 60 years or older, followed during hospitalization. Agreement between dose adjustments based on CKD-EPI 2021 and CG was assessed using the Kappa (κ) test. *Results:* A total of 54 medical records were analyzed, of which the majority were male (53.7%) and younger than 73 years (57.4%). The level of agreement ranged from very good to excellent for atenolol, spironolactone, morphine, metformin, and escitalopram. However, medications such as meropenem, domperidone, piperacillin tazobactam, vancomycin, metoclopramide, regular insulin, and enoxaparin showed moderate to low agreement. In addition, the results indicate that a change in clinical management would occur in 40.40% of the medications that did not present a good level of agreement when one equation or the other was selected. *Conclusion:* There is potential interchangeability between CKD-EPI 2021 and CG for medications that demonstrated a good level of agreement. However, caution is warranted when selecting the equation for medications not included in this group, as the choice may alter clinical management and affect therapeutic effectiveness or increase the risk of toxicity.

Keywords: Kidney Function Tests. Chronic Kidney Disease. Drug Utilization. Elderly.

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There was no funding for the execution of this work.

The authors declare that there is no conflict in the conception of this work.

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Received: October 25, 2025
Approved: January 7, 2026

http://dx.doi.org/10.1590/1981-22562026029.240073en

INTRODUCTION

The demographics of aging are changing rapidly as a result of increased life expectancy. It is estimated that by 2030 approximately 12% of the world population will consist of individuals aged 60 years or older. In Brazil, data from the 2022 census conducted by the Brazilian Institute of Geography and Statistics (IBGE) estimated that the population aged 60 years or older reached 32,113,490 individuals (15.6%), representing an increase of 56.0% compared with 2010[1,2].

Aging can be described as a process of irreversible deterioration of physiological activities related to survival and fertility, resulting in impaired tissue and organ function over the life course. This process is one of the most relevant risk factors for the development of a large proportion of chronic diseases, as demonstrated in major population-based studies[3,4].

Systemic changes resulting from prolonged human lifespan range from alterations in body composition to bioenergetic imbalance and neurodegeneration. These changes may lead to reductions in resting cardiac output, maximal respiratory capacity, nerve conduction velocity, and glomerular filtration rate (GFR), which are among the most frequently observed alterations[3,4].

In this context, nephrosenescence refers to the progressive decline in renal function associated with aging, which occurs even in healthy individuals. As life advances, the likelihood of developing chronic kidney disease (CKD) increases. For patients in the hospital setting, estimating renal function is essential, whether for diagnostic purposes and/or CKD management, or for dose adjustment of medications excreted via the renal route[5-7].

In clinical practice, renal function is estimated using equations based on serum creatinine (sCr). The first equation developed was the Cockcroft-Gault equation, in 1976, which estimates creatinine clearance (CrCl) rather than GFR. This is because both glomerular filtration and tubular secretion contribute to creatinine clearance. Tubular secretion of creatinine may account for up to 50% of its total clearance, particularly in the presence of impaired renal function and comorbidities such as obesity. Consequently, GFR may be overestimated when calculated using this equation. The Cockcroft-Gault formula estimates renal clearance based on body weight, age, and sex[5, 8-10].

In 2009, the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) research group in the United States conducted a study aimed at developing and validating a new sCr-based estimation equation. The first version of this equation considered, in addition to sCr, factors such as sex, age, and race. Adopted by the Kidney Disease Improving Global Outcomes (KDIGO) initiative since 2012, it has become the most widely used method worldwide. In 2021, the CKD-EPI formula was updated following a publication by the National Kidney Foundation (NKF) and the American Society of Nephrology (ASN), which removed race-based modifiers, as they are not biological parameters[10-12].

Within this framework, the predictive performance of drug pharmacokinetics may differ depending on whether the estimated glomerular filtration rate (eGFR) or estimated CrCl is calculated using an equation different from that employed in the original pharmacokinetic study. In both clinical pharmacology and drug development, the Cockcroft-Gault (CG) equation has served as the reference standard for decades. Therefore, to consider equivalence between estimation methods, the same medication must be evaluated using different formulas to calculate GFR and demonstrate similar performance within the same previously established population pharmacokinetic model[5].

The objective of this study was to assess the level of agreement between the CKD-EPI 2021 and Cockcroft-Gault equations, based on estimated glomerular filtration rate (eGFR) and estimated creatinine clearance (CrCl), respectively, regarding medication dose adjustment for renal function in older patients, and to determine whether these estimates imply changes in clinical management.

METHODS

This was an observational study with a longitudinal and prospective design involving older adults followed

during hospitalization at Hospital das Clínicas of the Federal University of Pernambuco (HC-UFPE), Brazil. Data were collected through review of patients' medical records using the *Aplicativo de Gestão para Hospitais Universitários (AGHUx)*, the electronic health record system used in Brazilian federal university hospitals, between August and November 2023.The convenience sample comprised older adults of either sex, aged 60 years or older, who were hospitalized during the study period and were using at least one medication listed in their prescription.

Exclusion criteria were as follows: absence of at least one recent serum creatinine (sCr) test result in the medical record, defined as a test performed within 72 hours before or after hospital admission; electronic prescriptions containing only medications prescribed as needed or at the physician's discretion; and absence of recorded body weight during hospitalization, as this information is essential for calculating estimated glomerular filtration rate (eGFR). Patients admitted directly to the Intensive Care Unit (ICU) or to the surgical block immediately after hospital admission were excluded. Patients initially admitted to a general ward and subsequently transferred to the ICU or surgical block were followed only until the time of transfer, as clinical instability and rapid fluctuations in clinical status in these settings could increase sample heterogeneity.

The following sociodemographic, clinical, and laboratory variables were recorded: sex, age in years, educational level, body weight in kilograms (kg), height in meters (m), body mass index (BMI), calculated as weight divided by height squared (kg/m^2), comorbidities, medication-related information (name, dose, route of administration, and total number of prescribed medications), and sCr (mg/dL), used to calculate eGFR and estimated creatinine clearance (CrCl).

After data collection, eGFR and estimated CrCl were calculated for all included patients using the CKD-EPI 2021 and CG equations, respectively, as available electronically on the National Kidney Foundation® platform. Prescriptions were analyzed regarding indication, dose, and dosing regimen, as well as evaluated in relation to renal function impairment. Medication-related information was obtained from the UpToDate® database, institutional protocols, and manufacturer prescribing information.

Data analysis was conducted using descriptive and inferential statistics. Qualitative variables were expressed as frequencies and proportions, whereas quantitative variables were presented as mean, median, range, and standard deviation. Agreement between dose adjustments based on CKD-EPI 2021 and Cockcroft-Gault was assessed using the Kappa (κ) test. This test, proposed by Cohen in 1960, uses the Kappa agreement coefficient. A κ value equal to 1 indicates perfect agreement between the evaluated methods, whereas values closer to zero indicate agreement attributable to chance. In this study, the following thresholds were adopted: values above 0.80 excellent, between 0.79 and 0.60 very good, between 0.59 and 0.40 moderate, and below 0.39 low[13]. Analyses were performed using a significance level of 0.05.

The study was submitted to and approved by the Research Ethics Committee of the Hospital das Clínicas of Pernambuco, under Certificate of Presentation for Ethical Consideration (CAAE) No. 69009823.4.0000.8807 and approval opinion No. 6045723, in accordance with Resolution No. 466/2012 of the Brazilian National Health Council (CNS), with a waiver of written Informed Consent Form (ICF). Ethical principles were observed throughout the study, and participant confidentiality and anonymity were strictly maintained.

HC-UFPE is managed by the *Empresa Brasileira de Serviços Hospitalares* (Ebserh), a federal public company that supports teaching, research, and extension and outreach activities at affiliated federal universities. The hospital is a medium and high complexity referral center for the Brazilian Unified Health System (SUS) in the state of Pernambuco and provides outpatient and inpatient care, including services in nephrology. The equations evaluated in this study were already used in routine hospital practice; however, there was no standardized guidance regarding which calculator should be used or the specific contexts for selecting one equation over the other.

DATA AVAILABILITY

The entire dataset supporting the results of this study is available upon request to the corresponding author.

RESULTS

During the study period, data were obtained from 88 patient medical records, of which 34 were excluded. Among these, 30 (88.2%) did not have creatinine results within 72 hours before or after hospital admission; 2 (5.9%) had prescriptions containing only medications prescribed as needed; 1 (2.9%) underwent surgery almost immediately after admission; and 1 (2.9%) did not have body weight recorded in the medical record by any professional category. Consequently, 54 medical records were analyzed, and their sociodemographic and clinical characteristics are described in Table 1.

The most prevalent comorbidities were systemic arterial hypertension and diabetes. CKD was present in a small proportion of the study population. Regarding BMI, 19 patients (35.2%) had values at the extremes of the classification, either underweight or with some degree of obesity. With respect to medications, a total of 504 drugs included in the institution's standardized formulary were prescribed (median = 8, mean = 9.3, standard deviation = ±5.3). Of these, 130 (25.8%) had recommendations for dose adjustment based on renal function.

The analysis of the level of agreement between the CKD-EPI 2021 and Cockcroft-Gault equations regarding the need for medication dose adjustment is presented in Table 2.

Table 3 presents the percentage of dose adjustment recommendations according to both equations for medications that showed moderate to low levels of agreement. Considering eGFR, 18 patients required dose adjustment for at least one medication. Among these patients, a total of 141 dose adjustments would have been required, taking into account the days on which the medications remained prescribed. Furthermore, considering this latter aspect, 57 adjustments (40.40%) would have resulted in different clinical management decisions depending on whether one equation or the other was used.

Table 1. Demographic, social, and clinical characteristics of the older adults included in the study (N = 54). Recife, Pernambuco, Brazil, 2023.

Characteristics	Values
Male sex – n (%)	29.0 (53.7)
Age (years) – m (± SD)	72.5 (8.8)
Age group – n (%)	
60-73	31.0 (57.4)
73 ≥	23.0 (42.6)
Body weight (kg) – m (± SD)	67.2 (17.9)
Height in meters (m) – m (± SD)	1.6 (0.1)
BMI, kg/m² – n (%)	
≤ 18.5 – Underweight	5.0 (9.3)
18.6–24.9 – Normal weight	19.0 (35.2)
25.0–29.9 – Overweight	16.0 (29.6)
30.0–34.9 – Obesity class I	10.0 (18.5)
35.0–39.9 – Obesity class II	2.0 (3.7)
≥ 40.0 – Obesity class III	2.0 (3.7)

to be continued

Continuation of Table 1

Characteristics	Values
Educational level – n (%)	
No formal education	21.0 (38.9)
Incomplete elementary education	14.0 (25.9)
Complete elementary education	9.0 (16.7)
Incomplete high school	1.0 (1.9)
Complete high school	7.0 (13.0)
Incomplete higher education	1.0 (1.9)
Complete higher education	1.0 (1.9)
Non-smokers and non-alcohol users – n (%)	50.0 (92.6)
Comorbidities* – n (%)	
Systemic arterial hypertension	46.0 (26.4)
Diabetes	28.0 (16.1)
Oncological diseases	16.0 (9.2)
Cardiac system diseases	15.0 (8.6)
Vascular diseases	15.0 (8.6)
CKD	6.0 (3.4)
Other**	48.0 (27.6)
No reported drug allergy – n (%)	52.0 (96.3)
Number of prescribed medications – m (± SD)	10.3 (5.5)
Length of hospital stay – m (± SD)	12.4 (12.7)
eGFR – CKD-EPI 2021 – n (%)	
≥ 90	14.0 (25.9)
60-89	21.0 (38.9)
30-59	15.0 (27.8)
≤29	4.0 (7.4)
CrCl – CG*** – n (%)	
≥ 90	10.0 (18.5)
60-89	14.0 (25.9)
30-59	24.0 (44.4)
≤29	6.0 (11.1)

Source: Study data, 2023; SD = standard deviation; CKD = chronic kidney disease; BMI = body mass index; kg = kilogram; kg/m² = kilograms per square meter; m, SD = mean and standard deviation; n, % = absolute and relative frequency; eGFR = estimated glomerular filtration rate expressed in mL/min/1.73 m²; CrCl = creatinine clearance expressed in mL/min. *Considering n = 174 as the sum of comorbidities across all patients. **"Other" includes conditions such as hypothyroidism, dyslipidemia, respiratory, gastrointestinal, hepatic, hematological, neurological, urological, and bone diseases. ***Cockcroft-Gault.

Table 2. Agreement between the CKD-EPI 2021 and Cockcroft-Gault equations regarding the need for medication dose adjustment according to the Kappa test. Recife, Pernambuco, Brazil, 2023.

Medication	n	κ	*p*	Level of agreement
Atenolol	33	1.000	< 0.001	Excellent
Spironolactone	19	0.883	<0.001	Excellent
Morphine	13	0.843	0.002	Excellent
Metformin	12	0.750	0.007	Very good
Escitalopram	18	0.640	0.004	Very good
Meropenem	12	0.500	0.079	Moderate
Domperidone	24	0.357	0.022	Low
Piperacillin + Tazobactam	17	0.354	0.056	Low
Vancomycin	19	0.336	0.050	Low
Metoclopramide	13	0.316	0.120	Low
Regular insulin	24	0.149	0.459	Low
Enoxaparin	91	0.109	0.120	Low

Source: Study data, 2023; κ = Kappa coefficient; n = sample size; p = significance level.

Table 3. Percentage of dose adjustment recommendations based on estimated glomerular filtration rate calculated using the CKD-EPI 2021 and Cockcroft-Gault equations for medications with κ values below 0.6. Recife, Pernambuco, Brazil, 2023.

Medication	CKD-EPI 2021			Cockroft-Goult		
	n (%)	m*	CI	n (%)	m**	CI
Meropenem	7 (58.3)	44.0	3.4	6 (50.0)	38.2	11.3
Domperidone	4 (16.7)	24.5	5.9	1 (4.2)	28.0	***
Piperacillin + Tazobactam	4 (23.5)	27.0	9.5	10 (58.8)	32.3	4.1
Vancomycin	12 (63.2)	17.9	6.9	17 (89.5)	25.6	4.6
Metoclopramide	1 (7.7)	52.0	***	4 (30.4)	46.3	11.1
Regular insulin	13 (54.2)	35.3	6.0	15 (62.5)	42.2	9.8
Enoxaparin	2 (2.2)	26.5	31.8	12 (13.2)	25.1	2.0

Source: Study data, 2023; n = absolute frequency; % = relative frequency; m = mean; CI = confidence interval. *Mean estimated glomerular filtration rate expressed in mL/min/1.73 m²; **Mean estimated creatinine clearance expressed in mL/min; ***Confidence interval could not be calculated due to the sample size consisting of only one observation.

DISCUSSION

The results of the present study show that the level of agreement between the CKD-EPI 2021 and Cockcroft-Gault (CG) equations for medication dose adjustment based on renal function varies according to the medication being adjusted. Complementarily, the choice of equation for this purpose may alter clinical management, which can positively or negatively affect treatment safety or effectiveness.

The κ values for atenolol, spironolactone, morphine, metformin, and escitalopram indicate a degree of variation between the two equations that may be considered negligible. This finding opens the possibility of discussing renal dose adjustment for these medications regardless of which of the two equations is used.

In 2011, the KDIGO initiative published a statement addressing recommendations on this topic, focusing on chronic kidney disease (CKD)

and acute kidney injury (AKI). According to this document, no specific equation is defined as the best option for this purpose. The recommendation is to use the method that provides the greatest accuracy, regardless of whether it is estimated creatinine clearance (CrCl), estimated glomerular filtration rate (eGFR), or measured creatinine clearance obtained from a 24-hour urine collection[14].

There is no evidence confirming the superiority of any single method for medication dose adjustment across all patient populations or clinical situations. In its most recent update, the KDIGO practical guidelines for CKD adopt a less favorable position regarding the use of the CG equation; however, they emphasize that, to date, few studies have compared different eGFR equations in the context of medication dosing[15].

Two equations, known as the Berlin Initiative Study equations 1 and 2 (BIS 1 and BIS 2), were developed and validated with the aim of estimating GFR specifically in older adults. This work consisted of a cross-sectional study conducted in Germany with 600 patients and used creatinine as the biomarker[16]. Despite the relevance of the initiative and its contributions, the sample comprised only White individuals older than 75 years, which limits extrapolation to other populations, including the one evaluated in the present study.

In addition, the KDIGO statement addresses the controversies surrounding the main equations, including CKD-EPI and CG. Methodological differences between equations strongly influence estimated values. In this regard, KDIGO recommends selecting a single formula for estimation, patient follow-up, and medication dose adjustment, as this approach may provide greater safety with respect to changes occurring in renal function[15].

Some pharmacokinetic studies evaluating drug clearance across different levels of renal function do not clearly specify which equation was applied in their methodology. These studies underpin clinical reference tools widely used in practice, such as UpToDate®, and this lack of clarity may represent a confounding factor in equation selection. Furthermore, the way adjustment ranges are presented in these tools, whether based on estimated CrCl or eGFR and expressed in mL/min or mL/min/1.73 m², respectively, may induce preference for a particular equation.

Additionally, the publication date of an article may be another factor influencing the choice of calculator. It is known that the first version of the CKD-EPI equation, which included race as a modifier, was created and validated in 2009[11]. Prior to that, few calculators were available, including the CG equation, originally published in 1976[9]. It is also noteworthy that pharmacokinetic testing related to renal function only became an official requirement in 1998, following guidance issued by the United States Food and Drug Administration[16]. This historical context may further influence equation selection, particularly regarding the use of CG for the purpose addressed in this study; however, it cannot be definitively stated that this was the equation used in studies conducted prior to the development of CKD-EPI.

As an example of the issues discussed above, atenolol was the medication with the highest $\varkappa$ value in this study, with the following dose adjustment recommendation described in UpToDate®: a maximum dose of 50 mg for CrCl between 10 and 30 mL/min and 25 mg for CrCl below 10 mL/min[17,18]. Pharmacokinetic studies evaluating the renal clearance of this drug do not specify which equation was used for estimation; however, they predate the development of the CKD-EPI equation.

From a practical standpoint, the greatest concern involves medications that showed moderate or poor agreement, that is, $\varkappa$ values below 0.60. In this study, antimicrobial agents, antiemetics, anticoagulants, and hypoglycemic agents, which are frequently used in hospital clinical practice, exhibited this pattern.

Among the antiemetic and gastrointestinal prokinetic agents identified in this study are domperidone and metoclopramide, medications that are often prescribed to oncology patients and that have potential cardiotoxicity[19]. In this study, oncological and cardiac diseases ranked third and fourth, respectively, in terms of prevalence. The routine use of these agents in this population is justified both by the patients' underlying clinical condition and by adverse reactions resulting from the

use of chemotherapeutic agents, which are essential for the treatment of several oncologic conditions[20].

Given the vulnerability of patients undergoing cancer treatment, it is essential to adopt assertive measures, such as medication dose adjustment based on renal function. The objectives of these measures are to reduce and prevent complications, such as loss or worsening of effective renal function due to the use of potentially nephrotoxic medications, including some chemotherapeutic agents. For patients who already have concomitant CKD at any stage, the goal is to minimize the impact of drug accumulation for medications that rely primarily on the renal route for clearance[14].

It is also noteworthy that metoclopramide is classified as potentially inappropriate for older adults according to the Beers Criteria[21], both when used alone, due to associated extrapyramidal effects, and when used concomitantly with other medications, because of drug drug interactions. Therefore, metoclopramide is a medication for which cautious use is recommended in older patients[21].

Another medication with low κ agreement was regular insulin, which is also frequently prescribed in the hospital setting, mainly for glycemic correction, but also in other conditions, such as hyperkalemic emergencies[22]. Used in the treatment of diabetes, this disease is one of the main causes of CKD and was the second most prevalent comorbidity in this study[17].

In the case of regular insulin, the issue lies in the fact that, in addition to its clearance, insulin is metabolized by the kidneys. This may lead to drug accumulation in patients with impaired renal function, potentially resulting in hypoglycemia[22]. However, dose adjustment based on renal function for this medication is not routinely performed in the hospital context, as capillary blood glucose is typically monitored frequently, and dose variations are generally guided by point of care glucose testing results.

With regard to antimicrobial agents, several studies have addressed safety and effectiveness in patients with impaired renal function. Meropenem, piperacillin with tazobactam, and vancomycin were also among the medications showing low agreement between formulas in the present study. A key consideration for these drugs is the influence of pharmacokinetic and pharmacodynamic factors (PK/PD) on the selection of dosing regimens used to treat infections, particularly those associated with healthcare delivery and caused by resistant microorganisms[23].

Further regarding these therapeutic agents, factors such as molecular hydrophilicity, volume of distribution (VD), clearance pathway, half-life, sepsis, infection focus, tested minimum inhibitory concentration (MIC), as well as renal function itself, among others, guide the choice of antibiotic dose. In addition, the risk of nephrotoxicity associated with these agents also influences therapeutic decision making, especially for vancomycin and piperacillin with tazobactam when used alone or concomitantly[17,23].

Finally, the medication with the poorest κ value in this study was enoxaparin, an anticoagulant used both for the treatment and prophylaxis of thromboembolic events. This drug tends to accumulate when CrCl is below 30 mL/min, in which case dose reduction or switching to unfractionated heparin is generally recommended[24].

It was also observed that, among the medications with an indication for dose adjustment included in this study, enoxaparin was the most frequently prescribed, appearing almost three times as often as the second most prescribed medication. This finding should be interpreted cautiously, as it raises the question of whether agreement results might have differed if prescription frequencies had been balanced across medications. Conversely, it is important to highlight that there was a considerable proportion of differing clinical decisions regarding dose adjustment depending on whether one equation or the other was adopted.

Thus, it is essential that the equation used be the one that ensures the most appropriate dose adjustment for treatment. Studies referenced by the UpToDate® tool for dose adjustment of meropenem, vancomycin, piperacillin, and enoxaparin used the CG equation to estimate CrCl[24-27]. In contrast, for domperidone, dose adjustment is based on expert opinion; for metoclopramide, studies do not specify which calculator was used; and for regular insulin, no reference is provided.

In this study, for most medications that showed moderate or low agreement, CG was the equation associated with higher percentages of dose adjustment. These findings suggest a potentially more conservative stance of the CG equation, in the sense of recommending dose modifications to preserve current renal function or to reduce the risk of toxicity resulting from decreased excretory capacity, despite the limitations reported. Conversely, meropenem and domperidone showed a higher number of dose adjustments when CKD-EPI 2021 was used, which also supports a conservative role of this latter equation for these two medications.

As discussed above, the equations used in this study have inherent limitations. For CKD-EPI, when comparing eGFR between obese and non-obese individuals with the same sCr value, results tend to be similar, as the equation uses a standard body surface area (BSA) of 1.73 m^2, based on the average BSA of Americans in 2009. In contrast, the CG equation is more closely related to estimating measured CrCl than to true GFR, as creatinine undergoes tubular secretion. Moreover, the development of the CG equation predates the standardization of creatinine measurement using isotope dilution mass spectrometry (IDMS) by the National Institute of Standards and Technology (NIST) in 2005, which may lead to overestimation of CrCl when CG is applied using current standardized assays[9,14].

Among the limitations of this study, the small number of participants should be highlighted. This was mainly due to the short period available for data collection and the absence of sCr measurements within the time frame established in the inclusion criteria, the latter being the primary reason for the exclusion of potential candidates. Another limitation was the performance of a single body weight measurement for all patients at the beginning of the study, without longitudinal follow-up aligned with sCr assessments, particularly among patients with longer hospital stays. Body weight is a variable that may undergo significant changes during hospitalization, especially in individuals with fluid retention secondary to cardiovascular conditions, CKD, and AKI.

Nevertheless, it is noteworthy that this study presents an important strength by addressing a topic that remains underexplored in the Brazilian scientific literature, despite its high relevance to clinical practice. In the context of older adults, the findings underscore the importance of conscious, careful, and rational healthcare, contributing to more effective therapies and to the reduction of health-related complications, with an emphasis on patient safety. In addition, the study may support healthcare services in minimizing patient harm, reducing length of hospital stay, and lowering healthcare costs. It also contributes to improving clinical reasoning and promoting the alignment of interprofessional practices within the institution where the study was conducted.

CONCLUSION

The findings reveal the existence of disagreements among the various stakeholders involved in the medication use process regarding the estimation of kidney function and dose adjustment. Significant uncertainty persists as to which equation should be preferred or which provides the most appropriate support for clinical decision making. In this study, the CKD-EPI 2021 and Cockcroft-Gault equations demonstrated levels of agreement ranging from very good to excellent for dose adjustment of certain medications, suggesting the possibility of interchangeability between them in these cases. This may represent a favorable aspect for patients using such medications.

It should be emphasized that the considerations presented in this study are not intended to define clinical conduct nor to allow extrapolation beyond the institutional setting in which the research was carried out. However, the findings highlight the need for further investigations on this topic, given that renal function-based medication dose adjustment has direct implications for both treatment effectiveness and patient safety.

AUTHORSHIP

- Anderson Félix da Cruz – responsibility for all aspects of the study; project administration; conceptualization; data curation; writing – review & editing; methodology; funding acquisition; resources; and software.

- Matheus Eduardo do Nascimento Barreto – study conception and design; critical revision; project administration; conceptualization; data curation; writing – review & editing; methodology; funding acquisition.
- Francisca Sueli Monte Moreira – study conception and design; critical revision; approval of the final version; supervision; validation; visualization; formal analysis.
- Renally Cristina Lima da Silva – conception; data analysis; critical revision.
- Ricardo Brandão – study conception and design; critical revision; approval of the final version; supervision; validation; visualization; formal analysis.
- Erika Michelle do Nascimento Facundes Barbosa – supervision; validation; visualization; formal analysis.

Edited by: Camila Alves dos Santos

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Prevalence of frailty in hospitalized older adults with diabetes mellitus: systematic review and meta-analysis

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Abstract

Objective: To identify the prevalence of frailty in hospitalized older adults with diabetes mellitus based on a synthesis of evidence from the literature. *Method:* A systematic review was conducted, with searches performed in the MEDLINE, EMBASE, Virtual Health Library (VHL), Scopus, SciELO, and Web of Science databases, as well as in the reference lists of the selected studies. The inclusion criteria were hospitalized older adults diagnosed with diabetes mellitus and physical frailty, with no temporal restrictions. Searches were carried out in January 2025. The guidelines established by the Joanna Briggs Institute for evidence synthesis were followed. A meta-analysis model was used to estimate the prevalence of frailty, and a random-effects model was applied for data synthesis. *Results:* A total of 2,261 articles were identified, and 12 studies were included in the meta-analysis. Despite the variability observed in the instruments used to assess frailty, a high prevalence of frail individuals (40.4%; 95% CI: 23.0% to 60.5%; $I^2 = 97.7\%$, $\tau^2 = 2.2149$, $p < 0.0001$) and pre-frail individuals (34.8%; 95% CI: 22.3% to 49.8%; $I^2 = 97.7\%$, $\tau^2 = 0.6700$, $p < 0.0001$) was identified among hospitalized older adults diagnosed with diabetes. *Conclusion:* The findings reinforce the importance of systematic frailty assessment in hospitalized older adults diagnosed with diabetes mellitus as a basis for therapeutic planning and for improving care centered on functional status.

Keywords: Aged. Frailty. Diabetes Mellitus. Meta-analysis. Inpatients.

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There was no funding for the execution of this work.
The authors declare that there is no conflict in the conception of this work.

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Received: December 12, 2025
Approved: January 14, 2026

http://dx.doi.org/10.1590/1981-22562026029.250170en

INTRODUCTION

Physical frailty is one of the main contributors to functional decline and premature mortality in older adults, as it is characterized as a clinical state marked by increased individual vulnerability when exposed to internal and external stressors[1,2]. It has become increasingly evident that the risk of frailty in older adults may increase in the presence of chronic diseases, and this association has been demonstrated for diabetes mellitus (DM)[3].

Older adults living with DM present high rates of mortality, functional disability, and comorbidities, in addition to a higher risk of falls, cognitive impairment, and polypharmacy[4]. Global estimates report that DM affects nearly 589 million people aged 20 to 79 years, and if this trajectory persists, it is estimated to affect 853 million individuals by 2050[5]. The Diabetes Statistics Report linked to the United States Centers for Disease Control and Prevention (CDC) indicates that the prevalence of DM increases with age, reaching 29.2% (26.4% to 32.1%) among those aged 65 years or older[6].

The high prevalence of DM among older adults, together with the substantial rates of physical frailty, significantly compromises the health of hospitalized older adults, resulting in complex clinical interactions and challenging therapeutic management. DM is a risk factor for frailty[7], as both conditions share pathophysiological mechanisms, such as insulin resistance and the progressive loss of muscle mass and strength (sarcopenia)[8]. Insulin resistance, associated with hyperglycemia, diabetic complications, inflammatory cytokines, and endocrine alterations, may contribute to reductions in musculoskeletal mass and muscle weakness, thereby increasing the risk of frailty[9]. Using genetic data from large European cohorts, a study employing Mendelian randomization investigated the bidirectional causal relationship between DM and frailty. The findings showed that frailty significantly increases the risk of developing type 2 diabetes mellitus, while type 2 diabetes mellitus also increases the risk of frailty[10].

Although the literature includes studies addressing the relationship between frailty and DM, an important gap remains regarding the lack of consistent estimates of the prevalence of physical frailty in hospitalized older adults with DM, particularly in contexts of greater clinical vulnerability. The relevance of the present study is grounded in progressive population aging and the high global burden of diabetes mellitus, conditions that together intensify clinical complexity and the risk of adverse outcomes. Thus, estimating the prevalence of frailty in this group is essential to improve therapeutic planning, guide early interventions, and support clinical decision-making, contributing to enhanced hospital care, reduced complications, and the advancement of future research in this field.

In light of the above, this systematic review aimed to identify the prevalence of physical frailty in hospitalized older adults with diabetes mellitus based on a synthesis of evidence from the literature.

METHOD

This study was conducted in accordance with the recommendations of the Joanna Briggs Institute (JBI) Evidence Synthesis Groups[11]. The study protocol is published on the International Platform of Registered Systematic Review and Meta-analysis Protocols (INPLASY 202510016), doi: 10.37766/inplasy2025.1.0016.

To formulate the research question and guide the literature search, the CoCoPop strategy was used (Co – Condition: frailty; Co – Context: hospital setting; Pop – Population: older adults diagnosed with diabetes mellitus). After applying this strategy, the following research question was defined: What is the prevalence of frailty in hospitalized older adults diagnosed with diabetes mellitus?

The inclusion criteria for study selection were observational studies, including prospective and retrospective cohort studies, case-control studies, cross-sectional studies, and clinical trials; application of validated instruments to assess the variable of interest frailty; inclusion of hospitalized older adults aged 60 years or older of any nationality; publication in any language, with no restriction on publication date; and diagnosis of diabetes mellitus in accordance with the World Health Organization (WHO) diagnostic criteria published in 2018[12].

The exclusion criteria were lack of categorization regarding frailty status, duplicate studies indexed in more than one database, case reports, letters to the editor, conference abstracts, dissertations, theses, and monographs. The authors chose not to include gray literature due to the potential risk of compromising the validity and reproducibility of the results, as such materials do not undergo peer review.

The search strategy was tailored to each database and applied in January 2025 in the following sources: the National Library of Medicine (PubMed) via the Medical Literature Analysis and Retrieval System Online (MEDLINE); the Virtual Health Library (VHL); Scientific Electronic Library Online (SciELO); EMBASE; Scopus; and Web of Science. The following Medical Subject Headings (MeSH) terms were used: *Aged, Frailty, Frail Elderly, Inpatients, Hospitalization,* and *Diabetes Mellitus*. Boolean operators OR and AND were applied to structure the search strategy based on PubMed MeSH descriptors, as recommended to ensure efficient and accurate retrieval of scientific evidence from biomedical databases.

The search strategy was systematically developed with the support of a specialized librarian, who assisted in the selection of descriptors and the standardization of search combinations, thereby ensuring greater methodological rigor and reproducibility.

Accordingly, the search strategy was as follows: "Aged"[Mesh] OR (Elderly) AND "Frailty"[Mesh] OR (Frailties) OR (Frailness) OR (Frailty Syndrome) OR (Debility) OR (Debilities) OR "Frail Elderly"[Mesh] OR (Elderly, Frail) OR (Frail Elders) OR (Elder, Frail) OR (Elders, Frail) OR (Frail Elder) OR (Functionally Impaired Elderly) OR (Elderly, Functionally Impaired) OR (Functionally Impaired Elderly) OR (Frail Older Adults) OR (Adult, Frail Older) OR (Adults, Frail Older) OR (Frail Older Adult) OR (Older Adult, Frail) OR (Older Adults, Frail) AND "Inpatients"[Mesh] OR (Inpatient) OR "Hospitalization"[Mesh] OR (Hospitalizations) AND "Diabetes Mellitus"[Mesh] OR (Diabetes Mellitus). This strategy was translated into the specific controlled vocabularies of the other search sources and is described in the INPLASY registration (INPLASY 202510016).

Searches were conducted independently by two researchers, who applied the predefined eligibility criteria to the titles and abstracts retrieved. The search results were imported into the Rayyan® reference management software, in which the references were stored, organized, and classified[13]. After duplicate removal using the reference manager, ineligible studies were excluded.

The number of articles identified, including their distribution by database and aggregated totals, was systematized using the PRISMA flow diagram[14]. The flow diagram comprehensively details the screening stages, eligibility criteria, and reasons for study exclusion.

To minimize potential selection bias, after the initial refinement performed by the two reviewers, a meeting was held to discuss the selected articles. Disagreements were referred to a third reviewer, and consensus was reached regarding study inclusion or exclusion.

Following full-text reading of the eligible studies, data extraction was performed independently and in duplicate. Extracted data were compiled into a Microsoft Excel® table designed to cover the eligibility criteria. The table was based on JBI instruments[11] and included the following variables: author name, year of publication, country, sex, sample size, study design, frailty assessment instrument, and prevalence of frailty. The reference lists of the included primary studies were also manually reviewed in an attempt to identify potentially relevant articles not indexed in the searched databases.

To describe the level of agreement between reviewers, the Kappa statistic was used, which is based on the number of concordant responses, that is, the frequency with which reviewers reached the same decision[15]. In this study, the kappa agreement index was 0.98, indicating strong or almost perfect agreement between the researchers.

Eligible studies were fully appraised using the Joanna Briggs Institute critical appraisal tools. For cross-sectional studies, the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies was applied, whereas for cohort studies, the JBI Critical Appraisal Checklist for Cohort Studies was used[11].

For the meta-analysis, heterogeneity among studies was assessed using Cochran's Q test and the I^2 statistic, which enabled the selection of the most appropriate statistical model for estimating the pooled effect. Due to significant variability in study populations and methodologies, a random-effects model was applied, yielding the overall estimates of the prevalence of frailty and pre-frailty.

The results were graphically presented using forest plots, illustrating individual and pooled effects, and funnel plots to assess publication bias using Egger's test. The robustness of the estimates was evaluated through sensitivity analyses, in which individual studies were sequentially removed to assess their impact on the overall results.

The logit transformation was used to stabilize variance and to transform proportions onto a symmetric and unbounded scale [0,1]. In addition, the inverse-variance method was applied to combine study-specific estimates, assigning greater weight to studies with smaller standard errors. Hypothesis tests were conducted with a significance level of 5%.

As this study used articles retrieved from databases and did not involve human participants, approval by a Research Ethics Committee was not required. The study complies with current ethical standards. In addition, artificial intelligence was not used for writing, data analysis, or the preparation of this study.

DATA AVAILABILITY

The complete dataset supporting the results of this study has been made available in the Figshare repository and can be accessed via the doi: 10.6084/m9.figshare.30907523[16].

RESULTS

The database searches yielded 2,261 studies; 653 were excluded as duplicates, and 1,608 were selected for title and abstract screening. Of these, 1,589 articles were excluded based on title and abstract review, resulting in 19 studies selected for full-text reading. After completion of this stage, 11 articles were excluded and four new studies were added through other methods, namely reference checking of primary studies, resulting in a total of 12 articles included in the review. Figure 2 presents the Preferred Reporting Items for Systematic Reviews and Meta-Analyses PRISMA flow diagram used to illustrate the study selection process for this systematic review[14].

The reviewers included all studies that met the inclusion criteria and discussed the methodological limitations identified. A total of 3,542 participants were included in the meta-analysis, with sample sizes ranging from 101 to 1,652 participants. A predominance of males was observed in 50% of the studies, followed by females in 33.3%, while sex was not reported in 16.6% of the studies.

Methodological quality assessment scores indicated that most articles were of moderate to high quality. All articles, regardless of their methodological quality ratings (Chart 1), were subjected to data extraction and synthesis.

Among the countries in which the studies were conducted, China predominated (33.3%), followed by Vietnam (16.6%). The most frequently used instrument to assess frailty was the Frail Scale (53.8%), followed by the Clinical Frailty Scale (15.3%), the Frailty Index (7.7%), the Frailty Risk Score (FRS) (7.7%), the combined use of the Frail Scale and the Clinical Frailty Scale (7.7%), and the Fried Phenotype combined with the Reported Edmonton Frail Scale (REFS) (7.7%). Regarding study design, 58.3% were cross-sectional studies, 8.3% were multicenter cross-sectional studies, 8.3% were retrospective cohort studies, 8.3% were prospective cohort studies, and 16.6% were multicenter prospective cohort studies.

Table 1 presents the distribution of the characteristics of the studies that comprised the corpus of the systematic review, including the following variables: author and year, country of origin, sample size, sex, study design, frailty assessment instrument, and prevalence of frailty and pre-frailty.

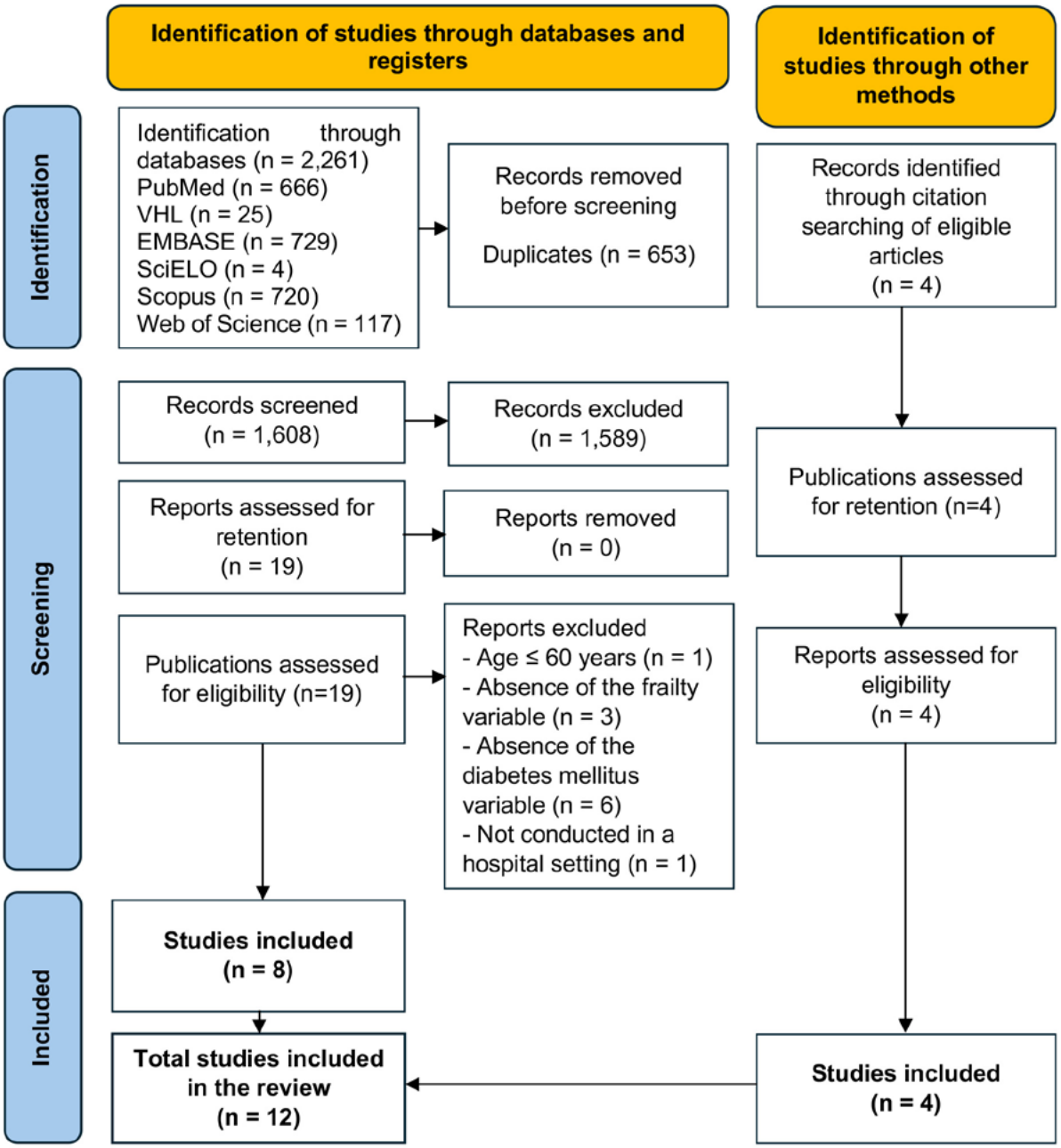


Figure 1. PRISMA flow diagram of study selection. Curitiba, PR, Brazil, 2025.

Source: Adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses[14].

Chart 1. Distribution of the results of the methodological quality assessment of the articles included in the study. Curitiba, PR, Brazil, 2025.

CROSS-SECTIONAL STUDIES*												
Author, year	1. Were the two groups similar and recruited from the same population?	2. Were exposures measured similarly to assign individuals to exposed and unexposed groups?	3. Was the exposure measured in a valid and reliable way?	4. Were objective and standardized criteria used to measure the condition?	5. Were strategies to address confounding factors described?	6. Were strategies implemented to deal with confounding factors?	7. Was the condition measured in a standardized and reliable manner?	8. Was appropriate statistical analysis used?	**Total**			
Li *et al.*, 2015[17]	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	8			
Vu *et al.*, 2017[18]	(+)	(+)	(-)	(+)	(+)	(+)	(+)	(+)	7			
Wenxiu *et al.*, 2019[19]	(+)	(-)	(--)	(+)	(+)	(-)	(-)	(+)	4			
Mackenzie *et al.*, 2015[20]	(I)	(+)	(-)	(+)	(+)	(-)	(-)	(+)	4			
O`neil *et al.*, 2022[21]	(+)	(+)	(-)	(-)	(+)	(-)	(-)	(-)	3			
Khuc *et al.*, 2021[22]	(I)	(+)	(-)	(+)	(+)	(+)	(-)	(+)	6			
Wang *et al.*, 2023[23]	(+)	(+)	(-)	(+)	(+)	(-)	(-)	(+)	5			
Zhang *et al.*, 2024[24]	(+)	(-)	(-)	(-)	(+)	(+)	(-)	(+)	4			
COHORT STUDIES **												
Author, year	1. Were the two groups similar and recruited from the same population?	2. Were exposures measured similarly to assign individuals to exposed and unexposed groups?	3. Was the exposure measured in a valid and reliable way?	4. Were confounding factors identified?	5. Were strategies to address confounding factors described?	6. Were the groups or participants free of the outcome at the start of the study or at the time of exposure?	7. Were outcomes measured in a valid and reliable way?	8. Was follow-up time reported and sufficient for outcomes to occur?	9. Was follow-up complete and, if not, were the reasons for loss to follow-up described and explored?	10. Were strategies used to address incomplete follow-up?	11. Was appropriate statistical analysis used?	**Total**
Lekan and McCoy, 2018[25]	(I)	(+)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(-)	(+)	6
Yanagita et al., 2018[26]	(I)	(+)	(-)	(-)	(+)	(+)	(-)	(+)	(+)	(+)	(+)	5
Rodríguez-Queraltó et al., 2010[27]	(I)	(+)	(+)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(+)	7
Fung et al., 2021[28]	(I)	(+)	(-)	(-)	(-)	(+)	(-)	(+)	(+)	(+)	(+)	6

(-) did not meet this criterion; (+) met this criterion; (I) unclear or not clear. Scores range from 1 to 8 or from 1 to 11, and higher scores indicate better methodological quality. *JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies[10]. **JBI Critical Appraisal Checklist for Cohort Studies[11].

Table 1. Distribution of the characteristics of the studies included in the corpus of the systematic review. Curitiba, PR, Brazil, 2025.

Author, year	Country of origin	Sample size	Female sex	Study design	Frailty assessment instruments	Prevalence of pre-frailty	Prevalence of frailty
Rodríguez-Queraltó *et al.*, 2010[27]	Spain	199	38%	Multicenter prospective cohort study	FRAIL Scale	41.2%	33.6%
Mackenzie *et al.*, 2015[20]	Canada	141	52.5%	Cross-sectional study	FRAIL Scale	NI	84.4%
Li *et al.*,2015[17]	China	146	21.9%	Cross-sectional study	FRAIL Scale	37.7%	15.1%
Vu *et al.*, 2017[18]	Vietnam	110	NI	Cross-sectional study	Fried Phenotype	40.1%	35.4%
					Reported Edmonton Frail Scale	NI	31.9%
Lekan and McCoy, 2018[25]	United States	136	57.2%	Retrospective cohort study	Frailty Risk Score ≥ 9	NI	73.5%
Yanagita *et al.*, 2018[26]	Japan	132	48%	Prospective cohort study	Clinical Frailty Scale	NI	41.6%
Wenxiu *et al.*, 2019[19]	China	126	NI	Cross-sectional study	FRAIL Scale	35.4%	36.5%
Fung *et al.*, 2021[28]	Hong Kong	215	NI	Multicenter prospective cohort study	Frailty index	NI	88.3%
O`neil *et al.*, 2022[21]	United Kingdom	101	55.4%	Cross-sectional study	Clinical Frailty Scale	34.6%	65.3%
Khuc *et al.*, 2021[22]	Vietnam	379	46.5%	Cross-sectional study	FRAIL Scale	8.7%	2.1%
Wang *et al.*, 2023[23]	China	1652	36.4%	Multicenter cross-sectional study	FRAIL Scale	59.7%	26.5%
Zhang *et al.*, 2024[24]	China	205	51.9%	Cross-sectional study	FRAIL Scale	NI	26.3%

NI – Not informed.

The pooled prevalence of frailty among hospitalized older adults with diabetes across all included studies was 40.4% (23.0% to 60.5%), I^2 = 97.7%, τ^2 = 2.2149, $p < 0.0001$, and the pooled prevalence of pre-frailty was 34.8% (22.3% to 49.8%), I^2 = 97.7%, τ^2 = 0.6700, $p < 0.0001$ (Figure 2).

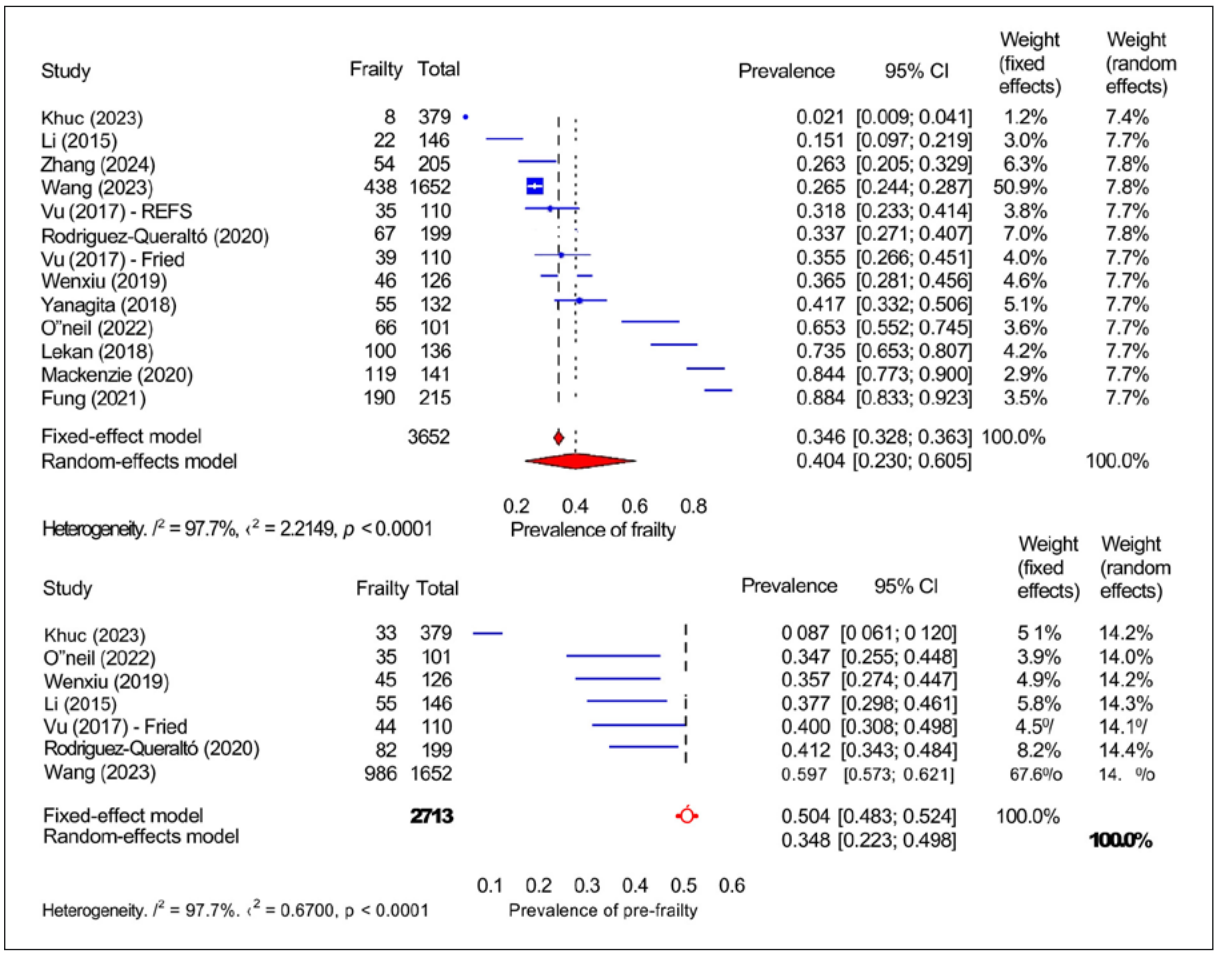


Figure 2. Estimated prevalence of frailty among hospitalized older adults with diabetes mellitus. Curitiba, PR, Brazil, 2025.

Source: Figshare, accessible via doi: 10.6084/m9.figshare.30907523[16]

The funnel plot for frailty prevalence shows asymmetry, with a greater concentration of studies on the right side representing higher prevalences and fewer studies on the left side representing lower prevalences, with no statistically significant evidence of asymmetry (t = 1.33, p = 0.2113). In the funnel plot for pre-frailty prevalence, there was statistically significant evidence of asymmetry (t = -3.22, p = 0.0234) (Figure 3).

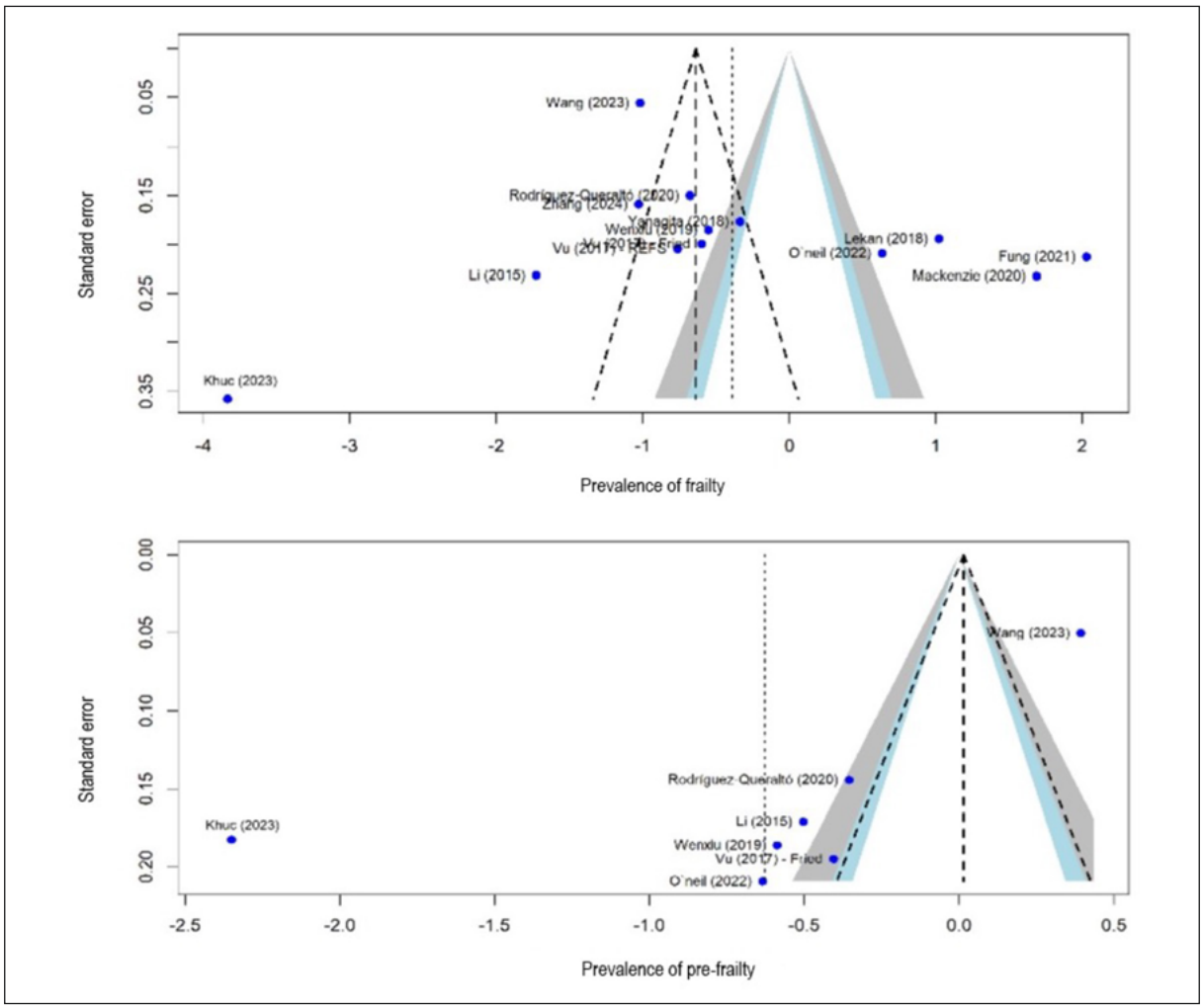


Figure 3. Funnel plot for the assessment of publication bias. Curitiba, PR, Brazil, 2025.

Source: Figshare, accessible via doi: 10.6084/m9.figshare.30907523[16]

DISCUSSION

The present systematic review with meta-analysis demonstrated a high prevalence of frailty (40.4%) and pre-frailty (34.8%) among hospitalized older adults with diabetes mellitus, indicating that most individuals in this population exhibit some degree of physiological vulnerability during hospitalization. These findings exceed the prevalences observed in community-based settings[29], supporting the hypothesis that the combination of diabetes and hospitalization increases frailty risk.

Other marked differences in frailty status are observed between community-dwelling and hospitalized older adults. Community-dwelling older adults show a lower prevalence of physical frailty and a higher prevalence of pre-frailty[30]. It is evident that the coexistence of diabetes mellitus and frailty acts as a strong predictor of hospitalization, which explains the higher proportion of frail older adults with diabetes in the hospital setting. This profile reflects more severe health conditions among hospitalized individuals, as they already present reduced physiological reserves and lower resistance to stressors, with an increased risk of severe complications and recurrent hospitalizations[31].

The substantial heterogeneity among the estimates of the included studies, with prevalences ranging from 2.1%[22] to 88.4%[28], suggests a strong influence of methodological and conceptual factors.

Such discrepancies may stem from differences in assessment instruments, adopted cutoff points, classification strategies that are dichotomous or multilevel, as well as from the clinical and sociodemographic characteristics of the samples. This pattern is widely discussed in the literature, which recognizes the lack of standardization in frailty measurement as one of the main determinants of variability in prevalence estimates.

The heterogeneity observed across studies may reflect differences in frailty status, morbidity profiles, and nutritional and functional status, elements associated with the progression of frailty in the hospital setting. Although these characteristics were not the primary focus of the present investigation, they contribute to the interpretation of the observed discrepancies. Among older adults diagnosed with diabetes mellitus, an association was observed between pre-frailty or frailty and female sex[22], older chronological age[18,23,26,28], lower income[22], and low educational attainment[18,22].

In addition, frailty was associated with longer duration of diabetes diagnosis[22], a higher number of morbidities[22], poor nutritional status[18,19], lower body weight and systolic blood pressure[26], the presence of cardiovascular diseases[18,23,27], cancer and gastrointestinal diseases[23], cerebrovascular and renal diseases[23,28], cognitive impairment[19], lower scores for instrumental activities of daily living[17,19], as well as impaired mobility and diabetic nephropathy[17].

These results corroborate previous studies on the relationship between these conditions and frailty in older adults with diabetes[29] and in those with multimorbidity[30]. The presence of these factors may influence transitions in frailty status, particularly among hospitalized older adults, while also highlighting certain modifiable characteristics that can be incorporated into care management and treatment strategies for hospitalized older adults[29].

Although the studies reported data on frailty in older adults with diabetes, their objectives were highly heterogeneous, including assessment of functional fitness in frail older adults[24]; evaluation of the association between diabetes mellitus and associated factors[18,19,22], specifically multimorbidities[26], acute coronary syndrome[27], and hospital outcomes[17,20,25]; assessment of the relationship between dysglycemia and frailty in older adults using insulin[28]; and evaluation of risk factors for frailty, including glycated hemoglobin[26], as well as hypoglycemic treatment in relation to therapeutic targets and hospital outcomes[21].

The funnel plot for frailty prevalence did not demonstrate publication bias. It was observed that two studies[17,22] were outside the expected funnel limits, indicating that their estimates may be under- or overestimated. Studies with more precise frailty estimates and smaller standard errors were located closer to the top of the plot[23] and or clustered around the central line of the funnel[27].

The main strengths of this study include the adoption of a systematic and comprehensive search strategy, methodological quality assessment, a standardized data extraction process, as well as the quantitative synthesis of results, presented using forest plots, and the application of statistical tests to assess publication bias. Nevertheless, some limitations should be considered when interpreting the findings. These include heterogeneity among the analyzed populations, sample sizes that are not always representative of the target population, the diversity of instruments used to assess frailty, variability in the classification of frailty status—either dichotomous or tripartite—and the exclusion of gray literature.

CONCLUSION

The prevalence of frailty among hospitalized older adults with diabetes mellitus was high, affecting 75.2% of the analyzed population, of whom 40.4% were classified as frail and 34.8% as pre-frail. The identification of both the prevalence and the coexistence of these two conditions highlights the clinical risks faced by hospitalized older adults.

This study provides an original contribution by consolidating prevalence estimates specifically for hospitalized older adults with diabetes, thereby addressing an important gap in the literature and support therapeutic planning. The findings also contribute to the improvement of care protocols and to the guidance of interdisciplinary strategies centered on functionality, in line with guidelines for older adult care in the hospital setting.

The results of this review indicate the need for future studies with longitudinal and multicenter designs capable of monitoring the progression of frailty among hospitalized older adults diagnosed with diabetes mellitus. The importance of standardizing frailty assessment instruments is emphasized, as well as conducting studies that investigate the association of frailty with clinical, functional, and economic outcomes. Furthermore, research evaluating multidimensional interventions and the systematic incorporation of frailty assessment into care protocols may contribute to improved clinical decision-making and to the qualification of care centered on functionality.

AUTHORSHIP

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Edited by: Larissa Neves Quadros

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Construction and content validation of the patient safety practices self-assessment form for Long-Term Care Facilities

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Abstract

Objective: To describe the methodological application of constructing a self-assessment form for safety practices in Long-Term Care Facilities in the city of Porto Alegre (RS), Brazil, and its content validation by experts. *Method:* Methodological study conducted in two stages. The first consisted of developing the Form through a focus group with 12 professionals from the Sanitary Surveillance service. The second involved content validation by eight experts in patient safety, sanitary surveillance, and gerontology, using the criteria of clarity, practical pertinence, and theoretical relevance. The Content Validity Index was applied to calculate item validity. *Results:* The construction process resulted in an instrument composed of 81 items organized into eight thematic domains, covering aspects such as structure, processes, safety of care, and indicators. Content validation showed high levels of agreement regarding clarity, practical pertinence, and theoretical relevance of the items. The initial Content Validity Index was 0.98, and after adjustments suggested by the experts, the final index value reached 1.0. *Conclusion:* This investigation enabled the development and validation of the form, based on national regulations and international guidelines, with a high content validity index, ensuring technical and semantic consistency. The form shows potential for application in institutional management and sanitary surveillance, supporting self-assessment, monitoring, and improving quality of care for institutionalized older adults.

Keywords: Patient Safety. Homes for the Aged. Public Health Surveillance. Total Quality Management.

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Funding: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES). Código de Financiamento 001 e Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) Chamada Universal, Process No. 407743/2023.

The authors declare that there is no conflict in the conception of this work.

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Received: September 5, 2025
Approved: January 23, 2026

http://dx.doi.org/10.1590/1981-22562026029.250149.en

INTRODUCTION

Population aging has occurred rapidly on a global scale, posing challenges to health, care, and social security systems[1]. The state of Rio Grande do Sul, Brazil, has the highest percentage of older adults in the country. Porto Alegre, the state capital, has fourth largest proportion of older adults among Brazil´s cities, representing 15.76% of the local population[2].

The World Health Organization's (WHO) Global Strategy on Aging and Health proposes that countries adopt measures and make investments, including the provision of long-term care[3]. In the Americas, although life expectancy has increased, healthy years of life have not kept pace, resulting in approximately 12 years lived with disabilities. This scenario increases the demand for continuous complex care. In response, the Pan American Health Organization (PAHO) published the Long-Term Care Policy 2025-2034, containing guidelines to support countries in strengthening sustainable, safe, and person-centered systems[4].

In this context, Long-Term Care Facilities for Older Adults (LTCFs) play a strategic role in protecting and providing this population with comprehensive care, ensuring quality, safe assistance. These institutions are characterized by providing collective housing for older adults in situations of vulnerability or with functional limitations requiring long-term care[5]. Understanding the structure, processes, and practices of these institutions is essential to guarantee safe quality care for this population[6].

In Brazil, the National Health Surveillance Agency (Anvisa) is responsible for the inspection and regulation of LTCFs[7], defining them as health services according to current regulations[8]. According to Anvisa records, Porto Alegre has 325 LTCFs in operation[9]. According to the Demographic Census, approximately 161,000 older adults live in LTCFs nationwide, 24.8% in the southern region, reflecting the demand for long-term care in areas with greater population aging[2].

Thus, patient safety guidelines are fundamental to prevent adverse events and avoidable harm in LTCFs, given the multiple risks present in caring for institutionalized older adults[6]. This scenario became even more evident during the COVID-19 pandemic, when many of these facilities struggled in adopting effective protective measures for the older population. According to estimates, in the initial phases of the health crisis, almost half of all deaths recorded globally occurred in these institutional contexts[10].

Anvisa published the Integrated Plan for Sanitary Management of Patient Safety, with the aim of assessing hospitals and guiding priority patient safety actions[11]..However, there are currently no systematized assessments available using tools specifically for LTCFs. The implementation of LTCF-adapted assessments are expected to stimulate and support preventive actions for the institutionalized older population. Additionally, the WHO's Global Patient Safety Action Plan 2021-2030 establishes Clinical Process Safety as its third strategic objective, toward promoting patient safety in all care settings, including LTCFs[6].

For patient safety assessments in the LTCF context to be adequate, obtaining valid and representative data constitutes a fundamental step in designing scientific investigations. Forms and questionnaires are widely used, and the quality of results depends on instruments with solid evidence of validity and reliability[12,13]. Thus, the methodological construction and improvement of instruments is essential to ensure precision and consistency in evaluating theoretical constructs. Content validity is of particular importance, verifying whether an instrument's items clearly, coherently, and comprehensively represent the concepts and domains to be measured[14].

Given the relevance of Patient Safety practices, specifically for older adults in long-term care, the growth of this population, the significant number of LTCFs, and the need to foster adherence to safe practices of high quality, the following research question was formulated: What is the process of constructing and validating a Patient Safety practices self-assessment form for Long-Term Care Facilities for Older Adults in the municipality of Porto Alegre/ Rio Grande do Sul state (RS)?

The objective of this investigation was to describe the methodological application of devising a self-

assessment form for older adult safety practices in the city of Porto Alegre (Rio Grande do Sul state), Brazil, and report its content validation by experts.

METHOD

A methodological study was carried out in two stages. Methodological studies aim to develop, improve, or evaluate scientific methods, contributing to the quality and reproducibility of research. In the health field, these studies are essential for constructing and validating measurement instruments, while ensuring their reliability, validity, and adequacy in relation to the theoretical constructs under analysis[14,15].

The first stage consisted of devising the Patient Safety Practices Self-Assessment Form for LTCFs (FAPSP-LTCF), using the Focus Group Technique. The second stage involved content validation of the instrument by a panel of experts. This study is part of a research project entitled "*Efeitos de um ciclo de melhoria nos indicadores relacionados à segurança do paciente em instituições de longa permanência para pessoas idosas: um ensaio clínico randomizado*" (Effects of an improvement cycle on patient safety-related indicators in long-term care facilities for older adults: a randomized clinical trial).

Stage 1: The task of devising the Patient Safety Practices Self-Assessment Form for LTCFs (FAPSP-LTCF) was performed at the facilities of the Health Surveillance Directorate (DVS) of the Municipal Health Secretariat of Porto Alegre, Rio Grande do Sul state, Brazil.

Study participants were professionals from the Health Services Surveillance Team (EVSIS) of DVS who met the inclusion criteria of working in LTCF inspection or being part of the Center for Patient Safety of the Health Surveillance agency (NSP VISA). Exclusion criteria included professionals who had not been active for at least one year. Members of this team, according to their interest in participating, composed the focus group. The focus group sessions were held within the participants' work environment, with the consent of those responsible, justified by the need to develop a diagnostic form of interest to the service.

The focus group consisted of 12 Health Surveillance specialists: six inspection agents, three NSP VISA professionals (three nurses and one physician), and three Health Services Health Surveillance managers (one nurse, one veterinarian, and one inspection agent). Two group sessions were held, with scheduling agreed upon by the participants, in March and in April 2024.

The Focus Group procedure entailed stages that included planning, creating the setting, recruiting, and holding of group session, as described in the study by Kinalski[15].

The devising of evaluative items on patient safety practices in the LTCF setting that make up the form was carried out participatively by the focus group. These items were developed based on Anvisa's Collegiate Board Resolutions (RDC) No. 36/2013 and No. 502/2021[16,17], the National Patient Safety Program (PNSP)[18], the WHO Global Patient Safety Action Plan 2021-2030[6], and the International Patient Safety Goals[18]. These Goals represent a global reference, based on Joint Commission International recommendations, strongly supported by WHO and validated by the PNSP through its protocols[18].

To finalize this stage, the resultant form was sent to the focus group participants for them to assess the correspondence of the items with the earlier discussions and decisions of the group.

In stage 2, content validation of the FAPSP-LTCF version was performed by a committee of expert judges. For data collection, the phases for content validation recommended by Davis[19] were followed: preparing form, selecting review panel of experts, conducting content validation, reviewing domain and items, provision of scoring for each evaluated item, and calculating the Content Validity Index (CVI).

Content validity corresponds to the degree to which the items of an instrument are considered appropriate and representative in relation to the construct evaluated[20]. According to Lynn, this involves two stages: instrument development grounded in theoretical and conceptual precepts, followed by critiquing of the items by experts[21] Content validation was conducted based on the criteria of clarity and comprehension, practical

pertinence, and theoretical relevance, as suggested by Yusoff and outlined below[20].

- Degree of clarity and comprehension: the clarity of instructions and language is related to the absence of ambiguity and precision in item formulation to avoid multiple interpretations, while comprehension concerns respondents' ability to adequately interpret the words and sentences used[20]. A four-point Likert scale was provided for experts: 1 = the item is not clear or comprehensible; 2 = the item is somewhat clear and comprehensible; 3 = the item is clear and comprehensible; 4 = the item is very clear and comprehensible.

- Degree of practical pertinence: practical pertinence aims to analyze whether the item is actually important in constituting the instrument[20]. A four-point Likert scale was provided for experts: 1 = the item has no practical pertinence; 2 = the item has little practical pertinence; 3 = the item has practical pertinence; 4 = the item has great practical pertinence.

- Degree of theoretical relevance: theoretical relevance seeks to evaluate the degree of association between the item and the supporting theory[20]. A four-point Likert scale was provided for experts: 1 = the item is not relevant; 2 = the item needs revision to assess relevance; 3 = the item is relevant, needs minor changes; 4 = the item is highly relevant.

An important aspect in this evaluation is the number and qualifications of expert judges. Participation of five to ten experts is recommended, considering the instrument's characteristics as well as the training, qualifications, and availability of the professionals involved[21]. Yusoff recommends a minimum of six experts, and not exceeding ten participants[20].

In the present study, the judge committee comprised eight experts who met the adapted Fehring[22] criteria of at least seven points for the items: Master's degree (2 points); Doctoral degree (4 points); dissertation/thesis (2 points); residency and/or specialization (2 points); professional practice in gerontology, patient safety, or health services surveillance for at least two years (2 points); teaching experience (1 point); and publication of articles in indexed journals and/or book chapters (1 point). Experts working in LTCFs located in the city of Porto Alegre (RS) were not invited. Notably, among those selected, two had expertise in patient safety, three in health services surveillance, two in gerontology, and one had experience in both gerontology and patient safety areas.

The CVI calculation enables examination of the clarity, relevance, and pertinence of the items comprising the instrument, ensuring conceptual coherence and semantic adequacy for the research objectives. Regarding the CVI score, in the case of five or fewer experts, unanimous agreement on each item's relevance is required[20]. With six or more evaluators, a minimum agreement score of 0.78 is recommended[21]. Yusoff adds that the CVI must be at least 0.80, preferably reaching 0.90 or more, to ensure greater robustness in content validity[20].

The content validity index score[21] was calculated by summing the score of each expert's response who indicated score "3" or "4", divided by the total number of expert responses. Hence, the formula used was CVI = number of "3" or "4" responses / total number of responses. The CVI was initially calculated for each item, according to clarity and comprehension, practical pertinence, and theoretical relevance. Subsequently, the CVI was calculated for each domain and, finally, for the total FAPSP-LTCF. Items rated with a score of "1" or "2" were revised, a new evaluation round by experts conducted, and the CVI recalculated for each item, domain, and for the final FAPSP-LTCF version.

The present study is nested within a larger project, approved by the Research Ethics Committee under number 6,608,476 and permit CAAE 74671523.7.3001.5338, according to Resolutions No. 466/2012[23] and No. 580/2018[24], duly authorized by the responsible parties of the institutions involved. All participants in the two stages signed the Informed Consent Form.

DATA AVAILABILITY

The full data set supporting the results of this study is available upon request from the

corresponding author. The complete FAPSP-LTCF was made available in the figshare® repository and can be accessed at: https://figshare.com/s/5487913f0e544e6b5633?file=61003045, DOI: https://doi.org/10.6084/m9.figshare.31045477.

RESULTS

In stage 1, during the focus group meetings, the FAPSP-LTCF was devised, composed of closed-ended questions. The focus group used the stages based on the study by Kinalski[15] as described below:

a) Planning

The Focus Group planning envisaged the dimension of participants composing a thematic and methodological group, considering their prior experiences. This was coordinated by a moderator (PhD candidate, study author) and an observer (supervising professor heading the study). The tools used for conducting the group sessions included setting familiarization at study sites for participant recruitment and a structured theme guide centered around three main objectives, each serving as the central focus of a session. The synthesis of key moments from each meeting is presented in Chart 1.

Chart 1. Key moments of group sessions. Porto Alegre, Rio Grande do Sul state, 2024

FOCUS GROUP SESSIONS		
Key moments	Session 1	Session 2
Session opening	Reception, presentation of researchers and research objective.	Synthesis of previous session and clarification of this session's objective.
Presenting participants	Formal presentation of all participants.	Presentation of a participant absent from previous session
Clarifying participative dynamic and discussion	Information on session development and theme guide.	
Establishing setting	Agreement on logistical and dynamics aspects of sessions and electronic equipment use. Commitment to research confidentiality. Signing of Informed Consent Form.	
Debate	Theme defined for Session 1: general data, infrastructure, and work processes in institutions.	Theme defined for Session 2: older adult care safety, continuing and permanent education, and care indicators.
Synthesis	Review and validation of central discussion ideas.	
Session closing	Thanks and arrangements for next session.	Thanks for participation.

Source: adapted[15]

b) Setting

The researcher conducted a preliminary visit to the field to identify the most appropriate strategy for participant recruitment and selection. At this time, a formal invitation was presented to the team, seeking to map the number of interested parties and, consensually, define the most suitable location, date, and time for the first group session.

c) Recruitment

After the exploratory visit to the study field, the researcher sent institutional invitations to the team's work email, clarifying doubts and gauging interest in participating.

d) Theme Guide

Structured theme guides were prepared, containing a script that guided the conduct of meetings, outlining the key moments of each session to favor directed and productive discussion. Two distinct thematic guides were developed, each aligned with the specific objectives of their respective session.

e) Group Sessions

All stages were meticulously organized and set up to mediate the dimension of the task. During the sessions, the moderator facilitated group dynamics and recorded the narratives. The observer, acting as a participant, joined the group, helping conduct meetings, as well as observe and control time.

The sessions took place in March and April 2024, each lasting 2 hours. The group debated issues related to institutional structure and processes, with a focus on health care safety. Eight domains were listed: general LTCF data, legal constitution, human resources, infrastructure, older adult care safety, work processes, continuing and permanent education, and care indicators; constituting a form with 92 questions. After review by the authors, 11 questions were removed due to similarity, for a total of 81 questions in the final version of the form in this stage.

Lastly, the final FAPSP-LTCF version was sent electronically to focus group participants, together with an invitation for critical review and feedback on the need for further adjustments. All participants confirmed the adequacy of content and the form of the FAPSP-LTCF, with no new suggestions or modification requests. Thus, the qualitative review of the construction phase was concluded, approving the final version in stage 1.

In stage 2, for FAPSP-LTCF content validation, the following phases were used:

a) Preparing content validation form: initial step consisting of preparing the instrument containing the FAPSP-LTCF, to ensure the expert judges committee clearly understood the task of analyzing the 81 items for clarity and comprehension, practical pertinence, and theoretical relevance criteria, as proposed by Yusoff[20].

A sample of the instrument containing the FAPSP-LTCF sent to the expert judges committee for content validation is presented in Chart 2.

Chart 2. Sample of instrument containing the FAPSP-LTCF sent to expert judges committee for content validation. Porto Alegre, Rio Grande do Sul, state 2025.

DOMAIN 5 – SAFETY IN CARING FOR OLDER ADULT (RESIDENT)			
Form Questions (Items Tested)	Clarity and Comprehension	Practical Pertinence	Theoretical Relevance
35) Does the institution have a mechanism of identifying residents? If yes, check which mechanism(s) is(are) used: □ Wristband with resident's name □ Name plate on resident's bed □ Name plate on wall □ Name plate on room door □ No resident identification mechanism □ Others _____	1 ( ) Not clear or comprehensible 2 ( ) Somewhat clear and comprehensible 3 ( ) Clear and comprehensible 4 ( ) Very clear and comprehensible	1 ( ) No practical pertinence 2 ( ) Little practical pertinence 3 ( ) Has practical pertinence 4 ( ) Great practical pertinence	1 ( ) Not relevant 2 ( ) Needs revision to assess relevance 3 ( ) Relevant, needs minor changes 4 ( ) Highly relevant
Comments or suggestions			
36) Does the LTCF have visual guidelines (posters, folders) or reminders encouraging hand hygiene practice for staff, residents, and families? If yes, check which guideline(s) is(are) used: □ Correct hand hygiene technique □ WHO's 5 moments for hand hygiene □ Messages about hand hygiene importance □ LTCF has no visual guidelines/ reminders at present □ Others _____	1 ( ) Not clear or comprehensible 2 ( ) Somewhat clear and comprehensible 3 ( ) Clear and comprehensible 4 ( ) Very clear and comprehensible	1 ( ) No practical pertinence 2 ( ) Little practical pertinence 3 ( ) Has practical pertinence 4 ( ) Great practical pertinence	1 ( ) Not relevant 2 ( ) Needs revision to assess relevance 3 ( ) Relevant, needs minor changes 4 ( ) Highly relevant
Comments or suggestions			

Source: Author elaboration, 2025

b) Selecting expert review panel: based on adapted Fehring[22] criteria, which considered individual experience on the topic to be studied. The committee comprised eight expert reviewers.

c) Conducting content validation: after initial contact presenting the proposal, the FAPSP-LTCF version was sent to experts by email together with clear instructions.

d) Reviewing domains and items: experts were requested to provide a critical review of each domain and its items according to the established criteria. They were also encouraged to provide written comments to improve item relevance in relation to the target domain. All comments were taken into consideration toward refining the domains and their respective items.

e) Provision of scoring for evaluated items: after reviewing each item in their respective domains, experts were asked to assign scores independently, using a 4-point Likert Scale, for each of the three criteria.

f) CVI calculation: after receiving the instrument containing the FAPSP-LTCF from each expert, a database was created in an Excel® spreadsheet containing all evaluations by item and domain. Excel® software was used for CVI calculation. The calculation was performed by item, by domain, and for the final form score. Subsequently, the scoring

classification was recoded as 1 (for scores 3 or 4) or zero (for scores 1 or 2).

The synthesis of scores according to each domain, by expert and criteria, conducted in the first stage of the Expert Committee is presented in Table 1.

Considering that the domains General Data, Infrastructure, Patient Safety, and Work Processes received suggestions for changes and scores of 1 or 2 in the clarity and comprehension dimension by experts A, E, and F, individual meetings were held with these reviewers in January and February 2025. The meetings were to validate the proposed modifications and allow re-evaluation of the items. After re-evaluation, the experts assigned new scores, resulting in a CVI calculation of 1.0 for all items and their respective domains, as shown in Table 2.

The complete final version of the FAPSP-LTCF is presented in Appendix A, Available from: https://figshare.com/s/5487913f0e544e6b5633?file=61003045. A The structure of the eight domains and their respective 81 items are presented in Table 3.

Table 1. Content Validity Index of FAPSP-LTCF domains from first evaluation by the Expert Judges Committee, according to clarity and comprehension, practical pertinence, and theoretical relevance criteria (N=8 experts). Porto Alegre, Rio Grande do Sul state, 2025.

Expert Committee/ Criteria		FAPSP-LTCF DOMAINS								
		General and demographic data	Legal constitution	Human resources	Infrastructure	Safety of Patient/ Older Adult	Work Processes	Continuing and Permanent Education	Indicators	CVI Total
E1	CC	1.0	1.0	1.0	0.81	0.75	0.75	1.0	1.0	0.91
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E2	CC	1.0	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E3	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E4	CC	1.0	1.0	1.0	1.0	0.94	1.0	1.0	1.0	0.99
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E5	CC	1.0	1.0	1.0	1.0	0.94	0.87	1.0	1.0	0.96
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E6	CC	0.84	1.0	1.0	1.0	0.94	1.0	1.0	1.0	0.96
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E7	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E8	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CVI by domain		0.99	1.0	1.0	0.99	0.98	0.98	1.0	1.0	0.98

E1 to E8 = Participating Experts; FAPSP-LTCF = Patient Safety Practices Self-Assessment Form for LTCFs; CC = Clarity and Comprehension; PP = Practical Pertinence; TR = Theoretical Relevance; CVI = Content Validation Index. **Source:** Author elaboration, 2025

Table 2. Content Validity Index of FAPSP-LTCF domains from final evaluation by the Expert Judges Committee, according to clarity and comprehension, practical pertinence, and theoretical relevance criteria (N=8 experts). Porto Alegre, Rio Grande do Sul state, 2025.

Expert Committee/ Criteria		FAPSP-LTCF Domains								
		General and demographic data	Legal constitution	Human resources	Infrastructure	Safety of Patient/Older Adult	Work Processes	Continuing and Permanent Education	Indicators	CVI Total
E1	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E2	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E3	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E4	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E5	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E6	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E7	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
E8	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	PP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CVI by domain		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

E1 to E8 = Participating Experts; FAPSP-LTCF = Patient Safety Practices Self-Assessment Form for LTCFs; CC = Clarity and Comprehension; PP = Practical Pertinence; TR = Theoretical Relevance; CVI = Content Validation Index. **Source:** Author elaboration, 2025.

Table 3. FAPSP-LTCF structure according to domain and respective number of items. Porto Alegre, Rio Grande do Sul state, 2025.

FAPSP-LTCF Domains	No. of items
Domain 1 - General and Demographic Data	13
Domain 2 - Legal Constitution	4
Domain 3 - Human Resources	6
Domain 4 – Infrastructure	11
Domain 5 – Safety of Patient/Older Adult	33
Domain 6 - Work Processes	8
Domain 7 - Continuing and Permanent Education	3
Domain 8 – Indicators	3
Total FAPSP-LTCF items	81

FAPSP-LTCF = Patient Safety Practices Self-Assessment Form for Long-Term Care Facilities for Older Adults. **Source:** Author elaboration, 2025.

DISCUSSION

The PAHO Long-Term Care Policy emphasizes the importance of comprehensive, consistent, and culturally sensitive assessments in LTCFs, allied with the formulation of quality standards and implementation of monitoring and management mechanisms[4]. Such assessments should support continuous improvement of care practices, from preventive actions to end-of-life care[3]. Another fundamental element for strengthening LTCFs is the strategic use of information through consistent, transparent systems that represent the needs of institutionalized older adults, guide decision-making, and support evidence-based public policies[4].

In applied research, there remains a significant gap in the availability of specific instruments for measuring patient safety in LTCFs. A recent scoping review identified 47 tools targeting different care settings, such as hospital, emergency, pre-hospital, and primary care; but none designed specifically for LTCFs[25].

A 2024 methodological study on the construction and content validation of a care quality self-assessment instrument in LTCFs, although focusing on multidimensional standards, considering safety as one of the dimensions of quality, addressed issues related to environmental safety, older adult care, technical routines, and use of indicators[26]. Although both instruments share underlying domains related to care quality, the FAPSP-LTCF differs by exploring aspects directly linked to safety in care provision for older adults. This specific emphasis reinforces the instrument's relevance for continuous monitoring, improving quality of care practices, and promoting safer environments within LTCFs.

International studies corroborate the relevance of evaluative instruments in LTCFs, while initiatives have been run for this purpose. The Nursing Home Survey on Patient Safety Culture by the Agency for Healthcare Research and Quality assesses safety culture in LTCFs[27] but fails to assess care practices, infrastructure, and institutional processes according to national regulations, a gap that the instrument validated in the present study seeks to fill. In South Korea, authors validated a questionnaire for assessing safety and care quality in LTCFs, covering domains such as emergency response, comfort management, infection prevention, staff training, material resources, and personnel adequacy[28]. Similarly, the FAPSP-LTCF was designed to evaluate care safety in Brazilian LTCFs, considering the particularities of the national regulatory scenario aligned with international guidelines.

A study conducted in the Netherlands validated the Quality Evaluation Questionnaires – Nursing Homes (QEQ-NH) for measuring care quality from three complementary perspectives: residents,

families, and professionals, with good validity and reliability (α>0.70), but focused on subjective dimensions[29]. Although the QEQ-NH captures multiple care quality dimensions, its main focus is on subjective perceptions, while the FAPSP-LTCF incorporates objective and normative dimensions, grounded in regulatory mechanisms. Both tools share the same goal of supporting quality management and fostering organizational culture focused on quality and safety of care for institutionalized older adults.

In Italy, a study highlighted that measuring patient safety in LTCFs is strategic for fostering quality interventions and consolidating an institutional culture based on transparency, accountability, and participation of professionals and families[30]. This rational converges with the FAPSP-LTCF´s aim of promoting an organizational environment committed to care safety.

In Brazil, the LTCF Quality Assessment Matrix[31] applied to entities participating in the Unified Social Assistance System Census represents progress in institutional evaluation, based on a multidimensional model covering care and social aspects. However, its approach differs from the FAPSP-LTCF scope, which was specifically designed to assess health care safety, focusing on practices and indicators directly linked to adverse event prevention and compliance with health regulations.

Promoting patient safety in LTCFs requires specific instruments attuned to the Brazilian institutional and regulatory context. The FAPSP-LTCF excels in this scenario by filling a methodological gap and providing a tool to support management practices, evaluation, and continuous quality improvement of care. Application of the tool can strengthen safety culture, articulated with public policies and aligned with international guidelines. Additionally, the FAPSP-LTCF demonstrates the importance of expanding applied research on long-term care as an essential strategy to ensure the safety, integrity, and well-being of institutionalized older adults.

Although the structuring of the themes that composed the focus group discussion was grounded in robust references related to Patient Safety, Gerontology, and Health Surveillance, the lack of a systematic literature review was identified as a weakness. Another limitation that may hamper generalization of the form to other regions of the country, due to structural, regulatory, and cultural differences, involves the profile of focus group participants and the expert judges committee, predominantly composed of professionals from the city of Porto Alegre, with the exception of one judge working in another Brazilian state.

CONCLUSION

This study presented the methodological description for constructing and validating the Patient Safety Practices Self-Assessment Form for Long-Term Care Facilities for Older Adults, based on national regulations and international guidelines, allowing the formulation of items contextualized to institutional practices. Content validation revealed clarity and comprehension, practical pertinence, and theoretical relevance, with an initial Content Validity Index of 0.98 and final index of 1.0 after adjustments suggested by experts. These results confer semantic consistency and technical foundation to the instrument for application in care safety management.

Given the scarcity of specific instruments for Long-Term Care Facilities for Older Adults, the Patient Safety Practices Self-Assessment Form for LTCFs represents a valuable tool to help support self-assessment, monitoring, and improvement of institutional practices, favoring a safety culture focused on the institutionalized older population. The form also shows potential for use by municipal and state Health Surveillance agencies, supporting inspection actions and promoting improvements in care and safety standards. This investigations may serve to stimulate new studies and integrated actions involving academia, public management, and services, promoting evidence-based practices centered on safety and quality of care.

AUTHORSHIP

- Taís Fernanda da Silva Anelo – conception, article writing and critical review, study design, data analysis and interpretation, approval of version for publication, responsibility for all aspects of

the study, vouching for matters related to the accuracy or integrity of any part of the work.

- Daniela Fortes Parizotto -article writing and critical review, approval of version for publication.
- Julia Braga da Silveira – study design, data analysis and interpretation, article writing and critical review, approval of version for publication.
- Janete de Souza Urbanetto - conception, article writing and critical review, design, data analysis and interpretation, approval of version for publication, and responsibility for all aspects of the study, vouching for matters related to the accuracy or integrity of any part of the work.

Edited by: Rayssa Horacio Lopes

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Factors associated with adverse drug reactions in community-dwelling older adults

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Abstract

Objective: To evaluate the factors associated with adverse drug reactions (ADR) in older adults in the context of primary health care (PHC). *Method:* An epidemiological, cross-sectional, analytical study was conducted in Basic Health Units in the cities of Caicó and Currais Novos, Rio Grande do Norte state, Brazil. Sociodemographic variables, behavioral habits, presence of comorbidities, medication use, perceived health, and occurrence of ADRs were investigated. The exposure variables investigated were: polypharmacy (use of five or more medications), and use of PIM; the outcome variable was the occurrence of potentially life-threatening or disabling adverse reactions (*delirium*, sedation, gastrointestinal hemorrhages, falls, fractures). Data analysis entailed descriptive statistics followed by bivariate analysis (chi-square) to investigate the association of variables, and multivariate analysis (binary logistic regression). *Results:* Overall, 100 participants aged 60 or older were included in the study. Polypharmacy was identified in 44% of the interviewees, PIM use in 28%, while 41% reported ADR, with falls being the most prevalent adverse event (26%). Bivariate analysis revealed ADR was associated with comorbidity, polypharmacy, and PIM ($p < 0.001$). On the multivariate analysis model, polypharmacy remained the only associated independent risk factor ($p < 0.01$). *Conclusion*: Polypharmacy constituted the main factor associated with ADRs in the community-dwelling older adults. The strengthening of rational prescribing practices, clinical protocols, and interprofessional work (physician-pharmacist) are essential to mitigate risks and ensure therapeutic safety in PHC.

Keywords: Primary Health Care. Older Adult. Potentially Inappropriate Medication List. Drug Prescriptions. Polypharmacy.

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Funding: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES). Funding Code 001.
The authors declare that there is no conflict in the conception of this work.

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Received: November 17, 2025
Approved: February 6, 2026

http://dx.doi.org/10.1590/1981-22562026029.250194.en

INTRODUCTION

Rapid population aging and the consequent changes in the demographic and epidemiological profiles of Brazilian society call for a new vision of care to address the increased prevalence of noncommunicable chronic diseases (NCDs), especially in the older adult population[1,2].

In older adults, the prevalence of polypharmacy and use of potentially inappropriate medications (PIMs) is high[2]. Polypharmacy is characterized by the concomitant use of five or more medications[1,3]. PIMs, in turn, are drugs whose risks outweigh the benefits of their use when there are therapeutically equivalent alternatives with safer scientific evidence[3].

Both polypharmacy and PIM use are risk factors for the occurrence of negative outcomes, which may result from adverse drug reactions (ADRs) and/or drug-drug interactions[1,4,5].

In this context, the American Geriatrics Society (AGS) established the Beers Criteria in 2012 as a list of PIMs for older adults[6]. These criteria were created by specialists with the aim of increasing prescription safety by identifying drugs to avoid in specific situations[7]. In Brazil, the Beers Criteria formed the basis for the creation of the Brazilian Consensus on Potentially Inappropriate Medications (CBMPI)[8] as an essential tool for classifying medications, rationalizing prescriptions, and reducing ADRs[3].

The Brazilian National Health System (SUS) promotes the rational use of medications through the formulation of an action plan to reduce polypharmacy[9]. The role of the multidisciplinary team in Primary Health Care (PHC), specifically the work of pharmacists, can have positive impacts in the prevention and resolution of medication-related problems, resulting in greater adherence to pharmacotherapy and improved control of chronic diseases[10].

The scenario of high prevalence of polypharmacy and PIMs in older adults prompted the present study, considering PHC as the organizer of care and comprehensive assistance to older adults. The objective of this study was to evaluate the factors associated with ADRs in older adults within the PHC setting.

METHOD

An epidemiological, cross-sectional, analytical study was conducted. The target population of the study was individuals aged 60 years or older, registered and attended at Basic Health Units (BHUs), with medication dispensing or basic pharmacy in the cities of Caicó and Currais Novos – Rio Grande do Norte (RN) state. According to data from the Brazilian Institute of Geography and Statistics (IBGE), the city of Caicó - RN, has approximately 61,146 inhabitants, of which 17.22% are aged 60 years or older[11]; and has 24 BHUs, five of which offer a medication dispensing service. The city of Currais Novos - RN has approximately 41,313 inhabitants, of which 18.36% are aged 60 or older[11]. The city has 18 BHUs, and medication dispensing is performed via basic pharmacy services.

The study participants were selected at time of picking up prescribed medications at BHU pharmacies. These units should make available resident professionals from the Family and Community Medicine Program and the Basic Care Residency Program of the Multicampus School of Medical Sciences of Rio Grande do Norte (EMCM/UFRN). The sample size was obtained by convenience. A total of 100 interviews were planned, considering the constraints for implementing the study within an appropriate timeframe.

Thus, the inclusion criteria were being aged 60 years or older and holding a document with a record of medications used (medical prescription, SUS user card, or Older Adult Health Booklet). None of the participants were subsequently excluded. Data were collected from March to August 2025 by medical students/EMCM (Caicó) and by the resident pharmacist in Basic Care/EMCM (Currais Novos), duly trained to apply the semi-structured data collection questionnaire. All participants were invited to take part in the study and sign the Informed Consent Form (TCLE).

The information for the following variables was collected: sociodemographic characteristics, behavioral habits, presence of comorbidities, medication use, perceived health, and occurrence of adverse drug reactions.

The exposure variables were: polypharmacy (use of five or more medications) and use of potentially inappropriate medications; the outcome variable was the occurrence of potentially life-threatening or disabling adverse reactions (*delirium*, sedation, gastrointestinal hemorrhages, falls, fractures).

The sociodemographic information collected included: sex, age, race/ethnicity, marital status, education, religious practice, and monthly income. Behavioral habits were investigated by asking whether the individual consumed alcohol and/or tobacco, whereas physical activity (PA) was investigated by asking about engagement in physical exercise in the last three months. The presence of comorbidities was assessed based on clinical diagnosis of the following chronic diseases: heart diseases, arterial hypertension, diabetes mellitus, malignant tumor, arthritis or rheumatism, pulmonary diseases, depression, osteoporosis, and stroke.

Perceived health was assessed using a Likert-type scale with response options very good, good, fair, poor, or very poor.

Regarding the presence of polypharmacy and PIMs, medication use was investigated by collecting name and dosage of the prescribed medication. Each medication reported was classified according to the Anatomical Therapeutic Chemical classification system (ATC), recommended by WHO, at levels 1 (anatomical group) and 2 (therapeutic subgroup). Also, medications were checked for inclusion in the National List of Essential Medicines (RENAME)[5].

The occurrence of polypharmacy was defined as reported concomitant use of five or more medications[1]. The occurrence of PIMs was characterized, regardless of clinical condition, according to the CBMPI, which consists of 118 criteria: 43 to be avoided regardless of clinical condition; and 75 depending on specific health conditions[3].

ADRs were investigated by asking the participant about the occurrence (within last year) of falls, fractures, hospitalizations, constipation, heart failure, depression, cognitive deficit, and renal dysfunction[3].

Data were stored and processed using statistical software. Descriptive analysis (absolute and relative frequency, measures of central tendency, and measures of dispersion) was performed to characterize the sample, and the confidence interval [95% CI] of the proportions observed among the categories analyzed was calculated. Bivariate analysis (Pearson's chi-square test) was then performed to investigate the association of variables. Finally, multivariate analysis (binary logistic regression) was conducted to adjust for possible confounding variables and identify factors associated with ADR occurrence. The 95% CI and significance level α=5% were estimated.

For the regression model, variables were grouped into blocks: 1) sociodemographic characteristics (sex and age group); 2) health conditions (presence of comorbidities, use of polypharmacy, and use of PIMs). Sociodemographic variables were included in the binary logistic regression regardless of the p-value from bivariate analysis, given their importance for adjusting the analysis. The remaining variables were selected according to the statistical significance on bivariate analysis, adopting inclusion criterion of p-value < 0.20.

The present study was approved by the Research Ethics Committee of the Faculty of Applied Social Sciences (CEP FACISA—UFRN), in accordance with the determinations of Resolution No. 466/12 of the National Health Council (CNS), which defines the regulatory guidelines and norms governing research involving humans, and Resolution No. 510/2016 of the National Health Council (CNS). CAAE: 85766424.0.0000.5568 / Approval no.: 7.392.508.

DATA AVAILABILITY

The full data set underpinning the study results is available from *figshare* at https://doi.org/10.6084/m9.figshare.31231507.

RESULTS

A total of 100 participants aged 60 years or older were interviewed (50 in Caicó and 50 in Currais Novos), registered and attended under the Family Health Strategy of these cities.

The characteristics of the sample, according to sociodemographic variables, behavioral habits, and health conditions, together with the 95% CI of the proportions in each category analyzed, are given in Table 1. The mean age was 71.41 ± 7.88 years. Participants were predominantly female, aged 70 years or older, married or in a stable union, brown, practicing a religion, with educational level below complete elementary school, and income less than two minimum wages. Regarding behavioral habits, only regular physical activity was reported by the majority of respondents. With regard to health conditions, most participants reported having comorbidities and a perceived health status of fair.

Table 1. Sample characterization according to sociodemographic variables, behavioral habits, and clinical and health conditions. Caicó and Currais Novos, Rio Grande do Norte, 2024.

Variables	Relative Frequency (%) N= 100	Confidence Interval [95%] of proportions observed
Sociodemographics		
Age: μ = 71.41 ± 7.88 years [Min = 60; Max = 97]		
Age Group (years)		
60-69	44	[35.0 – 54.0]
≥70	56	[46.0 – 65.0]
Sex		
Female	79	[70.0 – 87.0]
Male	21	[13.0 – 30.0]
Education		
Incomplete primary	71	[63.3 – 80.6]
Complete primary	12	[5.1 – 17.3]
Complete secondary or greater	15	[8.2 – 21.4]
Not known or no response given	2	[1.1 – 3.1]
Income (minimum wages)		
≤ 1	40	[28.0 – 47.0]
>1 and ≤2	31	[22.0 – 41.0]
> 2	29	[17.0 – 33.0]
Marital Status		
Single	16	[9.0 – 24.0]
Married/Stable union	48	[38.0 – 58.0]
Separated/Divorced	10	[5.0 – 16.0]
Widowed	26	[17.0 – 35.0]
Race/Ethnicity		
Yellow / Asian	2	[0 – 5.0]
White	39	[29.0 – 48.0]
Brown / Mixed	47	[37.0 – 58.0]
Black	12	[6.0 – 19.0]
Religion		
Yes	98	[95.0 – 100.0]
No	2	[0 – 5.0]

to be continued

Continuation of Table 1

Variables	Relative Frequency (%) N= 100	Confidence Interval [95%] of proportions observed
Behavioral Habits		
Alcohol use		
Yes	6	[2.0 – 11.0]
No	94	[89.0 – 98.0]
Tobacco use		
Yes	7	[2.0 – 12.0]
No	93	[88.0 – 98.0]
Physical activity		
Yes	52	[43.0 – 62.0]
No	48	[38.0 – 57.0]
Clinical characteristics		
Presence of comorbidities		
Yes	70	[61.0 – 79.0]
No	30	[21.0 – 29.0]
Perceived health		
Very good/Good	40	[21.2 – 50.6]
Fair	52	[42.4 – 61.0]
Poor / Very poor	8	[2.0 – 11.1]
Polypharmacy use (≥5 medications)		
Yes	44	[34.0 – 53.0]
No	56	[47.0 – 66.0]
Potentially Inappropriate Medications use		
Yes	28	[20.0 – 38.9]
No	67	[61.1 – 90.0]
Missing data	5	-
Adverse Reactions reported		
Yes	41	[50.0 – 69.0]
No	59	[28.0 – 47.0]

The main diseases and adverse reactions reported are presented in Table 2. The most prevalent main comorbidities were systemic arterial hypertension, arthritis, and diabetes. The most prevalent adverse effects were falls.

The results of the bivariate analysis of presence of adverse reactions and age group, sex, physical activity, presence of comorbidities, use of polypharmacy, and PIMs are presented in Table 3. Pearson's chi-square test revealed a significant association between adverse reactions and comorbidity ($p < 0.001$), polypharmacy ($p < 0.001$), and PIMs ($p < 0.001$).

Following bivariate analysis, multivariate analysis was performed using binary logistic regression to control for possible confounding variables and to evaluate factors associated with ADRs (Table 4). Only polypharmacy remained as an associated factor, independently of age, sex, presence of comorbidities, or use of PIMs.

Table 2. Comorbidities and adverse drug reactions in community-dwelling older adults. Caicó and Currais Novos, Rio Grande do Norte, 2024.

Variables	Relative Frequency (%) N= 100	Confidence Interval [95%] of proportions observed
Comorbidities		
Arterial Hypertension		
Yes	84	[77.0 – 91.0]
No	16	[9.0 – 23.0]
Heart Disease		
Yes	30	[21.0 – 39.0]
No	70	[61.0 – 79.0]
Diabetes Mellitus		
Yes	41	[31.0 – 51.0]
No	59	[49.0 – 69.0]
Tumor		
Yes	3	[0.0 – 7.0]
No	97	[93.0 – 100.0]
Arthritis		
Yes	42	[32.0 – 52.0]
No	58	[48.0 – 68.0]
Pulmonary Disease		
Yes	8	[3.0 – 14.0]
No	92	[86.0 – 97.0]
Depression		
Yes	18	[11.0 – 26.0]
No	82	[74.0 – 89.0]
Osteoporosis		
Yes	23	[15.0 – 32.0]
No	77	[68.0 – 85.0]
Stroke		
Yes	1	[0 – 3.0]
No	99	[97.0 – 100.0]
Adverse Reactions		
Falls		
Yes	26	[18.0 – 34.0]
No	74	[66.0 – 82.0]
Hospitalization		
Yes	6	[2.0 – 11.0]
No	94	[89.0 – 98.0]
Fractures		
Yes	5	[1.0 – 10.0]
No	95	[90.0 – 99.0]
Constipation		
Yes	14	[8.0 – 22.0]
No	86	[78.0 – 92.0]

to be continued

Continuation of Table 2

Variables	Relative Frequency (%) N= 100	Confidence Interval [95%] of proportions observed
Heart Failure		
Yes	4	[1.0 – 8.0]
No	96	[92.0 – 99.0]
Depression		
Yes	7	[2.0 – 12.0]
No	93	[88.0 – 98.0]
Cognitive Deficit		
Yes	5	[1.0 – 10.0]
No	95	[90.0 – 99.0]
Renal Dysfunction		
Yes	8	[3.0 – 13.0]
No	92	[87.0 – 97.0]

Table 3. Bivariate analysis of the presence of adverse reactions and sociodemographic variables, behavioral habits, and clinical and health conditions. Caicó and Currais Novos, Rio Grande do Norte, 2024.

Variables	Adverse Reactions		*p*-value
	Yes	No	
Age Group (years)			
60-69	14	30	0.09
≥70	27	29	
Sex			
Female	34	45	0.42
Male	07	14	
Physical Activity			
Yes	19	33	0.34
No	22	26	
Presence of Comorbidity			
Yes	36	34	< 0.001
No	05	25	
Polypharmacy			
Yes	30	14	< 0.001
No	11	45	
Potentially Inappropriate Medication			
Yes	17	11	0.01
No	21	46	

Table 4. Binary logistic regression model to identify factors associated with adverse drug reactions in community-dwelling older adults. Caicó and Currais Novos, Rio Grande do Norte, 2024.

Variables	Odds Ratio [95%CI]	*p*-value
Model 1: Health Conditions		
Presence of Comorbidity		
No	1.00	0.23
Yes	2.15 [0.62 – 7.51]	
Polypharmacy		
No	1.00	0.004
Yes	4.69 [1.63 – 13.52]	
Potentially Inappropriate Medication		
No	1.00	0.09
Yes	2.46 [0.87 – 6.98]	
Model 2: Health Conditions adjusted for age group and sex		
Presence of Comorbidity		
No	1.00	0.23
Yes	2.19 [0.62 – 7.71]	
Polypharmacy		
No	1.00	0.01
Yes	4.31 [1.42 – 13.10]	
Potentially Inappropriate Medication		
No	1.00	0.07
Yes	2.63 [0.90 – 7.71]	
Age Group (years)		
60-69	1.00	0.57
≥70	1.35 [0.48 – 3.77]	
Sex		
Male	1.00	0.76
Female	0.83 [0.26 – 2.70]	

DISCUSSION

The main finding of this study revealed that polypharmacy was an independent risk factor for ADR occurrence, even after adjusting the model for confounding variables such as age, sex, presence of comorbidities, and use of PIMs. This result confirms the premise that the number of drugs used may be a determining factor for the occurrence of adverse events that, taken alone, exerts a greater influence than age or specific therapeutic classes. The finding corroborates robust evidence in the literature showing that concomitant use of multiple drugs plays a key role in drug interactions and negative clinical outcomes, especially among older adults[7,15,22].

Although the adjusted multivariate analysis identified polypharmacy as a factor contributing to ADRs, the findings on bivariate analysis are noteworthy showing that ADR occurrence was also associated with the presence of comorbidities and use of PIMs. This result suggests a triad of clinical vulnerability: comorbidities, PIM use, and polypharmacy, which should not be overlooked, especially given the high prevalence of these conditions in PHC[3,19,20].

In the present study, findings regarding health conditions reaffirm the high burden of chronic diseases in the older adult population. The majority of participants (70%) had comorbidities, a finding similar to that observed in other studies involving PHC users[15,16]. Polypharmacy was identified in 44% and PIM use in 28% of respondents, corroborating the international panorama where polypharmacy ranges from 13.9% to 64.5%[1,4,7,14,17,18], and PIM use mirrors studies that applied both the Beers criteria and the CBMPI, reporting rates from 27.6% to 32.9%[3,21]. Adverse reactions were reported by 41%, with falls being the most reported event.

This scenario highlights the complexity of clinical management in PHC. Although some medications are classified as inappropriate for older adults, in many cases they are essential for the appropriate management of chronic conditions, given that each condition may require one or more medications for treatment and control[7,15,20].

Placing these results in context, the profile of the study sample (low educational level, low income, and high prevalence of chronic diseases) mirrors that of other investigations conducted in the Brazilian Northeast and within PHC in general[1,12,13,14], where unfavorable socioeconomic factors compromise self-care and therapeutic adherence, exacerbating the risk associated with polypharmacy[14].

It should be reiterated that polypharmacy played a key role in ADR occurrence, having a greater influence than the other factors assessed, representing a priority risk marker. This points to the need for policies and protocols defining periodic review of prescriptions in PHC, as well as the adoption of non-pharmacological measures for the treatment and control of chronic diseases. Studies show that interventions centering on medication review, based on shared decision-making, and professional training, are effective in reducing medication burden[23].

In this context, quaternary prevention serves as a vital tool for mitigating excessive medicalization[24], in which the pharmacist is key in carrying out medication reconciliation, identifying problems related to prescribing, and potentially preventing readmissions and avoidable costs to the health system[1,25].

However, these results should be interpreted within the constraints of the study limitations: cross-sectional design precluding the establishment of direct causality between variables; selection bias due to convenience sampling; and measurement bias from self-reports.

Of these limitations, self-reports of ADRs are of most note, given they are susceptible to both recall bias (forgetting past events or medication names) and information bias (lack of knowledge on the patient´s clinical condition). Hence, these factors may have led to an underestimation of the actual prevalences of ADRs.

Despite its cross-sectional design, relatively small sample size, and non-probabilistic selection, the study has several strengths, including the methodological rigor applied (use of validated instruments and standardization in data collection) and adjusted statistical analysis.

Therefore, given the importance of this topic and exploratory nature of the present investigation, future studies with probabilistic, representative sampling, longitudinal designs, and both quantitative and qualitative data should be conducted. Additionally, studies evaluating interventions, such as systematic review of prescriptions, multiprofessional integration, and health education, can help inform effective strategies for safe care.

CONCLUSION

In summary, polypharmacy constituted the main factor associated with adverse drug reactions in the community-dwelling older adults, representing a priority challenge for Primary Health Care. The strengthening of rational prescribing practices and clinical protocols, coupled with interdisciplinarity, is fundamental to mitigate risks and ensure greater therapeutic safety for the older adult population.

Although some medications classified as inappropriate are necessary for the management of chronic conditions, their prescription should be accompanied by periodic review, considering number of drugs, administration times, and potential interactions.

Interprofessional work (physician-pharmacist) and patient-centered care are essential to promote rational prescribing and reduce adverse events associated with medication use.

AUTHORSHIP

- Alícia Carolina da Silva Medeiros: Writing and critical review; Final approval of the version; Data interpretation; Data curation; writing - first draft; writing - review and editing; investigation and methodology.
- Manuel do O de Sousa Neto: Conception of the work; Writing and critical review; Conceptualization; Investigation; Methodology.
- Matheus dos Santos Batista: Writing and critical review; Conceptualization; Investigation; Methodology.
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ACKNOWLEDGEMENTS

The authors extend thanks to the Graduate Studies Office of the Federal University of Rio Grande do Norte (UFRN) for institutional and academic support in the conducting of this study.

Edited by: Camila Alves dos Santos

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Level of advanced glycation end products in older adults: association with diet and body composition

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Abstract

Objective: To evaluate dietary intake of advanced glycation end products (AGEs) in older adults and potential correlations with body composition and muscle health. *Methods*: A cross-sectional observational study involving individuals aged 60 and older (n=72) was conducted. Data collection included application of a food frequency questionnaire for AGE-rich foods (FFQ-AGE). Skin autofluorescence (SAF) was measured as a marker of AGE accumulation. Body composition was assessed using body mass index (BMI), bioimpedance, and calf circumference, while sarcopenia risk was evaluated using handgrip strength, Timed Up and Go (TUG) Test, and SARC-F score. *Results*: The average dietary AGE intake was 12,104±5,719 kU/day, with no significant differences by sex or marital status. No correlation was found between dietary AGE intake and SAF, BMI, or physical performance. However, SAF positively correlated with BMI, fat mass, and sarcopenic obesity index, indicating an association with unfavorable body composition. Only 2.8% of participants were sarcopenic according to SARC-F, although 20.8% had low handgrip strength and 37.5% had impaired mobility on the TUG test. *Conclusion:* Although dietary AGE intake did not correlate with AGE accumulation or physical performance, SAF was associated with obesity-related measures. These findings suggest that AGE accumulation in older adults may be more influenced by body composition or endogenous production than dietary intake. Monitoring SAF could be useful for assessing cardiovascular risk and health outcomes in aging populations.

Keywords: Advanced Glycation end Products. Obesity. Older Adults. Diet.

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Funding: Gambero, A. is a scholarship recipient of Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq 302733/2022-1).

The authors declare that there is no conflict in the conception of this work.

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Received: October 28, 2025
Approved: February 5, 2026

http://dx.doi.org/10.1590/1981-22562026029.250181.en

INTRODUCTION

The term "glycation products" refers to numerous compounds with different structures that form from the Maillard reaction, a chemical reaction between reducing carbohydrates and amino compounds during food processing and cooking. Initially, reducing sugars such as glucose and fructose react with the ε-amino group of lysine, which is most abundant in foods, a reaction known as "glycation" of lysine. Subsequently, these products undergo Amadori rearrangements, forming Amadori rearrangement products (ARPs) such as fructosyllysine (FL) from glucose, and also Heyns rearrangement products (HRPs) such as glucosyl- and mannosyllysine from fructose. Because they are unstable, ARPs undergo degradation reactions during food processing and preparation, forming 1,2-dicarbonyl compounds such as glyoxal (GO), methylglyoxal (MGO), and 3-deoxyglucosone (3-DG), which are highly reactive. Advanced glycation end products (AGEs) exert harmful effects because they activate receptors for advanced glycation end products (RAGEs) present in different cells or bind to biomolecules, leading to loss of their function[1].

RAGE is a cell surface receptor of the immunoglobulin superfamily. The binding of AGEs to RAGE triggers a series of downstream signaling events, such as activation of nuclear factor kappa B (NF-ϰB), which in turn promotes production of inflammatory cytokines such as tumor necrosis factor alpha (TNF-α), interleukin-6 (IL-6), and interleukin-1β (IL-1β), creating a pro-inflammatory environment characteristic of pathological aging[2]. Glycation of enzymes and insulin receptors contributes to insulin resistance and mitochondrial dysfunction, reducing efficiency in energy production. Lastly, AGEs create cross-links in collagen fibers and contractile muscle proteins, making these more rigid and less functional, accelerating loss of strength and muscle mass. Thus, an increase in expression of RAGEs and AGEs is observed in conditions such as type 2 diabetes mellitus (DM), cardiovascular disorders, sarcopenia and frailty in chronic kidney disease, cancer, and Alzheimer's disease[3].

Given the role of AGEs in diseases associated with aging, research suggests that dietary patterns, such as diets rich in ultra-processed foods, meats grilled at high temperatures, fried foods, and low-moisture foods that have high concentrations of pre-formed AGEs, besides diets with high glycemic index that increase postprandial glycemia and accelerate glycation of endogenous proteins (such as hemoglobin and collagen), increasing the internal load of AGEs independently of direct intake, may act as a direct modulator of the biochemistry of aging[4].

However, studies exploring the potential association between AGE-rich diets and health outcomes are hampered by a lack of quantitative information and insufficient structural characterization of AGEs in foods. The traditional Brazilian diet is vegetable-based, with rice, beans, and small amounts of meat. However, this pattern has been changing rapidly, with inclusion of breads, oils, fats, soft drinks, pizzas, and snacks. Older adults living alone eat increasingly less traditional Brazilian food and may be exposed to an AGE-rich diet[5], promoting the development of age-associated diseases.

The objective of this study was to evaluate dietary intake of AGEs and their accumulation among older adults seen under a university program, and to investigate potential associations with body composition and muscle health.

METHODS

A cross-sectional observational study was conducted involving 72 participants from the Vitalità Center for Aging and Longevity at PUC-Campinas aged ≥60 years, who consented to take part in the investigation. The study was approved by the Institutional Research Ethics Committee (CEP – PUC - CAAE: 75683723.2.00005481; Report Number: 6.529.820). Data collection was carried out between March and December 2024 and met the requirements of Resolution No. 466/2012.

Basic sociodemographic information collected included age, sex, educational level, and marital

status. Medications being used were recorded and participants were asked to self-declare their skin phototype using the Fitzpatrick scale. A semi-quantitative self-administered questionnaire of 67 food items containing AGE-rich foods (FFQ-AGE) was completed by participants. The FFQ-AGE was created based on the AGE-rich food table devised by Uribarri et al.[6] and adapted for the Brazilian diet, substituting foods of similar composition in terms of amount of AGE, drawing on the Food Frequency Questionnaire used in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil)[7]. Food portions were expressed in household measures (tablespoon, cup) or traditional food portions (piece, unit). Participants reported the number of times and frequency with which they consumed a food (more than 3x/day, 2-3x/day, 1x/day, 5-6x/week, 2 -4x/week, 1x/week, 1-3x/month, never/rarely) and reported seasonal consumption. Level of AGE intake was calculated by multiplying the amount of AGE per food portion by the frequency of consumption.

The mean of three consecutive skin autofluorescence (SAF) measurements on participants' right forearms was obtained using the Diagnoptics® AGE Reader device. The AGE Reader also calculates cardiovascular risk by stratifying the SAF value by participant age, giving a score of 1 to 4, indicating low, mild, moderate, and high cardiovascular risk, respectively.

Body composition was analyzed by calculating body mass index (BMI; kg/m²) from weight and height data obtained using a mechanical medical scale. Obesity was defined as a BMI ≥32 kg/m² for older female individuals and ≥28 kg/m² for older male individuals. The amount of fat mass was estimated by electrical bioimpedance (Biodynamics, 310e, TBW). The cut-off values for percentage fat mass indicating obesity was ≥35% for women and ≥24% for men. Calf circumference was measured for the dominant leg using a non-elastic tape in the standing position, at the maximum circumference in the plane perpendicular to the longitudinal line of the calf. Calf circumference ≤34 cm for men and ≤33 cm for women can be considered a surrogate marker of low muscle mass. Sarcopenic obesity was calculated using the ratio of the diagnostic variables for obesity (fat mass) and sarcopenia (calf circumference). Handgrip strength (kg) was evaluated using a digital dynamometer (Instrutherm, DM-90). The cut-off value indicating low muscle strength was ≤27 kg for men and ≤16 kg for women. Functional capacity was evaluated using the Timed Up and Go test (TUG test)[8]. The time taken to rise from the chair, walk 3 meters, and sit back down again on the chair was timed by the observer with the aid of a stopwatch. For the TUG test, a time of ≤10 s was considered normal, whereas ≥11 s was defined as frailty with greater risk of impaired mobility. Participants answered the SARC-F questionnaire, which evaluates strength, mobility, and falls in the last year. Each item has three severity levels, with scores ranging from zero to two points. A SARC-F score ≥4 out of 10 is recommended in International Guidelines as the value to identify individuals at risk of sarcopenia[9].

Anthropometric data, bioimpedance, handgrip strength, and the TUG test were performed by the same researcher. The weighing scales, handgrip, and bioimpedance equipment were duly calibrated by their manufacturers or representatives before study initiation.

Exploratory data analysis was performed by calculating descriptive statistics (mean, confidence interval, and percentage). Bivariate correlation analyses were performed using Spearman or Pearson Correlation Coefficients, for non-parametric or parametric variables, respectively. Multivariate linear regression analysis was performed on variables with $p<0.20$ in the bivariate analysis. P-values <0.05 were considered significant.

DATA AVAILABILITY

The full anonymized data set underpinning the study results is available from **FIGSHARE** at https://figshare.com/s/8b6b1b2b7f1b5384100e.

RESULTS

Of the 72 participants, the majority declared gender as female and had completed higher education.

Regarding marital status, half of the sample reported living with a partner and half lived alone. Participant age ranged from 60 to 81 years. Roughly one-third of the sample took no medications routinely for chronic diseases (Table 1). Among participants using medications, the main groups reported included statins (15.7%), angiotensin blockers (13.1%), and metformin (11.8%).

Male and female weight and height differed, but BMI was the same across genders. However, in terms of percentage fat mass, calculated by electrical bioimpedance, more women had a body composition characterized as obese than men (Table 2). There was no gender difference for calf circumference or skin autofluorescence. Skin autofluorescence could not be determined for 6 participants (3 women and 3 men) who self-reported a skin phototype of 5-6 on the Fitzpatrick scale. No gender difference was evident for performance on the TUG test. As expected, handgrip test performance was significantly higher among men. Sarcopenic obesity was determined by calculating fat mass divided by calf circumference. The results reveal a higher index in females than males (Table 2).

Applying the cut-off point stated in the Methods section, the sample showed risk of impaired mobility and low muscle strength. Only one man and two women were considered at high risk of sarcopenia on the SARC-F questionnaire. Obesity was also observed, as measured by BMI and by percentage fat mass using electrical bioimpedance, based on the cut-off parameter defined. For the overall sample, obesity was more prevalent when using the percentage fat mass parameter than for BMI. There were no statistically significant gender differences for the scores evaluated (Table 3).

Table 1. Sociodemographic characteristics and number of medications used for chronic conditions by older adults attending the Vitalità Center for Aging and Longevity at PUC-Campinas (N=72). Campinas, São Paulo state, 2024.

Variable	n (%)
Gender	
Female	57 (79.2)
Male	15 (20.8)
Educational level	
No formal study	1 (1.4)
Primary	6 (8.3)
Secondary	25 (34.7)
Higher	34 (47.2)
Post-graduate	6 (8.3)
Marital status	
Single	9 (12.5)
Married	37 (51.4)
Divorced	9 (12.5)
Widowed	17 (23.6)
Medications used routinely	
None	22 (30.6)
1 medication	14 (19.4)
2-4 medications	24 (33.3)
≥5 medications	12 (16.7)

Table 2. Age, body composition, skin autofluorescence, and physical performance of older adults attending the Vitalità Center for Aging and Longevity at PUC-Campinas (N=72). Campinas, São Paulo state, 2024.

Variable	Total mean (Confidence interval*)	Male mean (Confidence interval*)	Female mean (Confidence interval*)	Correlation coefficient	*p*#
Age (years)	68.1 (66.7-69.4)	70.9 (68.4-73.4)	67.3 (65.8-68.9)	0.273	**0.020**
Body weight (Kg)	72.4 (69.5-75.3)	79.4 (73.5-85.3)	70.6 (67.4-73.8)	0.292	**0.013**
Height (m)	1.63 (1.6-1.65)	1.73 (1.69-1.78)	1.59 (1.58-1.62)	0.575	**0.0001**
Body Mass Index (BMI)	27.3 (26.3-28.2)	26.3 (24.7-27.9)	27.5 (26.4-28.7)	-0.110	0.35
Fat mass (%)	32.3 (30.6-34.1)	22.8 (19.8-25.9)	34.7 (33.17-36.23)	-0.578	**0.0001**
Fat mass (kg)	23.4 (21.6-25.2)	17.9 (15.1-20.7)	24.8 (22.9-26.8)	-0.376	**0.001**
Calf circumference (cm)	37.5 (36.9-38.0)	37.9 (37.0-38.8)	37.4 (36.8-38.0)	0.123	0.305
Skin autofluorescence (A.U.)	2.64 (2.52-2.75)	2.8 (2.5-3.0)	2.6 (2.5-2.7)	0.107	0.390
Skin phototype (Fitzpatrick scale)	2.7 (2.4-3.0)	3.5 (2.8-4.2)	2.6 (2.2-2.9)	0.268	**0.022**
TUG test (seconds)	10.3 (9.8-10.8)	10.6 (9.1-12.1)	10.2 (9.7-10.7)	-0.044	0.710
Handgrip strength (kg)	26.7 (23.4-30.0)	38.3 (29.4-47.2)	23.7 (20.7-26.7)	0.442	**0.0001**
Sarcopenic obesity (fat mass/calf circumference)	0.62 (0.58-0.67)	0.47 (0.40-0.55)	0.66 (0.61-0.71)	-0.409	**0.0004**

TUG test = Timed Up and Go test. *95% confidence interval. # *p*-value for Spearman correlation coefficient.

Table 3. Physical performance scores and body composition of older adults attending the Vitalità Center for Aging and Longevity at PUC-Campinas (N=72). Campinas, São Paulo state, 2024.

	Total n (%)	Male n (%)	Female n (%)	Correlation coefficient	**p*
TUG test				-0,114	0,336
Normal	45 (62.5)	11 (73.3)	34 (60.0)		
Higher risk of impaired mobility	27 (37.5)	4 (26.7)	23 (40.0)		
Handgrip strength				-0.179	0.132
Normal	57 (79.2)	14 (93.3)	43 (75.0)		
Low muscle strength	15 (20.8)	1 (6.7)	13 (25.0)		
SARC-F				0.064	0.592
Healthy	69 (96.0)	14 (93.3)	55 (96.0)		
Sarcopenia	3 (4.0)	1 (6.7)	2 (4.0)		
Calf circumference					
Normal	72 (100)				
BMI				-0.180	0.130
Normal	58 (80.6)	10 (66.7)	48 (84.2)		
Obese	14 (19.4)	5 (33.3)	9 (15.8)		
Fat Mass				0.185	0.119
Normal	35 (48.6)	10 (66.7)	25 (43.9)		
Obese	37 (51.4)	5 (33.3)	32 (56.1)		

TUG test = Timed Up and Go test. SARC-F. BMI = body mass index. **p*-value for Spearman correlation coefficient.

The FFQ-AGE revealed that, overall, average dietary AGE intake was 12,104±5,719 kU/day. For AGE consumption by gender, men consumed 12,317±5,554 kU/day, while women consumed 11,695±6,499 kU/day. Regarding marital status, men living alone consumed 13,590±6,007 kU/day (n=10) and married women 11,898±5,763 kU/day (n=36), with no significant difference by marital status. The foods frequently consumed that contributed to level of dietary AGE intake were fast food hamburgers and French fries, pizza with baked crust, avocado, nuts in general, butter, and margarine. There was no correlation between SAF measurements and participant age, calf circumference or physical performance (TUG test and handgrip strength performance), dietary AGE intake, or number of medications taken routinely. However, a positive correlation was found between BMI, fat mass, and sarcopenic obesity on bivariate correlation analysis (Table 4). Skin autofluorescence reader scores indicating higher cardiovascular risk (Mean = 2.42; CI = 2.11-2.73) correlated positively with BMI (p=0.0022) and fat mass (p=0.0027). In the multivariate model (R^2=0.9732), only BMI remained an independent predictor of SAF values (Table 5).

Table 4. Correlation coefficients between skin autofluorescence (SAF) and anthropometric, dietary, and clinical variables in older adults attending the Vitalità Center for Aging and Longevity at PUC-Campinas (N=72). Campinas, São Paulo state, 2024.

Variable	SAF	*p
Age	-0.05	0.6884
BMI	0.44	**0.0002**
Fat Mass	0.39	**0.0010**
Calf circumference	0.12	0.3293
TUG test	-0.05	0.6540
Handgrip strength	0.21	0.0776
Sarcopenic obesity	0.38	**0.0014**
Dietary AGE	0.03	0.7740
Number of medications	-0.09	0.4421

TUG test = Timed Up and Go test. SARC-F. BMI = body mass index. Dietary AGE = dietary advanced glycation end products. *p-value for Spearman correlation coefficient.

Table 5. Multivariate analysis between skin autofluorescence (SAF) and anthropometric and strength variables in older adults attending the Vitalità Center for Aging and Longevity at PUC-Campinas (N=72). Campinas, São Paulo state, 2024.

Variables	β	Confidence Interval	*p
BMI	0.089	0.0565 - 0.1216	**<0.0001**
Fat mass	0.020	-0.0083 - 0.0487	0.1616
Handgrip strength	0.006	-0.0031 - 0.0152	0.1946
Sarcopenic obesity	-1.029	-2.210 - 0.1515	0.0864

BMI = body mass index. *p-value for multiple linear regression analysis (Least Squares).

DISCUSSION

Studies in the literature have reported an association of accumulation of AGEs in skeletal muscle with reduced muscle regeneration and structural alterations in the extracellular matrix of skeletal muscle. In a cross-sectional study involving 2,744 European participants with a mean age of 74.1 years, cutaneous AGE levels, measured using skin autofluorescence, were high and associated with a higher prevalence of sarcopenia[10].

Thus, one of the main questions of this study was whether AGE accumulation is associated with changes in body composition, such as the presence of sarcopenia or obesity during aging, thereby predisposing individuals to reduced quality of life and the development of chronic diseases. A non-invasive method for detecting and quantifying the accumulation of fluorescent AGEs in tissues is by reading skin autofluorescence (SAF) using ultraviolet (UV) technology. SAF has been increasingly used as a surrogate for more complex methodologies and has been validated against measurements of collagen-bound fluorescent AGEs such as pentosidine, low-molecular-mass cross-links (LMC), and Nε-carboxyethyl-lysine (CEL), for example, in patients with diabetes mellitus[11]. The challenges of employing SAF in an older population with a wide range of skin phototypes (1 to 6 on the Fitzpatrick scale) and the lack of established reference values were also encountered in the present study. The results revealed no correlation between skin autofluorescence and calf circumference, TUG test score, or handgrip strength in the sample assessed, suggesting that AGE accumulation was not associated with physical performance or muscle health of participants. Age was also found not to correlate with skin autofluorescence, and there was no correlation between SAF values and different skin phototypes.

A study of people with type 1 diabetes and healthy young adults (mean age 31 years) showed that skin autofluorescence values increased with age and that the values in individuals with diabetes were only reached later in life by healthy individuals. The authors reported an increase in SAF of 0.029±0.003 arbitrary units (AU) per year in diabetic individuals versus 0.022±0.002 AU per year in healthy individuals, who had SAF values of 1.66±0.02 AU and 1.48±0.03 AU, respectively[12]. Notably, by comparison, the mean SAF value (2.5±0.5) detected in the present study population (mean age 68.1 years) was higher. However, in a more recent study of a Brazilian population with type 2 diabetes with and without chronic kidney disease (mean age of 58±7 years), SAF values were 3±0.8 AU and 2.5±0.7 AU, respectively[13].

In another study including healthy individuals and participants with chronic diseases such as diabetes, chronic kidney disease, or cardiovascular disease SAF values were 1.90±0.42 and 2.27±0.51, respectively. The mean ages of the healthy and chronically ill groups were 43.58±11.77 and 55.51±12.07 years, respectively[14]. These findings suggest that the older population assessed in the current investigation had higher SAF values due to age and the presence of both healthy and chronic conditions, given that only 30.6% of participants did not routinely take medications. In addition, a Spanish study recently proposed reference SAF values for individuals ≥60 years of 2.28±0.56[15], suggesting that Brazilian older adults may have relatively higher SAF values.

The present results showed that SAF values, as a proxy of AGE accumulation, were positively correlated with BMI, percentage fat mass, and sarcopenic obesity on the bivariate analysis. Cardiovascular risk, as calculated by the SAF reader, also correlated positively with BMI and fat mass. Multivariate analysis confirmed BMI as a predictor of AGE accumulation during aging.

Lifestyle changes, particularly in dietary patterns, are essential for preventing and controlling obesity. Recent studies have shown that consumption of AGE-rich foods may promote obesity and the development of chronic cardiovascular diseases.

A positive association between dietary methylglyoxal (MGO) and body-weight gain was demonstrated in a European cohort study[16]. The present cross-sectional study failed to show any correlation between dietary AGE intake and BMI, fat mass, or muscle performance score in the older adults assessed. No correlation was found between

skin autofluorescence and dietary AGE intake. It is important to note that the dietary assessment tool employed focuses on AGE-rich foods, and that high glycemic-load diets may also favor AGE accumulation in the body. The FFQ applied showed that the participants consumed 12,104±5,719 kU/day of dietary AGEs. Although no reference value for AGE intake has been established, some studies report a wide range of 4,000 to 24,000 kU/day, without taking the health status of participants into account[17]. The disparity among studies is large because different methods of data collection were used. Uribarri et al., using a three-day food record, reported a baseline intake of 12,400±1,000 kU/day in an intervention study involving participants aged over 60 years, with no differences between men and women[18]. In another study, AGE intake in middle-aged individuals was 9,754±3,936 kU/day versus 9,893±3,784 kU/day in older adults, and no correlation was found between dietary intake, body composition, or metabolic parameters using data from 24-hour recalls and an FFQ[19]. In a Dutch study, high dietary AGE intake was not associated with physical frailty[20].

Limitations of the present study include its cross-sectional design, lack of a control group, and the absence of a detailed clinical assessment of participants' health status. Other limitations were the small sample size, the possibility of recall bias when completing questionnaires, and the fact that the sample does not fully reflect the Brazilian older population, as illustrated below.

According to data published in 2022 by the Brazilian Institute of Geography and Statistics (IBGE), the total number of people aged 60 years or older (32,113,490) corresponded to 15.6% of the national population, representing a 56.0% increase compared to the 2010 census. Of these older adults, 55.7% were women and 44.3% were men. The present sample did not mirror this distribution, suggesting that older women may be more socially active and more likely than men to seek activities offered by university outreach programs. Regarding educational level, 20.7% of women aged 25 years or older had completed higher education versus 15.8% of men. In the age group of 65 years or older, literacy was 93.5% for women and 92.5% for men[21]. The sample was also not representative of the Brazilian older population with respect to education, suggesting that opportunities to return to university are more accessible to older Brazilians with higher educational level[21].

The presence of sarcopenia in aging populations is common and poses a major problem, as it dramatically increases the risk of falls, frailty, disability, hospitalization, and mortality among older adults. In 2019, the European Working Group on Sarcopenia in Older People (EWGSOP) updated the original definition of sarcopenia as a muscle disease (muscle failure) in which low muscle strength overtakes low muscle mass as the primary determinant and predictor of adverse outcomes[22]. A systematic review and meta-analysis including 9,416 participants from 31 studies of Brazilian older adults found that the prevalence of sarcopenia was 16.0% when both low muscle mass and low muscle function were criteria compared with 17.0% when based solely on low muscle mass[23]. All participants in the current sample had calf circumferences above the cut-off for low muscle mass, and only 4% had SARC-F scores indicating risk of sarcopenia. However, 20.8% had low performance on the handgrip test, indicating loss of strength, which is considered more important than muscle mass alone. Moreover, 37.5% of participants failed to attain normal performance on the TUG test and therefore had a higher risk of falls. Loss of muscle strength, not attributable to neurological or primary muscular disease, is known as dynapenia, although the distinction between dynapenia and sarcopenia may not be clinically relevant[24].

The presence of obesity has a major impact on negative health outcomes. A recent study that sought to determine the optimal BMI range for older adults suggested that an ideal BMI is 31–32 kg/m² for older women and 27–28 kg/m² for older men[25]. By contrast, another study showed that a BMI ≥30 kg/m² was associated with a 60% increased risk of mobility limitations, regardless of lifestyle habits[26]. If applying these geriatric-specific ranges rather than the cut-offs proposed for younger adults (overweight > 25 kg/m²), 19.4% of the current sample would be classified as obese. Based on a healthy body-fat

percentage for women aged 60-79 years of 24–35% and for men of 13–24%, the fat mass values obtained by bioimpedance for the sample assessed indicate that 48.6% of the participants were obese, underscoring the need for early interventions to prevent obesity in older adults in Brazil.

CONCLUSION

Accumulation of advanced glycation end products, evaluated by skin autofluorescence, was associated with unfavorable body composition, particularly obesity, indicating an increased risk of cardiovascular diseases. A diet rich in advanced glycation end products was not correlated with the observed accumulation of these products, suggesting that increased endogenous production or reduced excretion capacity are the main factors associated with AGE accumulation during aging. New therapeutic strategies need to be developed and may be useful in the future to control AGE accumulation that occurs with aging, especially in obese adults.

AUTHORSHIP

- Maria Cecília Ferreira – Data collection; data analysis and interpretation; approval of the version to be published.
- Camila Santos Lemos – Data collection; approval of the version to be published
- Júlia Constantino Aun – Data collection; approval of the version to be published.
- Juliana Alves Macedo – Project conception; data analysis and interpretation; approval of the version to be published.
- Gabriela Alves Macedo – Project conception; data analysis and interpretation; approval of the version to be published.
- Alessandra Gambero – Project conception; funding acquisition; data analysis and interpretation; manuscript writing

Edited by: Camila Alves dos Santos

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Social participation of older adults in the SABE Study (2010): a latent class analysis according to sex

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Abstract

Objective: To investigate the social participation patterns of older adults and their differences according to sex. *Method*: A cross-sectional, analytical study of 1,266 older adults participating in the 2010 Wellbeing and Aging Study (SABE) in the city of São Paulo, São Paulo state, was conducted. Social participation was measured using 14 questions, classified based on the taxonomy of Levasseur et al.: socially oriented activities (SOAs), task-oriented activities (TOAs), and social engagement (SE). Latent class analysis was used to identify patterns. *Results*: Four latent groups were identified: class 1 - variability in activities, especially SE; class 2 - variability in both SOAs and TOAs; class 3 - SOAs only; and class 4 - low variability in all activities. Men endorsed competitive activities, avoiding activities associated with the female domain, while the opposite occurred for women. Women exhibit greater variability in socialization activities, possibly reflecting freedom after transitional events that diminish gender roles. Lower social participation among men reflects dependence on work- and family-related interactions. *Conclusion*: There are different patterns of social participation associated with sex-related expectations, which influence the definition of social activities among older adults. Understanding these patterns enables professionals and policymakers to tailor programs and social actions by considering differing preferences according to sex.

Keywords: Aging. Social Participation. Older Adult.

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Study funding: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) – Doctoral scholarship no. 88887.830001/2023-00.

The authors declare no conflict of interest in the conception of this work.

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Received: December 12, 2025
Approved: March 2, 2026

http://dx.doi.org/10.1590/1981-22562026029.250168en

INTRODUCTION

The development of strategies to promote active healthy aging is recommended by the World Health Organization (WHO)[1]. Social participation (SP) is one of the pillars toward this objective[1,2]. Greater SP is associated with the adoption of healthy behaviors, presence of social support, and improvement in physical and mental functioning[3,4]. Moreover, SP promotes increased trust of individuals in their community and facilitates access to emotional support[4].

In the older population, the issue is particularly relevant because late life is marked by a decline in SP, partly as a result of changes in roles and social arrangements typical of this stage of life (e.g., retirement, loss of loved ones), as well as changes in physical health[5]. A systematic review showed that the most common SP trajectory is downward, with few studies reporting stability, and fewer still demonstrating increased social participation at advanced ages[5]. In another study, results revealed that two-thirds of the sample exhibited decline in the activities they participated in over time, while only one-third maintained levels of engagement[6]. Factors such as migration, morbidity, and psychosocial aspects underlie this change over time[6].

Many studies have sought to elucidate the antecedents and outcomes of SP, considered a modifiable factor in aging[7]. Evidence shows that SP influences mental health and functionality in older adults[7-9], and is associated with better cognitive levels[10], lower risk of incident disability, and mortality[11]. Additionally, older adults with greater social participation exhibit lower risk of presenting depressive symptoms[7], while low SP levels increase this risk[12].

Differences in SP also exist in relation to gender[13], where participation proves more positive and beneficial for women than men[8]. For females, creating and maintaining social relationships is more central to promoting health-promoting behaviors[14]. By contrast, men engage more in work-related activities, while women participate in a broader range of social activities[13].

In Brazil, SP level is the lowest (8.53%) of the three pillars of active aging (i.e., health, participation, and security)[2]. Evidence shows the more advanced the age, the lower SP tends to be[15]. Brazilian older adults who participate in social activities — clubs, religious groups, community groups, or senior centers — report better perceived health[16]. Nationally, the prevalence of social participation also varies widely (17.4% - 89%) depending on the form of measurement, region of the country, and access to community services[16].

Despite being central to active healthy aging, SP has been treated inconsistently in the literature[17] due to differences in concepts determining its measurement and results. For example, the inclusion of paid work in the definition and measurement of social participation in the older adult population may result in lower prevalence, while non-inclusion may have the opposite effect[5].

Thus, Levasseur et al.[17] systematized the definitions found in the literature and proposed the definition that social participation is a person's involvement in activities that provide interaction with other people in society or the community. In this construct, the authors note that activities may be socially oriented (SOA), task-oriented (TOA), and social engagement (SE).

Although this systematization has contributed to the literature, the measure used by most studies is the sum of participation in different activities, limiting understanding of this phenomenon. This approach disregards the effects of different types of activities on health indicators[18] and precludes understanding of the different patterns of activity adopted by older adults[19].

SP can manifest as single or groups of different activities. The accumulation hypothesis holds that the more a person participates in a task, the greater the chance of participating in others[20]. The competition hypothesis holds that engagement in some tasks precludes participation in others (e.g., engaging in tasks caring for spouse or grandchildren may prevent participation in recreational activities)[20]. This information is not reflected when only the sum of activities is taken into account.

Latent class analysis (LCA) allows the identification of different behavioral patterns from observable

indicators[21]. In the context of SP, this analysis allows the identification of patterns among people, pooling them into groups according to their similarities in social activities involved. In the literature, different latent groups of social participation among older adults have been identified[22-24]. However, these studies reveal high variability in the latent groups identified.

The objective of the present study was to identify the patterns/profiles of social participation among community-dwelling older adults according to sex. Revealing the different patterns of social participation adopted by older adults may offer a new perspective on this phenomenon, capturing its dynamicity. Standardizing the conceptualization of these profiles employing a consolidated theoretical framework will enable comparisons with future studies seeking to elucidate how different clusters of activities adopted by older adults act on health outcomes in a similar or different fashion.

METHOD

A cross-sectional study drawing on data from the Health, Well-being and Aging Study (SABE) was conducted. The SABE study began in 2000, under the coordination of the Pan American Health Organization (PAHO), with the goal of investigating health conditions in the older adult population across seven urban centers in Latin America. In Brazil, the study was conducted in the city of São Paulo based on a probabilistic sample comprising 2,143 participants. From 2006 onward, and only in the São Paulo city, the study became longitudinal with multiple cohorts. New waves of data collection were performed in the years 2006, 2010, and 2015, evaluating 2,143, 1,413, and 1,345 participants, respectively[25]. The 2010 wave was approved by the Research Ethics Committee (COEP) of the School of Public Health of the University of São Paulo (COEP Opinion No. 23/10). The data were provided by the coordination of the SABE Study, which also approved the execution of the present study..

The current study was based on 2010 data. Participants who failed to provide a response for at least one of the social participation variables were excluded, giving a final sample of 1,266 participants.

Social participation encompassed 14 variables (Chart 1) for evaluating respondent involvement in social activities, based on the theoretical framework of Levasseur et al.[17] Each activity was coded dichotomously (yes; no).

Levasseur et al.'s [17] taxonomy distinguishes each level according to the degree of involvement with others and the main goal of the activities pursued. Within this structure, the concepts of *participation*, *social participation* and *social engagement* are distributed across different levels. The broadest concept, *participation*, encompasses all six levels; *social participation* corresponds to levels 3 to 6; and *social engagement* to levels 5 and 6. The objectives associated with each level and the corresponding concepts are outlined below.

- **Level 1:** Basic-needs oriented, without the presence of other people (i.e., activities that prepare for connecting with others) (Participation);
- **Level 2:** Basic-needs oriented, in the presence of others but without interaction (Participation);
- **Level 3:** Socially oriented (i.e., involving interaction, but not performing another activity together) (Social participation);
- **Level 4:** Task-oriented (i.e., performing activities together) (Social participation);
- **Level 5:** Oriented toward helping others (Social participation and social engagement);
- **Level 6:** Oriented toward society (Social participation and social engagement).

All levels, with the exception of level 1, were represented by at least one indicator (i.e., one social participation variable). Indicators for level 1 were not included because this level involves no social interaction. Although level 2 also entails no interaction, a single indicator was adopted that reflects greater engagement in activities outside the home and situations involving higher social exposure (i.e., travelling outside the city). The indicators were classified according to this taxonomy, enabling the latent groups identified to be distinguished and labeled (Chart 1).

Chart 1. Description of social participation variables according to Levasseur et al.'s taxonomy[17]. SABE Study, São Paulo, São Paulo state, 2010.

Description of indicator (adapted from original study protocol)	**Classification of indicator according to Levasseur et al.'s taxonomy[17]**
Contact by letter, telephone or e-mail	Level 3: Socially oriented – Social participation
Visits friends and relatives	Level 3: Socially oriented – Social participation
Volunteer work outside the home	Level 5: Oriented toward helping others – Social participation and social engagement
Travels outside the city	Level 2: Basic-needs oriented – Participation
Participates in a regular exercise program	Level 4: Task-oriented – Social participation
Invites people to come to their home	Level 3: Socially oriented – Social participation
Goes out with others to public places	Level 3: Socially oriented – Social participation
Participates in organized social activities	Level 4: Task-oriented – Social participation
Engages in handicraft activities	Level 4: Task-oriented – Social participation
Plays board or card games	Level 4: Task-oriented – Social participation
Engages in musical activities	Level 4: Task-oriented – Social participation
Engages in cultural activities	Level 4: Task-oriented – Social participation
Participates in political activities	Level 6: Oriented toward society – Social participation and social engagement
Participates in online chats or uses social networks	Level 3: Socially oriented – Social participation

LCA was used to investigate social participation patterns. LCA aims to identify response patterns in observable indicators, based on the theoretical assumption that a latent variable — not directly measurable — explains these patterns among groups of individuals. Thus, LCA estimates the probability of each person belonging to a given group, based on the similarity of item endorsement patterns[26]. Unlike variable-centered approaches, LCA adopts a person-centered perspective, seeking to group them according to common latent characteristics. In this study, the analysis was initially applied to the total sample and subsequently performed separately by sex, with the purpose of exploring possible differences in social participation patterns.

To evaluate the model with the best fit, Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Sample-size-adjusted BIC (aBIC) were used, considering that lower values indicate better fit to the data. Identifying the ideal number of latent classes was carried using the Adjusted Lo-Mendell-Rubin Likelihood Ratio Test, which compares a model with *k* classes to the previous *k-1* model, indicating whether the addition of a new class results in significant improvement in fit. A *p*-value <0.05 suggests that the model with more classes offers better performance. The entropy value was also analyzed, which expresses the degree of separation between latent classes, considered satisfactory for a value >0.80. Analyses were conducted in R software, using the **poLCA** package[26]. The chi-square test with Rao-Scott correction was employed for the analysis of differences between classes and sex.

DATA AVAILABILITY

The full dataset underpinning the study results are available upon request from the corresponding author.

RESULTS

The sample comprised individuals aged between 60 and 103 years (mean = 70 years), and more than half of the participants were female (59.9%). Most participants lived with others (84.5%) and reported

having a partner (54.6%). Mean years of education was 5.5 years, ranging from 0 to 21 (SD = 4.4) years. Regarding monthly income, 42.4% of participants reported insufficient income to meet their basic needs.

For the overall sample, models with 1 to 6 classes were estimated, with the 7-class model excluded due to convergence issues, defined as the presence of classes containing less than 5% of the sample. On the analyses stratified by sex, models with up to 7 classes were estimated. The 8-class model among women and the 7-class model among men were not considered because they had classes containing less than 5% of the sample.

The fit indices (AIC, BIC, aBIC), *p*-values for comparisons of consecutive models, and entropy values are presented in Table 2. For the overall sample, given that the entropy value was below the established criterion (>0.8), the 6-class model was not considered against the other models. Model 4 exhibited better fit values (BIC and aBIC) and was selected as the most adequate due to its better interpretability according to the guiding theory of social participation. For men, the 4-class model had the lowest BIC value and an entropy value >0.8, and also represented the model with best interpretability. The 4-class model was also selected for women due to its superior interpretability over model 5, while the other models with 6 and 7 classes contained groups with low representativeness (less than 10% of sample).

The probability of endorsement in each social participation indicator, according to latent group and sex, is presented in Figure 1. The latent groups identified were conceptualized according to the number of items endorsed at each level of the social participation taxonomy. Items where the endorsement probability was >0.5 were considered more strongly endorsed by people in that group.

Statistically significant differences were found between sex and social participation patterns (*p*-value=0.006). Hence, LCA was performed separately to better identify and characterize groups, Chart 2 presents groups characterized according to the concepts of participation, social participation, and social engagement, and to nature of activities pursued (socialization, task, helping others, helping society).

Table 1. Fit Indices for Latent Group Models based on social participation variables in older adults. SABE Study, São Paulo, São Paulo state, 2010.

	Overall sample (n=1,266)						Women (n= 811)						Men (n= 455)					
Classes	AIC	BIC	aBIC	Entropy	LL	*p* LRT	AIC	BIC	aBIC	Entropy	LL	*p* LRT	AIC	BIC	aBIC	Entropy	LL	*p* LRT
1	22813.51	22885.53	22841.05	1	-11392.76		14412.67	14478.44	14433.98	1	-7192.33		8346.91	8404.60	8360.17	1	-4159.46	
2	14883.40	15032.56	14940.44	0.99540	-7412.70	<0.01	9426.82	9563.07	9470.98	0.99	-4684.41	< 0.01	5356.77	5476.26	5384.22	0.99	-2649.39	< 0.01
3	13574.34	13800.66	13660.89	0.9064	-6743.17	<0.01	8452.74	8659.47	8519.74	0.93	-4182.37	< 0.01	5014.89	5196.18	5056.54	0.88	-2463.44	< 0.01
4	13455.12	13758.60	13571.18	0.8204	-6668.56	<0.01	8388.91	8666.10	8478.74	0.87	-4135.45	< 0.01	4958.43	5201.53	5014.29	0.86	-2420.22	< 0.01
5	13406.51	13787.14	13586.37	0.8148	-6629.71	<0.01	8365.21	8712.90	8477.91	0.81	-4108.61	< 0.01	4941.19	5246.09	5011.24	0.86	-2396.59	< 0.001
6	13373.06	13830.84	13548.13	0.7962	-6597.53	<0.01	8339.55	8757.70	8475.70	0.82	-4080.78	< 0.01	4950.23	5316.94	5034.48	0.86	-2386.11	0.18

Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Sample-size-adjusted BIC (aBIC), Adjusted Lo-Mendell-Rubin Likelihood Ratio Test (*p* LRT), Log-Likelihood (LL).

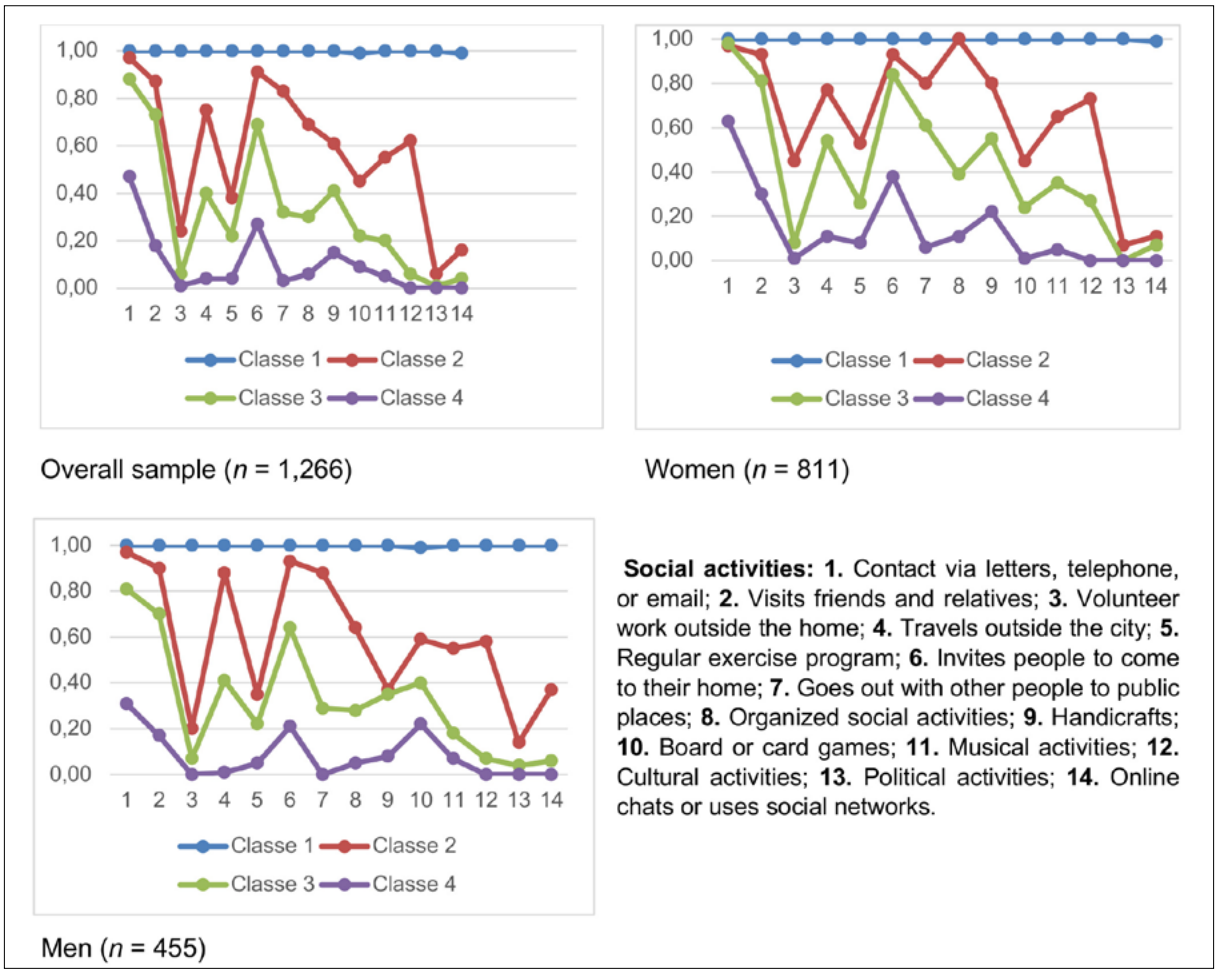


Figure 1. Probability of endorsement in each social participation indicator, according to latent group identified on latent class analysis. SABE Study, São Paulo, São Paulo state, 2010.

Chart 2. Characteristics of latent groups for social participation and sex. SABE Study, São Paulo, São Paulo state, 2010.

Classes	Overall sample	Women	Men
Class 1	High variability of social participation and social engagement (27.65%).	High variability of socialization activities, task-oriented and social engagement (27.25%).	High variability of socialization activities, task-oriented and social engagement (28.35%).
Class 2	Variability for social participation (slightly lower than class 1), absence of social engagement (18.32%).	High variability of socialization activities, except via digital channels; good variability of task-oriented activities, **except card and board games.** No social engagement (10.85%).	High variability of socialization activities except via digital channels; good variability of task-oriented activities, **except exercises and handicrafts**. No social engagement (11.21%).
Class 3	Predominantly socially oriented (absence of task-oriented social participation, absence of social engagement) (31.20%).	Predominantly socially oriented, except via digital channels, with **participation only in handicrafts as task-oriented activities** (29.35%).	Predominantly socially oriented, **except via digital channels and in public places (e.g., restaurants or cinema).** No task-oriented participation or social engagement (39.12%).
Class 4	Absence of social participation and social engagement (22.83%).	Low social participation and social engagement (32.55%).	Low social participation and social engagement (21.32%).

For both sexes, class 1 stands out for high variability of socialization and task-oriented activities and social engagement. The general profile of class 2 is also similar across different sexes, where there is variability in participation in task-oriented social activities and variability in means of socialization, except via digital channels. In this class, there were gender specific differences for tasks not engaged in. Women showed endorsement for all tasks, except card and board games, while men showed no endorsement for exercise programs and handicrafts (Chart 2).

The third latent group identified for each sex was also similar overall, and marked by a predominance of activities involving socialization *per se*, with the exception of socializations via digital channels. Specifically for men, there was low probability of endorsement for socializations in public places (e.g., restaurants or cinema). Men in this class did not show high probabilities of endorsement for task-oriented activities, while women exhibited high probability for handicrafts only. Lastly, the fourth class proved similar for both sexes, consisting of participants with low participation and absence of social engagement (Chart 2).

DISCUSSION

The objective of the present study was to identify types of social participation in a sample of Brazilian community-dwelling older adults. Using the latent class analysis (LCA) technique, four classes were identified based on the taxonomy proposed by Levasseur et al.[17] Class 1 included participants with high variability in activities and social engagement. Class 2 exhibited high variability in activities, but to a lesser degree than Class 1, and absence of social engagement. The third class contained people who participated solely in socialization oriented activities, and not in task-oriented activities nor activities whose purpose was change in society (social engagement). The fourth class was characterized by people with low social participation and absence of social engagement.

The four-class model also proved to be the best fit for data in other studies[19,23,27]. However, the naming of classes differed across studies. The study by Lestari et al.[23] investigated social relationships comprehensively, including frequency, social support, and employed task-oriented activity indicators only. In the study by Van Hees et al.[27], task-oriented activities were grouped into a single indicator, and thus failed to reflect participation diversity.

The use of taxonomy allowed the nature of each pattern to be distinguished qualitatively, proving superior to three-class models generally defined by participation frequency and intensity[22,24]. In the present study, taxonomy helped distinguish intermediate classes, i.e., those not categorized by broad or low variety of participation. The intermediate groups stand out for absence of social engagement and differ regarding activity variability: one oriented toward socialization activities and another that also includes task-oriented activities. The use of taxonomy and selection of diverse indicators allowed the investigation of the plurality of SP of people beyond the extreme ends of the continuum, facilitating division into two qualitatively distinct classes.

The emergence of a single class with high social participation corroborates the accumulation hypothesis, i.e., people who engage in one social activity tend to also engage in others[20]. Although the study used no care activity indicators, the frequent formation of a class with low participation may reflect the competition hypothesis (i.e., participation, generally care activities, precludes participation in other types of activity).

After identifying associations between class and sex, patterns of social participation for each sex were investigated. For both sexes, Class 1 was characterized by high variability in SP and the presence of social engagement, and class 4 by low social participation and absence of social engagement. The intermediate classes were structured differently in men and women, revealing specific preferences concerning task-oriented social activities. Thus, these constitute distinct SP profiles with respect to tasks and socializations. In the second group of greater variability in social activities, women endorsed all task-oriented activities, with the exception of card and board games, whereas men endorsed all activities, except handicrafts and exercise.

The sex-based disparities reveal the maintenance, in leisure-time pursuits, of a gender expectation system that determines expectations of males and females. This structure is rooted in a historically constructed process to delimit roles, fostering a power system that favors male domination[28]. Although contested, this mindset persists in leisure-time pursuits[28]. Among males, greater endorsement of competitive activities is expected; whereas women are expected to engage in motherhood, care tasks, and passivity[28]. Thus, women's lower endorsement of card and board games may reflect this delimitation, while men tend to identify aesthetic and expressive activities as pertaining to the female domain, explaining lower endorsement of handicrafts.

The cohort of this study experienced the enaction of laws in Brazil banning engagement in leisure activities deemed incompatible for women (Law No. 3,199/1941), a scenario which may have impacted the way this group perceived these activities. From childhood, the differentiation conferred to sexes encourages men to engage in more physical demanding activities, such as soccer and grappling, while women are encouraged to pursue lighter exercise, such as ballet, dance, and walking[28].

Men and women differed regarding adoption of regular physical exercise. This activity was endorsed by women in more than one class, while for men this was constrained to Class 1. The effect of social participation in physical exercise on health outcomes may be stronger for women[9]. This greater sensitivity to the protective factor initiates a feedback process, where the positive effects of social participation in physical activities increase adoption. Thus, the wider adoption of exercise activities by women may reflect the greater benefits experienced by them.

For both men and women, a class formed that participated almost exclusively in socially oriented activities. However, in this group, men endorsed activities in public places to a lesser extent than women. Men typically depend more on women to maintain their SP levels and prioritize family interactions, while women exhibit greater variation in social contacts (i.e., community and friendship domain) and leisure activities[13].

Women also showed participation in handicraft activities. This disparity may be a reflection of differences experienced after external events associated with this phase of life. Men tend to participate more in work-related social activities and are consequently more susceptible to the changes brought on by retirement[29]. Women tend to enjoy greater diversity in activities prior to retirement and, therefore, are more resistant to this phenomenon[13].

Retirement and widowhood are transitional events characteristic of more advanced ages accompanied by different consequences for men and women regarding social participation[8]. While for women widowhood is a transition phase that liberates them from obligations associated with gender roles, thus allowing them to be more innovative in activities they participate in, for men there is a decrease in activities after retirement, as their pattern of engagement is strongly influenced by the provider role[13].

Moreover, the range of activities offered to women by senior centers is broader[30], impacting adhesion of men due to lower interest in these activities[13].

The findings point to the need for future studies to address the gender variable and gain a deeper understanding of the social construction of social participation in old age. The sex variable, used in the present study, refers exclusively to biological aspects (man and woman), which may be a limiting factor for understanding expectations associated with gender. Another relevant limitation involves the absence of care activity indicators. These activities may determine, albeit partially, availability for engagement in other forms of social participation. Hence, these indicators should be included in future studies investigating social participation profiles.

The use of secondary data restricted the possibility of using a greater number of indicators and prevented their equal distribution across the appropriate levels of taxonomy. Moreover, the temporal cutoff of the sample may mean that some advances in means of social interaction, such as wider use of social networks, are not reflected. Despite these limitations, the study stands out for its grouping of social participation indicators based on the homogeneity of responses, furthering understanding on the profile of

the older adult population by clarifying relationships of this phenomenon according to sex.

CONCLUSION

There are different patterns of social participation and gender expectations determine the social activities of older adults. For the overall and sex-stratified samples, the four-class model had the best fit and interpretability. Men and women are grouped into different social participation profiles. A difference in intermediate classes was evident in terms of preferences in activities adopted, a phenomenon influenced by gender expectations.

Men endorse more activities of a competitive nature, avoiding activities characteristic of females, whereas the opposite holds true for women. Women in intermediate classes show greater variability of socialization activities than men, reflecting liberation from gender roles after transitional changes experienced in later life (i.e., widowhood), whereas men reveal dependence on socializations linked to work and family interactions.

Understanding the different social participation profiles helps to better characterize the preferences of older adults, informing the creation of programs promoting participation and increasing adherence. The use of this taxonomy to define indicators and social participation patterns in future studies is important to facilitate comparisons. Lastly, investigating different patterns of social participation associated with health outcomes is fundamental in determining whether specific patterns are more or less beneficial for health.

AUTHORSHIP

- Eduardo A. Rocha – Conceptualization, Writing - Original Draft, Writing - Review and Editing, Methodology, Final approval of the version.
- Yeda A. O. Duarte – Project Administration, Validation and Visualization, Conception and design, Writing or critical review, Final approval of the version.
- Daniella P. Nunes – Project Administration, Formal Analysis, Writing - Review and Editing, Methodology, Software, Supervision, Validation and Visualization.

Edited by: Andressa Coelho Gomes

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Evidence on the effectiveness of cognitive-behavioral therapy for reducing suicidal ideation in older adults: a rapid systematic review

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Abstract

Objective: To evaluate the available evidence on the effectiveness of cognitive-behavioral therapy (CBT) in reducing suicidal ideation in older adults, and to analyze the therapeutic factors associated with its efficacy. *Method:* A rapid systematic review of articles published between 2000 and 2024 was conducted across international databases. Studies applying CBT-based interventions to older adults with suicidal ideation were included. Six studies were selected: two randomized clinical trials, one secondary analysis, one feasibility pilot study, and two ongoing protocols. *Results:* Problem-solving therapy (PST) demonstrated effectiveness in reducing suicidal ideation, with results maintained at follow-up. The Tele-PST modality showed significant reductions in ideation and hopelessness, while face-to-face PST mainly reduced hopelessness. Continuous Identity Cognitive Therapy (CI-CT) showed favorable preliminary results in a pilot study. The ongoing protocols, focusing on emotion-centered PST and online group interventions, explore new adaptations of CBT, although no results have been published yet. *Conclusion:* CBT, especially PST and its variants, appears to be a promising approach for reducing suicidal ideation in older adults. However, the evidence is still limited and preliminary, and larger, more robust trials are needed.

Keywords: Cognitive Behavioral Therapy. Problem Solving Therapy. Suicidal Ideation. Old Age. Telemedicine. Psychological Intervention.

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There was no funding for the execution of this work.
The authors declare that there is no conflict in the conception of this work.

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Received: September 10, 2025
Approved: January 5, 2026

http://dx.doi.org/10.1590/1981-22562026029.250154en

INTRODUCTION

Globally, suicide rates and suicidal ideation among older adults have increased. This has become a major public health concern in countries like Chile[1]. Contributing factors include lack of social support, physical health issues, and negative views of aging[2].

Internationally, suicide rates are higher among middle-aged and older adults[3]. In Chile, the problem worsens due to changes in family structures and the effects of aging[4,5]. The suicide rate among older adults in Chile is over 12 per 100,000. It is especially high for men aged 80 or older (39.5 per 100,000), leading to about 360 deaths each year in this group [4,6]. This is a silent crisis, often overlooked in public debate and health policies.

Suicide and suicidal ideation are complex and multicausal topics[7]. The World Health Organization (WHO)[8] defines suicide as "the act of intentionally carrying out an action to take one's own life."

Suicidal ideation involves any thought about ending one's own life. These thoughts can be active (with a clear suicide plan) or passive (thinking about wanting to die)[9].

Globally, suicidal ideation is a public health problem and is hard to manage. It affects families and communities[5]. Researchers study suicide to find biological, psychological, and sociodemographic risk and protective factors[10,11].

At the health system level, risk factors are limited access to mental health care, insufficient professional training, and low preventive effectiveness. At the individual level, key factors include loneliness, isolation, depression, previous attempts, access to medications, and cortisol alterations[9].

According to the WHO, old age is a process of accumulating cellular damage that leads to loss of physical and mental capacities. This increases the risk of disease and, ultimately, of death[12]. Aging is neither linear nor uniform. It is influenced by biological, social, and economic factors[12].

Suicidal ideation affects older adults, so professionals must be ready to intervene[5]. In old age, this ideation is complex and multifactorial. It is shaped by both biological and external factors. Medical, psychiatric, and family problems also raise suicide risk[2,5].

Loneliness and depression, risk factors for suicidal ideation in older adults, are linked to cognitive-behavioral interventions. CBT addresses dysfunctional thoughts, isolation, and fewer meaningful activities. It helps modify negative beliefs, promotes coping strategies, and encourages behavioral activation, which is key to reducing suicidal ideation in this group[4]. Specific risk factors include: a) male gender, b) chronic pain, c) age over 80 years, d) depression, e) low income, f) chronic sleep disorders, g) social isolation, h) memory problems, i) widowhood or separation, j) hearing or visual problems, k) illnesses limiting autonomy, l) access to lethal means, m) alcohol use, and n) previous suicide attempts[4].

Suicidal ideation in older adults requires a multidimensional approach that includes pharmacotherapy, crisis intervention, and psychotherapy[13]. Psychotherapy not only addresses the main symptoms of suicidal ideation but also promotes resilience and improves quality of life, constituting an effective and comprehensive long-term intervention[14]. The most recent evidence shows that psychotherapeutic interventions enhance protective resources such as sense of purpose, psychological well-being, and adaptive coping styles, strengthening resilience and contributing to suicide prevention[15].

Psychotherapy effectiveness means an intervention improves symptoms and well-being[16-18]. Cognitive-behavioral therapy (CBT) and dialectical behavior therapy (DBT) are the top-proven therapies for reducing suicidal ideation[5].

Cognitive-behavioral therapy has been favorably adapted to recurrent problems of old age, such as grief, chronic illnesses, and loneliness, helping individuals develop specific skills to cope with difficulties[19]. In addition, in the context of limited resources, it offers

the possibility of brief and effective interventions to reduce suicidal ideation, with a simpler format[20].

Its effectiveness centers on immediate cognitive change through the development of concrete strategies to cope with the stressors typical of older adulthood, such as functional losses, grief, isolation, mild cognitive deficits, and transitions in social roles. Likewise, it allows for the interruption of the spiral of suicidal thoughts through cognitive restructuring and strengthens practical skills for managing stress and loss, making it particularly relevant for this age group[21].

Evidence from meta-analyses and systematic reviews shows that interventions based on cognitive-behavioral therapy, including its digital modalities, are consistently associated with small to moderate reductions in the intensity of suicidal ideation. Randomized clinical trials report beneficial effects both for treatments specifically aimed at suicide prevention and for "indirect" interventions focused on depressive or anxious symptoms[22,23]. Meta-analyses of digital interventions with a cognitive-behavioral focus have shown significant reductions in suicidal ideation and depressive symptoms, although their effects on anxiety and hopelessness are more modest[24].

Factors influencing the effectiveness of CBT have been identified, including the mode of delivery (face-to-face vs. digital), the duration and frequency of sessions, the measures used to assess ideation, and the combination with pharmacotherapy or group interventions[25]. These reviews highlight methodological limitations, including heterogeneity across studies, limited long-term follow-up, and a scarcity of research focused on older adults.

CBT shows promise for reducing suicidal ideation in older adults. However, limited and preliminary evidence means larger trials with representative samples and longitudinal designs are still needed to determine its definitive effectiveness and identify therapeutic mechanisms[22,25].

Given the clinical urgency of the topic and the need to synthesize the available evidence efficiently, a rapid systematic review design was chosen to address the question: What evidence exists regarding the clinical efficacy of cognitive-behavioral psychotherapy in reducing suicidal ideation in older adults, and what therapeutic mechanisms and clinical factors explain its effectiveness in this group?

This review aims to synthesize what is known about the effectiveness of CBT in reducing suicidal ideation in older adults and to directly analyze which therapeutic factors within CBT most contribute to this outcome.

METHODOLOGY

The research conducted corresponds to an exploratory rapid systematic review aimed at analyzing the available scientific evidence. The PRISMA method guidelines were followed[26,27]. A bibliographic search was conducted across the most relevant databases for clinical trials (WOS, SCOPUS, PubMed). A "snowball" search strategy (snowball sampling) was also carried out to identify additional resources beyond the main search. The snowballing technique is a complementary strategy that allows the identification of relevant studies from the references of the included articles ("backward") or from those that cite them ("forward"). In rapid reviews, this technique optimizes time and broadens search coverage, helping retrieve literature that may not appear through traditional strategies[28,29].

However, its application is limited by the quality and currency of the initial studies, which may introduce selection bias and omit recent evidence. In addition, as it is not fully reproducible, it may reduce methodological transparency; therefore, it is recommended to use it as a complement to structure systematic searches[29,30]. This review was not registered in PROSPERO, as it corresponds to a rapid systematic review. According to the recommendations of the Cochrane Rapid Reviews Methods Group, this type of review may omit such registration due to its accelerated nature and the need to synthesize evidence within abbreviated timeframes; nevertheless, the absence of registration is acknowledged as a limitation of the study, partially mitigated by the detailed and transparent description of the method used.

Inclusion criteria: Population: Adults aged 60 years or older presenting suicidal ideation; Intervention: Cognitive-behavioral psychotherapy; Comparator: Control group or usual treatment; and Outcome: Reduction in suicidal ideation, decrease in the frequency and severity of suicidal thoughts. Additional inclusion criteria: a) Peer-reviewed research, b) Studies published in English, Spanish, or French, c) Publication period between 2000 and 2024, d) Quantitative studies.

The temporal delimitation between 2000 and 2024 was defined based on the consolidation of cognitive-behavioral therapy, the updating of clinical guidelines for suicide prevention, and the emergence of digital interventions grounded in this approach, thereby enabling the integration of clinically relevant evidence aligned with contemporary developments in the field.

Exclusion criteria: a) Publications that do not present research results (comments, letters to the editor, viewpoints, books, book chapters, reviews, etc.), and b) studies written in languages other than those established. Based on the inclusion and exclusion criteria, the following search equation was determined: ((older AND adults) OR elderly OR seniors OR aged OR (people AND "over 60") OR elder*) AND ((cognitive AND therapy) OR (cognitive AND behavioral)) AND suicid*.

DATA AVAILABILITY

The complete dataset supporting the findings of this study is available from the corresponding author upon reasonable request.

RESULTS

The complete process carried out in the present study can be observed in the PRISMA flow diagram (Figure 1).

Identification process: The results from the consulted databases yielded 222 records. In this initial phase, duplicate documents were removed, resulting in 216 records.

Screening process: Of the 216 records, titles, abstracts, and keywords were reviewed according to the inclusion and exclusion criteria. This process was conducted by two independent reviewers (JM and CI), yielding 88 articles for eligibility assessment.

Eligibility process: Articles were examined in full text to decide which would be included in the study. Selection was carried out by the principal investigator (JM) and corroborated by a second reviewer (CI). Six (6) articles were selected for inclusion in the narrative synthesis; the identified studies are presented in data matrix 1.

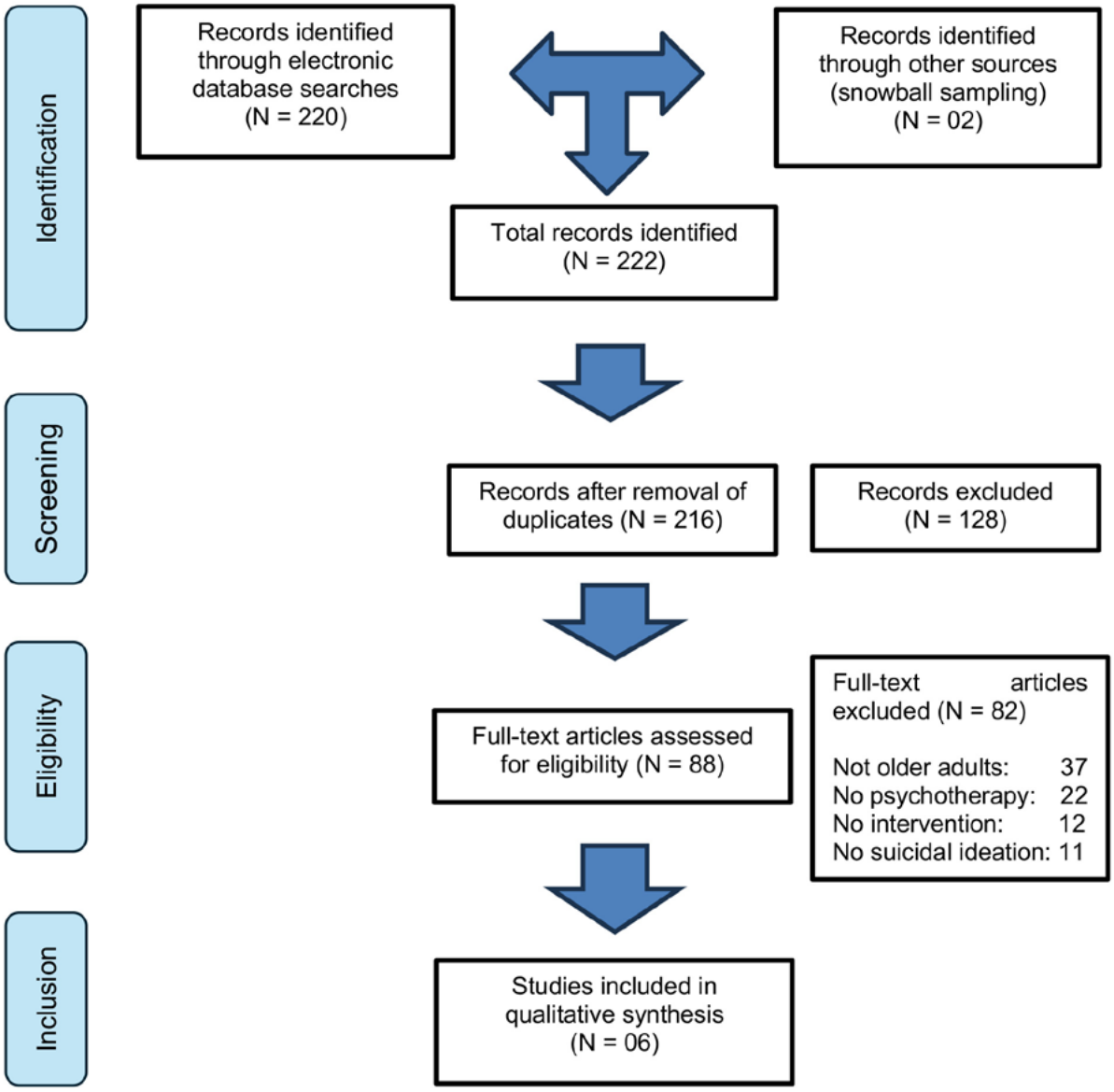


Figure 1. Rapid systematic review flow diagram: "Evidence on the Effectiveness of Cognitive-Behavioral Therapy in Reducing Suicidal Ideation in Older Adults." Concepción, CL, 2025.

Table 1. Description of the articles included in the review. Concepción, CL, 2025.

ID	Article	Method	Participants	Intervention	Resulted
1	Gustavson, K. A., Alexopoulos, G. S., Niu, G. C., McCulloch, C., Meade, T., & Areán, P. A. (2016). Problem-solving therapy reduces suicidal ideation in depressed older adults with executive dysfunction. American Journal of Geriatric Psychiatry, 24(1), 11-17. https://doi.org/10.1016/j.jagp.2015.07.010	ECA	221 individuals aged 65 years or older with a diagnosis of major depression (according to the SCID for DSM-III-R) and executive dysfunction.	Twelve weekly sessions of Problem-Solving Therapy (PST) or Supportive Therapy (ST).	PST showed greater effectiveness than ST in reducing suicidal ideation, with improvements of 60.4% versus 44.6% at 12 weeks ($p = 0.031$), with this advantage maintained at 36 weeks (OR = 0.50, $p = 0.05$).
2	Choi, N. G., Marti, C. N., & Conwell, Y. (2016). Effect of Problem-Solving Therapy on Depressed Low-Income Homebound Older Adults' Death/Suicidal Ideation and Hopelessness. Suicide & Life-Threatening Behavior, 46(3), 323–336. https://doi.org/10.1111/sltb.12195	ECA	158 older adults aged 50 years or older (mean age 74 years), with multiple chronic conditions and functional limitations.	Participants received (1) in-person PST (Problem-Solving Therapy) with six home-based sessions, (2) Tele-PST with one initial in-person session and five sessions via videoconference, or (3) 30-minute support calls to provide support and monitoring (control).	Tele-PST significantly reduced suicidal ideation ($d = 0.31$; $p = 0.009$; small-to-moderate effect) and hopelessness. In-person PST reduced hopelessness ($d = 0.17$; $p = 0.002$; small effect), but not suicidal ideation ($p = 0.165$).
3	Arslanoglou, E., Banerjee, S., Pantelides, J., Evans, L., & Kiosses, D. N. (2019). Negative emotions and the course of depression during psychotherapy in suicidal older adults with depression and cognitive impairment. American Journal of Geriatric Psychiatry, 27(12). https://doi.org/10.1016/j.jagp.2019.08.018	Secondary analysis of a randomized controlled trial.	63 older adults who completed 12 weeks of treatment, 26 of whom had suicidal ideation at baseline.	It does not focus on a specific intervention but rather analyzes the relationship between negative emotions and non-emotional symptoms of depression during two interventions of the randomized controlled trial: Problem Adaptation Therapy (PATH) and Supportive Therapy for Cognitive Impairment (ST-CI).	Older adults with suicidal ideation showed greater disability, lower social support, earlier onset of depression, and poorer memory performance. The study highlighted the central role of negative emotions during depression.
4	Wagner, B., Hofmann, L., & Maaß, U. (2020). Online-group intervention after suicide bereavement through the use of webinars: Study protocol for a randomized controlled trial. Trials, 21(1). https://doi.org/10.1186/s13063-019-3891-5	Randomized controlled trial protocol.	Adults bereaved by the suicide of a loved one.	A 12-session online group intervention, based on webinars, with a cognitive-behavioral approach, addressing themes such as feelings of guilt, stigmatization, and meaning reconstruction.	Ongoing protocol, with no results available yet. The intervention addresses guilt, stigmatization, meaning reconstruction, and the relationship with the deceased.

to be continued

Continuation of Table 1

ID	Article	Method	Participants	Intervention	Resulted
5	Sokol, Y., Ridley, J., Goodman, M., Landa, Y., Hernandez, S., & Dixon, L. (2021). Continuous Identity Cognitive Therapy: Feasibility and Acceptability of a Novel Intervention for Suicidal Symptoms. Journal of Cognitive Psychotherapy, 35(1). https://doi.org/10.1891/JCPSY-D-20-00023	Pilot/ feasibility study.	17 military veterans with severe mental illness and suicidal ideation.	Group-based Continuous Identity Cognitive Therapy (CI-CT), with a duration of 4 weeks (three hours per session).	The intervention was feasible and acceptable, with preliminary reductions in suicidal ideation, depression, and hopelessness, largely maintained at the 1-month follow-up.
6	Beaudreau, S. A., Lutz, J., Wetherell, J. L., Nezu, A. M., Nezu, C. M., O'Hara, R., Gould, C. E., Roelk, B., Jo, B., Hernandez, B., Samarina, V., Otero, M. C., Gallagher, A., Hirsch, J., Funderburk, J., & Pigeon, W. R. (2023). Beyond maintaining safety: Examining the benefit of emotion-centered problem-solving therapy added to safety planning for reducing late-life suicide risk. Contemporary Clinical Trials, 128, 107147. https://doi.org/10.1016/j.cct.2023.107147	Randomized controlled trial protocol.	180 U.S. veterans aged ≥60 years with suicidal ideation and diagnoses of depression, anxiety, or PTSD.	Six-session Emotion-Centered Problem-Solving Therapy (EC-PST), together with safety planning (SP).	Ongoing protocol, with no results available yet. It evaluates whether EC-PST provides additional clinical benefits to SP in reducing suicidal ideation and increasing reasons for living.

Studies on Problem-Solving Therapy (PST): Choi et al.[31] conducted a 36-week randomized controlled trial (RCT) to evaluate the effectiveness of in-person Problem-Solving Therapy (PST), tele-based Problem-Solving Therapy (Tele-PST), and Supportive Therapy (ST) in 158 adults (mean age 74 years) with depression, low income, and home confinement. The results indicated that Tele-PST was the most effective in reducing suicidal ideation, with a small-to-moderate effect size (d=0.31; p=0.009) and also decreased hopelessness in 36 weeks. In-person PST also reduced hopelessness with a small effect size (d=0.17) but did not show significant differences in reducing suicidal ideation compared to ST (p=0.165). In contrast, the comparison between in-person PST and ST did show significant differences in the reduction of hopelessness (p=0.002).

Gustavson et al.[32] conducted an RCT with 221 individuals aged 65 years or older with a diagnosis of major depression and executive dysfunction. Participants were randomly assigned to two groups, one receiving psychotherapeutic interventions based on Problem-Solving Therapy (PST) and the other based on Supportive Therapy (ST). Results showed that PST was more effective than ST in reducing suicidal ideation, with improvements of 60.4% versus 44.6% at 12 weeks (p=0.031), and these benefits were maintained at 36 weeks (OR=0.50; p=0.05).

Studies on Continuous Identity Cognitive Therapy (CI-CT): Sokol et al.[33] conducted a pilot feasibility study investigating a group-based Continuous Identity Cognitive Therapy (CI-CT) intervention over 4 weeks (three hours per session) with 17 veterans

with severe mental illness and suicidal ideation. This therapy combines elements of cognitive-behavioral therapy (CBT) with acceptance and commitment therapy (ACT), aiming to help individuals develop a coherent and positive life narrative, promoting a hopeful view of the future self. The results showed that this intervention was feasible and acceptable, achieving reductions in suicidal ideation, depression, and hopelessness. At the 1-month follow-up, most of these benefits were maintained. Additionally, an increase in continuity and positivity toward the future self was observed.

Ongoing Studies: Beaudreau et al.[34] is developing a randomized controlled trial (RCT) protocol extending through 2027. Its objective is to evaluate the effectiveness of a psychotherapeutic intervention based on Emotion-Centered Problem-Solving Therapy (EC-PST), together with safety planning (SP), compared to an intervention based solely on safety planning (SP), in reducing suicidal ideation and increasing reasons for living among U.S. veterans aged over 60 years with suicidal ideation, as well as diagnoses of common mental disorders such as depression, anxiety, or post-traumatic stress disorder (PTSD).

Wagner et al.[35] is conducting an RCT protocol to evaluate the effectiveness of a 12-session online group psychotherapeutic intervention, based on webinars and focused on CBT for suicidal ideation. This intervention is aimed at adults bereaved by the suicide of a loved one, addressing themes such as feelings of guilt, stigmatization, meaning reconstruction, and the relationship with the deceased. Results have not yet been published. Both studies are relevant, although they do not yet present definitive results.

Studies on characteristics of older adults with suicidal ideation in clinical trials: Arslanoglou et al.[36] conducted a secondary analysis of a randomized controlled trial comparing Problem Adaptation Therapy (PATH) and Supportive Therapy for Cognitive Impairment (ST-CI), identifying that 26 of the 63 older adult participants had suicidal ideation at baseline. This group showed greater cognitive disability, lower social support, earlier onset of depression, and poorer performance on memory tests compared to those without suicidal ideation. These findings suggest that suicidal ideation in older adults with depression cannot be understood as an isolated phenomenon, but rather as part of a network of cognitive, social, and emotional vulnerabilities, reinforcing the need for comprehensive psychotherapeutic interventions that simultaneously address these clinical dimensions.

Synthesis of the available evidence on the effectiveness of cognitive-behavioral therapy in reducing suicidal ideation in older adults: The presented synthesis corresponds to a narrative synthesis, in which the studies were organized according to therapeutic modality, study design, and the outcomes evaluated—primarily suicidal ideation, hopelessness, and depressive symptoms—in order to facilitate a comparative integration of the findings.

The evidence on the effectiveness of cognitive-behavioral psychotherapy (CBT) in reducing suicidal ideation in older adults is limited but promising.

Problem-Solving Therapy (PST) has shown positive results: Gustavson et al.[32] found it to be more effective than Supportive Therapy (ST), with improvements of 60.4% versus 44.6% at 12 weeks ($p=0.031$), maintained at 36 weeks (OR=0.50; $p=0.05$).

Choi et al.[31] demonstrated that Tele-PST significantly reduced suicidal ideation ($d=0.31$; $p=0.009$; small-to-moderate effect) and hopelessness, whereas in-person PST only reduced hopelessness ($d=0.17$; $p=0.002$; small effect) without impacting suicidal ideation ($p=0.165$).

Another modality, Continuous Identity Cognitive Therapy (CI-CT), showed in a pilot study with veterans with severe mental illness preliminary reductions in suicidal ideation, depression, and hopelessness, with most benefits maintained at follow-up[33].

Ongoing studies[34, 35] are exploring innovative adaptations. Taken together, PST and its variants (Tele-PST, EC-PST), along with CI-CT, appear to be promising interventions, although more robust trials are required to confirm their effectiveness.

Analysis of the therapeutic factors of CBT that effectively contribute to the reduction of suicidal ideation in this population: The reviewed studies show that the effectiveness

of cognitive-behavioral psychotherapy (CBT) in reducing suicidal ideation in older adults depends on specific therapeutic factors.

Problem-Solving Therapy (PST) teaches skills to identify and address problems in a structured manner, which reduces hopelessness and depression—central variables in suicide risk[31,32].

Adaptations such as Tele-PST facilitate access for homebound individuals and improve adherence[31].

The management of negative emotions, incorporated in Emotion-Centered PST (EC-PST), aims to strengthen coping capacity in older veterans and target reductions in suicidal ideation[34].

Meanwhile, Continuous Identity Cognitive Therapy (CI-CT) promotes a perception of continuity in the future self and increases hope, showing preliminary reductions in suicidal ideation and hopelessness[33].

Overall, the evidence suggests that CBT contributes to the reduction of suicidal ideation through the teaching of problem-solving skills, the reduction of negative emotions, the strengthening of hope, and the adaptation of intervention formats that enhance accessibility and relevance for older adults.

DISCUSSION

The results of this systematic review on the effectiveness of CBT in reducing suicidal ideation in older adults indicate that the available evidence remains limited. A critical evaluation of the methodological robustness of the studies, considering aspects such as sample size, blinding, and the validity of the instruments used, allows for a nuanced interpretation of the findings and helps delimit the degree of reliability of the conclusions drawn.

Six studies were identified, including clinical trials, a pilot feasibility study, ongoing protocols without results, and a secondary analysis of interventions with a different primary objective. Although the available evidence is limited and presents significant gaps, these works allow for some relevant reflections on the effectiveness of CBT in older adults.

The examined studies suggest that, within cognitive-behavioral therapies, Problem-Solving Therapy (PST) in its various formats may be potentially effective in reducing suicidal ideation in older adults. PST's emphasis on breaking down complex problems into manageable steps is particularly relevant for older individuals, who frequently face multiple psychosocial and health-related stressors. It may directly counteract tunnel vision and hopelessness—strong predictors of suicidal ideation in this population. However, the heterogeneity of the studied populations—veterans, individuals with executive dysfunction, bereaved adults, and older adults with depression—may limit direct comparisons between modalities and the generalizability of findings[37]. Greater clarity is needed regarding the specific impact of each modality, considering variables such as session duration, frequency, and specific content.

For example, Emotion-Centered PST (EC-PST) and Tele-PST are promising approaches. Still, their effectiveness may depend on tailoring to the individual patient context, including the degree of executive dysfunction, level of social support, and access to online resources. In this regard, the feasibility of telepsychotherapy in older adults is relevant, considering potential barriers such as digital literacy, access to devices, and socioeconomic inequalities, which may limit the implementation and effectiveness of these modalities.

Other studies provide complementary perspectives. The secondary analysis[36] highlights the role of negative emotions, cognitive disability, and low social support during depression in adults with suicidal ideation, suggesting that interventions must integrate these dimensions to be more effective.

Similarly, the pilot study[33] showed that Continuous Identity Cognitive Therapy (CI-CT) is feasible and acceptable, with preliminary reductions in suicidal ideation, depression, and hopelessness, supporting the relevance of working with the narrative of the future self as a therapeutic resource.

Ongoing protocols[34] are exploring the combination of EC-PST with safety planning in older veterans, while others[35] adapt a group-based online CBT program for adults bereaved by suicide.

Taken together, the reviewed interventions offer a range of options that could be implemented in clinical practice. The incorporation of digital tools, such as online sessions and home-based formats, represents innovations that expand access to psychological care for older adults with limited mobility or in contexts of public health crises.

The predominance of pilot studies and ongoing protocols highlights that conclusions regarding the effectiveness of CBT are largely preliminary. Nonetheless, both PST in its various formats (in-person, emotion-centered, and tele-based) and CI-CT share key therapeutic mechanisms, including the reduction of hopelessness, cognitive restructuring, and the strengthening of life purpose, which may explain their effects on suicidal ideation. Therefore, although these interventions appear as promising tools, their large-scale implementation should be accompanied by continuous and cautious evaluation. At the same time, clinical psychology can consider these methodologies to provide more accessible treatments tailored to the emotional, cognitive, and social needs of older adults.

Strengths and Limitations: Rapid systematic reviews are useful for synthesizing evidence with less time and resources than a traditional review, although they present limitations when interpreting their results[37].

One of the main limitations of this study is the absence of a formal risk of bias assessment; however, a second reviewer examined the methodological process and the selected articles, following recommendations for rapid reviews[36].

Additionally, relevant multimodal interventions may not have been identified with the applied search criteria. Future reviews could integrate multimodal programs to evaluate their impact, particularly in primary care settings or in resource-limited contexts.

Suggestions for Future Research: A key gap is the sustainability of effects, highlighting the need for studies with longer follow-ups to assess the persistence of benefits. Likewise, the reviewed studies emphasize the importance of expanding research by implementing specific strategies that consider access to services, social support, and the presence of comorbidities. Current evidence remains insufficient in several dimensions, including small sample sizes, lack of long-term follow-up, absence of direct comparisons between therapeutic modalities, and limitations in population characterization, which restricts the generalizability of findings and the robustness of conclusions[35].

Given the high prevalence of suicidal behavior in older adults[4,32,33,35-39], this population could benefit from preventive interventions, such as early detection and the reduction of vulnerabilities (emotional disorders, physical health problems, loneliness, and safe medication management).

CONCLUSIONS

The studies show that cognitive-behavioral therapy (CBT), particularly Problem-Solving Therapy (PST)—including its telehealth formats—is promising for reducing suicidal ideation in older adults. However, the available evidence remains limited, making it difficult to confirm with certainty its effectiveness in reducing suicide risk and highlighting the urgency of further research to consolidate these findings. Practically, these results suggest that mental health services, primary care, and community prevention programs could progressively integrate these interventions, adapting them to the specific needs of older adults to improve access and the effectiveness of suicide prevention.

AUTHORSHIP

- Javier Muñoz – Study conception, data analysis and interpretation, article writing, and approval of the final manuscript.
- Carolina Inostroza – Study conception, data analysis and interpretation, critical review of the article, and approval of the final manuscript.

Edited by: Cristian Arnecke Schröder

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Challenges of longevity in the digital age: a study on the effectiveness of digital inclusion programs in health literacy for older adults

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Abstract

Objective: analyze the effectiveness of a digital inclusion program on the digital health literacy of elderly people participating in social groups. *Methodology:* Quasi-experimental study without a control group, of the before-and-after quasi-experimental type, conducted in health district 4 in Recife/PE with elderly social groups between April and November 2023. People of both sexes were included, and those with severe cognitive impairment, identified using the 10CS cognitive screening tool, were excluded. The digital inclusion program consisted of three workshops, each lasting three hours, held once a week. Health digital literacy was measured using the eHEALS scale. *Results:* Of the 210 study participants, 119 had low digital health literacy ($p<0.001$). About 66% of older adults with low literacy moved to moderate and high digital literacy, and men showed improvement in digital literacy compared to women. *Conclusions:* The digital inclusion program proposed in this study had a positive effect on digital health literacy, especially by reducing low literacy.

Keywords: Elderly. Information Technology. Health Literacy.

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Research funding: Foundation for Support of Science and Technology of the State of Pernambuco - FACEPE (Notice No. 14/2022 Inclusive Innovation in Combating Digital Exclusion in Pernambuco - INCLUI.PE DIGITAL). This publication was financed by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. PROAP-CAPES.

The authors declare no conflict in the conception of this work.

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Received: September 28, 2025
Approved: March 3, 2026

http://dx.doi.org/10.1590/1981-22562026029.250162.en

INTRODUCTION

One of the most striking characteristics of recent decades has been the rapid expansion of technological development accompanied by the interconnection of online communication and information devices. Older adults have been thrust into the world of digital information and communication technologies (DICTs) without assistance in developing informational competencies for autonomous and safe use[1].

DICTs number among the technologies most used by older adults, allowing easy access to information related to health, tourism, instant messaging, bank accounts, searches, shopping, electronic mail, among others, via platforms such as e-government, e-banking, e-shopping, e-health, and e-learning. In the health sphere, applications for e-health are increasingly common, offering services and products that aim to meet the health needs of the older adult population[2].

For older adults to fully exploit the benefits of technology in a broader fashion, exposure to digital devices must advance to include critical analysis of the content available[3], i.e., digital literacy. This approach is understood as an educational social practice for the development of technological skills that facilitate digital practices with an element of reflection by users, entailing the inclusion of social, cultural, and discursive aspects in the learning process[4].

The concept of digital health literacy can be defined as the ability to search, find, understand, and evaluate health information from electronic sources and apply knowledge acquired to address or resolve a health problem[5]. The level of digital health literacy of older adults can be evaluated using the digital health literacy scale – eHEALS, one of the first of its kind developed to measure level of digital health literacy[6].

Population aging, in an increasingly digital society, calls for strategies promoting inclusion of older adults in a way that allows them to fully exploit these novel technological-digital solutions during the process of aging[7]. Emphasis on education is one of the approaches to be considered, not only with respect to literacy of older adults in general, but also digital literacy[8].

It is noteworthy that, in Brazil, low educational level, absence of appropriate programs/social projects for digital literacy tailored to users, and a lack of free spaces for access to computers and the internet, are barriers that hinder older adults' access to technological resources[9].

Low digital health literacy among older adults can result in difficulties accessing, navigating, monitoring, and managing health information available on digital platforms. Failure to carry out critical analysis of available content can lead to the propagation of false information, potentially causing harm to the health of older adults, warranting the promotion of digital awareness programs for this population.

The study by Botelho[10] analyzed scientific output on digital inclusion of older adults and associated factors. The author reviewed 30 digital inclusion studies, with 15 having interventions based on workshops administered in-person, remotely, or by telephone. However, none of the studies addressed digital health literacy.

Therefore, the objective of this study is to analyze the effectiveness of a digital inclusion program on the digital health literacy of older adults participating in social groups in health district 4 of Recife, Pernambuco state, Brazil.

METHODS

A before-and-after type quasi-experimental study without a control group was conducted. The study involved social groups of older adults in health district 4 (HD4) of Recife (Pernambuco state) and at the Center for Older Adults (NPI) of the Federal University of Pernambuco (UFPE). Recife is the capital city of Pernambuco state in Brazil, with an area of 218.843 km² and population of 1,488,920 people[11]. The aging index in Pernambuco is 48.7 older adults for every 100 children; The Recife Health Department divides the city into eight health districts. Health district 4 (HD4) covers the neighborhoods of Caxangá, Cidade Universitária, Cordeiro, Engenho do Meio, Ilha do Retiro, Iputinga, Madalena, Prado, Torre, Torrões, Várzea, and Zumbi.

Under a partnership with the City of Recife, the contacts of Community Health Workers (CHWs) were made available. Through these CHWs, the contacts of leaders of social groups of older adults in HD4 linked to Family Health Units (USFs) were obtained. With the support of the CHWs, social groups of older adults, location, and opening hours were mapped, and telephone contact was made. The City of Recife also provided the contacts of coordinators of Social Assistance Reference Centers (SARCs) and Community Peace Centers (CPCs) located in the HD4 area. After participants had agreed to take part in the study and signed the informed consent form, data collection began.

The NPI of the UFPE encompasses the health care sector and the Open University for Older Adults (UnAPI). The health care sector serves as an outpatient unit that offers health care services focused on active and healthy aging, while the UnAPI represents a space for group socializing, with encouragement for active participation of older adults, valorizing their potential and talents, running courses that facilitate the acquisition of new knowledge and integration into society.

Given the lack of official information about the functioning of the social groups and number of participants severely affected by the COVID-19 pandemic, a convenience sample was employed.

For the study, older adults aged 60 years or over, of both sexes and residing in HD4, were included. Individuals with severe cognitive impairment, as diagnosed by the 10CS cognitive screening instrument, were excluded. The expected losses of the study refer to older adults who underwent evaluation but did not attend the reassessment.

The digital inclusion program was performed in three stages:

- Stage 1 - older adult evaluation: at this stage, demographic and socioeconomic data were collected, and the level of digital health literacy measured using the eHEALS scale.

The demographic and socioeconomic profile questionnaire consisted of four blocks: general details on respondent, educational level, housing, and income, comprising a total of 13 questions. The first block, collecting general details on the respondent, probed: name, age, date of birth, sex, marital status, and family arrangement. The second block, covering educational level, collected the following information: illiteracy, educational level, retired or pensioner/social assistance benefit **(**BPC) recipient, and current occupation. In the third block, housing, the following information was requested: type of group, how long have you been part of this group? In the fourth block, income, the following information was collected: family income (minimum wage/2023-MW = R$1,302.00).

Cognitive screening was performed using the Portuguese version of the 10-Point Cognitive Screener (10CS) developed by Apolinário[12]. The 10CS is a questionnaire divided into four blocks: temporal orientation, learning/memory, verbal fluency for animals, and recall. Scoring is as follows: ≥8 points for normal cognition, 6-7 points for possible cognitive impairment (mild impairment), and ≤5 points for probable cognitive impairment (severe impairment).

The eHEALS scale was developed by Norman and Skinner[6] and validated for use in the Brazilian older adult population by Oliveira[13]. The scale measures level of digital health literacy. The Brazilian version used in the present study has shown excellent psychometric properties for measuring levels of digital health literacy in Brazilian adults.

The eHEALS contains eight statements: 1) I know what health resources are available on the Internet; 2) I know where to find useful health resources on the Internet; 3) I know how to find useful health resources on the Internet; 4) I know how to use the Internet to answer my questions about health; 5) I know how to use the health information I find on the Internet to help me; 6) I have the skills I need to evaluate the health resources I find on the Internet; 7) I can distinguish high-quality from low-quality health resources on the Internet; 8) I feel confident in using information from the Internet to make health-related decisions.

Responses vary on a five-point Likert-type scale, where 1 (never tried), 2 (not at all), 3 (not very easily), 4 (with some ease), and 5 (very easily), potentially totaling 8-40 points. A higher score indicates greater digital health literacy.

The study by Mialhe[14] presents the normalization of scoring ranges for the Brazilian version of the eHEALS and establishes three classification ranges for digital health literacy: low, moderate, and high, with score classification controlled for educational level of the respondent. Adults with an educational level up to incomplete secondary education have their digital health literacy classified as follows: low (≤10), moderate (11-26), or high (27-40), whereas respondents with complete secondary education through higher education are classified as low (≤ 24), moderate (25 -32), or high (33-40).

- Stage 2 - intervention: at this stage, older adults participated in the digital inclusion program. The program consisted of three digital inclusion workshops, held once a week, with each meeting lasting 3 hours.

The digital inclusion workshops were run by a team of 14 researchers, previously trained through a 60-hour course on applying data collection instruments and conducting the workshops.

The ratio of the digital inclusion workshops was 1:4 (1 researcher for every 4 older adults). The content of the workshops centered on mobile phone handling and safe internet browsing in search of health information. Topics such as fake news and scams were also addressed. Through a problem-based methodology based on the Maguerez Arch[15], relevant and significant themes for the group were addressed at the meetings. Thus, at each meeting, the group expressed their needs, which formed the basis of activities to be carried out that day, with a consistent focus on mobile phone handling and safe internet browsing in search of health information.

Importantly, the participant's own mobile phone was used in the workshops. This is a relevant criterion that enhances the continuity of use. Additionally, highly specific needs, such as: handling spreadsheets, text and image applications, video editing, etc., were noted for offering future courses targeting these needs.

As support material, a digital inclusion booklet with photos and step-by-step instructions for mobile phone handling was prepared by the research team. The booklet contained illustrated information about the basic functions of mobile devices, communication, data and file storage, internet, calendar, entertainment, privacy, and problem-solving. The booklet was printed and delivered to each research participant.

- Stage 3 - older adult reassessment**:** during this stage, the eHEALS scale was reapplied.

To characterize the demographic and socioeconomic profile of the older adults assessed, percentage rates were calculated and respective frequency distributions constructed. For comparing the prevalence of categories of the variables evaluated, the chi-square test was applied to compare proportions.

The Shapiro-Wilk test was used to determine the normality of the sample. When non-normality was established, the median was used to represent the level of digital health literacy measured on the eHEALS. Comparison of the medians of eHEALS scores between initial and second assessments was performed using the Wilcoxon test.

The chi-square test for homogeneity was used for classification of digital health literacy into low, moderate, and high, based on Mialhe's[14] classification.

Comparison of the medians of eHEALS scores at reassessment for the demographic and socioeconomic profiles of participants was performed using the Mann-Whitney test and the Kruskal-Wallis test, depending on the number of categories in the factors assessed. A significance level of 5% was considered for all statistical tests performed.

The study complies with Resolution No. 466/2012 and Resolution No. 510/2016 of the National Health Council and was approved by the Research Ethics Committee involving Humans of the Health Sciences Center of the Federal University of Pernambuco (REC/HSC/UFPE), CAAE: 77124023.7.0000.5208, opinion No. 6.813.185 dated May 9, 2024.

DATA AVAILABILITY

The full data set underpinning the study results is available from the original article database at https://doi.org/10.6084/m9.figshare.31198045.

RESULTS

The study population initially comprised 311 older adults, of which 32 (10.3%) had severe cognitive impairment and were subsequently excluded. There were also 69 losses (22.2%) consisting of participants who did not attend stage 3 of the Digital Inclusion Program (reassessment), giving a final study sample of 210 participants.

Regarding the demographic and socioeconomic profiles of the sample, participants were predominantly female (84.3%), retired (85.2%), living without partner (57.1%), had high educational level (36.2%), and income of 1-3 minimum wages (39.1%) (Table 1).

The vast majority of older adults in the sample were classified as having low digital health literacy. Results at reassessment showed an increase in the number of older adults with high digital health literacy (Table 2).

Table 1. Distribution of demographic and socioeconomic profile of sample (N=210). Recife, Pernambuco state, 2023

Factor assessed	n(%)	p-value
Sex		
Male	33(15.7)	<0.001[1]
Female	177(84.3)	
Age (years)		
60-69	107(51.0)	0.783[1]
≥70	103(49.0)	
Family arrangement		
With partner	90(42.9)	0.038[1]
Without partner	120(57.1)	
Educational level		
Up to incomplete secondary	70(33.3)	<0.001[1]
Complete secondary to higher	140(66.7)	
Retired or pensioner		
Yes	179(85.2)	<0.001[1]
No	31(14.8)	
Occupation		
Employer/self-employed	31(14.8)	<0.001[1]
Formally employed	6(2.8)	
Unpaid work	48(22.9)	
Does not work	125(59.5)	
Type of group		
Community group (registered with city hall)	31(14.8)	<0.001[1]
Community group (unregistered)	5(2.3)	
Social group CRAS/COMPAZ	22(10.5)	
Family Health Unit group	54(25.7)	
NPI	98(46.7)	
Family income (MW)		
< 1	4(1.9)	<0.001[1]
1	62(29.5)	
> 1-3	82(39.1)	
> 3	62(29.5)	

[1]p-value of chi-square test for proportion comparison. MW: Minimum wage; CRAS: Social Assistance Referral Centers; COMPAZ: Community Peace Centers; NPI: Center for Older Adults.

Table 2. Classification of digital health literacy at initial assessment and reassessment (N=210). Recife, Pernambuco state, 2023.

eHEALS classification ranges			*p*-value
	Assessment	Reassessment	
Up to incomplete secondary education			
Low	50(71.4%)	15(21.4%)	<0.001[1]
Moderate	18(25.7%)	18(25.7%)	
High	2(2.9%)	37(52.9%)	
Complete secondary to higher education			
Low	69(49.3%)	52(37.1%)	0.019[1]
Moderate	44(31.4%)	41(29.3%)	
High	27(19.3%)	47(33.6%)	

[1]*p*-value of chi-square test for homogeneity

The medians of eHEALS scores revealed for which classification ranges the intervention proved effective. There was a significant increase in the medians of scores for both low and moderate literacy groups (p-value <0.001) (Table 3).

All medians of eHEALS scores at reassessment showed a significant increase relative to initial assessment. However, median scores showed smaller increases for two items: "I have the skills I need to evaluate the health resources I find on the Internet" and "I feel confident in using information from the Internet to make health-related decisions" (Table 4).

With respect to demographic and socioeconomic factors, at reassessment men showed a significantly greater increase in median eHEALS score than women.For the other factors evaluated, no significant differences between categories were observed (Table 5).

Table 3. Evaluation of digital health literacy level at assessment and reassessment. (N= 210). Recife, Pernambuco state, 2023.

eHEALS classification ranges	Assessment		Reassessment	
	Median	IQR	Median	IQR
Up to incomplete secondary education				
Low	11.4	8.0	23.0	6,0
Moderate	16.0	10.0	28.0	11,0
High	35.0	0.0	36.0	8,0
p-value	<0.001[1]		<0.001[1]	
Complete secondary to higher education				
Low	15.0	10.0	16.0	14,0
Moderate	28.0	5.0	31.0	3,0
High	37.0	6.0	37.0	4,0
p-value	<0.001[1]		<0.001[1]	

IQR - Interquartile Range. [1]*p*-value of Kruskal-Wallis test.

Table 4. eHEALS scores of older adults at initial assessment and reassessment. (N=210). Recife, Pernambuco state, 2023.

Item assessed	Assessment	Reassessment	*p*-value[1]
I know what health resources are available on the Internet	2.0	4.0	<0.001
I know where to find useful health resources on the Internet	2.0	4.0	<0.001
I know how to find useful health resources on the Internet	2.0	4.0	<0.001
I know how to use the Internet to answer my questions about health	2.0	4.0	<0.001
I know how to use the health information I find on the Internet to help me	2.0	4.0	<0.001
I have the skills I need to evaluate the health resources I find on the Internet	2.0	3.0	<0.001
I can distinguish high-quality from low-quality health resources on the Internet	2.0	4.0	<0.001
I feel confident in using information from the Internet to make health-related decisions	2.0	3.0	<0.001
TOTAL SCORE	18.0	31.0	<0.001

[1]p-value of Wilcoxon test. Data expressed as median

Table 5. eHEALS scores of older adults at initial assessment and reassessment for demographic and socioeconomic factors. (N=210). Recife, Pernambuco state, 2023.

Factor assessed	Assessment		Reassessment		*p*-value
	Median	IQR	Median	IQR	
Sex					
Male	16.0	17.0	33.0	7.0	<0.001[3]
Female	19.0	20.0	29.0	14.0	<0.001[3]
p-value	0.798[1]		0.009[1]		-
Age (years)					
60-69	18.0	19.0	32.0	13.0	<0.001[3]
≥70	16.0	19.0	31.0	13.0	<0.001[3]
p-value	0.560[1]		0.627[1]		-
Family arrangement					
With partner	16.0	21.0	32.0	13.0	<0.001[3]
Without partner	18.5	18.0	29.0	14.0	<0.001[3]
p-value	0.576[1]		0.062[1]		-
Educational level					
Up to incomplete secondary education	13.0	8.0	32.0	13.0	<0.001[3]
Complete secondary to higher education	25.0	17.0	30.5	15.0	<0.001[3]
p-value	<0.001[2]		0.170[2]		-
Retired or pensioner					
Yes	18.0	18.0	28.5	12.0	<0.001[3]
No	19.0	22.0	29.0	19.0	0.067[3]
p-value	0.554[1]		0.375[1]		-

to be continued

Continuation of Table 5

Factor assessed	Assessment		Reassessment		*p*-value
	Median	IQR	Median	IQR	
Occupation					
Employer/self-employed	23.0	20.0	32.0	22.0	0.110[3]
Formally employed	20.5	27.0	31.5	11.0	0.172[3]
Unpaid work	24.5	17.0	29.0	10.0	0.022[3]
Does not work	16.0	18.0	30.0	12.0	<0.001[3]
p-value	0.055[2]		0.647[2]		-
Type of group					
Community group (registered with city hall)	19.0	22.0	30.0	13.0	<0.001[3]
Community group (unregistered)	8.0	12.0	34.0	12.0	0.043[3]
Social group – CRAS/COMPAZ	16.0	15.0	28.5	15.0	0.002[3]
Family Health Unit group	15.0	8.0	29.0	11.0	<0.001[3]
NPI	26.0	16.0	32.0	15.0	0.012[3]
p-value	<0.001[2]		0.842[2]		-
Family income (MW)					
<1	8.0	7.0	37.0	12.0	0.068[3]
1	15.0	15.0	29.0	18.0	<0.001[3]
>1-3	16.0	15.0	32.0	12.0	<0.001[3]
> 3	28.0	11.0	31.0	12.0	0.594[3]
p-value	<0.001[2]		0.334[2]		-

IQR: Interquartile Range. [1]*p*-value of Mann-Whitney test. [2]*p*-value of Kruskal-Wallis test. [3]*p*-value of Wilcoxon test; CRAS: Social Assistance Referral Centers; COMPAZ: Community Peace Centers; NPI: Center for Older Adults; MW: Minimum Wage.

DISCUSSION

In this study, the majority of median scores for the digital health literacy level showed an increase at reassessment relative to initial assessment. The two items whose median scores showed smaller increases were: "I have the skills I need to evaluate the health resources I find on the Internet"; and "I feel confident in using information from the Internet to make health-related decisions". With respect to demographic and socioeconomic aspects, men showed a significantly greater improvement in level of digital health literacy than women, with no significant difference among the other factors at reassessment.

Digital inclusion of older adults is extremely important as it enables them to access a host of information, from entertainment to education, and provides this group with a range of knowledge that empowers them to make decisions regarding their own health[16]. Older adults with a high level of digital health literacy are capable of researching and accurately discriminating health information, judging the veracity of context, and increasing resilience to misinformation on the internet[17]. The significant increase in the median eHEALS scores for most of the items assessed demonstrates the potential of offering courses and technological experiences for older adults as effective strategies for promoting learning and supporting the lifelong learning model[18].

The vast majority participants had digital health literacy classified as low. At reassessment, there was an increase in the number of participants with high digital health literacy, likely drawn from the moderate literacy group, given the number of individuals classified with low literacy was only slightly reduced at reassessment. The medians of eHEALS scores revealed an increase in scores in the groups with low and moderate digital health literacy, while performance was largely unchanged in the high literacy group.

Studies by Nunes[1]; Liu[19]; Kyaw[20] reported that older adults feel insecure with information found on the internet, and many do not know how to differentiate true from false information, or fake news. Given the intervention centered on digital inclusion, and not health literacy in particular, this might explain the smaller increase in median scores for the dimensions of assessment and decision-making concerning health-related information. A significant contingent have difficulty evaluating the accuracy of information found online. Participants aged over 50 years had lower levels of confidence, suggesting the need for greater support for this group to evaluate and filter health information more effectively[21].

Despite the likely success of the Program in improving the level of digital health literacy of the population studied, no evidence is available in the literature on more effective program models for this purpose, with a wide variety of protocols used[22-24]. Promoting digital literacy for older adults confers many benefits, such as the ability to evaluate the reliability of information found online, protect personal privacy and security, and deal with interactions on social networks[1,20,25]. Older adults participating in the Geronto Network, an international network of gerontology research and studies created in 2016 with the goal of integrating academia, services, and civil society to promote quality of life and autonomy of older adults, showed a moderate level of digital health literacy, with greater security in the stages of searching and accessing information, but weaknesses in critical evaluation and in transforming the information into care actions[26].

The current program proved effective for older adults who had low and moderate digital health literacy, increasing their scores at reassessment. Many participants classified with high literacy on initial assessment, at program completion, later reported they had self-evaluated as having high literacy, but noted, at reassessment, that the program was effective and in fact they did not have high literacy initially. The study by Domingues[27] highlights the importance of digital inclusion initiatives aimed at the older adult population since, according to the study, the individuals felt more participatory in their contexts (cultural, personal, and virtual) after the workshops.

Analysis of the demographic and socioeconomic aspects of the sample showed that participants were predominantly female, retired, living without a partner, had high educational level, and a family income of 1-3 minimum wages. Additionally, 46.7% of the individuals in the sample were members of the NPI of UFPE.

Women typically seek health services more often, exhibiting greater self-care than men. The prevalence of women may reflect men´s resistance to seeking technological innovations and improvements in quality of life[28]. In the study by Domingues[27], the sociodemographic profile of the sample also showed a predominance of women, framing as justification that women are more interested in engaging in new experiences and learning new things, while men believe the time to learn and have new experiences is over. Data from the National Health Survey (NHS)[29] showed that women tend to seek health services more frequently, whether for preventive check-up consultations or specific reproductive health issues, such as prenatal care, preventive exams, etc. The proportion of women who consulted a doctor in the 12 months prior to the interview was 82.3%, while the percentage of men was 69.4%[30].

Male gender, higher income and educational level, as well as younger age and better functional capacity, are predictors that favor learning in the use of technologies[10]. In this study, the finding was surprising, given the predominance of women in the sample and the theory that men show resistance to seeking innovations. However, it is noteworthy that women, from an early age, were encouraged to be mothers and "homemakers" while men were taught leadership activities, to be the provider of the household, factors which, over time, brought men into closer contact with the technological world. This hypothesis finds support in the results of the studies by Romano[31] and Gallo[32].

Teaching-learning group workshops favor collaboration in learning and performing activities, promote socialization, and improve self-efficacy. The high educational level of the sample may be related to the fact that a high percentage of the sample were members of the NPI. The individuals engaged in this program frequent spaces where teaching activities

centered on lifelong education are promoted, have greater access to health information, and are part of groups with more intense social activities, and tend to have higher educational level and live under social conditions that are more favorable for personal development. The use of DICTs is not only relatively uncommon among older adults, but also highly stratified by differences in sex, age, professional activity, marital status, and educational level[33]..

Retired older adults who enjoy a good level of income and are not engaged in work usually occupy their free time with leisure and social activities. Therefore, the vast majority of this group attend teaching and socialization groups. Some investigations corroborate this finding, such as the studies by Figueiredo[25]; Oliveira[13]; Nunes[1]. Having a higher income guarantees more opportunities to own digital devices, such as smartphones, tablets, and internet access, and has a significant association with digital health literacy[20-34].

The study has some limitations, such as the lack of a control group, which would have conferred greater reliability to the findings, and the fact that no sample size calculation was performed, with a convenience sample being used instead. Thus, future randomized clinical trials evaluating the effectiveness of the intervention are warranted. Notwithstanding, the study furnishes important data on the use of digital inclusion interventions for older adults, which can contribute to future programs aimed at this group.

CONCLUSION

The digital inclusion program in this study positively influenced digital health literacy, reducing low literacy and increasing the number of older adults with moderate and high levels. The vast majority of participants had low digital health literacy. After completing the digital inclusion program, there was an increase in the number of older adults with moderate and high digital health literacy. Despite the improvements in digital health literacy, difficulties ascertaining the safety of information on the internet persist. Further studies exploring this issue should be conducted, with the aim of identifying the shortcomings of the older adult population regarding internet use and difficulties developing critical thinking with respect to health information retrieved.

AUTHOR CONTRIBUTIONS

- Raissa Luisa S. Batista - Database cleaning and organization, analysis, discussion and interpretation of data, writing and revision of the article.
- Carla Cabral S. A. Lins - Review of ethical research requirements and text revision for article writing.
- Maria das Graças W. S. Coriolano - Devising of the research theme, definition of the research question, objectives and data collection instruments, discussion and interpretation of data and article revision, study oversight.

ACKNOWLEDGEMENTS

The authors extend thanks to Tamires do Nascimento, for coordinating with research sites, data collection and tabulation; to Anna Karla de Oliveira Tito Borba, for field support and manuscript review; and to researchers Taiuani Marquine Raymundo and Vanessa de Lima Silva, for technical review of the text.

Edited by: Isac Davidson S. F. Pimenta

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Temporal and spatial dynamics of mortality from cerebrovascular diseases in older adults in Brazil, 2008–2022

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Abstract

Objective: To analyze the epidemiological profile and the temporal and spatial dynamics of mortality from cerebrovascular diseases in older adults in Brazil. *Method:* Ecological study with temporal trend and spatial analysis. Data were obtained from the Mortality Information System of the Department of Informatics of the Brazilian Unified Health System (SIM/DATASUS), covering the period from 2008 to 2022. Cerebrovascular disease was used as the underlying cause of death. For the temporal trend analysis, Brazilian regions were adopted as the units of analysis. For the spatial analysis, Brazilian municipalities were considered as the geographic units. *Results:* A total of 1,233,337 deaths from cerebrovascular diseases in older adults were recorded between 2008 and 2022, corresponding to a mortality rate of 328.386 per 100,000 inhabitants. There was a predominance among individuals aged 80 years or older (45.12%), those identified as White (52.45%), and individuals with low educational attainment, concentrated among those with no formal education (24.39%) or between one and three years of schooling (25.84%). A decreasing temporal trend in mortality was identified across all regions of the country, although the values remain high. Spatial analysis revealed a heterogeneous distribution of mortality, with a predominance of high-mortality clusters in the Northeast and South regions, as well as more localized clusters in the North region. *Conclusion:* There is a decreasing temporal trend in mortality from cerebrovascular diseases among older adults in Brazil, despite the persistence of high rates. The presence of spatial clusters of high mortality, particularly in the Northeast and South regions, reflects the structural, regional, and socioeconomic inequalities that characterize the country, reinforcing the need for public policies that are sensitive to territorial specificities and health inequities.

Keywords:
Cerebrovascular Diseases. Stroke. Mortality. Spatial Analysis. Aged.

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Funding: This study was supported by a CNPq Scientific Initiation Fellowship (PIBIC), 2023–2024 – Call No. 01/2023/COPES/POSGRAP/UFS.

The authors declare that there is no conflict in the conception of this work.

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Received: October 8, 2025
Approved: March 3, 2026

http://dx.doi.org/10.1590/1981-22562026029.250167en

INTRODUCTION

Population aging is a global and irreversible phenomenon. According to the United Nations (UN), the world population is aging rapidly, and it is estimated that by 2050 the number of individuals aged 65 years or older will reach 1.6 billion, representing more than 16% of the global population[1].

According to data from the Brazilian census, whereas in 2010 the proportion of individuals aged 60 years or older corresponded to 10.8% of the population, in 2022 this proportion increased to 15.8%[2]. In addition to changes in Brazil's demographic profile, there is also the epidemiological transition, characterized by shifts in morbidity and mortality patterns, with infectious diseases being gradually replaced by noncommunicable diseases (NCDs)[3].

Considering the general population, without age stratification, approximately 75% of deaths are attributed to NCDs[4]. Within this group, cerebrovascular diseases stand out as the second leading cause of death worldwide. Among Latin American countries, Brazil has one of the highest mortality rates, despite a decline in recent years[4].

Chronic diseases may lead to continuous medication use, increased dependence on family members, caregivers, and healthcare services, and higher costs for both families and the State[5]. The magnitude of the burden imposed by chronic diseases is evidenced by indicators such as disability-free life expectancy, which can be used to estimate the expected gains from reducing or eliminating these conditions[6].

Although global rates of incidence, prevalence, and disability due to cerebrovascular diseases have shown a decreasing trend in recent years, analysis of absolute numbers indicates an increase in cases, disabilities, and deaths[7].

Cerebrovascular diseases comprise a group of conditions related to cerebral circulation, classified in Chapter IX of the International Classification of Diseases, 10th Revision (ICD-10: I60–I69), encompassing different clinical entities, including cerebrovascular accident (CVA)[8], the main acute event associated with high mortality and disability.

Given this context and the complexity imposed by Brazil's continental dimensions, ecological studies using different methodologies have been employed as valuable analytical tools, as they allow the investigation of populations of interest while also providing evidence to support the development of public policies with the potential to improve population health[9,10].

Despite the relevance of cerebrovascular diseases in the context of public health and population aging, studies that jointly analyze temporal trends and spatial distribution of mortality over extended periods at municipal and regional levels remain scarce. In this context, the present study seeks to expand the understanding of mortality patterns from these diseases in Brazil, focusing on older adults, as this age group is the most affected and at higher risk of mortality and adverse outcomes.

The findings have relevant potential for the field of Geriatrics and Gerontology, providing evidence to support researchers, policymakers, and healthcare professionals in planning strategic actions aimed at population aging. Therefore, this study aimed to analyze the epidemiological profile and the temporal and spatial dynamics of mortality from cerebrovascular diseases in older adults in Brazil.

METHODS

This ecological study with temporal trend and spatial analysis was conducted using secondary data obtained from the Mortality Information System of the Brazilian Unified Health System (SIM/SUS), available in the electronic database of the Department of Informatics of the SUS (DATASUS). Mortality from cerebrovascular diseases, defined as the underlying cause of death, was analyzed among older adults residing in Brazil, using Brazilian regions as the units of analysis for temporal trend assessment and municipalities as the units for spatial analysis over the last 15 years.

The identification of cerebrovascular diseases recorded as the underlying cause of death was performed using diagnostic categories according to Chapter IX of the International Classification of

Diseases, 10th Revision (ICD-10: Diseases of the circulatory system), categories I60 to I69.

Epidemiological variables (sex, age group, marital status, race/ethnicity, and educational attainment) were included exclusively to characterize the profile of deaths from cerebrovascular diseases in the older population and were used only for descriptive analysis, without temporal stratification or inferential analysis. All deaths among individuals aged 60 years or older residing in Brazil were considered according to the year of registration.

Descriptive analysis was performed using absolute frequencies and percentages for both sociodemographic variables and the main categories of cerebrovascular diseases. The mean mortality rate was calculated by dividing the number of deaths among older adults due to cerebrovascular diseases by the population of older adults residing in the same year and location, multiplied by 100,000 population.

To describe mortality trends in Brazil, data from the five Brazilian regions were analyzed for the period from 2008 to 2022, considering population data for each respective year. Population data were based on the 2010 and 2022 demographic censuses and intercensal estimates provided by the Brazilian Institute of Geography and Statistics (IBGE) for each year analyzed.

Temporal trend analysis was performed using the Joinpoint Regression Model. This model enabled the calculation of the Annual Percent Change (APC) and the Average Annual Percent Change (AAPC). Trends were classified as stationary, increasing, or decreasing according to the slope of the regression line. Trends were expressed as APC and AAPC and were considered stationary when the regression coefficient did not differ significantly from zero ($p>0.05$).

For spatial analysis, the units of analysis comprised the 5,568 Brazilian municipalities and the Federal District, as recorded in the 2022 demographic census, along with mortality data for older adults across the study period obtained from DATASUS information systems. Population data for all municipalities between 2008 and 2022 were considered.

The mortality rate from cerebrovascular diseases in older adults was calculated for the study period. The numerator corresponded to the mean number of deaths due to cerebrovascular diseases among individuals aged 60 years or older during the period, and the denominator corresponded to the resident older population in Brazilian municipalities in 2015, multiplied by 100,000 inhabitants. The choice of 2015 was based on it being the midpoint of the study period and therefore representative of the average population. Spatial distribution was assessed using exploratory data analysis, generating a choropleth map of mortality rates from cerebrovascular diseases among older adults in Brazilian municipalities. The map was presented in quartiles, with darker shades indicating higher mortality rates.

Spatial autocorrelation was assessed using the Global Moran's I for mortality rates among older adults. Positive values (between 0 and +1) indicated direct spatial autocorrelation, while negative values (between 0 and −1) indicated inverse spatial autocorrelation. The Local Indicators of Spatial Association (LISA) were used to generate maps identifying areas with statistically significant local spatial autocorrelation, allowing the detection of clusters and spatial outliers.

The Moran scatterplot was used to evaluate spatial autocorrelation of mortality rates from cerebrovascular diseases, comparing the observed value in each municipality with the mean value of neighboring municipalities. The plot is divided into four quadrants representing different spatial association patterns. The High–High quadrant (Q1) indicates municipalities with high rates surrounded by municipalities with similarly high rates, while the Low–Low quadrant (Q2) represents areas with low rates among neighbors with similar values, indicating positive spatial association. The High–Low (Q3) and Low–High (Q4) quadrants indicate negative spatial association, identifying municipalities with values that differ from their surroundings, characterized as spatial outliers. Associations with $p<0.05$ were considered statistically significant.

Brazil's digital cartographic base was obtained in shapefile format using the SIRGAS 2000 Geodetic Reference System (Geocentric Reference System for the Americas), updated in 2022.

Approval from a Research Ethics Committee was not required, as secondary data from the Brazilian Ministry of Health website were used. These data are publicly available and do not allow individual identification, in accordance with National Health Council Resolution No. 510/2016.

DATA AVAILABILITY

The complete dataset supporting the findings of this study is publicly available on Figshare and can be accessed at https://doi.org/10.6084/m9.figshare.31175437.

RESULTS

During the study period, a total of 1,233,337 deaths from cerebrovascular diseases were recorded among individuals aged 60 years or older in Brazil, corresponding to a mortality rate of 328.386 per 100,000 inhabitants. Table 1 presents the epidemiological profile of individuals who died during the period from 2008 to 2022.

Table 1. Epidemiological characteristics of mortality from cerebrovascular diseases among older adults in Brazil, 2008–2022.

Variables	(N – %)
Sex	
Female	(621,291 – 50.37)
Male	(611,942 – 49.62)
Unknown	(104 – 0.01)
Age group	
60-69	(272,233 – 22.07)
70-79	(404,626 – 32.81)
80 or older	(556,478 – 45.12)
Marital status	
Married	(439,691 – 35.65)
Widowed	(429,015 – 34.78)
Single	(189,753 – 15.39)
Separated	(62,739 – 5.09)
Other	(20,110 – 1.63)
Unknown	(92,029 – 7.46)
Race/ethnicity	
White	(646,897 – 52.45)
Mixed-race	(416,037– 33.75)
Black	(104,999 – 08.51)
Asian	(8,154 – 0.66)
Indigenous	(2,288 – 0.18)
Unknown	(54,962 – 4.45)
Education (years of schooling)	
None	(300,893 – 24)
1 to 3	(318,713 – 25.84)
4 to 7	(211,721 – 17.17)
8 to 11	(100,011 – 8.11)
12 or more	(38,804 – 3.15)
Unknown	(263,195 – 21.34)
TOTAL (n – %)	**(1,233,337 – 100.00)**

Source: Ministry of Health. Mortality Information System of the Brazilian Unified Health System (SIM/SUS).

Among deaths from cerebrovascular diseases, classified according to ICD-10 codes, deaths were recorded for conditions related to eight categories, and no deaths were reported for categories I65 (Occlusion and stenosis of precerebral arteries, not resulting in cerebral infarction) and I68 (Cerebrovascular disorders in diseases classified elsewhere) (Table 2).

Table 3 presents the temporal trend of deaths from cerebrovascular diseases across the regions of Brazil. Decreasing trends were observed in all five regions, as well as for Brazil overall. The Northeast and Central-West regions showed declining trends throughout the entire study period. The Southeast and South regions demonstrated a reduction only during the period from 2008 to 2020, although with greater magnitudes of decline, a pattern similar to that observed for Brazil as a whole. In contrast, the North region exhibited a distinct pattern, with decreasing trends between 2008–2010 and 2015–2022, but a slight increasing trend between 2010 and 2015. When evaluating the average trend (AAPC), a decreasing trend was observed in all Brazilian regions, with the Southeast and South regions showing the greatest reductions.

Figure 1 presents the spatial analysis of mortality from cerebrovascular diseases in Brazilian municipalities for the period from 2008 to 2022. Figure 1A shows, through a choropleth map, that darker shading corresponds to higher mortality rates from cerebrovascular diseases. High rates were observed in municipalities across all Brazilian states, particularly in municipalities along the northeastern coast and throughout the states of Maranhão and Piauí, as well as in municipalities in the South region, especially in the states of Rio Grande do Sul and Paraná.

In the spatial autocorrelation analysis (Figure 1B), areas exhibiting spatial dependence were identified, as evidenced by the presence of clusters classified in quadrant Q1 (High-High), which represent clusters of municipalities with high mortality rates from cerebrovascular diseases surrounded by neighboring municipalities that also present high rates. These clusters were identified in municipalities in Northeastern states such as Paraíba, Pernambuco, Alagoas, and Sergipe, in virtually all municipalities in the state of Piauí, and in the northern and southern areas of Maranhão. In the North region, clusters were identified in the states of Amazonas and Pará, and in the South region, in the states of Santa Catarina and Rio Grande do Sul.

Table 2. Deaths from cerebrovascular diseases by ICD-10 category among older adults, Brazil, 2008–2022.

Code – ICD-10	Category – ICD-10	Total deaths	%
I60	Subarachnoid hemorrhage	35,031	2.84
I61	Intracerebral hemorrhage	147,364	11.95
I62	Other nontraumatic intracranial hemorrhage	14,907	1.21
I63	Cerebral infarction	87,403	7.09
I64	**CVA, not specified as hemorrhagic or ischemic**	**519,251**	**42.10**
I66	Occlusion and stenosis of cerebral arteries, not resulting in cerebral infarction	1	0.00
I67	Other cerebrovascular diseases	188,752	15.30
I69	Sequelae of cerebrovascular diseases	240,628	19.51
Total		**1,233,337**	**100**

Source: Ministry of Health. Mortality Information System of the Brazilian Unified Health System (SIM/SUS).

Table 3. Temporal trend of deaths from cerebrovascular diseases among older adults by region of Brazil, 2008–2022.

Region	(APC)*	Trend	(AAPC)**	Trend
North	2008-2010:-4.4259*** 2010-2015:0.7691*** 2015-2022:-2.6821***	Decreasing Increasing Decreasing	-1.7175***	Decreasing
Northeast	2008-2022:-2.3078***	Decreasing	-2.3078***	Decreasing
Southeast	2008-2020:-3.8051*** 2020-2022:1.1143	Decreasing Stationary	-3.1173***	Decreasing
South	2008-2020:-4.2920*** 2020-2022:3.4247	Decreasing Stationary	-3.2259***	Decreasing
Central-West	2008-2022:-2.7305***	Decreasing	-2.7305***	Decreasing
Brazil	2008-2016:-2.9248* 2016-2020:-4.0345* 2020-2022:0.7800	Decreasing Decreasing Stationary	-2.7241*	Decreasing

*APC: Annual Percent Change; **AAPC: Average Annual Percent Change; ***Statistically significant value: p<0.05.

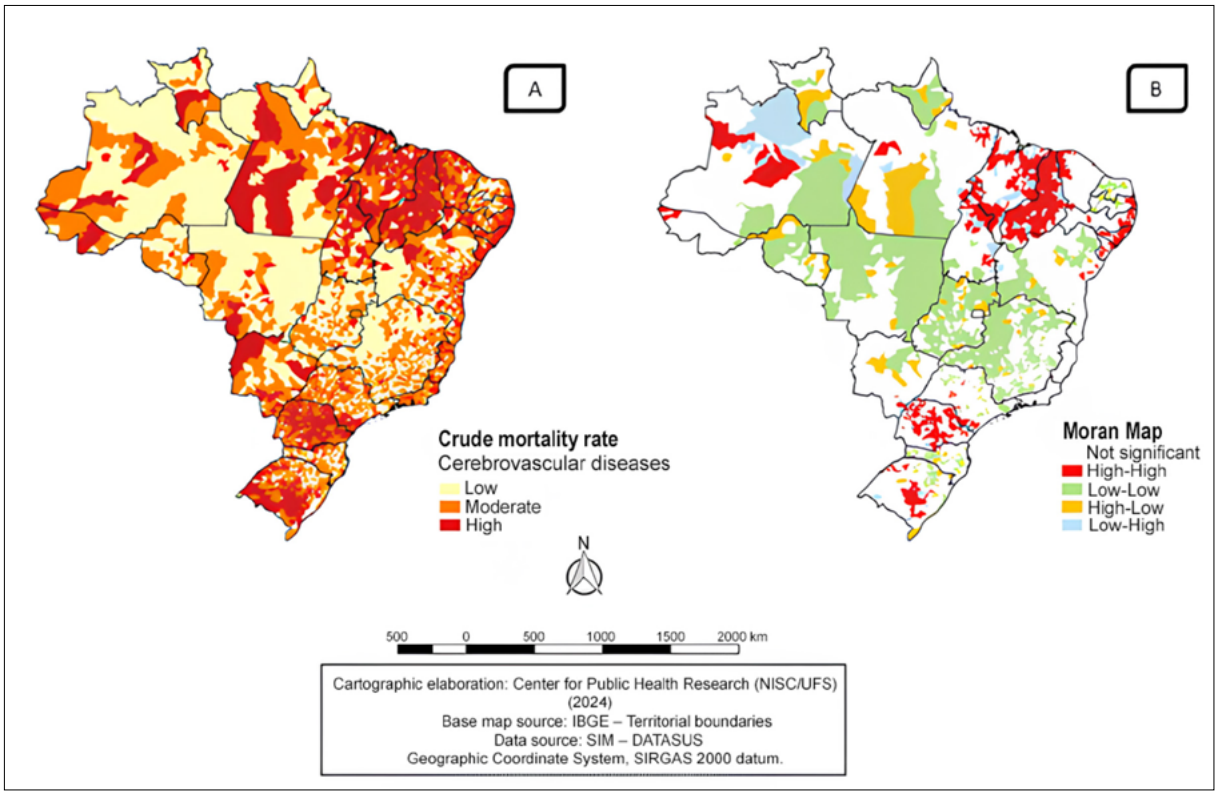


Figure 1. A: Spatial distribution of crude mortality rates from cerebrovascular diseases among older adults, by municipality, Brazil, 2008-2022. B: Spatial autocorrelation of mortality from cerebrovascular diseases among older adults, by municipality, Brazil, 2008-2022.

DISCUSSION

During the study period, Brazilian municipalities exhibited spatial and temporal variations in mortality from cerebrovascular diseases among individuals aged 60 years or older. This finding highlights the epidemiological complexity of a country with continental dimensions and substantial socioeconomic and demographic diversity.

Despite the declining trend in mortality rates nationwide, high absolute numbers of deaths were still observed. Spatial analysis revealed clusters of high mortality in the Northeast and South regions, indicating areas of greater vulnerability. Spatial factors, as well as socioeconomic conditions and access to healthcare services, may influence the distribution of mortality from cerebrovascular diseases and may reflect regional inequalities and the need for targeted strategies.

Among cerebrovascular diseases, CVA constitutes the main clinical manifestation within this group of conditions and accounts for a high burden of mortality. In Brazil, CVA has been among the leading causes of death for more than three decades and, despite a reduction in mortality rates over this period, it still results in more than 100,000 deaths annually across all age groups[11]. This declining trend follows the global pattern and has been mainly attributed to advances in primary prevention, early diagnosis, and acute treatment. High rates are also observed in low- and middle-income countries, where stroke care is often inconsistent, fragmented, and associated with poor clinical outcomes[7,11].

The high proportion of deaths classified under category I64 (cerebrovascular accident, not specified as hemorrhagic or ischemic), as well as the substantial contribution of category I69 (Sequelae of cerebrovascular diseases), warrants attention. The frequent use of code I64 may reflect limitations in the diagnostic process, particularly in settings where timely access to imaging or specialized services capable of distinguishing CVA subtypes is lacking. Similarly, the prominence of sequelae of cerebrovascular diseases (I69) may indicate both the cumulative burden of these conditions over time and weaknesses in continuity of care and longitudinal follow-up of affected individuals. In this context, further studies are recommended to investigate the relationship between these findings and regional inequalities in the organization of emergency care networks, diagnostic capacity, and the quality of underlying cause-of-death reporting.

The reduction in mortality rates from cerebrovascular diseases in Brazil over time may be associated with advances in the national healthcare system. These include the implementation of Primary Health Care (PHC) in 1994, the development of CVA care units starting in 2012, and the establishment of the Strategic Action Plan to Tackle Noncommunicable Diseases in Brazil in 2011[4].

According to Souza et al., strategic objectives defined in this Strategic Action Plan include reducing premature mortality, decreasing the prevalence of smoking and harmful alcohol consumption, increasing physical activity, promoting fruit consumption, and stabilizing the growth of obesity. All these initiatives represent important tools for prevention and early intervention and are therefore highly relevant for reducing deaths from cerebrovascular diseases in the country[8]. In this context, timely and effective care at every point along the care pathway is essential, which depends not only on the structure of the healthcare network but also on the preparedness of healthcare professionals and the population's level of health literacy, factors that must be coordinated to ensure appropriate patient referral[12].

Local studies have shown that insufficient investment in public health may hinder reductions in mortality indicators, reinforcing that local conditions and healthcare financing are key determinants of more favorable outcomes[7]. Health education plays a central role in prevention strategies, particularly in the early recognition of the signs and symptoms of cerebrovascular diseases such as CVA, facilitating timely care-seeking and thereby reducing mortality risk. The implementation of care pathways should be accompanied by continuing education programs to ensure that healthcare teams are adequately trained to provide effective and high-quality care[9,13].

A previous study[4] that analyzed trends in cerebrovascular mortality in Brazil and its association with Human Development and Social Vulnerability

found that the Southeast and South regions had higher absolute rates but showed significant declines, whereas the North and Northeast regions, despite initially presenting lower rates, exhibited increases during certain periods. According to the authors, this heterogeneous pattern reflects social, economic, demographic, and epidemiological differences between regions, including educational attainment, income, access to healthcare services, and coverage of specialized units[4].

This scenario reflects the profound socioeconomic inequality in the country, which is expressed in marked differences in life expectancy across Brazilian regions and directly influences mortality patterns. These inequalities are also reflected in regional differences in life expectancy, which are higher in southern states and lower in the Northeast region[2]. The greater clustering of deaths observed in southern states may be associated with higher life expectancy in these areas. Considering that the risk of death from cerebrovascular diseases increases substantially with advancing age, particularly from 80 years onward, the larger proportion of individuals in older age groups contributes to the increased mortality observed.

The concentration of mortality in more advanced age groups reinforces the role of population aging and the accumulation of risk factors over the life course in the dynamics of cerebrovascular diseases. It is important to consider that the observed reduction in mortality rates may be partially associated with the so-called 'denominator effect': as the older population increases, the absolute number of deaths tends to be diluted within a larger population base, potentially reducing rates without necessarily reflecting a decrease in individual risk of death. Additionally, older age groups often include individuals who accumulate multiple risk factors for cerebrovascular diseases, such as hypertension, dyslipidemia, diabetes, and smoking[4,14].

This study identified a predominance of deaths from cerebrovascular diseases among White older adults. However, age- and race/ethnicity-adjusted analyses have shown that the risk of cerebrovascular mortality is higher among Black individuals, followed by Mixed-race individuals, and lower among White individuals[15]. This apparent paradox may be explained by differences in life expectancy across racial groups: while White women live, on average, up to 80 years, Black women live approximately 76 years; among men, life expectancy is 74.5 years for White individuals and 68.6 years for Black individuals[16]. Thus, the higher absolute number of deaths among White individuals may reflect not a higher risk, but a greater likelihood of surviving to older ages, when cerebrovascular diseases are more frequent and lethal. Conversely, lower survival among Black and Mixed-race populations may reduce their likelihood of reaching these more vulnerable age groups, reflecting historical and structural health inequalities.

The data also showed that most deaths occurred among individuals with lower levels of educational attainment. Unfavorable socioeconomic conditions may limit access to health information, hinder the acquisition of healthy foods, reduce the availability of adequate spaces for physical activity, and restrict access to healthcare technologies[14]. These factors are compounded by the impact of low educational attainment, which limits access to education and reduces awareness of health issues, thereby influencing the adoption of healthy behaviors and the capacity for social mobilization aimed at improving quality of life[17-19].

The North and Northeast regions showed the smallest reductions in mortality rates from cerebrovascular diseases during the study period. Consistent with the literature, a previous study[20] found that these regions exhibited less pronounced declines and, in some municipalities, increases in mortality rates, possibly influenced by socioeconomic factors, access to healthcare services, underreporting, and delayed demographic transition.

In different countries, individuals with lower income tend to use healthcare services less frequently, mainly due to access barriers, resulting in poorer health conditions. This situation is also evident within countries. In Brazil, small differences in monthly household per capita income are sufficient to identify older adults with poorer health conditions, lower physical mobility, and reduced use of healthcare services. Therefore, it is essential to consider the socioeconomic context of different

locations in order to develop and implement policies tailored to each social context.

Further supporting the impact of socioeconomic factors on mortality rates from cerebrovascular diseases, the Global Burden of Disease study (2015) showed that the greatest reductions in mortality rates occurred in Brazilian states within the highest development tertile[4]. This finding helps explain the prominence of the Northeast region in terms of high mortality rates observed in municipal-level crude mortality maps and spatial autocorrelation analyses. In this context, the combination of high numbers of deaths and a slow demographic transition contributes to higher mortality rates compared with other regions of the country.

Although the data used were obtained from official records, the possibility of underreporting and inconsistencies in the completion of death certificates, as well as regional variations in the quality of information recorded in the Mortality Information System, cannot be ruled out. The high use of nonspecific diagnostic categories, such as I64 and I69, may also reflect limitations in access to diagnosis and heterogeneity in the structure of healthcare services; therefore, the results should be interpreted with caution. The use of a fixed denominator (2015 population) for the mortality rate in the spatial analysis represents an approximation for the period and may distort absolute levels in municipalities with substantial population variation. Furthermore, given the ecological study design, the findings do not allow for individual-level inferences or the establishment of causal relationships. Nevertheless, the analysis of deaths across the entire Brazilian territory represents an important methodological strength, as it allows for the representation of the reality of a country with continental dimensions over a 15-year period. Taken together, these limitations do not invalidate the findings, but reinforce the need to interpret them in light of regional inequalities and the structural conditions of the Brazilian healthcare system.

CONCLUSION

The findings of this study indicate a decreasing temporal trend in mortality from cerebrovascular diseases among older adults in Brazil over the past 15 years, although rates remain high. Spatial analysis revealed the presence of regional clusters of high mortality, particularly in states in the Northeast and South regions, demonstrating a heterogeneous distribution across the national territory.

These findings reinforce the importance of public policies focused on prevention, early diagnosis, and comprehensive care for cerebrovascular diseases, taking into account regional and socioeconomic inequalities in the context of population aging in Brazil. Considering the inherent limitations of the ecological design, further studies using individual-level analytical approaches are needed to deepen the understanding of the determinants of cerebrovascular disease mortality among older adults and their impact on population aging.

AUTHORSHIP

- Gabrielle Castro de Oliveira: conceptualization; data curation; methodology; writing, original draft; writing, review and editing.
- Marcus Valerius da Silva Peixoto: data analysis and interpretation; critical review; writing, review and editing; methodology.
- Júlia Guimarães Reis da Costa: writing, original draft; writing, review and editing; approval of the version to be published.
- Andrezza Marques Duque: responsible for all aspects of the study; project administration; conceptualization; data curation; writing, review and editing; methodology; funding acquisition.

Edited by: Cristian Arnecke Schröder

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Delirium in hospitalized older adults: influence of sociodemographic and clinical factors in a longitudinal study

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Abstract

Objective: To analyze the effects of sociodemographic and clinical characteristics on the occurrence of delirium in hospitalized older adults. Method: A prospective longitudinal study was conducted with 427 older adults aged ≥60 years without delirium at hospital admission, between March 2022 and July 2023. Delirium was monitored daily until discharge or death. Kaplan–Meier curves were used to estimate survival, and Cox proportional hazards regression was used to calculate hazard ratios (95% CI), assessed using the Wald test. The proportional hazards assumption was verified using Schoenfeld residuals. Results: The risk of delirium was 5.47 times higher in frail individuals, 2.5 times higher in those receiving palliative care, and 2.51 times higher in individuals with dementia. Income greater than 3.1 minimum wages was a protective factor, reducing the risk by 71% compared with the 0–1 minimum wage category. Older adults with hospitalizations in the previous 12 months had a 56% lower risk of delirium. Age ≥80 years (p=0.0007), widowhood (p=0.0142), low body weight (p=0.0002), frailty (p<0.001), dementia (p≤0.0001), and palliative care (p≤0.0001) were associated with shorter time to first delirium episode. Conclusion: Frailty, dementia, and the need for palliative care were the main risk factors for delirium in older adults, whereas higher income showed a protective effect. Recognition of these factors allow the implementation of targeted, individualized, and more effective preventive and therapeutic strategies for delirium in hospitalized older adults.

Keywords: Aged. Hospitalization. Delirium. Observational Study. Risk Factors.

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No funding was received for this study.
The authors declare no conflict of interest in the conception of this study.

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Received by September 21, 2025
Approved by March 12, 2026

http://dx.doi.org/10.1590/1981-22562026029.250159.en

INTRODUCTION

Delirium is an acute and multifactorial neuropsychiatric syndrome, considered one of the most prevalent conditions among hospitalized older adults, due to the concomitant presence of multiple risk factors[1]. It is characterized by alterations in consciousness and attention, disorganized thinking, fluctuation in cognitive status, as well as symptoms such as hallucinations, incoherent speech, emotional lability, and disturbances of the sleep–wake cycle[2]. These manifestations reflect the vulnerability of the central nervous system in the presence of acute clinical conditions, adverse effects of medications (including intoxication or withdrawal), surgical and anesthetic procedures, and metabolic or electrolyte imbalances[3].

The epidemiology of delirium varies according to the clinical and care context. In the hospital setting, the hospitalization process itself acts as a stressor for older adults, contributing to delirium rates ranging from 18% to 35% at admission and from 11% to 29% during hospitalization[4]. In a more detailed analysis, prevalence reaches 26.2% in clinical wards, being particularly high in palliative care (55.9%) and internal medicine wards (41%)[5]. Despite its high frequency, delirium remains underdiagnosed in approximately one third of cases, compromising patient safety and quality of care[6].

The consequences of delirium extend beyond the acute episode and associated distress, being related to increased morbidity and mortality[7], prolonged length of hospital stay, persistent functional and cognitive decline[8], as well as higher rates of institutionalization after discharge and increased healthcare costs[7].

Furthermore, delirium is not a uniform entity but rather a heterogeneous syndrome that encompasses patients with different sociodemographic profiles, degrees of vulnerability, cognitive reserve, and clinical presentations. Treating all cases as "one delirium with a single cause" makes it difficult to identify specific risk factors, underlying pathophysiological mechanisms, and personalized strategies for prevention and management[9]. Moreover, recent longitudinal studies have demonstrated that, even in specific clinical scenarios, delirium is strongly associated with increased in-hospital and post-discharge mortality[10,11].

Given its high prevalence in the hospitalized geriatric population and its functional and cognitive impact, it is imperative to understand its local epidemiology, identify modifiable risk factors, and improve prevention and management strategies[12]. Nevertheless, there is a lack of studies that systematically integrate sociodemographic and clinical characteristics in the Brazilian hospital context. In addition to these limitations, there is an important gap in the analysis of time to delirium onset, an essential aspect for identifying critical periods of risk and guiding timely preventive interventions. The absence of such data limits the identification of specific risk profiles and makes the implementation of targeted interventions more difficult.

In this context, the present study aimed to analyze the effects of sociodemographic and clinical characteristics on the occurrence of delirium in hospitalized older adults in an institution located in the southern region of Brazil.

METHOD

For the systematic development of this study, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed[13].

This is a prospective longitudinal study conducted with older adults aged ≥60 years, without a diagnosis of delirium at admission, hospitalized with clinical conditions that allowed follow-up in medical or surgical wards of a medium-complexity hospital in southern Brazil. Data collection was conducted between March 2022 and July 2023, and the follow-up period corresponded to the length of hospital stay. Delirium occurrence was assessed daily as the dependent variable. The prospective longitudinal design allows the observation of outcome incidence over time in the same individual, enabling the analysis of temporal changes and associations with greater methodological robustness[14].

To define the study sample, the following inclusion criteria were defined: age ≥60 years, hospitalization, and absence of delirium at hospital admission. Individuals presenting clinical instability were excluded, defined as the presence of hemodynamic, respiratory, or metabolic alterations, or acute symptoms associated with clinical severity at the time of evaluation, as well as those under droplet precautions.

This article is a subproject of the main study entitled "Physical frailty and clinical, functional, psychosocial, nutritional outcomes and care demands in hospitalized older adults". The time frame used for sample size calculation corresponded to the pre-pandemic period (year 2019). The calculation considered a prevalence of 50% of delirium in hospitalized older adults, a 95% confidence level, and a sampling error of 5%. Based on these parameters, the minimum sample size obtained was 352 patients, to which 20% was added to account for possible losses to follow-up.

From the initial sample of 547 older adults, 120 (21.9%) presented delirium at admission and were therefore excluded from longitudinal follow-up. Thus, 427 individuals were followed daily during hospitalization. The occurrence of delirium was assessed until discharge or death. Assessments were conducted by a trained research team using validated instruments for delirium detection, and diagnoses were confirmed by a geriatrician.

For data collection, a sociodemographic and clinical questionnaire was used, including the following variables of interest: sex, age, race/ethnicity, marital status, education, income, delirium, physical frailty, comorbidities, palliative care, and history of falls. Nutritional status was classified using the Body Mass Index (BMI), with values from 22 to 27 kg/m² considered normal weight, values below this range were classified as underweight, and values above as overweight[15]. Physical frailty was classified according to the five components of the Fried phenotype, namely: handgrip strength, gait speed, fatigue/exhaustion, weight loss, and energy expenditure. Based on the measurement of these five markers, older adults were classified into three categories: frail, when three or more criteria were present; pre-frail, when one or two markers were identified; and non-frail, when none of the markers were present[16]. The dependent variable (delirium) was assessed daily using the Confusion Assessment Method (CAM), a validated instrument that investigates four cardinal features: acute onset and fluctuating course, inattention, disorganized thinking, and altered level of consciousness[17].

At baseline, sociodemographic variables, clinical history, delirium, and physical frailty were collected from participants. During the in-hospital follow-up assessments, delirium was monitored daily, from admission until discharge or death, using the Confusion Assessment Method (CAM). At the final assessment (hospital discharge), physical frailty and delirium were reassessed, maintaining the same instruments and procedures used at baseline, in order to verify changes in the status of these participants.

To analyze the occurrence of the first diagnosis of delirium in relation to demographic variables and clinical conditions, the population profile at hospital admission was compared with the diagnosis of delirium. Ninety-five percent confidence intervals (95% CI) estimated using the Wilson score were presented instead of p-values, as they provide more relevant information for clinical and epidemiological interpretation, including the magnitude of the effect and the precision of the estimates. The proportional hazards assumption was evaluated using Schoenfeld residuals.

Initially, survival analysis was explored using Kaplan–Meier curves. The log-rank test was used to compare survival curves between groups, testing whether survival times were statistically different. The null hypothesis of this test assumes that there is no significant difference in survival between the compared groups. Since the log-rank test does not allow simultaneous testing of the effect of other independent variables on survival time, semiparametric Cox proportional hazards models were performed.

In the modeling stage, crude hazard ratio (HR) estimates were presented with their respective 95% confidence intervals (95% CI). Multivariable Cox regression was used to estimate adjusted associations between the variables of interest and the time to outcome occurrence. The significance of the

covariate coefficients in the survival models was assessed using the Wald test.

The selection of independent variables to compose the multiple Cox regression model was based on theoretical and epidemiological criteria, prioritizing biological plausibility and previous literature on factors associated with delirium and survival. A full-model approach was adopted, in which all covariates of interest and adjustment variables (sociodemographic, clinical, and laboratory) were retained simultaneously in the multivariable analysis, regardless of the level of statistical significance (p-value) observed in the crude analysis. This strategy was used to ensure unrestricted control of confounding factors and to present adjusted estimates of the effect of each variable in the presence of the others, avoiding bias resulting from the exclusion of variables based purely on automated statistical criteria.

The adequacy of the final model was confirmed by the analysis of Schoenfeld residuals to verify the proportional hazards assumption. All statistical tests adopted a significance level of 5%.

The main study received approval from the Research Ethics Committee involving Human Beings of the Health Sciences Sector of the Universidade Federal do Paraná (No. 7.913.461) and from the Research Ethics Committee involving Human Beings of the Municipal Health Department of Curitiba (No. 5.055.260). All ethical principles were respected, including voluntary and informed participation of older adults and their caregivers, in accordance with the recommendations of Resolution No. 466 of the Brazilian National Health Council, dated December 12, 2012.

DATA AVAILABILITY

The entire dataset supporting the results of this study is available upon request from the corresponding author.

RESULTS

Table 1 shows that 14.05% of the older adults followed developed delirium during hospitalization. There was a predominance of females among individuals with delirium (53.3%) compared with those without delirium (52.9%). The mean age was higher in the delirium group (79.5 ± 9.79 years) compared with the non-delirium group (73.6 ± 8.25 years). Among participants who developed delirium, 48.3% were widowed and 45% reported income between 0 and 1 minimum wage.

Table 2 shows that, among individuals who developed delirium during hospitalization, the most frequent comorbidities were Chronic Obstructive Pulmonary Disease, dementia, stroke, and cancer. Among older adults without delirium, the most frequent comorbidities were hypertension, diabetes, congestive heart failure, and ischemic heart disease.

Figure 1 shows that frailer older adults ($p<0.0001$), those aged over 80 years ($p=0.0007$), widowed individuals ($p=0.0142$), those receiving palliative care ($p\leq0.0001$), those with low body weight ($p=0.0002$), and those diagnosed with dementia ($p\leq0.0001$) experienced the first episode of delirium earlier during hospitalization. Income higher than three minimum wages was identified as a protective factor for incident delirium ($p=0.0106$).

Table 1. Frequency distribution of sociodemographic characteristics according to delirium occurrence (N=427). Curitiba, PR, 2022–2023.

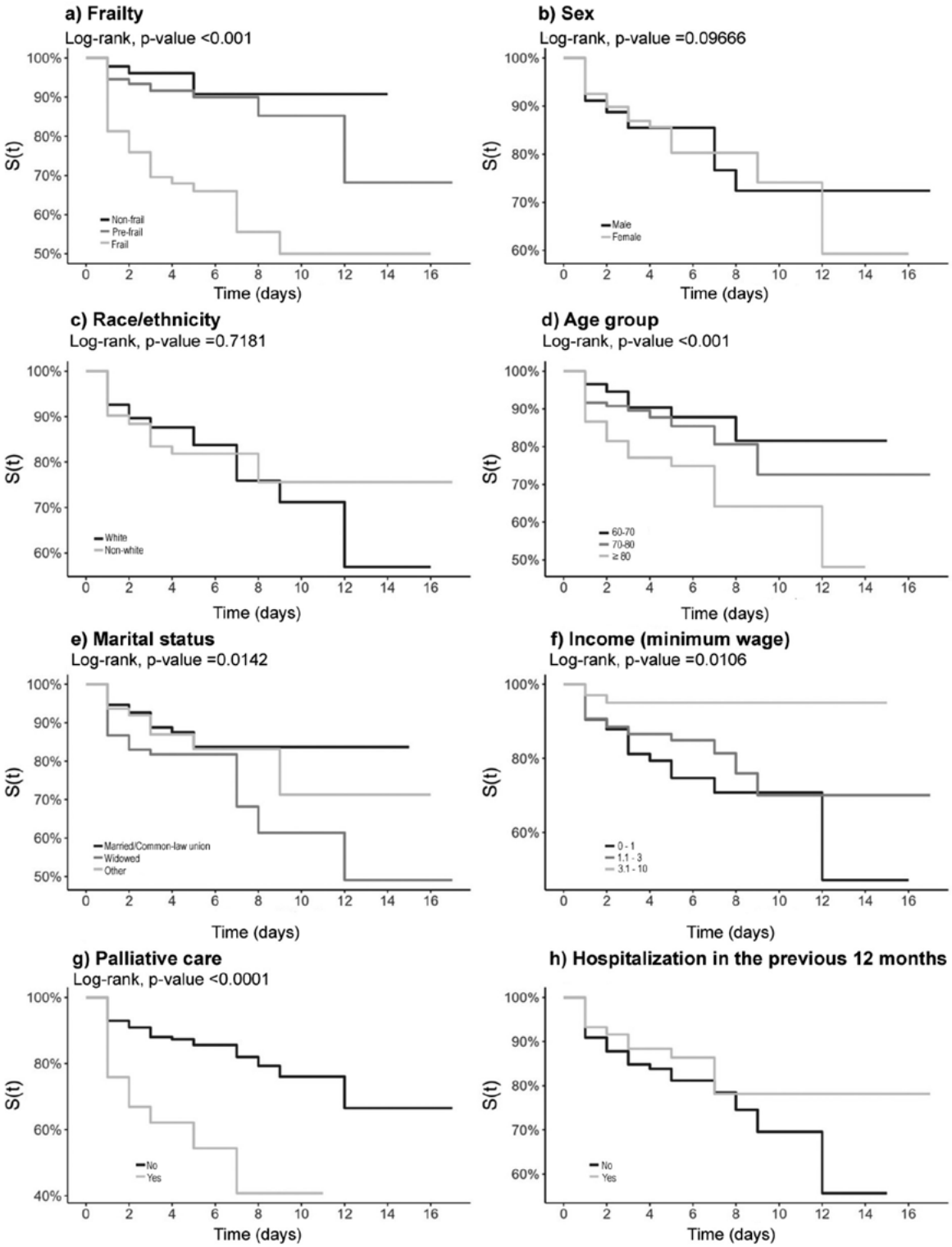
Variables	Occurrence of delirium			
	Yes		No	
	(N=60)	Relative frequency (95% CI)	(N=367)	Relative frequency (95% CI)
Sex				
Female	32	53.3% (40.9; 65.4)	194	52.9% (47.8; 57.9)
Male	28	46.7% (34.6; 59.1)	173	47.1% (42.1; 52.2)
Age				
Mean (SD)	79.5 (9.79)		73.6 (8.25)	
Median [Min, Max]	79 [60.100]		73 [60.95]	
Race/ethnicity				
White	38	63.4% (50.7; 74.4)	246	67% (62.1; 71.6)
Mixed-race	17	28.3% (18.5; 40.8)	99	27% (22.7; 31.7)
Black	5	8.3% (3.6; 18.1)	19	5.2% (3.3; 7.9)
Other	0	0% (0; 6)	3	0.8% (0.3; 2.4)
Marital status				
Married / Common-law union	21	35.1% (24.2; 47.6)	184	50.1% (45; 55.2)
Widowed	29	48.3% (36.2; 60.7)	114	31.1% (26.5; 36)
Divorced	5	8.3% (3.6; 18.1)	49	13.4% (10.2; 17.2)
Single	5	8.3% (3.6; 18.1)	18	4.9% (3.1; 7.6)
Other	0	0% (0; 6)	2	0.5% (0.1; 2)
Education (years of schooling)				
Illiterate	10	16.7% (9.3; 28)	65	17.7% (14.1; 21.9)
1 to 8 years	46	76.6% (64.6; 85.6)	280	76.3% (71.7; 80.4)
> 8 years	4	6.7% (2.6; 15.9)	22	6% (4; 8.9)
Occupational status / Income				
Retired	42	70% (57.5; 80.1)	263	71.7% (66.8; 76.0)
Pension / LOAS / Social benefit recipient	17	28.3% (18.5; 40.8)	51	13.9% (10.7; 17.8)
Working	1	1.7% (0.3; 8.9)	21	5.7% (3.8; 8.6)
Unemployed	0	0% (0; 6)	32	8.7% (6.2; 12)
Living arrangement				
Spouse and/or children	47	78.3% (66.4; 86.9)	266	72.5% (67.9; 77)
Parents and/or siblings	3	5% (1.7; 13.7)	8	2.2% (1.1; 4.3)
Relatives	1	1.7% (0.3; 8.9)	17	4.6% (2.9; 7.3)
Caregiver	1	1.7% (0.3; 8.9)	0	0% (0; 1)
Homes for the Aged	2	3.3% (0.9; 11.4)	3	0.8% (0.3; 2.4)
Living alone	6	10% (4.7; 20.1)	72	19.6% (15.9; 24.1)
Not informed	0	0 (0%)	1	0.3% (0.1; 0.8)
Older adult income (MW)				
0 – 1	27	45% (33.1; 57.5)	101	27.5% (23.3; 32.4)
1.1 – 3	27	45% (33.1; 57.5)	166	45.2% (40.3; 50.5)
3.1 – 5	2	3.3% (0.9; 11.4)	61	16.7% (13.2; 20.8)
5.1 – 10	1	1.7% (0.3; 8.9)	4	1.1% (0.4; 2.8)
No income	0	0% (0; 6)	20	5.4% (3.6; 8.3)
Not informed	3	5% (1.7; 13.7)	14	4.1% (2.3; 6.3)

LOAS: Brazilian Organic Law of Social Assistance; MW: Minimum Wage. Wilson score method.

Table 2. Frequency distribution of comorbidities and occurrence of delirium (N=427). Curitiba, PR, 2022–2023.

Variables	*Delirium*		No *delirium*	
	(n=60)	Relative frequency (95% CI)	(n=367)	Relative frequency (95% CI)
Hypertension				
No	15	25% (15.8-37.2)	88	24% (19.9-28.7)
Yes	45	75% (62.8-84.2)	278	76% (71.3-80.1)
Diabetes mellitus				
No	40	66.7% (54.1-77.3)	228	62.1% (57.1-66.9)
Yes	20	33.3% (22.7-45.9)	139	37.9% (33.1-42.9)
Chronic obstructive pulmonary disease				
No	49	81.7% (70.1-89.4)	309	84.2% (80.1-87.6)
Yes	11	18.3% (10.6-29.9)	58	15.8% (12.4-19.9)
Chronic kidney disease				
No	50	83.3% (72-90.7)	307	83.7% (79.5-87.1)
Yes	10	16.7% (9.3-28)	60	16.3% (12.9-20.5)
Congestive heart failure				
No	55	91.7% (81.9-96.4)	300	81.7% (77.5-85.4)
Yes	5	8.3% (3.6-18.1)	67	18.3% (14.6-22.5)
Dementia				
No	41	68.3% (55.8-78.7)	329	89.6% (86.1-92.4)
Yes	19	31.7% (21.3-44.2)	38	10.4% (7.6-13.9)
Stroke				
No	45	75% (62.8-84.2)	298	81.2% (76.9-84.9)
Yes	15	25% (15.8-37.2)	69	18.8% (15.1-23.1)
Depression				
No	52	86.7% (75.8-93.1)	324	88.3% (84.6-91.2)
Yes	8	13.3% (6.9-24.2)	43	11.7% (8.8-15.4)
Cancer				
No	54	90% (79.9-95.3)	336	91.6% (88.3-94)
Yes	6	10% (4.7-20.1)	31	8.4% (6-11.7)
Ischemic heart disease				
No	56	93.3% (84.1-97.4)	320	87.2% (83.4-90.2)
Yes	4	6.7% (2.6-15.9)	47	12.8% (9.8-16.6)

Wilson score method.



to be continued

Continuation of Figure 1

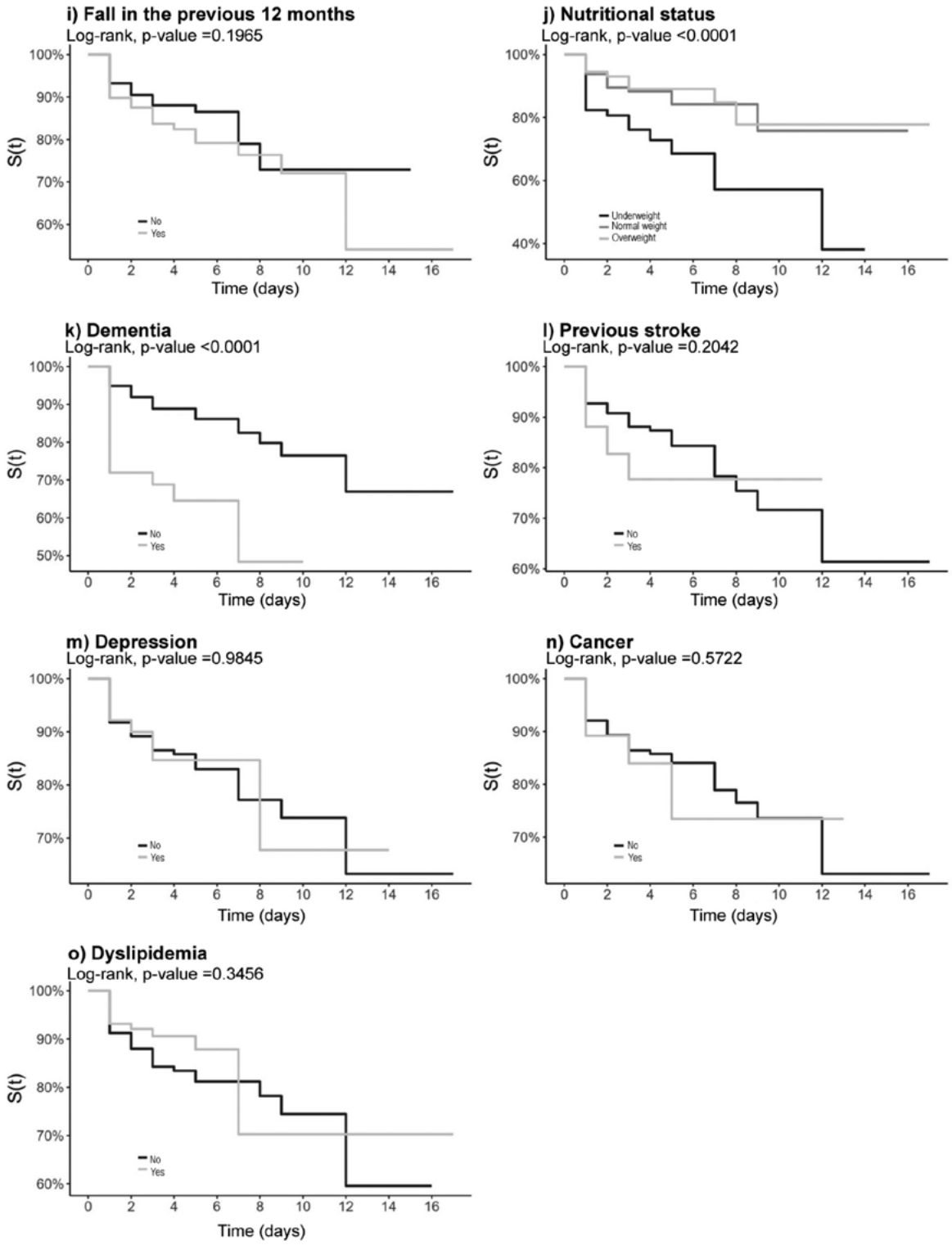


Figure 1. Kaplan–Meier survival curves for sociodemographic characteristics and comorbidities of hospitalized older adults until the development of delirium (N = 427). Curitiba, PR, 2022–2023.

Kaplan–Meier survival curves and log-rank test, $p<0.05$.

The overall Kaplan–Meier curve (Figure 2) shows that the cumulative probability of delirium-free survival remained above 50% throughout the observation period. Consequently, the median delirium-free survival time was not reached in the total sample (95% CI: 12 days to not reached). The restricted mean delirium-free survival time was 13.1 days (SE: 0.63).

Table 3 shows that frail older adults had a 5.47-fold higher risk of early-onset delirium. Receiving palliative care was associated with a 2.5-fold higher risk, and the presence of dementia was associated with a 2.51-fold higher risk of early-onset delirium. Income higher than 3.1 minimum wages was associated with a 71% lower risk of occurrence, and a history of previous hospitalizations was associated with a 58% reduction in the risk of early-onset delirium.

As shown in Figure 3, no violations of the proportional hazards assumption were identified. This finding was confirmed by the proportional hazards assumption test, whose p-values were greater than 0.05, indicating that the null hypothesis was not rejected. Therefore, the adjusted model adequately met the assumptions of the Cox proportional hazards model.

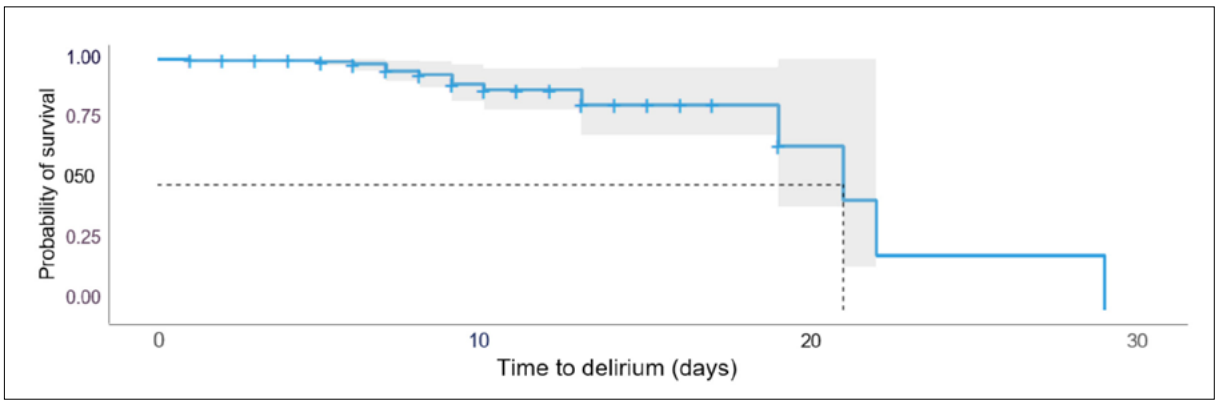
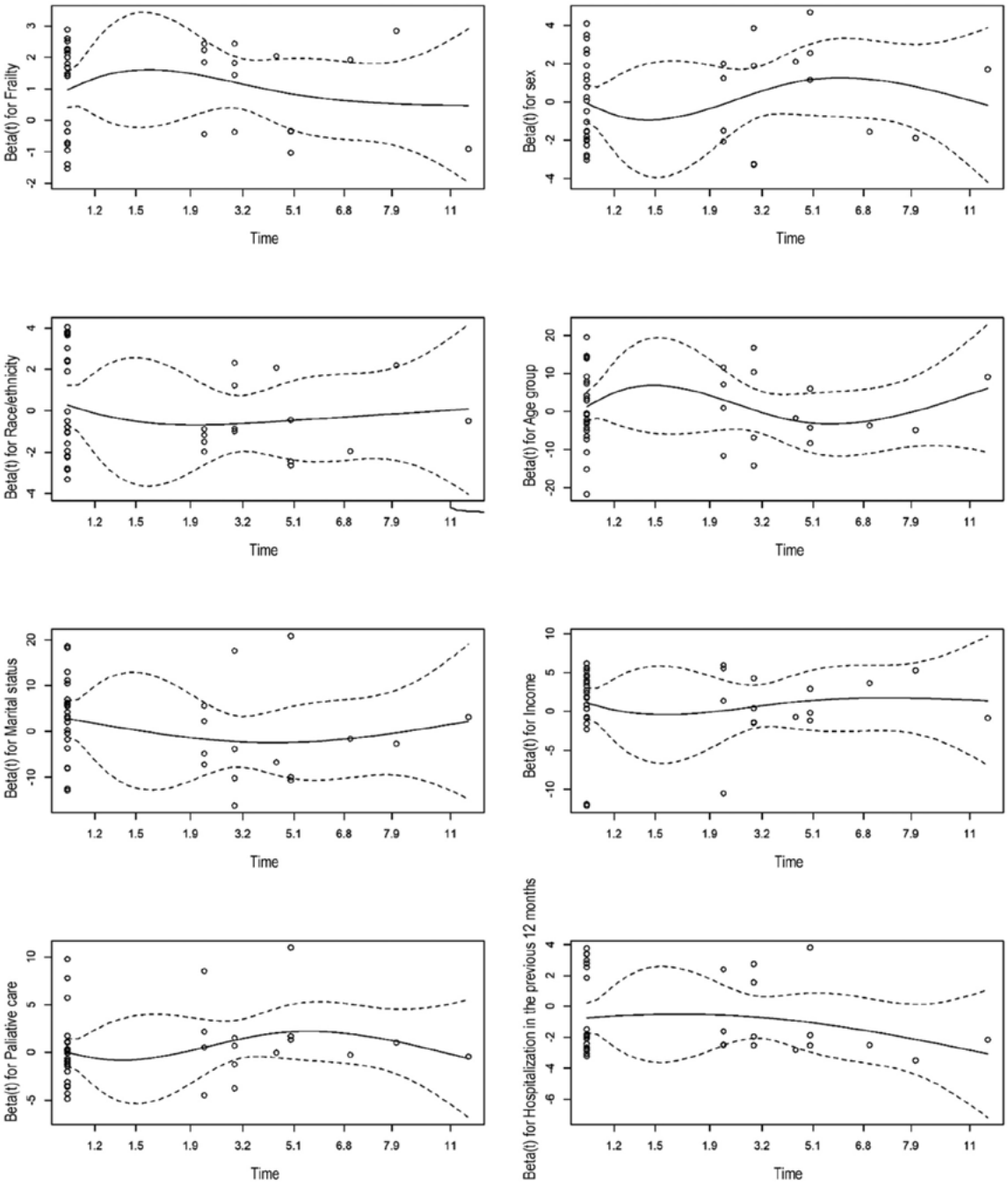


Figure 2. Kaplan–Meier survival curves of hospitalized older adults until the development of delirium (N=427). Curitiba, PR, 2022–2023.

Table 3. Cox proportional hazards models for the association between first diagnosis of delirium and sociodemographic characteristics and comorbidities of hospitalized older adults (N=427). Curitiba, PR, 2022–2023.

		HR	95% CI	p-value	Adjusted		
					HR	95% CI	p-value
Frailty	Non-frail	Ref.			Ref.		
	Pre-frail	1.86	0.63; 5.47	0.26	1.57	0.52; 4.78	0.426
	Frail	7.22	2.57; 20.28	0	5.47	1.77; 16.84	**0.003**
Sex	Female	Ref.			Ref.		
	Male	0.98	0.59; 1.64	0.95	1.58	0.86; 2.91	0.141
Race/ethnicity	White	Ref.			Ref.		
	Non-white	1.1	0.65; 1.87	0.71	1.02	0.57; 1.81	0.95
Age group	60–70	Ref.			Ref.		
	70–80	1.5	0.73; 3.10	0.27	1.04	0.48; 2.24	0.926
	≥80	2.87	1.46; 5.63	0	0.98	0.45; 2.15	0.959
Marital status	Married / Common-law union	Ref.			Ref.		
	Widowed	1.96	1.12; 3.45	0.02	1.7	0.86; 3.37	0.127
	Other	1.17	0.55; 2.50	0.68	1.11	0.49; 2.52	0.806
Older adult income (MW)	0 - 1	Ref.			Ref.		
	1,1 - 3	0.75	0.44; 1.28	0.3	0.92	0.52; 1.61	0.764
	3,1 - 10	0.24	0.07; 0.80	0.02	0.29	0.08; 0.99	**0.048**
Palliative care	No	Ref.			Ref.		
	Yes	3.7	1.96; 6.99	0	2.5	1.11; 5.63	**0.027**
Hospitalization in the previous 12 months	No	Ref.			Ref.		
	Yes	0.71	0.41; 1.23	0.22	0.44	0.24; 0.80	**0.008**
Fall in the previous 12 months	No	Ref.			Ref.		
	Yes	1.4	0.84; 2.33	0.2	1.4	0.80; 2.45	0.242
Nutritional status	Normal weight	Ref.			Ref.		
	Underweight	2.39	1.30; 4.40	0.01	1.05	0.49; 2.23	0.897
	Overweight	0.82	0.43; 1.57	0.55	0.93	0.46; 1.91	0.851
Dementia	No	Ref.			Ref.		
	Yes	3.76	2.18; 6.50	0	2.51	1.34; 4.70	**0.004**
Previous stroke	No	Ref.			Ref.		
	Yes	1.47	0.82; 2.63	0.2	0.89	0.45; 1.74	0.726
Depression	No	Ref.			Ref.		
	Yes	0.99	0.47; 2.09	0.98	1.09	0.46; 2.58	0.837
Cancer	No	Ref.			Ref.		
	Yes	1.28	0.55; 2.98	0.57	1.3	0.54; 3.11	0.561
Dyslipidemia	No	Ref.			Ref.		
	Yes	0.76	0.42; 1.36	0.35	0.73	0.39; 1.39	0.343

HR – Hazard Ratio; 95% CI – 95% confidence interval; MW – Minimum Wage; Stroke – Cerebrovascular accident. Cox proportional hazards regression model.



to be continued

Continuation of Figure 3

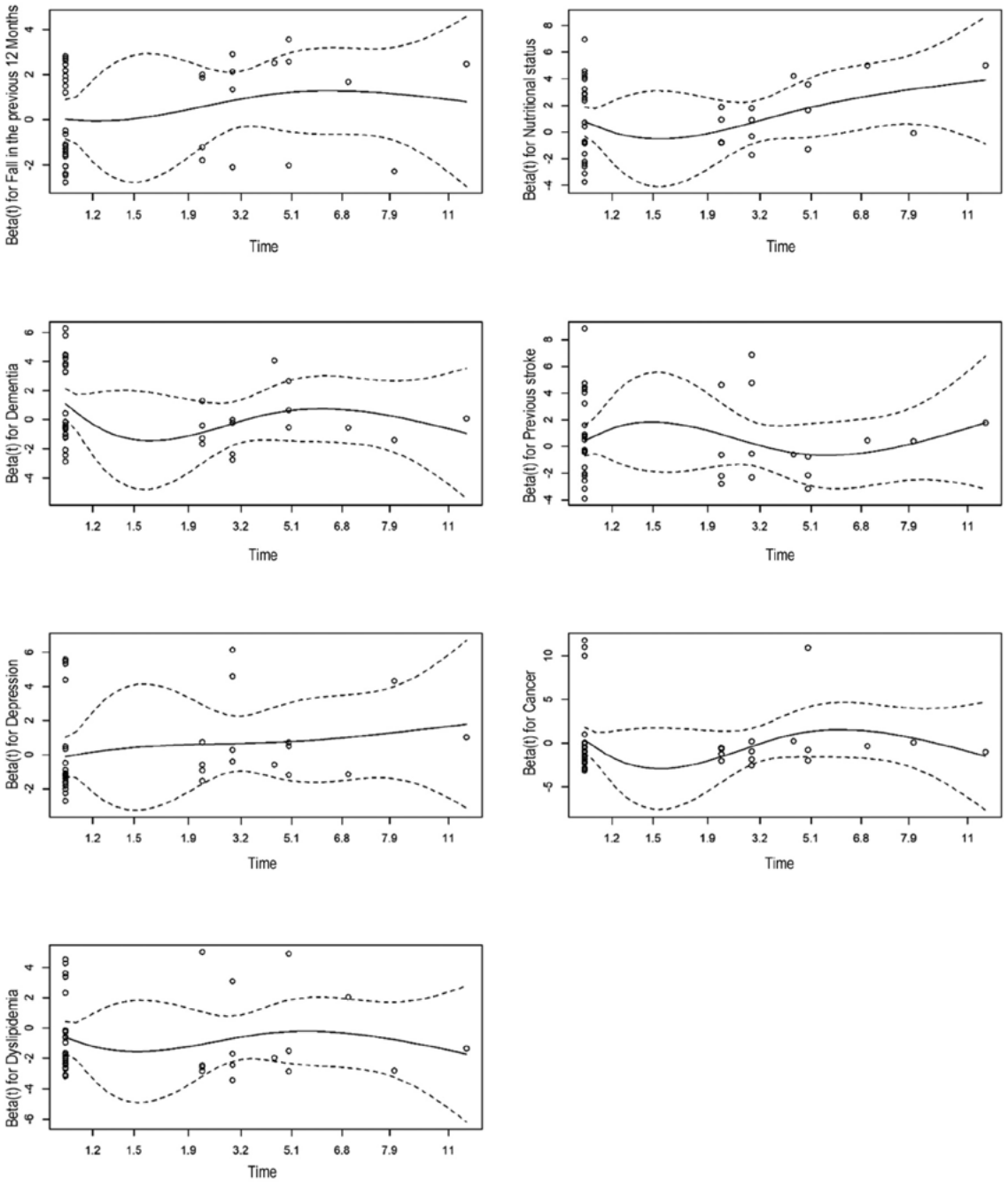


Figure 3. Schoenfeld residual plot – first diagnosis of delirium in hospitalized older adults (N=427). Curitiba, PR, 2022–2023.

DISCUSSION

The characteristics observed in the sample, such as frailty, dementia, and the need for palliative care, represent classical markers of physiological and cognitive vulnerability associated with delirium. Advanced age is associated with reduced homeostatic reserve, immune dysfunction, and a greater burden of comorbidities, increasing the risk of an exaggerated response to acute stressors[18]. Population-based data from Spain corroborate the importance of advanced age as a predisposing factor for delirium. In a sample of 4,628,397 hospitalized patients, an increase in delirium prevalence with advancing age was observed, reaching 48% among individuals aged 81 to 90 years[19].

Frailty, defined as a state of increased vulnerability to acute stressors[16], is a strong clinical predictor of delirium. In the present study, frail individuals had a 5.47-fold higher risk of delirium compared with non-frail individuals, in agreement with previous studies reporting a two- to threefold increased risk in hospitalized populations[20,21]. In a recent literature review, the authors stated that frailty and delirium share common pathophysiological mechanisms, including chronic inflammation, neurodegeneration, metabolic insufficiency, and increased vascular burden, suggesting that both may represent interrelated manifestations of an accelerated biological aging process[22]. These findings highlight the importance of systematic strategies for screening and management of frailty as a central component in the prevention of delirium in hospitalized older adults.

Frail older adults tend to develop delirium earlier than non-frail individuals. The relationship between frailty, delirium, and length of hospital stay was explored in a multicenter study using the Clinical Frailty Scale[23]. Delirium occurred earlier in frail patients. Among those who developed delirium during hospitalization, length of hospital stay did not vary according to frailty status; however, in older adults without delirium, greater frailty was associated with progressively longer hospital stay. Thus, the impact of delirium may outweigh the incremental effect of frailty on the duration of hospitalization[23].

Low body weight also emerged as a significant risk factor, associated with earlier onset of delirium, as reported in a study conducted in South Korea with 5,622 hospitalized older adults, in which the overall incidence of delirium reached 19%, with a significantly higher risk among underweight patients (OR 1.51; 95% CI 1.07–2.12)[24]. Although the literature addresses several risk factors for delirium development, there is still a gap regarding the analysis of time to onset of the condition.

Regarding dementia, the present study identified a 2.51-fold higher risk of delirium in individuals with this diagnosis, in agreement with the literature that identifies dementia as an important predisposing factor[25,26]. Reduced cognitive reserve and difficulty adapting to the hospital environment reinforce this vulnerability. Another variable explored was room type, with a lower risk of delirium observed in older adults hospitalized in single rooms (HR 0.66; 95% CI 0.48–0.93)[24]. A systematic review aimed to evaluate risk stratification instruments for delirium, and the synthesis of results identified dementia as the most frequent factor, with odds ratios ranging from 3.3 to 18.33[27].

Longitudinal studies demonstrate that the presence of dementia is associated not only with a higher risk of delirium but also with longer hospital stay (14.3 vs. 7.7 days) and increased hospital costs[28]. Therefore, this condition is highly relevant in planning care for hospitalized older adults.

In the social domain, variables such as widowhood and low income reveal less explored but critical dimensions related to vulnerability to delirium. Income higher than three minimum wages was identified as a protective factor against early occurrence of delirium, with a relative risk reduction of 71%. These findings are supported by a prospective cohort study conducted in Boston (USA), in which populations living in socioeconomically disadvantaged neighborhoods had a doubled risk of postoperative delirium (RR 2.0; 95% CI 1.3–3.1; p=0.01)[29]. These results suggest that social determinants should be interpreted considering contextual inequalities, access to trained caregivers, and the availability of social support networks. Lower

socioeconomic status has also been associated with a higher incidence of frailty, greater likelihood of progression to more advanced frailty states, and lower probability of reversal[30].

Widowhood, in turn, may reflect loss of social and emotional support, favoring isolation and reducing resilience to acute stressors. Studies indicate that older adults living alone constitute a heterogeneous group, in which some maintain independence and diversified support networks, while others present a higher risk of prolonged hospitalization and increased hospital costs[31,32]. These findings highlight the importance of integrated social approaches to mitigate vulnerabilities that predispose to delirium.

In the clinical domain, receiving palliative care emerges as a robust factor associated with increased risk of delirium. In the present study, older adults receiving palliative care had a 2.5-fold higher risk of delirium compared with those not receiving this type of care. Systematic reviews demonstrate widely variable prevalence of delirium in palliative care, estimated between 4% and 88%, with approximately one third of hospitalized patients in palliative settings presenting delirium[33], reaching up to 93% in terminal stages[34].

The high prevalence of delirium in palliative care reflects the complex interaction of multiple precipitating factors, including polypharmacy, use of medications with anticholinergic effects, metabolic disturbances, infections, and exacerbated physical and psychological distress, making this population particularly vulnerable[34]. Recognition of this increased risk reinforces the need for systematic strategies for prevention, early identification, and individualized management of delirium in palliative care, aiming to reduce suffering and improve quality of life for patients and caregivers.

Unexpectedly, older adults with a history of hospitalization in the previous 12 months showed a 58% lower relative risk of delirium diagnosis compared with those without previous hospitalization. One possible explanation for this finding is that prior hospitalizations may have facilitated the recognition of risk factors and the implementation of multicomponent preventive strategies, as demonstrated in programs such as the Hospital Elder Life Program[35]. In addition, a possible selection bias should be considered, since more fragile patients or those who had previously developed delirium may have died, characterizing a survivor bias.

Delirium is a challenging condition for research in the hospital setting, given its fluctuating presentation. A limitation of this study is the scarcity of investigations that systematically incorporate the variable "time to delirium onset" in hospitalized older adults, which makes direct comparisons difficult and increases the complexity of temporal analysis of this geriatric syndrome.

CONCLUSION

The identified risk factors represent markers of multidimensional vulnerability in older adults, indicating reduced physiological, cognitive, and social reserve to cope with acute stressors, with frailty, presence of dementia, and the need for palliative care standing out as the main independent risk factors. Conversely, higher income was identified as a significant protective factor, highlighting the role of socioeconomic determinants in the occurrence of delirium.

Survival analysis allowed the identification of significant differences in the time to the first episode, reinforcing the relevance of preventive strategies directed toward higher-risk groups. These findings contribute to the improvement of early screening and clinical management of delirium in older adults, with implications for clinical practice and health policy planning.

In this context, delirium should not be considered merely an episodic event, but rather a sign of overall clinical decompensation and increased risk for worse clinical outcomes, such as mortality and functional decline. The identification and management of these conditions are essential to prevent the occurrence of delirium and to mitigate its consequences.

AUTHOR CONTRIBUTIONS

- Clovis Cechinel — study conception and design; drafting or critical revision of the manuscript; final approval of the version to be published; responsibility for all aspects of the work; conceptualization; data curation; writing – review and editing; investigation; methodology; software; validation; visualization.

- Maria Helena Lenardt — drafting or critical revision of the manuscript; final approval of the version to be published; responsibility for all aspects of the work; project administration; formal analysis; methodology; supervision; validation; visualization.

- João Alberto Martins Rodrigues — study conception and design; drafting or critical revision of the manuscript; final approval of the version to be published; responsibility for all aspects of the work; formal analysis; conceptualization; data curation; writing – review and editing; investigation; methodology; software; validation; visualization.

Edited by: Maria Luiza Diniz de Sousa Lopes

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Profile and practices of municipal managers in older persons' health care: perspectives and challenges in the Amazonian context

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Abstract

Objective: To analyze the profile of managers responsible for implementing health policies for older persons. *Methodology*: This is a descriptive, exploratory, cross-sectional study with a quantitative approach. Data were collected in 2024 from municipal managers responsible for older persons' health care. A synchronous remote interview technique was used, involving the administration of an online questionnaire and real-time recording of responses by the researcher. *Results*: The study reveals a profile predominantly composed of young women, with a mean age of 40.4 years (±8.7), holding temporary positions within municipal health departments, with an average tenure of 2.5 years (±3.1) in their roles, and trained as nurses. The findings also indicate that 89.2% of respondents share management responsibilities with other health programs, 65.7% are unaware of legal frameworks and guiding documents, 54.3% have prior management experience, and 45.7% do not participate in Municipal Councils for Older Persons (CMPI). *Conclusion*: The study highlights weaknesses in the management of older persons' health policies, expressed by limited training in aging and public health policy management, employment instability, and the need to improve working conditions to avoid disruptions in work processes. Investment in continuous professional development is recommended, along with strategies to reduce staff turnover and workload among technical staff, ensuring management capable of promoting care pathways aligned with the specific needs of the older population in the Amazon region.

Keywords: Primary Health Care. Aged. Professional Training. Health Policy. Health Management.

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Não houve financiamento para a execução deste trabalho.

Os autores declaram não haver conflito na concepção deste trabalho.

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Received: October 6, 2025
Approved: March 24, 2026

INTRODUCTION

Although Brazil has advanced legislation for older persons, its practical implementation still faces challenges, requiring greater efforts to ensure autonomy and healthy aging amid demographic changes. For the first time, the number of older persons has exceeded that of young people aged 15 to 24 years (14.8%)[1]. From this perspective, care is guided by the National Policy for the Health of Older Persons (PNSPI), aligned with the World Health Organization (WHO), which seeks to strengthen intersectorality, improve the quality of care, and expand access within the Health Care Network (RAS)[1,2].

In the state of Amazonas, geographic, climatic, and socioeconomic barriers impose multidimensional constraints. Overcoming these distances and service gaps requires innovative solutions that address the specific needs related to access to health care and improvements in lifestyle habits[2].

Such territorial singularities demand that managers demonstrate strategic and governance capacity, enabling them to operate under conditions of limited institutional capacity and adapt care to riverine and Indigenous contexts, in order to ensure that the PNSPI is effective in hard-to-reach areas.

It is noteworthy that the growth rate of the older population in Amazonas, according to the most recent census, showed an increase of 3.5%, reaching 8.8% of the total population over a ten-year period. In Manaus, this group represents 10% of the population, equivalent to 237,000 individuals aged over 60 years[1].

In this context, the current epidemiological profile in Brazil requires a model of care capable of meeting population health needs through an organized and coordinated RAS, including the development of care pathways, definition of competencies, and articulation among points of care[3]. Such networks were established to overcome fragmentation and ensure comprehensiveness of care through different services, as well as to promote active and healthy aging[4].

From this perspective, Primary Health Care (PHC) assumes a strategic role as the preferred entry point into the RAS. According to its guiding principles, PHC organizes care by integrating health promotion, prevention, and treatment, while coordinating care networks to enhance longevity and quality of life. These attributes ensure comprehensive and effective care for older adults within the Brazilian Unified Health System (SUS), from entry into the RAS to longitudinal care, ensuring the efficient use of public resources, in accordance with the principle of economic efficiency[5,6].

Within this framework, the Unified Social Assistance System (SUAS) emerges as a key partner within the SUS in the care of older adults, bringing together public authorities and civil society[7]. This integration highlights the need for qualified managers capable of using evidence and a holistic perspective to overcome the challenges of the Amazonian context and ensure the effectiveness of public policies[8].

Given this context, analyzing the profile of managers responsible for health policies for older adults is essential to improve management practices, shed light on the lived realities, and reinforce the need for ongoing professional development to promote healthy aging.

METHODS

This is a descriptive, exploratory, cross-sectional study with a quantitative approach, using municipalities in the state of Amazonas as the research setting. A data collection instrument was developed and adapted from an ongoing project: "Qualification of municipal managers of the health policy for older adults in the state of Pernambuco: action research." All closed-ended questions were configured as single-response items, resulting in a final version comprising 31 questions distributed across three thematic blocks.

The study setting included the 62 municipalities of Amazonas. Its population currently totals 3,941,613 inhabitants, of whom 4.2% are aged over 60 years[1]. The study population consisted of municipal managers responsible for older adult health actions, designated by the State Health Department.

The sample included all professionals active during the study period, with a final participation of 35 managers. At least two contact attempts (message/phone call) were made with each professional. Non-participation may be related to operational limitations, divergent political priorities, lack of awareness regarding the study's impact, logistical barriers, or possible institutional resistance to exposing vulnerabilities.

In this sense, the low participation compromises the representativeness of the study by introducing selection bias, reflecting only the realities of the most engaged or better-structured contexts. This limitation restricts the analysis of regional and socioeconomic diversity and may result in public policies that fail to address challenges faced by smaller municipalities or those with lower administrative capacity.

Non-participation cases were classified as sample attrition that might have been mitigated if data collection had occurred in person; however, this strategy was not feasible due to long intermunicipal distances, extended duration of river travel, and the high cost of air transportation.

Data were collected in 2024 from municipal managers of older adult health care using a synchronous remote interview technique, involving the administration of an online questionnaire and immediate recording of responses by the researcher. For those who accepted the invitation, individual contact (audio/video) was established to present the project and conduct a full reading of the Informed Consent Form (ICF). After agreement and signing of the ICF, the online questionnaire was administered, and responses were recorded simultaneously.

To characterize the managers' profile, an exploratory data analysis was performed using JAMOVI software, version 2.3.28, including the description of quantitative variables (mean and standard deviation) and absolute (n) and relative (%) frequencies for categorical variables.

For qualitative data, Bardin's content analysis framework[9] was employed, following the stages of pre-analysis (transcription and organization), material exploration (coding), and categorization of semantic elements. All stages and analytical procedures were conducted by the researcher, including reading, coding, and grouping. Based on this process, a deeper interpretative effort was undertaken to support the theoretical reconstruction of the analyzed data.

Subsequently, the researcher performed a final review to validate meanings and construct thematic categories. The categorization process, structured around central ideas identified as Recording Units (RU)[9], allowed the emergence of three analytical categories in the dataset: deficit in professional training, precarious labor conditions, and institutional fragility.

The research project was submitted to the Research Ethics Committee of the Universidade Federal do Amazonas (Opinion No. 7,175,387). Ethical aspects were observed in accordance with Resolution No. 466/12 of the National Health Council (CNS).

It is noteworthy that the data in this study were properly anonymized, ensuring the protection of individual information. Their reuse will be authorized only under previously established conditions, directed toward scientific and institutional purposes.

DATA AVAILABILITY

The dataset is not publicly available due to the protection of participants' privacy and may be accessed only upon request to the corresponding author.

RESULTS

Data analysis showed that among the 62 eligible individuals, 56.5% agreed to participate. However, even after at least two contact attempts, by message or telephone call, a non-response rate of 43.5% was recorded and classified as sample attrition.

Based on single-response items, the results were structured into three thematic axes: 1. Sociodemographic identification; 2. Education and professional background; and 3. Comprehensive health care for older adults.

The municipal management of health actions for older adults in Amazonas shows a profile predominantly composed of young women, with 68.6% identifying as female. The results also indicate that the mean age of participants was 40.4 years (±8.7), which is consistent with findings from another study[10].

Regarding age distribution, most participants were between 25 and 34 years (46%). However, it should be noted that studies focusing on managers of older adult health actions remain scarce. Concerning place of residence and work, 100% of respondents both lived and worked in their respective municipalities.

The data indicate that 100% of participants had completed higher education. Regarding undergraduate background, 51.4% were nurses, while the remaining 48.5% were professionals from other fields, as described in Table 1. In line with this finding, a survey conducted by the National Council of Municipal Health Secretariats (CONASEMS) in the Northern region between 2017 and 2020 found that 54.4% of individuals in leadership positions were nurses, highlighting their predominance in decision-making processes within public services and their contribution to municipal management of the SUS[10]. The mean time since completion of higher education was 9.3 years (±7.1) (Table 1).

Among respondents, 88.6% had completed postgraduate education, of whom 62.9% had completed a specialization. Regarding the field of their most recent postgraduate training, 28.6% reported Public Health or a related field (Table 1); however, only one individual specialized in Gerontology. In this study, the term Public Health encompasses Collective Health, a Latin American interdisciplinary approach integrating social sciences and public health.

Table 1. Distribution of managers according to level of education, undergraduate degree, postgraduate education, and field of most recent postgraduate training. Manaus, AM, 2025.

Variable	n (%)
Level of education	
Specialization	9 (25.7%)
Master's degree	2 (5.7%)
Undergraduate degree	24 (68.6%)
Undergraduate field of training	
Physical Education	7 (20.2%)
Nursing	18 (51.4%)
Physiotherapy	3 (8.6%)
Social Work	1 (2.9%)
Other	6 (17%)
Postgraduate level	
Master's degree	3 (8.6%)
Completed graduate specialization	22 (62.9%)
Incomplete graduate specialization	6 (17%)
None	4 (11.4%)
Field of most recent postgraduate training	
Public Health or related field	10 (28.6%)
Gerontology or related field	1 (2.9%)
Other	20 (57.1%)
Prefer not to answer	2 (5.7%)
Not applicable / No postgraduate training	2 (5.7%)

Source: Research database. n=35; single-response items; percentages calculated based on total respondents; rounded values may not sum to 100%.

Participation in complementary training in Public Health or Gerontology was reported by 71.4% of professionals. Among these, one-third of the training programs had a duration of less than 20 hours. It was also observed that most municipalities did not regularly offer training courses, which may negatively impact the promotion of self-care and independence among older adults. Among professionals who participated in training, 54.3% were able to identify them, and of these, 48.6% reported having attended training in Gerontology (Table 2).

It was also observed that 42.9% of participants reported the availability of health training in their municipality of practice. Regarding the most recent training, 33.5% reported that it addressed multidimensional assessment, while 13.5% reported comprehensive care for older adults. In terms of frequency, 33.3% of respondents indicated that training sessions were conducted semiannually (Table 2).

Table 2. Distribution of managers according to participation in complementary training, training type, frequency, and classification. Manaus, AM, 2025.

Variable	n (%)
Complementary training in Public Health or Gerontology	
Courses with a duration of up to 40 hours	6 (17.1%)
Courses with a duration of 121 hours or more	4 (11.4%)
Courses with a duration of up to 20 hours	7 (20%)
Courses with a duration of up to 120 hours	4 (11.4%)
Short courses lasting less than 4 hours each	4 (11.4%)
Prefer not to answer	1 (2.9%)
No	9 (25.7%)
Name of the training	
Gerontology	17 (48.6%)
Public Health	1 (2.9%)
Not applicable / No training	10 (28.5%)
Cannot recall	5 (14.3%)
Prefer not to answer	1 (2.9%)
Other	1 (2.9%)
Availability of training in Older Adult Health	
No	20 (57.1%)
Yes	15 (42.9%)
Frequency of training	
Annual	3 (20%)
Occasionally	5 (33.3%)
Semiannual	5 (33.3%)
Quarterly	2 (13.3%)
Training in Older Adult Health	
Multidimensional assessment of older adults	5 (14.2%)
Comprehensive care for older adults	2 (5.7%)
Other	8 (22.8%)
Not applicable	17 (48.5%)
Prefer not to answer	3 (8.5%)

Source: Research database. n=35; single-response items; percentages calculated based on total respondents; rounded values may not sum to 100%.

Regarding employment status, the study revealed that 65.7% were temporary employees, 17.1% held appointed positions, and 8.5% were permanent civil servants. The data also show that 82.9% of participants combined management responsibilities with other activities, while 8.6% were exclusively dedicated to these demands but received no additional compensation, and 5.7% were compensated and worked exclusively in management roles (Table 3). It is noteworthy that the mean duration of work in the management of older adult health is 2 years.

When categorized by time in management of Older Adult Health, the data show that 34.3% of professionals had been in the role for less than one year, while 62.9% had between 1 and 10 years in this role. Regarding previous management areas, 51.4% had developed managerial activities in the health sector (Table 3). It is noteworthy that 100% of respondents were responsible for managing the program at the time of the interview.

The data indicate that, regarding knowledge of legal frameworks, 28.6% cited the Statute of Older Adults. However, in self-assessment regarding the PNSPI, 51.4% reported having a good level of knowledge. Concerning knowledge of policy guidelines and manuals, 74.3% stated they were familiar with them (Table 4).

Regarding the existence of specific goals for older adults' health demands, 45.7% of professionals reported that such objectives were included in the municipal health plan. Concerning the existence of care pathways, 40% indicated that they existed but had not been formally published, while 31.4% reported their absence. With respect to home care programs, 85.7% stated that these existed only within primary health care.

When asked to evaluate actions ensuring care for older adults, 40% rated them as good and 22.9% as excellent. Regarding the existence of a Municipal Councils for Older Persons (CMPI) and the participation of the Municipal Health Department (SMS), the results showed that 45.7% reported that no CMPI was in operation in their municipality (Table 4).

Figure 1 presents the main limitations for the implementation of older persons' health policies in municipalities. Content analysis according to Bardin[9] allowed these limitations to be grouped into three central categories: deficit in professional training, evidenced by lack of knowledge of legal frameworks and limited specific training in aging; precarious employment conditions, marked by high turnover and temporary contracts, which compromise continuity of actions and comprehensiveness of care; and institutional fragility, expressed in the absence of consolidated care pathways, low representation in municipal councils, and difficulties in intersectoral coordination. These findings indicate that the identified barriers go beyond isolated issues and reflect structural constraints in health management.

Similarly, it is observed that management weaknesses are not restricted to the technical dimension but result from the combination of training gaps, contractual instability, and insufficient governance mechanisms. The analysis showed that these factors compromise the effectiveness and sustainability of public policies aimed at older adults. Thus, the need for continuous investment in professional training, improvement of employment conditions, and strengthening of institutional capacity is highlighted, with a view to consolidating care pathways capable of responding to the demands of population aging in Amazonas.

Table 3. Distribution of managers according to professional data. Manaus, AM, 2025.

Variable	n (%)
Employment status	
Temporary contract employee	23 (65.7%)
Political appointee	6 (17.1%)
Permanent civil servant	3 (8.6%)
Other	2 (5.7%)
Prefer not to answer	1 (2.9%)
Manager exclusively dedicated to this role	
No	29 (82.9%)
No additional compensation for the role	3 (8.6%)
Prefer not to answer	1 (2.9%)
Compensated for the role	2 (5.7%)
Time in management of the Older Adult Health Program	
Less than 1 year	12 (34.3%)
Between 1 and 10 years	22 (62.9%)
More than 10 years	1 (2.9%)
Previous management experience	
Less than 1 year	19 (54.3%)
Between 1 and 5 years	11 (31.4%)
Between 5 and 10 years	2 (5.7%)
More than 10 years	3 (8.6%)
Areas of previous management	
Hospital management	1 (2.9%)
Other coordination roles	1 (2.9%)
Coordination of health programs	5 (14.3%)
Primary Health Care (PHC) management	4 (11.4%)
PHC management and coordination of health actions	2 (5.7%)
Hospital management and coordination of health actions	1 (2.9%)
Coordination of Sexually Transmitted Infections (STIs)	1 (2.9%)
Clinical practice and Basic Health Unit (BHU) management	1 (2.9%)
Nursing management	1 (2.9%)
Indigenous Health Coordinator; Municipal Laboratory Manager	1 (2.9%)

Source: Research database. n=35; single-response items; percentages calculated based on total respondents; rounded values may not sum to 100%.

Table 4. Distribution regarding knowledge of policies. guidelines. and provision of care for older adults. Manaus, AM, 2025.

Variable	n (%)
Knowledge of legal frameworks	
Statute of Older Adults	8 (22.9%)
National Policy for the Health of Older Persons (PNSPI)	4 (11.4%)
Other	2 (5.7%)
No	3 (8.6%)
Cannot recall	10 (28.6%)
Prefer not to answer	8 (22.9%)
Self-assessment of knowledge of policies	
Good	18 (51.4%)
Fair	12 (34.3%)
Excellent	2 (5.7%)
Poor	2 (5.7%)
Knowledge of PNSPI guidelines/manuals	
No	6 (17.1%)
Yes	26 (74.3%)
Prefer not to answer	3 (8.6%)
Identification of manuals	
Older Person's Health Handbook	9 (25.7%)
Primary Health Care Notebooks No. 19	3 (8.6%)
Other manuals	7 (20%)
Prefer not to answer	16 (45.7%)
Specific goals for older adult health	
Yes	16 (45.7%)
No	15 (42.9%)
Prefer not to answer	4 (11.4%)
Care pathway	
Yes, but not officially published	14 (40%)
Yes, officially published and implemented	2 (5.7%)
Yes, officially published but not implemented	1 (2.9%)
No	11 (31.4%)
Prefer not to answer	7 (20%)
Access to specialized professionals	
Yes	8 (22.9%)
No	27 (77.1%)

to be continued

Continuation of Table 4

Variable	n (%)
Multidimensional assessment	
Older Person's Health Handbook	25 (71.4%)
Other instruments	6 (17.1%)
No	3 (8.6%)
Prefer not to answer	1 (2.9%)
Home care program	
Available only within Primary Health Care	30 (85.7%)
In SAD III modality	1 (2.9%)
In SAD II modality	4 (11.4%)
Evaluation of activities carried out in the municipality	
Excellent	8 (22.9%)
Good	14 (40%)
Fair	10 (28.6%)
Poor	1 (2.9%)
Prefer not to answer	2 (5.7%)
Existence of CMPI and participation in plenary sessions	
There is no CMPI in the municipality	16 (45.7%)
A CMPI exists, but the SMS has no seat	1 (2.8%)
A CMPI exists, but another representative of the SMS holds a seat	4 (11.4%)
A CMPI exists, and I hold a seat	7 (20%)
A CMPI exists but is not currently functioning	1 (2.8%)
Prefer not to answer	6 (17.1%)

Source: Research database. n=35; single-response items; percentages calculated based on total respondents; rounded values may not sum to 100%. SAD – Home Care Service; CMPI – Municipal Councils for Older Persons; SMS – Municipal Health Department.

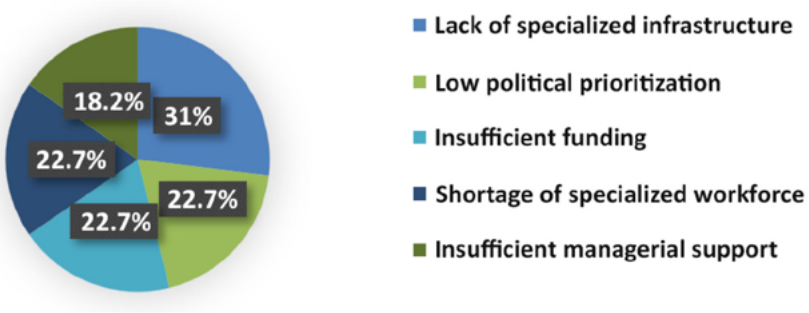


Figure 1. Distribution of limitations for the implementation of policies. Manaus, AM, 2025.

Source: Research database.

DISCUSSION

The management of older adult health actions in municipalities of Amazonas reveals a profile predominantly composed of young women, highlighting a marked trend toward workforce feminization[11]. This phenomenon stems from the historical association of care with the female gender, consolidated sociocultural patterns, and the significant presence of women in health professions, both in service provision and in the coordination of health policies.

The mean age of managers in municipalities of Amazonas, estimated at 40 years, is consistent with findings from other studies[10,12], reinforcing the notion that maturity is a requirement for assuming management positions. However, it is observed that the most frequent age group falls between 25 and 34 years, which may bring innovation and dynamism, but also challenges related to limited experience in policies targeting this population. It is also noteworthy that there is a scarcity of studies specifically addressing managers of older adult health actions, which limits more robust and in-depth comparisons.

Regarding educational background, this study indicates a predominance of nurses in the management of health actions for older adults. These findings emphasize the central role of this professional category in decision-making processes within public services, which can be attributed to their training focused on leadership, service organization, and comprehensive care, particularly in Primary Health Care, making them well-suited for coordination and health policy management roles[13].

With respect to complementary training, the results show that most respondents have limited training in aging; only one participant reported having a specialization in Gerontology. Furthermore, most municipalities do not regularly offer training programs for professionals, which may negatively impact the promotion of self-care and independence among older adults.

Thus, it becomes evident that, despite advances in legislation through the development of strategies and instruments for the care of the older population, these measures are ineffective without engagement from professionals and governmental bodies, both essential to effective public policy implementation and health care delivery[14].

To operationalize and implement such policies, it is necessary to establish specific goals to define and adapt plans, projects, and activities within the health sector, facilitating periodic monitoring, strategic planning, and timely intervention in outcomes, so that they remain consistent and effective over time[15]. This study identified municipalities that already incorporate actions targeting older adults within their Municipal Health Plans, demonstrating concern for the improvement, maintenance, and recovery of functional capacity in this population.

In this context, the relevance of Municipal Councils for Older Persons (CMPI) is highlighted, as they are essential to ensure the effectiveness of public policies through oversight and social participation of this group[16]. However, the study shows that most municipalities do not have a functioning council, resulting in a gap in representation and weakened social control. This scenario limits the development of inclusive policies and demonstrates that, even in the presence of clear guidelines from the PNSPI, there is influence from the executive branch over their creation and operation, hindering the implementation of intersectoral policies[17,18]. Therefore, ensuring their operation is essential to consolidate social participation and integrate aging into municipal planning.

Regarding prior management experience, the data reveal a predominance of professionals with less than one year in the role, which may be associated with political turnover, scarcity of specialized professionals, and the relatively young profile of the workforce. This situation may lead to weakened management, risk of discontinuity, and reduced effectiveness of policies[13].

Concerning previous management roles, 45.7% of participants had no prior experience in other areas. It is noteworthy that the average duration of work in the management of older adult health is two years, which may be related to limited familiarity with policies addressing older adults among respondents. It is important to recall that the PNSPI and the Statute of Older Adults guide social and health actions to ensure

rights and protection, requiring shared responsibilities across sectors and encouraging autonomy and active participation of older adults in society[19].

Accordingly, the average duration observed in this study reflects high turnover among professionals, most of whom are employed under temporary or appointed contracts. The absence of stable employment ties may compromise the longitudinality of care, lead to disorganization within the health system, and negatively affect the quality of care provided. Moreover, professionals working under precarious conditions, without access to rights and benefits, tend to show lower engagement in the consolidation of long-term public policies[20].

Another aspect to be highlighted is the diversity of employment arrangements, ranging from tenured civil servants to contracts under the Consolidation of Labor Laws (CLT), with a large proportion of professionals being temporarily hired or occupying appointed positions. The coexistence of these different arrangements reflects regional complexity, marked by difficulties in workforce retention, political influence, and even budgetary constraints affecting hiring practices, which may contribute to precariousness and institutional fragility[21].

In light of this, the study highlights the need to address precarization of labor in the public sector. The National Humanization Policy (PNH), together with occupational health policies, provides guidance for this process, aiming to ensure compliance with constitutional principles and the democratization of access to public services, enabling workers to effectively mediate the relationship between society and the State[22].

Regarding exclusive dedication to managerial responsibilities, most participants reported performing duties inherent to their professional roles in parallel with their managerial functions, which may lead to work overload and hinder the acquisition of specific training focused on older adult health. Given the impracticality of assigning a dedicated professional exclusively to these demands, since most municipalities are small, training focused on understanding life cycles and their specificities may contribute to a more comprehensive perspective among technical staff.

This study reveals that, although most municipalities reported having a defined care pathway, few have formally published and implemented it. This indicates weaknesses in the articulation and integration of multidisciplinary actions, compromising comprehensive and longitudinal patient care. The literature highlights that a well-structured care pathway positively influences the reorganization of care for older adults, the quality of healthy aging, and the sustainability of the Brazilian health system[23].

Within the care pathway, the Older Person's Health Handbook is a low-complexity tool that enables individualized record-keeping, encourages self-care, supports longitudinal follow-up, facilitates care planning and allows multidimensional assessment of older adults[17]. Although cited by many managers, the literature attributes its underuse to lack of knowledge, unavailability of the instrument in Basic Health Unit (BHU), and limited time for completion, which may negatively affect the health and quality of life of older adults[24]. Nevertheless, its use reflects an intention to improve health outcomes and optimize financial resources.

Accelerated population aging, driven by scientific advances, urbanization, and declining birth and mortality rates, poses new challenges to the effectiveness and sustainability of public policies. This scenario requires the reformulation of public policies that promote intersectoral actions to extend life expectancy and mitigate social inequalities, ensuring comprehensive care for older adults[25].

In this context, the predominance of nurses in public health management results from the interaction between organizational factors, such as training oriented toward leadership, lack of specific training, and precarious employment conditions, and federative factors, including political turnover, decentralization of the SUS, and territorial inequalities. In municipalities of Amazonas, this combination of institutional fragility and precarization compromises the implementation of the PNSPI, hindering logistics, technical support, and continuing education, as well as weakening regional coordination, leading to discontinuity of actions and increased vulnerability to adverse regional conditions[19].

The limitations of this study include the voluntary participation of only 35 managers (56.5%), even after

at least two contact attempts by telephone. This limitation could have been minimized through in-person data collection, which was not feasible due to long intermunicipal distances, extended river travel time, and the high cost of air transportation in the region.

CONCLUSION

The findings indicate weaknesses in the management of older adult health care in the municipalities studied, characterized by limited experience among managers in aging-related issues and public management. It is therefore imperative to invest in continuous training and to implement strategies to reduce staff turnover and workload, ensuring management capable of effectively promoting care pathways aligned with population needs.

In the Amazonian context, understanding local specificities, such as low population density, traditional populations (Indigenous peoples, *quilombola* communities, and especially riverine populations), and their distinct ways of life along rivers or in isolated areas, is essential, as these factors represent structural challenges. Overcoming such barriers is fundamental to achieving universality, comprehensiveness, and continuity of care for older adults.

Among the most relevant aspects identified in this study are limited training in aging, lack of knowledge of public policies and employment instability. These factors may lead to discontinuity in longitudinal care, compromise the quality of services, and result in disorganization of the health system.

Potential strengths include the presence of specific goals in municipal plans and the use of instruments aimed at improving the quality of care, which support the organization of health team activities and enable monitoring by family members. However, the operationalization of public policies within the SUS requires health managers with continuous learning capacity, who prioritize innovative solutions, address the diverse health needs of urban and rural older populations, and promote social participation toward a more just, inclusive and equitable society.

Investment in continuing education and strategies to reduce staff turnover and workload is recommended, ensuring management capable of promoting appropriate care pathways. Furthermore, it is imperative to prioritize policies targeting individuals aged 60 years and older. These findings are expected to support future research and contribute to the implementation of health policies for older adults in alignment with local realities.

It is also important to acknowledge methodological limitations of the study, such as the use of a convenience sample, high attrition rate (43.5%), self-reported data, and the descriptive nature of the analysis. These factors may limit the generalizability of the findings and the establishment of causal relationships, without diminishing the relevance of the evidence produced as a basis for reflection and for improving the management of older adult health care.

AUTHOR CONTRIBUTIONS

- Vivianne Karol Gomes Palha – Project Administration; Formal Analysis; Conceptualization; Data Curation; Writing – Original Draft Preparation; Writing – Review & Editing; Investigation; Methodology; Resources; Validation; Visualization.
- Tamires Carneiro de Oliveira Mendes – Project Administration; Formal Analysis; Conceptualization; Data Curation; Writing – Review & Editing; Methodology; Supervision; Validation; Visualization.
- Sanay Vitorino de Souza – Formal Analysis; Conceptualization; Data Curation; Writing – Review & Editing; Supervision; Visualization.
- Grasiela Piuvesam – Formal Analysis; Writing – Review & Editing; Visualization.
- Vanessa de Lima Silva – Formal Analysis; Conceptualization; Visualization.
- Kenio Costa de Lima – Conceptualization; Methodology; Visualization.

Edited by: Cristian Arnecke Schröder

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Development and validity evidence of a care-educational website for fall prevention in hospitalized older adults

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Abstract

Objective: To develop and test the validity evidence of a care-educational website focused on fall prevention in hospitalized older adults. Method: This methodological study was conducted at the Júlio Bandeira de Mello University Hospital, using a non-probabilistic convenience sample. The study followed the Praxis Model for Technology Development, encompassing three stages: pragmatic, productive/artistic, and experimental. Results: Data were collected from 15 professionals (nurses and nursing technicians) using a word cloud platform, which allowed the identification of difficulties in fall prevention and preferences regarding the format and elements of the technology. Based on the demands identified, a responsive website for use on mobile devices was then developed, structured into modules "Quizzes," "Results," and "Reviews," using online platforms. For the content validity evidence testing, nine experts participated. Evaluation was performed using an adapted version of the Educational Health Content Validation Instrument, applied via an online form and analyzed using the Content Validity Index. The website yielded a total Content Validity Index of 0.97, with all items showing values above 0.80, in addition to statistical confirmation by the binomial test. Conclusion: The website showed content validity evidence and potential for training professionals in fall prevention among hospitalized older adults. Further evaluations are recommended to verify the appearance and usability of the technology.

Keywords: Educational Technology. Accidental Falls. Aged. Validation Study.

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Funding: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). Nº do processo: Editais nº 01/2023 e nº 01/2024. Bolsa de Projeto de Iniciação Científica.

Os autores declaram não haver conflito na concepção deste trabalho.

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Received: December, 19, 2025
Approved: April, 8, 2026

http://dx.doi.org/10.1590/1981-22562026029.250207en

INTRODUCTION

A progressive process of population aging is evident worldwide, with repercussions for both direct health care delivery and research. This phenomenon highlights the importance of developing measures aimed at promoting and maintaining health, as well as the quality of life of this population.

Aging is characterized by a series of biopsychosocial changes, particularly changes in cognition, muscle mass and vision, besides reduced bone density, polypharmacy, and more frequent need for hospitalization, making this population more susceptible to adverse events such as falls[1]. Falls may occur in any setting, including in hospital, where patient falls represent the fourth most frequently reported healthcare-related incident in Brazil[2].

Therefore, fall-risk assessment is one of the indicators used to evaluate the quality of hospital care with regard to patient safety during hospitalization, as well as post-discharge quality of life[3]. A study of hospitalized older adults at a university hospital showed that a large proportion of the sample was at high risk of falls during hospitalization[4], reinforcing the importance of developing measures to reduce these events.

In this context, care-educational technologies (CETs) stand out as an innovative resource incorporated into care practice, since they foster co-responsibility for care and help users understand and share information associated with the caregiving process in a fun participatory way[5].

Notably, the development of technological innovations that enhance the abilities of the target audience and promote information sharing has attracted significant attention among contemporary researchers[6]. Thus, the development of a CET aimed at preventing falls in hospitalized older adults emerges as a promising alternative to address this challenge.

Moreover, fall prevention requires professional training on the topic and the use of appropriate strategies for guiding patients and family members, favoring the joint identification of determinant risk factors and the development of strategies to minimize them[7]. Hence, investment should be made in permanent education measures so that professionals may acquire the necessary knowledge on the subject, allowing them to intervene effectively and help resolve this issue.

Within this context, the development of a CET for professional training constitutes an essential strategy for fall prevention. Through the use of interactive care-educational resources, healthcare professionals can improve their knowledge on the subject, promoting greater safety and quality in care delivery[5].

In addition, the tool encourages continuous learning and the practical application of knowledge, stimulating the critical and reflective skills needed to identify risk factors and develop measures to prevent adverse events.

It is also essential to develop and use accurate and effective technologies, since they yield highly satisfactory results when properly developed[8]. To assess the quality of the product and the extent to which its intended objectives are met, the validity evidence of CETs must be tested after their creation[9]. Therefore, the aim of the present study was to develop and test the content validity evidence of a care-educational website for fall prevention in hospitalized older adults.

METHOD

This methodological study was conducted with the aim of investigating, organizing, and analyzing data to construct, assess, and validate the resultant product[10]. A non-probabilistic convenience sample was used in all stages of data collection. The study was conducted at the Júlio Bandeira de Mello University Hospital (HUJB), located in the city of Cajazeiras (Paraíba state, Brazil), in the westernmost region of the state. The city covers a land area of 562.703 km^2, is situated 477 km from the state capital João Pessoa, and has a population of roughly 63,239 inhabitants and population density of 112.38 inhabitants/km^2 [11].

The study was conducted in compliance with the ethical requirements and recommendations set forth in the regulatory guidelines and standards for studies involving humans and in Resolutions

466/12 and 510/2016. The study was approved by the Research Ethics Committee of the Federal University of Campina Grande under opinion number 8.156.593 and comprised part of an umbrella project entitled "Construction and validation of care-educational technologies in the field of interdisciplinarity in health". All participants signed an informed consent form.

The present investigation comprised the following stages: 1) Data collection from HUJB professionals; 2) Development of the care-educational technology; and 3) Testing content validity evidence of the resultant care-educational technology, as outlined below.

In the first stage, data on HUJB professionals were collected. The methodological framework of the Praxis Model for Technology Development (PMTD) was adopted to elucidate the issue and identify the main triggering factors of the problem, and develop effective solutions from the participatory perspective of researchers together with the target audience. This process enabled the essential aspects of the technology to be identified through interaction with the target audience.

The PMTD proposes four stages to be followed in product development, being most notable for explicitly emphasizing the importance of performing a situational diagnosis, as well as for the active participation of the target audience in deciding the product characteristics. The first stage is the pragmatic phase, in which researchers become immersed in the situation and identify obstacles. The productive/artistic phase entails developing a transformative solution, resulting in the construction of a technological product, whereas the experimental phase involves gathering evidence for the validity of the technology. Lastly, the revolutionary phase is based on applying the product and ascertaining its effectiveness [9].

Thus, to align the study with the PMTD[9], the pragmatic stage was carried out with HUJB professionals to increase audience participation in deciding the type of technology to be developed and its characteristics. The professionals included were those who provide direct and continuous care and therefore have greater contact with hospitalized older adults, namely nurses and nursing technicians from the medical and surgical clinics of HUJB. Professionals who were off work (on maternity or medical leave) were excluded, as were those who had worked in the sector for less than six months, for lack of professional experience to meet the study criteria.

Four questions were devised for data collection, namely: 1) "Do you use care-educational technology to facilitate nursing care?"; 2) "What difficulties/needs are faced in the process of reducing the risk of falls among hospitalized older adults?"; 3) "Which care-educational technology could help reduce these difficulties/needs?"; and 4) "Which element(s) are indispensable in this CET?".

As a strategy for data collection, an online platform was used to create word clouds with real-time feedback, allowing these clouds to be generated from the answers to the questions outlined above. Importantly, as professionals answered the questions, images of the previously formed word clouds were added to each question so that the audience can see the collective opinion, as recommended by the PMTD.

Thus, data collection commenced in person with the professionals available at the service, by providing a QR code that directed them to a form containing the Informed Consent Form, the link to the word clouds formed, together with the questions to be answered.. Any queries, clarifications, and opinions were addressed during data collection.

The analysis of the data collected was performed directly on the platform used, by evaluating the word clouds derived from the professionals' responses. In these clouds, the most frequent response is represented by the largest word in the cloud, and the number of professionals who responded similarly is displayed.

In the second stage, the care-educational technology was developed. Based on the findings of the previous phase, the feasibility of the proposal most frequently suggested by the professionals was discussed, as well as the central points supporting construction of the CET, with a focus on minimizing the risks of falls among hospitalized older adults. On the basis of this process, the type of CET most

indicated by the participating professionals was developed.

In the third phase, content validity analysis was conducted. This should be carried out by specialists in the field, since their expertise ensures greater rigor in evaluating the information and material presented. For this type of verification, the use of standardized validated instruments is recommended, as these allow the level of agreement among evaluators to be measured[12].

This process involves careful appraisal of the material composing the technology in order to confirm both its relevance for the target audience and the appropriateness of the content to the topic in question[13]. Regarding the selection of the sample for testing content validity evidence, the criteria proposed by Fehring[14] were adopted, with adaptations deemed necessary.

Accordingly, the selection of participants took place via the Lattes Platform, by analyzing curricula and checking for a minimum score of five points[14], distributed across at least two of the criteria presented in Table 1. In addition, experts who failed to return the assessment instrument within the maximum period of 20 days were excluded.

Furthermore, there is no consensus in the literature on the minimum number of participants in studies testing content validity evidence. Therefore, the recommendation of Salbego and Nietsche[9], which suggests 5 to 27 evaluators, was adopted, with a minimum of nine experts defined. In this respect, the CET developed underwent evaluation by healthcare professionals, including nurses, physiotherapists, and others with expertise in human aging, considering aspects such as presentation format, clarity of objectives, and practical applicability[15].

To this end, the Educational Health Content Validation Instrument (IVCES)[15] was used, with the necessary adaptations for the study. The instrument comprises 18 items across three dimensions, with responses on a scale from 0 to 2. Based on the instrument, a questionnaire was developed in a virtual environment through an online form-creation platform, which was used to transform the instrument into a multiple-choice questionnaire sent to the evaluators, encompassing:

1. Profile of the specialist – socioeconomic and professional information;

2. Presentation of the technology – product identification, logo, screens, and functions;

3. Objectives and relevance – description of the purpose of the technology and its importance for care practice.

The appraisal was carried out using a Likert scale, widely applied in the health field, which allows the degree of agreement for each item to be quantified. The response options were: 0) Disagree; 1) Partially agree; 2) Totally agree, and the evaluator was instructed to select only one alternative per item.

With regard to analysis of the data obtained through the IVCES, the Content Validity Index (CVI) was applied to assess the proportion of agreement among specialists both for each individual item (I-CVI) and for the questionnaire as a whole (S-CVI)[16]. The I-CVI was calculated by summing the responses scored as 1 and 2 for each question and dividing by the total number of evaluators. The S-CVI was obtained by averaging the I-CVI values of all questions, reflecting the overall agreement among the judges[16].

With regard to the minimum value considered acceptable for agreement among evaluators, the literature indicates a minimum threshold of 0.80 as a reference for validation of new instruments[17]. This value was therefore established in the present study as the minimum criterion for obtaining validity evidence.

Table 1. Selection criteria for experts. Cajazeiras, Paraíba state, 2025.

Criteria	Scoring
Thesis/dissertation/monograph in the field of human aging	2 points/publication
Participation in research groups/projects in the field of human aging	1 point/year
Professional practice in the field of human aging	2 points/year
Published work in the field of human aging	1 point/publication
Participation in examination boards using an assessment instrument	2 points/year

Source: Adapted from Fehring (1994); author elaboration.

DATA AVAILABILITY

All data collected underpinning the study results are available upon request from the corresponding author.

RESULTS

To facilitate understanding of the study, the results and discussion are presented in phases: 1) Data collection from HUJB professionals; 2) Development of the care-educational technology; and 3) Testing of content validity evidence for the resultant care-educational technology.

The first stage involved 15 professionals (nurses and nursing technicians) from the HUJB medical clinic, and the word clouds shown in Figures 1 and 2 were obtained. The word clouds depicted in Figure 1 show that most professionals do not use CETs and also reveal some of the difficulties faced in the process of reducing the risk of falls, highlighting problems in the hospital's infrastructure.

In addition, Figure 2 describes some suggestions for technologies that may help mitigate these difficulties, with the app format being the most frequently suggested. However, some professionals reported in person during study participation that storage space on devices could be an obstacle to the use of the technology. Therefore, it was decided to develop a responsive website similar to an app that could be used on mobile devices.

Several elements considered indispensable in the technology to be developed, such as cartoon design, bright colors, care, and safety, are also presented in Figure 2. All suggestions were accepted and incorporated, allowing inclusion of information relevant to the target audience in the technology.

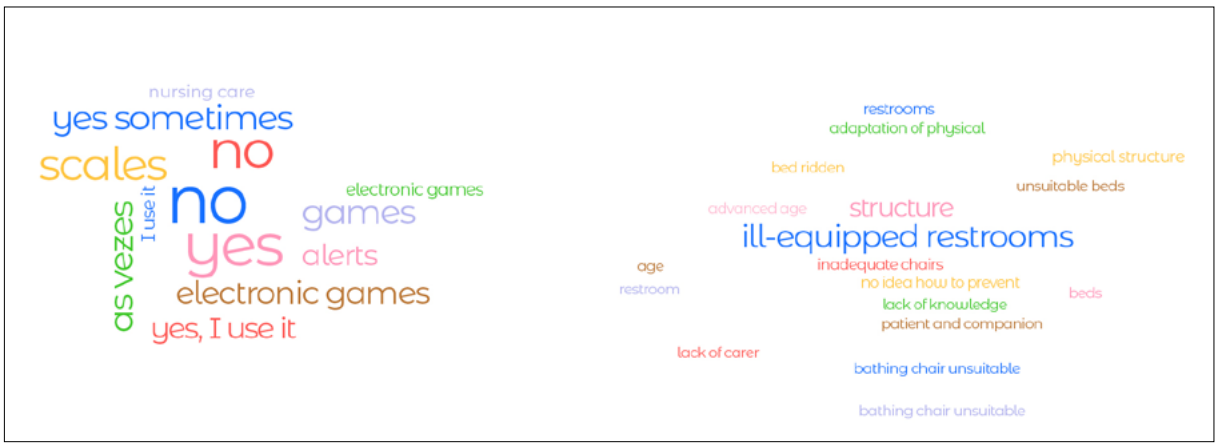


Figure 1. Word clouds derived from the professionals' responses, respectively, to questions 1) "Do you use care-educational technology to facilitate nursing care?"; and 2) "What difficulties/needs are faced in the process of reducing the risk of falls among hospitalized older adults?". Cajazeiras, Paraiba state, 2024.



Figure 2. Word clouds derived from the professionals' responses, respectively, to questions 3) "Which care-educational technology could help reduce these difficulties/needs?"; and 4) "Which element(s) are indispensable in this CET?". Cajazeiras, Paraiba state, 2024.

Thus, the results from the data-collection stage were used as a basis for defining the key points of the technology. An editor with support for creating code was used to develop the CET. The web system was developed in four modules using a library that offers components facilitating navigation and interface construction. In addition, to ensure greater flexibility as new functions were added, a service-oriented architecture (SOA) was adopted.

The modules developed were: Authentication, Quizzes, Results, and Reviews, using a free publicly available online platform[18], whose products were employed. One of these products is responsible for simplifying user registration and authentication and was applied in the authentication module to control access and account creation. A document-based NoSQL database was also used to store user information, and for managing questions and answers for the quizzes.

To make the system available, a tool was used that allows a custom domain to be configured and the system to be updated directly from the source code. The code is also versioned in a repository, enabling change control and integration with the platform for automatic publication after each update.

The CET content was based on the Ministry of Health's Fall Prevention Protocol[19] and on a review of the literature on risk factors for falls and other issues related to the topic[20].

Six topics are included in the CET: 1) "Falls among hospitalized older adults": a brief introduction to the subject; 2) "Intrinsic factors": explanation of what intrinsic factors are and citing some of them; 3) "Extrinsic factors": definition of extrinsic factors and citing some of them; 4) "Importance of prevention and how to prevent": the importance of preventing falls, as well as measures and actions to adopt in order to achieve this; 5) "Professional conduct": the correct way professionals should act to reduce falls; and 6) "Guidance for the patient and companion": guidance to be provided to the patient and their companion.

Regarding the design of the technology, the avatar featured in it was based on the characteristics of the researcher who developed the website, while the clothing represents the uniform of her research group, whose focus is the development and validation of CETs. The scenario used in the technology was based on the hospital ward where the CET was developed, and both the avatar and the setting were created by a designer and are the authors' own work.

As a result, the care-educational website was developed, with two of its screens depicted in Figure 3.



Figure 3. Screens from the care-educational website. Cajazeiras, Paraíba state, 2025.

Nine experts took part in the stage of testing content validity evidence for the care-educational technology. Of these, seven held a doctoral degree as their highest qualification, eight were trained in nursing, and seven reported having 10-30 years of experience. The data were grouped and analyzed, and the CVI calculated, yielding an S-CVI of 0.97 (row 24 in Table 2). In addition, all evaluation items for the technology had an index above 0.80 (column 3 of Table 2), and no changes to the educational website content were required.

Furthermore, after calculating the CVI and, in an effort to increase study reliability, the Shapiro-Wilk test was performed to determine sample normality and decide which type of statistical test should be applied. This calculation yielded a *p*-value of approximately 0.00000321, i.e., lower than the pre-established significance level (0.05), demonstrating non-normality of the sample. Therefore, nonparametric tests were the most fitting, and the binomial test was elected to check statistical significance.

Two variables must be established for the binomial test: the Null Hypothesis (H_0) and the Alternative Hypothesis (H_1), whereby H_0 indicates that the sample probability is equal to the reference probability, whereas H_1 indicates the probability differs. Thus, the expectation was that the data collected would be similar to the reference values and the *p*-value would be >0.05 whereby H_0 would not be rejected. In addition, the value of 0.80 was adopted for the null hypothesis, since the minimum level of agreement among the specialists was set at 80%. The following reference values were therefore adopted:

- H_0: P (proportion of "agree" responses) ≥0.80;
- H_1: P (proportion of "agree" responses) <0.80.

Moreover, the significance level adopted was 0.05, hence the decision criterion for rejecting H_0 would be obtaining a *p*-value <0.05. In view of this, Table 2 contains, for each instrument item, data on the number of "totally/partially agree" responses, the I-CVI for each question, the value obtained upon applying the binomial test, and the test conclusion confirming acceptance of H_0.

Table 2. Content evaluation according to Content Validity Index (CVI) and binomial test. Cajazeiras, Paraiba state, 2025.

Item	Partially/Totally agree	CVI-I	p-value (binomial test)	Conclusion
	n (%)	n		
1. OBJECTIVE: purposes, goals, or aims				
1.1 The questions and reviews of each topic cover the scope of the proposed theme.	9 (100)	1.00	1.000	Do not reject H_0
1.2. The questions and reviews of each topic are appropriate to the teaching-learning process.	8 (88.9)	0.89	0.866	Do not reject H_0
1.3. The questions and reviews of each topic clarify possible doubts about the theme.	8 (88.9)	0.89	0.866	Do not reject H_0
1.4. The questions and reviews of each topic encourage reflection on the theme.	8 (88.9)	0.89	0.866	Do not reject H_0
1.5. The questions and reviews of each topic encourage behavior change.	8 (88.9)	0.89	0.866	Do not reject H_0
2. STRUCTURE/PRESENTATION: organization, structure, strategy, coherence, and sufficiency				
2.1. The questions and reviews present language appropriate to the audience.	9 (100)	1.00	1.000	Do not reject H_0
2.2. The questions and reviews present language appropriate to the educational material.	9 (100)	1.00	1.000	Do not reject H_0
2.3. The questions and reviews present interactive language, allowing active involvement in the educational process.	9 (100)	1.00	1.000	Do not reject H_0
2.4. The questions and reviews present correct information.	9 (100)	1.00	1.000	Do not reject H_0
2.5. The questions and reviews present objective information.	9 (100)	1.00	1.000	Do not reject H_0
2.6. The questions and reviews present clarifying information.	9 (100)	1.00	1.000	Do not reject H_0
2.7. The questions and reviews present the necessary information.	8 (88.9)	0.89	0.866	Do not reject H_0
2.8. The questions and reviews present a logical sequence of ideas.	9 (100)	1.00	1.000	Do not reject H_0
2.9. The questions and reviews present a current theme.	9 (100)	1.00	1.000	Do not reject H_0
2.10. The questions and reviews present texts of adequate length.	9 (100)	1.00	1.000	Do not reject H_0
3. RELEVANCE: significance, impact, motivation, and interest				
3.1. The questions and reviews stimulate learning.	9 (100)	1.00	1.000	Do not reject H_0
3.2. The questions and reviews contribute to knowledge in the area.	9 (100)	1.00	1.000	Do not reject H_0
3.3. The questions and reviews arouse interest in the theme.	9 (100)	1.00	1.000	Do not reject H_0
S-CVI: 0.97				

Left-sided binomial test performed to determine whether proportion of positive responses from experts for evaluated items evaluated was significantly greater than 80% (null hypothesis: $p>0.80$). A p-value >0.05 indicates no statistical evidence for rejecting the null hypothesis ($p\leq0.80$). Significance level adopted: 0.05. **Source:** author elaboration, 2025.

DISCUSSION

Data collection from the professionals showed that most did not use CETs to assist in the care process. However, these tools contribute to the development of knowledge and skills among nursing professionals, besides promoting greater safety in patient care delivery[5,21], demonstrating the need to encourage adherence to and use of these tools.

Moreover, the difficulties faced in the process of reducing the risk of falls among hospitalized older adults were identified, showing problems with the hospital infrastructure, inadequate beds and shower chairs, and lack of professional knowledge, consistent with the findings of the study by Veras et al.[20]. Therefore, once these obstacles have been identified, it is incumbent on the bodies responsible to promote improvements in hospital infrastructure and to adapt furniture so as to facilitate the care process and reduce the occurrence of adverse events.

With regard to CET development, the most frequently suggested type of tool was the app. However, the various different device screen formats, together with different systems (iOS and Android), pose a challenge in developing app interfaces that can adapt to these differences without impairing the user experience[22]. In addition, free storage space for the app is required on devices, which is not always available. Therefore, the most fitting alternative was to develop a responsive website very similar to an app able to meet all the needs identified.

In this respect, via the first stage described in the methodological design of the study, with the participatory perspective of the target audience during the process of creating the technological product, the essential aspects of the technology suggested by the professionals were identified. Thus, the content present on the website was built based on data collection together with scientific support to ensure the reliability, credibility, and robustness of the material presented in the CET. Hence, as recommended by the methodological model adopted[9], the technology was developed together with users, thus ensuring greater adherence to its use.

After the tool had been developed, participation by experts yielded an S-CVI of 0.97, which is considered excellent, indicating a high level of agreement among participants on the quality of the content present in the technology. This value is well above the previously established minimum and exceeds that reported by other studies testing validity evidence of CETs[23,24].

Therefore, when developing care-educational materials, they should be evaluated so as to ensure product effectiveness can be maximized. It is paramount for health professionals and researchers to understand the methods used to test validity evidence of care technologies in order to increasingly obtain reliable instruments with the methodological rigor necessary and appropriate to meet the needs of the target audience[25].

Even after obtaining evidence of content validity for the CET, it is essential to validate its appearance and usability, since these aspects directly influence effectiveness in practice. Appearance validation allows checking that the design, visual organization, language, and graphic resources are appropriate for the target audience, favoring clarity, attractiveness, and understanding. Usability assessment, in turn, ensures the tool is intuitive, accessible, and easy to navigate, reducing technological barriers that may compromise use. Also, analysis of these attributes helps improve user experience, increase engagement, and strengthen adherence to the proposed guidance[26]. Thus, appearance and usability validation consolidates the overall quality of the technology, increases its potential impact on care practice, and should be carried out as a follow-up of the study.

Furthermore, the present study faced the difficulty of the long period required to obtain judges' responses regarding the content validity evidence for the website. More than 60 judges received the invitation email, but after five months, only nine had responded. This led to a smaller expert sample and the need to extend the development period of this stage, initially envisaged to take two months. Nonetheless, according to the literature, the number of participants was sufficient[9].

CONCLUSION

Ultimately, a tool was obtained that underwent testing for content validity evidence, where the language and content were checked, ensuring effectiveness in disseminating knowledge to the intended target audience. Importantly, the technology must still undergo other validity tests to determine its practicality and ease of use, as well as whether the illustrations and colors are appropriate for the material. Only then will the technology be fit to prepare professionals to assist in the process of reducing falls among older adults in the hospital environment.

Therefore, the product devised will confer benefits for hospitalized older adults, companions, professionals involved in care, and the institution, given the development and content validity evidence of an important tool capable of mitigating the issue in question through professional training.

Lastly, the technology developed in the study can be used nationwide, given the similarity of the health status of older adults throughout the country, enabling the target audience to master the subject and become knowledge multipliers, disseminating this learning to patients, companions, and other professionals.

AUTHOR CONTRIBUTIONS

- Silvana Vidal Oliveira de Assis – Formal analysis; Administration of Project Conception and study design; Writing – First draft; Writing – Review and Editing; Methodology; Data analysis and interpretation; Approval of final version for publication.
- Lara Évilly Leandro da Costa – Writing – Review and Editing; Approval of final version for publication.
- Rayrla Cristina de Abreu Temoteo – Writing – Review and Editing; Approval of final version for publication.
- Karla Karolline Barreto Cardins – Review and Editing; Approval of final version for publication.
- Fabiana Ferraz Queiroga Freitas – Administration of Project; Formal analysis; Supervision; Writing – Review and Editing; Approval of final version for publication.

Edited by: Camila Alves dos Santos

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Clinical and functional predictors of mortality in octogenarians: limitations of the Fried frailty phenotype for risk stratification

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Abstract

Objective: To evaluate frailty as a predictor of mortality in octogenarians. *Methods:* This retrospective cohort study included individuals aged 80 years or older who were followed from 2016–2018 through 2024–2025. Sociodemographic, clinical, and functional variables, including the presence of frailty, were analyzed, with all-cause mortality as the outcome. Data analysis included descriptive statistics and multivariable Cox regression to estimate the factors associated with mortality. *Results:* Osteoporosis, urinary incontinence, and severe depressive symptoms were identified as predictors of mortality. The Fried frailty phenotype did not demonstrate significant predictive value for mortality in the sample analyzed. *Conclusion:* Frailty, when assessed on the basis of specific clinical and functional conditions, was relevant for predicting mortality among the oldest-old, whereas the Fried frailty phenotype showed limitations in this age group. These findings reinforce the need for more sensitive instruments for prognostic assessment in individuals aged 80 years or older.

Keywords: Aged, 80 and over. Mortality. Retrospective Studies. Urinary Incontinence. Depression. Frailty.

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Funding: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Call No. 21/2023, Track B, Transdisciplinary Studies, Grant No. 382649/2026-5. Long-term fellowship, category: Industrial Technological Development (DTI-B).

The authors declare no conflicts of interest related to this study.

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Received: February 17, 2026
Approved: July 7, 2026

http://dx.doi.org/10.1590/1981-22562026029.260016en

INTRODUCTION

Brazil is experiencing rapid population aging, with an annual growth rate exceeding 4% between 2012 and 2022. Projections indicate that, by 2030, older adults will account for approximately 30% of the population, outnumbering children and adolescents. Nevertheless, socioeconomic inequalities that affect their living conditions persist. Of particular importance is the expansion of the population aged 80 years or older, which is predominantly female and has a high prevalence of functional limitations. Over the past 15 years, the number of oldest-old adults with disabilities is estimated to have increased by 77%[1,2].

The risk of developing frailty increases significantly with advancing age and is influenced by comorbidities, physical inactivity, unhealthy dietary habits, and unfavorable socioeconomic conditions. Frailty is a state of physiological vulnerability associated with aging, characterized by reduced physiological reserves and a diminished ability to respond to adverse events. It is associated with a greater risk of falls, loss of autonomy, and mortality and is distinct from disability, social vulnerability, and multimorbidity[3].

Frailty therefore has important prognostic value, enabling the screening of older adults at greater risk of adverse events[4] and supporting targeted therapeutic interventions. Evidence indicates that frailty, functional limitations, and social isolation increase the risk of mortality independently of chronic diseases and sociodemographic factors[5,6]. These findings may inform care protocols in primary health care, particularly for individuals aged 80 years or older, given the heterogeneity of the older population and its differing needs for monitoring and care[7].

Analyzing trends in health care expenditures and causes of mortality among the oldest-old is essential to overcoming the reductionist view that aging alone determines greater use of health care resources. Increased costs are more strongly associated with clinical profile, disability, multimorbidity, and proximity to death than with chronological age. Although mortality among the oldest-old has been increasingly investigated, chronological age and specific diagnoses continue to be emphasized as the main predictors of mortality. This approach may have limitations in this age group, in which traditional risk factors tend to have lower discriminatory ability[8,9].

Accordingly, the present study was based on the hypothesis that frailty is an independent predictor of mortality among individuals aged 80 years or older. Therefore, this study aimed to evaluate frailty as a predictor of mortality among the oldest-old, thereby contributing to improvements in risk stratification and to the provision of care focused on functional status.

METHODS

This analytical, comparative, retrospective cohort study was conducted in two data collection phases. The first phase was conducted between 2016 and 2018 under a protocol approved by the Research Ethics Committee (approval No. 8,423,250; CAAE No. 50075215.2.0000.0029). Individuals aged 80 years or older who were voluntarily recruited from the geriatric outpatient clinic of the Universidade Católica de Brasília (UCB) were eligible. After providing written informed consent, individuals with moderate or severe dementia were excluded. Dementia severity was determined through cognitive assessment using the Mini-Mental State Examination (MMSE), based on cutoff scores adjusted for educational attainment.

During the first phase, data were collected from 222 participants on sociodemographic characteristics, previously diagnosed chronic diseases, urinary incontinence, frailty status, depressive symptoms assessed using the Geriatric Depression Scale (GDS), cognitive performance assessed using the MMSE, and risk of sarcopenia. A convenience sample was used, comprising eligible participants recruited from the outpatient clinic. This sampling strategy is frequently adopted in studies involving adults of advanced age because of the difficulty of accessing this population. Assessments were conducted on dates and at times previously scheduled with the participants at the UCB facilities. Details of the recruitment procedures, blood collection, and physical assessments have been described in previous studies[10-13].

During the second data collection phase, which was approved by the Research Ethics Committee (approval No. 8,423,250; CAAE No. 75167923.6.0000.0029) and conducted between 2024 and 2025, surviving participants who voluntarily consented to participate were reassessed for frailty using the same procedures applied during the first phase. For participants who had died, information was obtained from family members or caregivers through interviews, review of a copy of the death certificate, and consultation of the National Registry of Deceased Persons (*Cadastro Nacional de Falecidos* [CNF], Brazil).

Participants were contacted using the telephone numbers and addresses provided during the first phase, and the responsible caregiver or family member was identified. Interviews were conducted by telephone, in person at the UCB facilities, or at the participant's home, according to the respondent's preference.

Figure 1 shows the numbers of individuals assessed at baseline, followed up, and included in the analysis.

The sample size was not calculated a priori because the study used a previously established open cohort comprising a convenience sample. Therefore, all eligible individuals assessed at baseline who met the inclusion criteria and had complete data for the variables of interest were included. The final sample size (n = 129) was thus determined by the number of participants successfully followed up and the number of deaths observed during the follow-up period.

The study complied with the ethical and scientific principles established by Brazilian National Health Council Resolution No. 466 of December 12, 2012, and Resolution No. 510 of April 7, 2016, which establishes the standards applicable to research in the Human and Social Sciences involving data obtained directly from participants. The principles and guidelines of the Brazilian General Data Protection Law (Law No. 13,709/2018) were also observed, ensuring the confidentiality, privacy, and protection of the information collected.

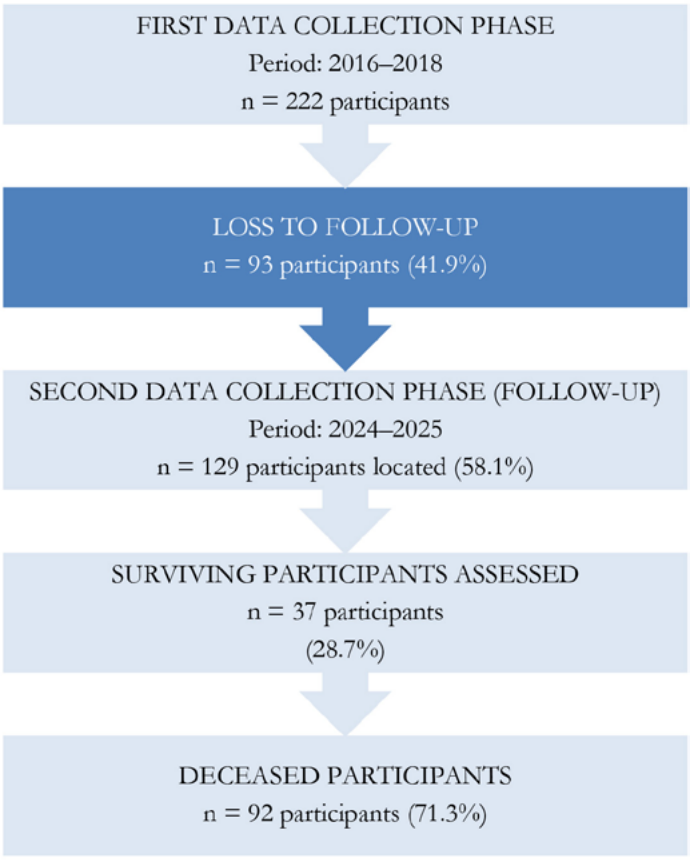


Figure 1. Flowchart of the cohort recruitment and follow-up process (n = 129). Brasília, Federal District, 2026.

All responses were recorded into the REDCap platform (Research Electronic Data Capture), with access restricted to authorized researchers. During the second phase of the study (2024–2025), which involved telephone interviews and administration of the Geriatric Depression Scale and the Mini-Mental State Examination, additional measures were adopted to ensure participant privacy, informed consent, and data security throughout all stages of the study.

Data analysis was conducted in three sequential stages. First, a comprehensive descriptive analysis of the study variables was performed. For continuous variables, measures of central tendency and dispersion were calculated, including the mean, standard deviation, percentiles, median, and minimum and maximum values. Categorical variables were summarized using absolute frequencies and proportions. The normality of the distributions was assessed using the Shapiro–Wilk test, in accordance with recommendations established in the literature on nonparametric statistics[14].

Survival analysis was performed using the Kaplan–Meier estimator[15]. Time was calculated from the date of the first-wave assessment until death (the last contact with the patient while alive). Predictors of mortality were analyzed using the Cox proportional hazards model. The proportional hazards assumption was assessed.

Use of Artificial Intelligence

The authors declare that only academic and editorial support resources permitted under the guidelines of the *Brazilian Journal of Geriatrics and Gerontology* (RBGG) were used. Their use was restricted to spelling and grammar checking, language editing, stylistic refinement, and textual organization of the manuscript. No resources were used to generate data, formulate hypotheses, interpret results, or replace the authors' scientific judgment. The final content was critically reviewed and approved by all authors, who assume full responsibility for the manuscript.

DATA AVAILABILITY

The complete dataset supporting the findings of this study is available from the corresponding author upon reasonable request.

RESULTS

Participants were followed for 9 years. At the end of this period, only 14.1% had survived (95% CI). Table 1 presents the baseline sociodemographic and anthropometric characteristics of the sample according to vital status at follow-up. Most surviving participants were female (64.86%). The median age of the surviving participants at the time of the first data collection phase was 91 years, whereas the median age of the participants who died was 85 years.

Table 2 presents the baseline clinical and functional characteristics, including cognition assessed using the Mini-Mental State Examination (MMSE), mood assessed using the Geriatric Depression Scale (GDS), number of chronic diseases, self-rated health, and screening for sarcopenia and frailty, according to vital status at follow-up.

Table 1. Baseline sociodemographic characteristics of the sample according to vital status at follow-up. Brasília, Federal District, 2025.

Variables	Survivors n = 37	Deceased participants n = 92
Sex		
Female	24 (64.86)	56 (60.87)
Male	13 (35.14)	36 (39.13)
Age (years)	91.00 (85.00; 98.00)	85.00 (78.00; 101.00)
Marital status		
Married	10 (27.03)	8 (8.79)
Single	27 (72.97)	83 (91.21)
Race/skin color (IBGE classification)		
Asian	0 (0.00)	2 (2.20)
White	16 (43.24)	61 (67.03)
Indigenous	5 (13.51)	1 (1.10)
Mixed race	16 (43.24)	25 (27.47)
Black	0 (0.00)	2 (2.20)
Body mass index (BMI), kg/m²	25.50 (13.70; 38.22)	25.56 (15.16; 35.47)

*Categorical variables are expressed as n (%), and continuous variables as median (minimum; maximum). IBGE, Brazilian Institute of Geography and Statistics.

Note: Missing data were observed for some variables. Among participants who died, data were missing for marital status (n = 1), race/skin color (n = 1), and BMI (n = 19).

Table 2. Baseline cognition (MMSE), mood (GDS), chronic diseases, self-rated health, and screening for sarcopenia (SARC-F) and frailty (Fried frailty phenotype), according to vital status at follow-up. Brasília, Federal District, 2025.

Variables	**Survivors** n = 37	**Deceased participants** n = 92
MMSE total score	24.00 (5.00; 28.00)	19.00 (0.00; 29.00)
MMSE classification		
Cognitively intact	13 (38.24)	26 (34.21)
Cognitive impairment	21 (61.76)	50 (65.79)
GDS total score	3.00 (0.00; 10.00)	4.00 (1.00; 14.00)
GDS classification		
Normal	22 (70.97)	25 (35.21)
Depressive symptoms	9 (29.03)	23 (32.39)
Severe depressive symptoms	0 (0.00)	23 (32.39)
Heart disease	6 (20.69)	21 (30.88)
Hypertension	25 (86.21)	60 (82.19)
Stroke/cerebral ischemia	4 (13.79)	12 (18.75)
Diabetes mellitus	8 (27.59)	19 (27.54)
Cancer	4 (13.79)	13 (20.97)
Arthritis/rheumatism	4 (13.79)	19 (31.67)
Lung disease	2 (6.90)	10 (15.87)
Depression	0 (0.00)	20 (30.77)
Osteoporosis	6 (20.69)	31 (47.69)
Urinary incontinence	8 (27.59)	33 (50.77)

to be continued

Continuation of Table 2

Variables	**Survivors** n = 37	**Deceased participants** n = 92
Number of self-reported chronic diseases		
0	4 (12.12)	7 (9.09)
1–3	25 (75.75)	48 (62.33)
4–6	4 (12.12)	20 (25.97)
7	0 (0.00)	2 (2.60)
Self-rated health		
Very poor	1 (2.70)	0 (0.00)
Poor	3 (8.11)	5 (6.17)
Fair	14 (37.84)	46 (56.79)
Good	11 (29.73)	21 (25.93)
Very good	8 (21.62)	9 (11.11)
Risk of sarcopenia	10 (35.71)	26 (34.21)
Frailty status		
Non-frail	5 (15.63)	4 (5.19)
Prefrail	26 (81.25)	51 (66.23)
Frail	1 (3.13)	22 (28.57)

Abbreviations: MMSE, Mini-Mental State Examination; GDS, Geriatric Depression Scale; SARC-F, Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls. Categorical variables are expressed as n (%), and continuous variables as median (minimum; maximum).

Note: Missing data were observed for some variables. Among survivors, data were missing for cognitive impairment (n = 3), GDS assessment (n = 6), presence of chronic diseases (n = 8), number of chronic diseases (n = 4), risk of sarcopenia (n = 9), and frailty status (n = 5). Among participants who died, data were missing for cognitive impairment (n = 16), GDS assessment (n = 21), heart disease (n = 24), hypertension (n = 19), stroke (n = 28), diabetes mellitus (n = 23), cancer (n = 30), arthritis/rheumatism (n = 32), lung disease (n = 29), depression (n = 27), urinary incontinence (n = 27), number of chronic diseases (n = 15), self-rated health (n = 11), risk of sarcopenia (n = 16), and frailty status (n = 15).

At the baseline assessment conducted during the first data collection phase, participants who remained alive at the end of follow-up exhibited better cognitive performance than those who died, although the prevalence of cognitive impairment was high and similar in both groups. Regarding mood, survivors had lower GDS scores and a higher proportion of individuals classified as normal. Conversely, participants who had died by the time of the second data collection phase had a higher median GDS score and a more balanced distribution across the normal, depressive symptoms, and severe depressive symptoms categories.

At baseline, hypertension was the most prevalent chronic condition among both participants who remained alive and those who died during follow-up, followed by diabetes mellitus, heart disease, and cancer, with similar proportions between the groups. Some conditions were more frequent at baseline among participants who subsequently died, including arthritis/rheumatism, lung disease, depression, osteoporosis, and urinary incontinence. In both groups, most participants reported having one to three chronic diseases. Regarding baseline self-rated health, survivors were predominantly classified in the fair to very good categories, whereas participants who died more frequently rated their health as fair or good.

The proportion of individuals at risk of sarcopenia was similar among survivors and participants who died. Regarding frailty status, prefrailty predominated in both groups. However, the proportion of frail

individuals was higher among participants who died than among survivors, whereas non-frail status was more frequent among survivors.

Table 3 compares frailty classifications between the first and second data collection phases among surviving participants. Classifications from the first phase are presented in the rows, and those from the second phase are presented in the columns. Five individuals initially classified as non-frail progressed to frailty. Among the 26 participants classified as prefrail during the first phase, 11 remained prefrail, 14 progressed to frailty, and one reverted to non-frail status. Only one participant was classified as frail during the first phase and remained frail during the second phase.

Univariable Cox regression models were fitted for the outcome of death. Only variables that met the proportional hazards (PH) assumption were included in these models, thereby ensuring the statistical validity of the results.

Age, MMSE score, baseline depression, and the frail category of the frailty classification showed evidence of violation of the proportional hazards assumption ($p<0.05$) and were therefore excluded from the primary survival analysis. The remaining variables met the assumption and remained eligible for inclusion in the Cox regression models.

Table 4, Panel A, presents the results of the univariable models for the predictors that met the proportional hazards assumption.

Being married was associated with a lower risk of mortality (HR =0.46; 95% CI: 0.22–0.95; p=0.037). Among the clinical conditions, osteoporosis (HR =2.24; 95% CI: 1.33–3.79; p=0.003), urinary incontinence (HR =1.79; 95% CI: 1.07–2.99; p=0.026), and risk of sarcopenia (HR =2.23; 95% CI: 1.37–3.61; p=0.001) were associated with a higher risk of death.

In the emotional domain, assessed using the Geriatric Depression Scale, the presence of depressive symptoms was associated with an increased risk of mortality (HR =2.18; 95% CI: 1.17–4.03; p=0.013). This association was even stronger for the severe depressive symptoms category (HR =4.16; 95% CI: 2.23–7.76; p<0.001) compared with the normal reference category.

Table 3. Frailty classification according to the Fried frailty phenotype at baseline and follow-up (second assessment). Brasília, Federal District, 2025.

Variables	Non-frail n = 1	Prefrail n = 18	Frail n = 18
Frailty classification, first phase			
Non-frail	0 (0.00)	5 (31.25)	0 (0.00)
Prefrail	1 (100.00)	11 (68.75)	14 (93.33)
Frail	0 (0.00)	0 (0.00)	1 (6.67)

Categorical variables are expressed as n (%). **Note:** Frailty classification data were missing at baseline for five participants (n = 5).

Table 4. Cox regression models for mortality. Panel A: Univariable analyses of variables that met the proportional hazards assumption. Panel B: Final multivariable model. Brasília, Federal District, 2025.

A. Univariable Cox regression models				
Predictor	HR (95% CI)	p-value	n	Events
Sex $_{\text{Female}}$	0.82 (0.53; 1.28)	0.388	119	82
Marital status $_{\text{Married}}$*	0.46 (0.22; 0.95)	0.037	118	81
Race/skin color $_{\text{White}}$†	1.40 (0.89; 2.21)	0.148	118	81
Body mass index, kg/m²	0.97 (0.93; 1.02)	0.287	103	66
Heart disease at baseline	1.08 (0.62; 1.90)	0.780	91	62
Hypertension at baseline	0.71 (0.39; 1.31)	0.272	95	66
Stroke/cerebral ischemia at baseline	1.18 (0.61; 2.29)	0.618	87	58
Diabetes mellitus at baseline	1.05 (0.59; 1.86)	0.860	91	62
Cancer at baseline	0.75 (0.35; 1.59)	0.452	85	56
Arthritis/rheumatism at baseline	1.65 (0.91; 2.97)	0.096	83	54
Lung disease at baseline	1.38 (0.65; 2.92)	0.401	86	57
Osteoporosis at baseline	2.24 (1.33; 3.79)	0.003	87	58
Urinary incontinence at baseline	1.79 (1.07; 2.99)	0.026	88	59
Number of self-reported chronic diseases	1.11 (0.96; 1.28)	0.151	103	70
GDS‡				
GDS $_{\text{Depressive symptoms}}$	2.18 (1.17; 4.03)	0.013	95	64
GDS $_{\text{Severe depressive symptoms}}$	4.16 (2.23; 7.76)	< 0.001	95	64
Risk of sarcopenia $_{\text{Yes}}$	2.23 (1.37; 3.61)	0.001	98	68
B. Multivariable Cox regression model				
Predictor	HR (95% CI)	p-value		
Marital status $_{\text{Married}}$*	0.32 (0.12; 0.83)	0.019		
GDS‡				
GDS $_{\text{Depressive symptoms}}$	2.04 (0.98; 4.23)	0.056		
GDS $_{\text{Severe depressive symptoms}}$	4.15 (2.02; 8.55)	< 0.001		

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval; GDS, Geriatric Depression Scale; PH, proportional hazards assumption. P-values were obtained using the Wald test. *Reference category: single; †reference category: non-White; ‡reference category: normal.

Note: Univariable and multivariable Cox regression analyses were performed for the outcome of death. Only variables that met the proportional hazards assumption were included. Participants with missing data were excluded from each analysis using complete-case analysis.

A multivariable Cox proportional hazards regression model was fitted to identify predictors of mortality. The five candidate variables that showed statistically significant associations in the univariable analysis were marital status, osteoporosis, urinary incontinence, depression, and risk of sarcopenia.

Table 4, Panel B, presents the final model obtained using backward stepwise selection based on the likelihood-ratio test. The model included 67 participants, among whom 47 deaths occurred. Marital status and severe depressive symptoms remained predictors of mortality among the oldest-old. Being married was associated with a lower risk of mortality than being single (HR =0.315; 95% CI: 0.120–0.827; p=0.019), whereas the severe depressive symptoms category was associated with a higher risk of death than the normal GDS category (HR =4.154; 95% CI: 2.018–8.548; p<0.001).

Given the limited sample size, the hazard ratio estimates showed some imprecision, as indicated by the wide 95% confidence intervals. Further studies with larger samples are therefore needed to strengthen the available scientific evidence.

DISCUSSION

The primary objective of this study was to evaluate the ability of frailty, assessed using the Fried frailty phenotype, to predict mortality in octogenarians. The predictive value of sociodemographic factors, the presence and number of chronic diseases, risk of sarcopenia, depressive symptoms, and urinary incontinence was also investigated, given the recognized impact of these factors in the literature.

Multivariable Cox regression analysis showed that marital status and depressive symptoms remained associated with mortality after simultaneous adjustment for the variables included in the model.

Being married was associated with a lower hazard of death, consistent with findings from recent studies. A cohort study involving 82,091 US adults aged 60 years or older also found an association between marriage and lower mortality[16], as did a Swedish study[17] involving 5,572,011 individuals. In this context, Potente, Palumbo, and Jalovaara[18] also emphasized the positive effect of educational attainment on longevity among individuals who were married or living with a partner. They noted that this benefit tended to be greater among men than among women, a finding also reported by Requena and Reher[19].

Regarding depressive symptoms, as assessed using the GDS, mortality risk increased progressively with symptom severity. Participants classified as having depressive symptoms had an approximately twofold higher risk of death, although the association was of borderline statistical significance (p=0.056), indicating a trend toward an increased risk of mortality in this population.

In contrast, the severe depressive symptoms category was strongly and statistically significantly associated with mortality, with a more than fourfold higher risk of death compared with participants without depressive symptoms. This finding reinforces the importance of depression as an independent prognostic factor in older adults. This relationship was described in a meta-analysis by Felipe et al.[20], who identified a 44% increase in the relative risk of death among older adults with depressive symptoms. The prevalence of depressive symptoms among Brazilian older adults is estimated at 21%[21]. This condition has also been associated with a higher incidence of cardiovascular diseases and all-cause mortality, with the magnitude of the association increasing according to symptom severity[22].

Notably, the most prevalent chronic conditions in the sample, namely hypertension, diabetes mellitus, cardiovascular disease, and cancer, were not statistically significant predictors of mortality. The Fried frailty classification, which was the primary focus of this study, was also not significantly associated with mortality. Conversely, osteoporosis, urinary incontinence, and severe depressive symptoms as classified using the GDS were associated with mortality in the sample.

These findings suggest that, in this population, such conditions may serve as markers of frailty, particularly in deficit accumulation models, such as the Frailty Index, or in multifactorial approaches. The Fried frailty phenotype used in this study focuses predominantly on physical components, including

weight loss, exhaustion, low muscle strength, slow walking speed, and low physical activity[23]. This interpretation is consistent with the meta-analysis by Tan et al.[24], which demonstrated a consistent association between frailty and mortality risk among older adults up to 90 years of age but found no statistically significant association among individuals older than 90 years.

In addition to the findings of the multivariable analysis, the clinical relevance of urinary incontinence, osteoporosis, and risk of sarcopenia should be emphasized, as these variables were associated with mortality in the univariable analysis.

Urinary incontinence was associated with a higher risk of mortality. It is a common geriatric syndrome recognized for its adverse effects on health and socioeconomic conditions and has also been associated with an increased risk of all-cause mortality among older adults. In this population, urinary incontinence may be strongly related to cognitive decline, physical inactivity, immobility, sarcopenia, and impairment in activities of daily living. Together, these factors contribute to more sedentary behavior[25]. Moreover, urinary incontinence frequently reflects underlying conditions, including frailty, falls, infections, and other comorbidities, which may also increase mortality risk[26].

Urinary incontinence represents a sign of systemic vulnerability and an important clinical marker of frailty, particularly among the oldest-old. Although it is not included in the original criteria of the Fried frailty phenotype, it is strongly associated with low physical activity, weakness, slowness, and exhaustion. In Rockwood's deficit accumulation model, urinary incontinence is frequently included as one of the deficits contributing to a higher Frailty Index, particularly among adults of very advanced age[24,27].

The presence of osteoporosis was associated with more than twice the risk of death in the sample analyzed (HR = 2.24), corroborating findings from an Asian study[28] that identified a significant association between osteoporosis risk, assessed using the Osteoporosis Self-assessment Tool for Asians (OSTA)[29], and all-cause mortality among older adults. A bidirectional causal relationship between osteoporosis and frailty was also demonstrated by Que et al.[30], and an association between these conditions was reported in a meta-analysis of 9,664 patients conducted by Hu et al.[31]. In addition, Shamsalinia et al.[5] reported a strong influence of frailty syndrome on osteoporosis severity. The association between the two conditions may be explained by shared multisystem mechanisms[30].

The association between sarcopenia and mortality was also reported by Zhang and Zeng[32], who identified a significant association between sarcopenia and all-cause mortality. Similar findings were reported in a systematic review and meta-analysis[33] that included adults from different settings and countries and used different methods to screen for sarcopenia and frailty. These findings reinforce the consistency of this association across different populations and clinical settings.

Although the present study did not demonstrate an association between frailty identified using the Fried frailty phenotype and mortality among the oldest-old, the findings indicate that osteoporosis, urinary incontinence, and depression are important and frequently interrelated markers of frailty in this population[23,27,34].

The Fried frailty phenotype, developed using data from the Cardiovascular Health Study, was established on the basis of a population composed predominantly of relatively healthy individuals aged 65 to 75 years[23]. Both the findings presented in this study and those of previous research have demonstrated important limitations when this phenotype is applied to the oldest-old[24,35].

In this context, several hypotheses should be considered. Individuals aged 80 years or older have likely undergone an intense process of selective survival, in which the frailest individuals died before reaching this age. Thus, certain components traditionally associated with frailty in this age group may reflect adaptations to advanced aging rather than necessarily indicating pathological states. Reduced muscle strength and slow walking speed, for example, tend to be highly prevalent and may therefore have lower discriminatory ability. Moreover, at very advanced ages, the baseline risk of mortality is high regardless of frailty status, which may attenuate the predictive ability of the classification.

Several limitations should be considered when interpreting the findings. First, this was an observational cohort study, which precludes establishing causal relationships between the variables investigated and mortality. In addition, although adjustments were made for potential confounding factors, the influence of residual confounding due to unmeasured variables cannot be ruled out.

Although the proportion of missing data was low and did not change the direction of the observed associations, the possibility of information bias cannot be completely excluded. The potential for bias related to the time interval between the assessment of clinical variables and outcome follow-up should also be considered, because health conditions, functional status, and psychosocial characteristics may change over time and influence the magnitude of the associations identified.

Possible changes in participants' clinical conditions and treatments during the follow-up period must also be considered, including treatment modifications, the onset of new comorbidities, and functional decline. These factors were not fully captured in the analyses. Despite these limitations, the present findings contribute to the understanding of factors associated with mortality among older adults and reinforce the importance of multidimensional assessment in this population.

CONCLUSION

Based on the findings of this study, frailty identified using the Fried frailty phenotype did not show significant predictive ability for mortality among the oldest-old. In contrast, marital status, depressive symptoms, osteoporosis, urinary incontinence, and risk of sarcopenia showed important associations with mortality, with severe depressive symptoms standing out as an independent predictor of mortality.

These findings reinforce the importance of a broader approach to frailty that incorporates markers of biological and functional vulnerability in the context of advanced longevity. From a clinical perspective, the results suggest that the early identification and management of these conditions may support risk stratification and the planning of more individualized care for octogenarians and other adults of advanced age.

These findings are consistent with the concepts of phenotypic and biological frailty in the context of advanced longevity, suggesting that certain clinical and functional conditions reflect greater systemic vulnerability and may have greater predictive ability than the conventional frailty phenotype among the oldest-old.

The protective association observed among married participants should also be highlighted, as it reinforces the importance of social determinants and interpersonal support for survival at more advanced ages. Similarly, the strong association between depressive symptoms and mortality emphasizes the need for greater attention to mental health in the care of the oldest-old.

Although limited by its observational design and by possible clinical changes during follow-up, this study contributes to a broader understanding of factors associated with mortality among octogenarians and nonagenarians. The findings reinforce the need for comprehensive geriatric assessment strategies that extend beyond the physical components of frailty, facilitating the early identification of potentially modifiable conditions and supporting more comprehensive interventions aimed at promoting longevity and better quality of life.

Future research should include longitudinal studies with repeated measurements of inflammatory biomarkers and functional assessments, as well as the development of integrative models combining clinical conditions, functional status, and biological indicators. Such approaches may improve mortality prediction and contribute to a better understanding of the mechanisms involved in advanced aging.

AUTHOR CONTRIBUTIONS

- **Ingridy Fátima Alves Rodrigues:** Conceptualization; Project administration; Methodology; Investigation; Data curation; Formal analysis; Writing, review, and editing.

- **Andressa Andrade Teymeny:** Investigation; Data curation; Validation; Research ethics review.
- **Karla Helena Coelho Vilaça e Silva:** Supervision; Methodology; Validation; Writing.

All authors read and approved the final version of the manuscript and agree to be accountable for all aspects of the work, ensuring the accuracy and integrity of every part of the study.

Edited by: Camila Alves dos Santos

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An analysis of aging through the lens of the 'What's the Problem Represented to be' approach in Brazilian health policies

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Abstract

Objective: To analyze how aging is represented in Brazilian health policies in light of the What's the Problem Represented to be? (WPR) approach. *Method*: A documentary and exploratory study based on the WPR approach. Data collection took place in official repositories of the Brazilian Ministry of Health, selecting six normative and guiding documents (2006 to 2023) directed at the health of older adults in the Unified Health System (SUS). The analysis was conducted based on six guiding questions to identify representations, narratives, and silences within the texts. *Results*: The analysis revealed three main categories: "Represented problems," which predominantly associate aging with chronic diseases, frailty, and dependence, reinforcing a curative and medicalizing model; "Dominant narrative," which portrays older adults as frail and lacking agency, paradoxically imposing an ideal of aging free from dependence; and "Underlying silences," which highlight the omission of gender, sexuality, and racial and socio-territorial disparities in care planning. *Conclusion*: The analyzed health policies tend to govern aging from a paternalistic and welfarist perspective, focusing on pathology and functional decline. A reconfiguration of these strategies is urgently needed to overcome standardized approaches, recognizing social inequities and the heterogeneity of aging. Promoting autonomy requires older adults to be recognized as subjects of rights and active protagonists in their care process.

Keywords: Aging. Health Policy. Health of the Elderly. Unified Health System. Policy Making.

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There was no funding for this work.

The authors declare no conflict of interest in the conception of this work.

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Received: May 5, 2026
Approved: July 29, 2026

INTRODUCTION

Brazil is experiencing an accelerated demographic and epidemiological transition, with declining birth and death rates, increased life expectancy, and an aging population. This phenomenon is multifactorial and stems from increased access to healthcare services, scientific and technological advancements, improved sanitary and environmental conditions, higher levels of education and income, and changes in the population's standard of living[1].

Aging has an impact on social and economic dimensions, and the labor market is beginning to demand adaptations for the inclusion and retention of older people, valuing their experiences and knowledge[2]. Life expectancy in the country reached 76.4 years in 2023, with 73.1 years for men and 79.7 years for women, exceeding pre-pandemic levels and demonstrating significant progress in longevity[3].

In this context, the increase in life expectancy challenges the healthcare system, especially given the higher prevalence of chronic conditions, persistent social vulnerabilities, and the need for continuous care[4,5].

Within this context, Brazil has enacted policies that address the comprehensiveness and multidimensionality of the aging of the Brazilian population. The National Health Policy for Older Adults (PNSPI), approved in 2006, stands out as a pioneering initiative, aiming to guide actions for promotion, prevention, and continuous monitoring, strengthening Primary Health Care (PHC) as the priority entry point to the Unified Health System (SUS)[6].

The National Health Promotion Policy (PNPS) broadens the perspective on aging and incorporates dimensions that affirm healthy aging, prioritizing healthy eating, regular physical activity, disease and injury prevention, combating violence, and intersectoral collaboration[7].

The Guidelines for the Care of Older Adults in the Brazilian Unified Health System (SUS) and the Technical Guidelines for the Implementation of the Care Pathway for Comprehensive Health Care for Older Adults embody the commitment to comprehensiveness and coordination of care, proposing risk stratification and standardization of care flows[8,9].

Following the COVID-19 pandemic, new strategies were adopted, such as the development of the Care Guide for Older Adults, focusing on strengthening self-care, autonomy, and family and social support[10]. These efforts reflect the challenge of reorganizing the care network to respond to a rapidly aging and heterogeneous population, demanding sustainable, equitable, and functionality-sensitive policies[11-13].

Given this scenario, analyzing these policies using the "*What's the Problem Represented to be?*" (WPR) approach, as proposed by Carol Bacchi, allows us to identify how aging is represented in the documents, the assumptions that underpin such representations, their silences, and their implications[14,15]. This perspective helps to understand the ways in which certain conceptions of aging shape institutional responses and distribute responsibilities between the State, family, and individual[16].

Revisiting Brazilian policies on aging is urgently needed, as highlighting implicit representations and practical effects resulting from silences can reorient care strategies within the SUS (Brazilian Unified Health System) and strengthen the transition to dignified, active, and equitable aging[16,17]. In this context, this study aims to analyze aging in light of the "*What's the Problem Represented to be*?" approach.

METHOD

This is a documentary and exploratory research, based on the "*What's the Problem Represented to be*?" (WPR) approach. Through six guiding questions, the WPR enables critical analysis of public policies and reflection on social representations, assumptions, silences, and effects produced in the analyzed documents[14,15].

The approach allows us to relate collective needs in the aging process and actions constructed within the scope of public policies, approaching the policy development cycle and considering epidemiological analyses, social demands and institutional processes of formulation, implementation and evaluation[18,19].

The analysis was guided by six guiding questions that structure the analytical reflection on how the "problem" of aging is constructed and legitimized in the health policies analyzed. For the application of these questions, the translation and methodological adaptation proposed by Rodrigues et al.[20] was used. The questions are presented in Table 1.

The study was conducted between February and November 2025 through document analysis of public policies, manuals, and guidelines related to aging and the health of older adults in Brazil. The search encompassed official repositories of the Ministry of Health, the Virtual Health Library (BVS), and the Federal Government portal (https://www.gov.br/saude), sources that contain normative and guiding documents for the organization of public policies within the Brazilian Unified Health System (SUS).

A twenty-year time frame (2005–2025) was adopted, with the aim of including documents produced during the period and context of the consolidation of policies aimed at the older population in the country.

The search strategy used the keywords "aging," "older adult health," "primary health care," and "public health policies," employed in isolation and in different combinations (Table 2).

In addition to the search in the BVS (Virtual Health Library), a supplementary survey was conducted on the official website of the Federal Government (https://www.gov.br/saude), following the path Ministry of Health → Content Centers → Publications → Guides and Manuals, to identify institutional documents not indexed in bibliographic databases, such as technical manuals, guidelines, and guides for implementing public policies.

After reviewing and reading the titles, those that addressed the object of study were selected. In the next step, official documents published by the Ministry of Health addressing population aging, the organization of healthcare for older adults, and care strategies within the Brazilian Unified Health System (SUS), especially in Primary Health Care (PHC), were included. Duplicate documents, materials without normative or technical character, and those that did not address other themes were excluded (Table 3). This workflow was guided by the specificities of the WPR approach.

Table 1. Guiding questions of the WPR approach applied to the analysis of health policies.

	QUESTION
1	What is the "problem" represented in a specific policy or policy proposal? (What is the implicit problem?)
2	What assumptions or presuppositions underpin this representation of the "problem"? (What underpins this problem?)
3	How did this representation of the "problem" arise? (How did it become legitimate?)
4	What is not problematized in this representation of the "problem"? Where are the silences? Can the "problem" be thought of differently? (What are the silences? What is omitted?)
5	What effects are produced by this representation of the "problem"? (What is the effect on older people and their care?)
6	How/where was this representation of the "problem" produced, disseminated, and defended? How was it (or could it be) questioned, interrupted, and replaced? (How did it become dominant? And how can it be questioned?)

Source: Adapted from Bacchi[14,15] and Rodrigues et al[20].

Table 2. Search strategy and number of results identified in the databases consulted.

Search Equations	Results
"Primary Health Care" AND "Public Health Policies"	33
"Aging" AND "Public Health Policies"	10
"Health of the Older Adults" AND "Aging"	16
"Health of the Older Adults" AND "Public Health Policies"	07
"Health of the Older Adults" AND "Aging" AND "Public Health Policies"	04

Source: Author's own elaboration, 2025.

Table 3. Regulatory and guiding documents analyzed according to year of publication.

DOCUMENTS ANALYZED	YEAR
Primary Care Notebooks - No. 19: Aging and Health of Older Adults	2006
National Health Policy for Older Adults	2006
National Health Promotion Policy	2010
Guidelines for the Care of Older Adults in the SUS: Proposal for a comprehensive care model	2014
Technical guidelines for the implementation of a care pathway for comprehensive health care for older adults in the Unified Health System (SUS)	2018
Care guide for older adults	2023

Source: Author's own elaboration, based on the official documents analyzed[6-10,22].

The organization of the analysis relied on a structured table with the six analytical questions from the framework "*What's the Problem Represents to be*?" (WPR)[14,15]. For each selected document, read and analyzed, discursive elements present were identified and recorded. After organizing the responses, issues and problems that converge on the representations in the documents about aging were demarcated. The answers to the six guiding questions allowed us to identify the forms of representation of the problem in public policies, as well as the assumptions, effects, and silences present in the analyzed documents.

This systematization enabled a comprehensive analytical interpretation of the categories: Problems Represented (PR), Dominant Narrative (DN), and Silences Underlying the Problem (SSP). The PR corresponds to the ways in which the documents define and frame issues related to aging and the health of older people; the DN refers to the predominant discourses and approaches in the policies analyzed; and the SSP concerns aspects that are little addressed or absent in the formulation of public policies, gaps and limitations in public policy related to aging in Brazil.

The researchers position themselves as an integral part of the problematization and recognize that the critical analysis of narratives does not aim to measure effectiveness or efficiency, but to interpret conceptions present in policies on aging. The documents consulted are publicly accessible and in the common domain, exempting the study from review by a Research Ethics Committee, in accordance with Resolution No. 510/2016 of the National Health Council[21].

Use of Artificial Intelligence

The use of the NotebookLM Artificial Intelligence tool (manufactured by Google, version accessible at notebooklm.google.com) is declared for the purpose of organizing scientific articles and content summaries, in the introduction writing review and writing revision stages.

DATA AVAILABILITY

All the data supporting the results of this study is available on Figshare and can be accessed at DOI: 10.6084/m9.figshare.32978306

RESULTS

Six documents published between 2006 and 2023 were included in the analysis (Table 3). The critical content appraisal, guided by the WPR methodology, resulted in three categories: (a) problems represented (PR); (b) dominant narrative (DN); and (c) silences underlying the problem (SSP).

As for the problems represented in the documentary texts, it can be said that they address

the accelerated growth of older adults in the world and in Brazil and highlight the relevance of the topic for health. They recognize that the plural structure that anchors Brazilian health actions and services is still under construction[6-10,22].

The National Health Policy for Older Adults and the Guidelines for the Care of Older Adults in the SUS (Brazilian Public Health System) emphasize the direct relationship between aging and the increase in chronic diseases and/or conditions, demanding multidimensional care[6,8].

The concept of aging aligns with that advocated by the World Health Organization, which establishes the relevance and urgency of the topic for the health agenda. The documents reinforce the association of aging with chronic diseases, dependency, frailty, and medicalization, with an emphasis on a curative and disease-centered model[13].

It is observed that the texts explicitly state guidelines based on demographic and epidemiological evidence; however, they omit regional differences within Brazil. They highlight the need for adaptation of SUS (Brazilian Public Health System) services and continuing education for professionals to care for older adults in light of the complex health needs of this phase of life[6-10,22].

Among the instruments described for assessment and monitoring, the Multidimensional Assessment of the Older Adults and the Older Adult's Health Booklet stand out as the basis for the care pathway for the older adult[9,10].

The procedures and guidelines for assessing older adults in Brazil are, in part, adapted from international models and do not always consider socio-regional profiles, individual characteristics, and the specific needs of the older adult. Basic Care Notebook No. 19 positions this group as recipients of care and refers to dependency as a problem to be addressed at both macro and micro-political levels[22].

The Technical Guidelines for the Implementation of the Line of Care for Comprehensive Health Care for Older Adults in the SUS recognize the invisibility of biopsychosocial and spiritual conditions of aging, but direct attention to the health of the older adult towards assessment instruments focused, above all, on dependence[9]. In relation to the dominant narratives, the documents make clear the complexity of aging related to the problems and losses linked to functional decline, performing as a being that is difficult to care for, due to the plurality that involves care at this stage. Paradoxically, it is inferred that aging must be free from functional dependence.

The older adult portrayed in the analyzed documents is frail and dependent, lacking the ability to take charge of their own care. This portrayal is reinforced by the epidemiological profile, marked by a triple burden of disease, with a predominance of chronic conditions.

Within this context, the *National Health Promotion Policy* reinforces the idea that health promotion is a collective responsibility, not just an individual one, without ignoring the demands for access to curative and rehabilitative care, which are still insufficient for this population. In this sense, the policy makes it clear that aging with quality requires intersectoral actions, healthy environments, and active lifestyles.

Regarding the monitoring of this population segment, the narrative in the documents explicitly outlines the evaluation model to be used in the care pathway within the Brazilian Unified Health System (SUS); however, it does not consider the number of healthcare professionals, the workload burden in these services, or the operationalization of a model that includes various screening tests and the implementation of a care plan.

This scenario is exacerbated in Primary Care, which remains the coordinator and organizer of care, considering the heterogeneity of aging. Emphasizing approaches that assess functionality, not just chronological age, aligns with health promotion.

These documents revealed omissions regarding topics related to gender issues, sexuality in aging, the unique context of caregiving, and the caregiver profile. Despite the existence of specific policies on women's health, the normative documents lack positions on the health of older women.

The discussion and specificities related to racial and territorial inequalities in aging were also not mentioned. The texts do not express characteristics that guide a care practice directed towards different territories and their sociocultural specificities.

In this context, based on what is left unsaid, they demonstrate that these social inequalities, in terms of access to the SUS (Brazilian Public Health System) and territory, impact care and its continuity. Furthermore, they do not consider social inequalities in the formulation of policies for older adults, which minimizes and/or negates their protagonism, active participation, and decision-making regarding their own care.

DISCUSSION

The results show that the representation of the triad of aging, chronic diseases, and dependency prevails, reinforcing the curative and medicalized model and minimizing the singularities of aging, although the normative documents analyzed recognize the relevance of population aging and present guidelines for the organization of care[6-10,22].

Brazil's situation, facing the accelerated aging process and the need to remodel healthcare for older adults, demands a contemporary model centered on the needs of a heterogeneous and complex public[12]. This scenario reflects the persistence of anachronistic conceptions rooted in society about this human process.

Minayo, in Anthropology, Health and Aging, discussed concepts surrounding aging, such as deprivation, stigma, and discrimination against the older population[23]. Two decades later, these constructs persist and challenge the effectiveness of intersectoral services. Furthermore, the author addresses the heterogeneity of aging patterns, highlighting the diverse characteristics of the population.

Within this line of reasoning, it is reinforced that aging is not merely a biological phenomenon, but also a product of the discourses and non-discourses manifested by policies. So, what kind of older adults are public policies producing?

From the perspective of social and anthropological sciences, old age is understood as a social construct, marked by different cultural representations and expectations. Classic studies indicate that the category "third age" is associated with an ideal of active, autonomous, and productive aging, frequently linked to stereotypes of well-being, participation, and consumption[24,25].

Those who do not fit into this model tend to be perceived as deviant from the standard considered ideal, which can contribute to processes of social exclusion and the invisibility of the singularities of aging[26,27]. This invisibility is materialized, above all, in frail or dependent older adults.

In this sense, we are faced with a situational duality: autonomous and independent older adults, integrated into the labor market, and dependent older adults with ongoing health needs. These health needs mostly stem from the worsening of chronic conditions and dementia. These events overburden intersectoral services and compromise sustainability, establishing themselves as a complex challenge on a global scale.

The implementation of policies faces challenges in meeting the demands of this duality and its distinct, yet interdependent, audiences. The organization of health services proposed in Brazilian aging policies directs care towards chronic conditions; and these diseases can affect people at any stage of the life cycle.

In this sense, do policies address or define the aging process? To answer this question, we turn to Foucault's concepts of biopower and biopolitics, understood as strategies and mechanisms through which modern power influences the lives of populations, regulating birth, mortality, health, and longevity[28].

From this perspective, public health policies can be understood not only as guiding principles of care, but also as devices that project appearances and norms about aging. In this context, the ideal of "successful" aging emerges, associated with autonomy, productivity, physical activity, and the maintenance of functional independence.

Although this "ideal" contributes to building the promotion of health and quality of life, it can also "design" a moral obligation for society to age actively and healthily.

Those who fail to conform to this model—older adults with frailty, functional dependencies, or complex chronic conditions—may be implicitly characterized and treated outside the perceived ideal of aging. We are faced with an exclusionary ideology.

This shift highlights the difficulty the Brazilian healthcare system faces in transitioning from a disease-focused care paradigm to one that prioritizes health promotion, autonomy, and social participation for older adults. Furthermore, the analysis of the texts revealed significant silences, especially regarding gender, sexuality, racial and territorial inequalities—fundamental aspects for understanding and applying guidelines and regulations for implementing strategies focused on aging.

By silencing aspects related to race, gender, territory, social class, and living conditions, the policies analyzed end up obscuring historical inequalities that intensify in old age, in contexts of greater social vulnerability.

References to the Social Determinants of Health corroborate that the health-disease process is conditioned by structural factors that extend beyond the individual and biomedical scope and that, when disregarded, limit the effectiveness of proposed interventions[29]. The omission of territorial specificities in normative documents represents not only a geographical issue, but also an obstacle to maintaining functional capacity, a central axis of contemporary gerontology[13].

By silencing nascent infrastructures—mobility, security—in Brazil's disparate contexts, policies impose unattainable active aging goals in areas of extreme social vulnerability.

Furthermore, the absence of an intersectional approach weakens the understanding of how different markers of oppression are articulated, produce, and reproduce inequalities in the aging of women, Black people, and populations residing in peripheral, rural, or Indigenous territories[30]. In the Brazilian context, this invisibility interacts with structural racism, understood as an organizing element of social and institutional relations that directly affects living conditions and access to health services throughout the life course[31].

By not explicitly incorporating these dimensions, the policies analyzed tend to reinforce standardized strategies that are insensitive to socio-territorial realities, distancing themselves from international recommendations that recognize equity as a central principle for promoting and enjoying healthy aging[17].

The way public policies represent older adults also reveals important limitations regarding their recognition as subjects of rights and political actors in the care process. By prioritizing approaches focused on the organization of services and the management of clinical conditions, the documents analyzed tend to position older adults predominantly as recipients of actions, with reduced appreciation for their autonomy, decision-making capacity, and participation in the construction of care strategies.

In light of recognition theory, this configuration expresses a deficit of social and political consideration, insofar as the protagonism of older adults is not consistently materialized in normative devices[32]. In Brazil, Debert problematizes the persistence of representations of old age that, although expanding rights on a formal level, maintain tutelary and hierarchical practices[24]. Camarano, in turn, highlights that population aging in Brazil demands policies that transcend the welfare logic, incorporating social participation and diversity of life trajectories[16].

Overcoming the guardianship and welfare-oriented model requires a redefinition of care strategies and society's perception of older adults, moving beyond the paradigm of "object of intervention" to recognize them as subjects of rights. Promoting autonomy requires health knowledge and practices that transcend the clinical setting itself and incorporate intergenerational dialogue, respect for life trajectories, and recognition of their wishes in therapeutic planning.

The true integration of older adults into the healthcare system will occur to the extent that policies foster social empowerment, allowing aging to be a

civilizational and civic achievement, not reduced to biological decline and governed by state protocols.

Convergently, Veras defends the need to reorganize the health care model for older adults, with an emphasis on functionality, autonomy and centrality of the subject[5,12]. Thus, the absence of institutional mechanisms for listening, deliberation and co-production of care limits the emancipatory potential of the policies analyzed and contributes to the maintenance of practices that make little progress in consolidating aging based on citizenship, autonomy and social recognition.

Thus, the discussion of the results allows us to understand that, although the policies analyzed represent advances in recognizing aging as a public health priority, significant gaps persist regarding the protagonism of older adults, the adaptation of services to different socio-territorial realities, and the incorporation of an effectively inclusive and equitable perspective in care planning.

Despite its relevance, this study has limitations that should be considered. The analysis focused on normative documents in the health context, which may not fully reflect the operationalization of these guidelines in other areas. Furthermore, the WPR approach prioritizes discourse analysis, not allowing for a direct assessment of the impacts of these policies on healthcare for older adults. Therefore, the results should be understood as a problematization of the representations present in policy formulation, and not as a measure of their effectiveness.

CONCLUSION

An analysis of Brazilian public policies within the SUS (Unified Health System) has shown that aging has been predominantly represented through its association with chronic diseases, frailty, and dependency, reinforcing a care model centered on illness and the medicalization of care. This discursive construction directly impacts the health of older adults, positioning them as passive subjects in the care process, with reduced appreciation for their autonomy and protagonism. Although the guidelines analyzed incorporate elements of policy formulation aimed at active aging, there is a persistence of standardized approaches that do not adequately address the heterogeneity of aging, especially in contexts marked by social, territorial, and cultural inequalities.

Based on the discussions presented, it is recommended that future research broaden the interface between policy analysis and empirical studies in the field of aging, investigating the implementation of guidelines within the context of the Brazilian Unified Health System (SUS) and their effects on care. Studies incorporating intersectional approaches are essential to improve policy formulation and address inequities in aging. Furthermore, the need for the development and evaluation of innovative technologies and strategies that strengthen continuity of care, contributing to the promotion of autonomy, comprehensiveness, and equity for the older population, is highlighted.

AUTHORSHIP

- Gerarda Maria Araújo Carneiro Paixão - Conception and design; Writing or critical review; Final approval of the version; Responsibility for all aspects of the work.
- Luiza Jane Eyre de Souza Vieira - Data analysis and interpretation; Writing or critical review; Final approval of the version;
- Luciana Araújo Gurgel - Data analysis and interpretation; Writing and critical review;
- Samira Valentim Gama Lira de Alencar - Data analysis and interpretation; Writing and critical review;
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Edited by: Camila Alves dos Santos

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Analysis of prescriptions and adaptations of solid dosage forms for older adults with dysphagia

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Abstract

Objective: To analyze the prescriptions of older adults with dysphagia and identify adaptations of solid oral dosage forms (SODFs) and problems associated with the related medications. *Method:* A retrospective, quantitative, and descriptive study was conducted based on the evaluation of prescriptions from older adults hospitalized in a university hospital between July and December 2024. Data were collected from a semi-structured form containing information on clinical-geriatric variables, functionality, frailty, and pharmacotherapy. The technical evaluation of prescriptions and adaptations of dosage forms was based on selected institutional protocols and manuals; medication-related problems were classified using Pharmacotherapy Workup. *Results*: The final sample consisted of 113 prescriptions from medical records of eight patients, with a mean age of 80.6 years, multimorbidities, frailty, and cognitive impairment. An average of two medication-related problems per prescription were observed, mostly related to technique, incorrect route of administration, and excess medication dose; only one case contained instructions on how to modify the medication. Of the 75 medications identified, 58% were SODFs; of these, 65.9% were crushable, 43.18% had alternative dosage forms, 9% presented contraindications, and 14% contained conflicting information. In two cases, no data on the possibility of adaptation were present. *Conclusion*: There was a high prevalence of problems related to pharmacotherapeutic safety, associated with limited adaptation of SODFs and absence of standardized recommendations for administration in older adults with dysphagia. These findings reinforce the importance of evidence-based guidelines and the role of the pharmacist in promoting the rational and safe use of medications in this population.

Keywords: Older adults. Deglutition Disorders. Pharmaceutical Preparations. Drug Utilization. Drug Administration Routes.

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No external funding was received to support this study.
The authors declare no conflict in the conception of this study.

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Received: March, 23, 2026
Approved: July, 10, 2026

http://dx.doi.org/10.1590/1981-22562026029.260048en

INTRODUCTION

Medications are pharmaceutical products intended to prevent disease and ensure people's well-being, and represent an essential tool in health care[1,2]. The use of medications has increased over the decades, largely in association with changes in the global epidemiological profile, particularly the predominance of chronic noncommunicable diseases, which require more complex pharmacological treatments[3]. In this context, medication administration plays an important role in patient adherence to pharmacotherapy, which must be convenient, safe, and cost-effective[4].

The oral route and use of solid oral dosage forms (SODFs), such as tablets and capsules, are preferred because of their lower cost, greater accessibility, convenience, and the possibility of self-administration, characteristics that are especially relevant in patients exposed to polypharmacy, as is often the case for older adults[1,5]. However, swallowing may become challenging for older adults who have some swallowing disorder, such as dysphagia, a clinical condition that may be caused by physiological changes associated with aging (presbyphagia) or due to complications of neurological diseases such as Parkinson's disease, dementia, multiple sclerosis, and stroke[5-8].

In older adults, dysphagia is one of the leading causes of malnutrition, dehydration, aspiration pneumonia, prolonged hospital stay, and death by choking[9,10]. The condition also affects medication administration, because patients may be afraid and/or refuse to use medications, especially SODFs, due to previous choking episodes[1,6]. Therefore, a number of strategies may be employed to promote adherence to pharmacotherapy in these patients, and the most commonly used methods involve pharmaceutical modifications of these dosage forms[11,12].

The methods most frequently used by family members, caregivers, and health professionals involve splitting and/or crushing tablets, emptying the contents of capsules, using thickeners in liquid preparations, and administering medications with foods and/or liquids other than water[12-14]. Although these strategies apparently resolve the issue of adherence, in practice they pose several problems. These approaches may cause pharmacokinetic alterations, changes in drug stability and compatibility, dosing errors, therapeutic ineffectiveness, and adverse events, in addition to occupational risks to the person handling the medication[1,15].

These negative outcomes, associated with factors such as hospitalization, polypharmacy, multimorbidity, and age-related pharmacokinetic and pharmacodynamic changes, increase the likelihood that older adults will experience medication-related problems (MRPs)[16]. Defined as an "event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes," MRPs can be described, as per the classification of the Pharmaceutical Care Network Europe (PCNE)[17], in terms of the problem that occurred, its causes, the interventions performed, acceptance of the intervention, and the outcomes obtained.

MRPs may involve different aspects of pharmacotherapy, including situations related to treatment need, effectiveness, safety, and adherence, according to the classification proposed by the Pharmacotherapy Workup method developed by Cipolle, Strand, and Morley[18]. These problems are therefore considered important indicators of the quality of pharmaceutical care and patient safety. Thus, ensuring pharmacological treatment is carried out correctly and safely in patients with swallowing disorders is a major challenge for health professionals.

Given this scenario, the aim of the present study was to analyze the prescriptions of older adults with dysphagia and identify the adaptations performed in SODFs and the MRPs associated with them, thereby contributing to interprofessional articulation within the health team and helping to improve care for older adults.

METHODS

A retrospective, descriptive, and quantitative study was carried out based on the analysis of data from the electronic medical records of older adults with dysphagia hospitalized in a geriatric ward, between July and December 2024. This period was selected because it corresponded to the full availability of records and speech-language pathology

evaluations necessary for information collection. The sample was nonprobabilistic and convenience-based, with a pre-established limit of 50 medical records and 400 prescriptions, taking into account ward bed availability, the operational capacity for data collection, and average length of hospital stay.

Data were collected between April and June 2025 from the institutional electronic system using a semi-structured form specifically developed for this purpose, covering clinical and geriatric variables, speech-language pathology assessment, diet type, prescriptions during hospitalization, and pharmacotherapeutic and technical evaluation of medications (whether there was follow-up by a pharmacist, modification of the dosage form, presence of correct administration instructions, and which MRPs were identified).

For inclusion purposes, medical records of patients aged 60 years or older were considered, with a diagnosis of dysphagia defined by the Brazilian Speech-Language Pathology Protocol for Swallowing Risk Assessment (PARD) as level IV or higher, and swallowing evaluation using the Functional Oral Intake Scale (FOIS) defined as levels 1-3[19,20], and who were receiving an adapted-consistency diet or using an alternative feeding route. Patients without solid oral medications in the prescription and individuals receiving parenteral nutrition were excluded from the final sample.

Data analysis entailed three stages. In the first stage, the clinical-geriatric profile of the participants was determined from the medical records, considering information on morbidities, functionality, and frailty. Functional capacity was assessed using the Katz scale for basic activities of daily living (ADLs) and the Lawton scale for instrumental activities of daily living (IADLs). Participants were categorized as dependent when they scored 0-2 points on the Katz scale and 9-12 points on the Lawton scale, and as partially dependent when scoring 3-4 points on ADLs and 10-20 points on IADLs. Frailty was measured by the Clinical Frailty Scale (CFS), and patients scoring five or higher were considered frail.

Diet consistency, feeding route, and the diagnosis and severity level of dysphagia were then assessed. Medications were categorized according to the World Health Organization (WHO) Anatomical Therapeutic Chemical (ATC) classification[21]. The technical analysis of prescriptions was performed using the Ministry of Health Protocol for Safety in Prescribing, Use, and Administration of Medications, based on safe-prescription verification items: a) patient identification; b) indication, dose calculations, and medication quantities; and c) dosage regimen, dilution, infusion rate, infusion time, and route of administration[22]. The Medication Prescription Safety Checklist developed by Pires et al.[23] was also used.

Lastly, after MRPs had been identified according to the definition proposed by the PCNE[17], these were classified according to the Pharmacotherapy Workup method into four categories: a) need/indication; b) effectiveness; c) safety; and d) adherence to pharmacological treatment[18]. The administration of SODFs was checked in publicly accessible manuals, such as the Handbook of Drug Administration via Enteral Feeding Tubes and the Manual for Medication Administration via Enteral Accesses of Hospital Sírio-Libanês[24,25]. In the absence of information in these materials, data and scientific articles indexed in databases such as UpToDate®, PubMed, Cochrane Library, and Science Direct, in addition to the electronic formulary of the Brazilian Health Regulatory Agency (ANVISA), were consulted[26].

Data were entered into online spreadsheets in Microsoft Excel® for Windows®, version 2016, and expressed as qualitative and quantitative variables through calculations of mean, prevalence rate, and relative and absolute frequency. The study complied with Resolution No. 466/2012[27] and Resolution No. 510/2016[28] and was approved by the institution's Research Ethics Committee under number 7.441.401, with CAAE registration 86490325.8.0000.8807. Given the study involved only secondary data from electronic medical records, the need for informed consent was waived.

USE OF ARTIFICIAL INTELLIGENCE

The authors declare that, during the preparation of the present study, the following digital scientific

resources were used: the Mendeley software (Mendeley Reference Manager®, version 2.110.0, Elsevier®), employed for management, organization, and review of the standardization of bibliographic references, and LeapSpace® (version https://www.sciencedirect.com/leapspace, Elsevier®), used as an artificial intelligence-based scientific research support tool for searching and identifying scientific articles related to the study topic. These tools were used in the introduction, methodology, discussion, and preparation of the manuscript references.

DATA AVAILABILITY

The full dataset underpinning the study results is available upon request from the corresponding author.

RESULTS

The initial list included 41 medical records of patients hospitalized during the data collection period. After applying the exclusion criteria, the final sample consisted of medical records for eight patients (Figure 1) and a total of 113 medical prescriptions throughout the hospitalization stays.

Patients had a mean age of 80.6±7.3 years, with dysphagia severity ranging from mild/moderate to severe, and 50% at level VI. Two medical records (25%) showed PARD VII and use of a nasoenteric tube (NET), while the others showed an adapted oral diet ranging from heterogeneous to semiliquid consistency.

Regarding clinical and geriatric profiles, two patients were partially dependent, whereas three were completely dependent for both basic and instrumental activities of daily living (Katz 0-2 and Lawton 9-12). All cases exhibited some degree of frailty, ranging from mild (CFS 5) to severe (CFS 8), and 50% were considered at high risk of falls. The most prevalent clinical conditions were hypertension (75%), diabetes mellitus, depressive disorder, and stroke (50% each).

A total of 75 drugs were cataloged, with a mean of nine medications per patient. Regarding ATC classification, approximately 21% of medications were group A (alimentary tract and metabolism), 16% groups B and C (blood and blood-forming organs, and cardiovascular system), and 7.5% group N (nervous system). For SODFs, 44 presentations were tablets and one was in powder form. In the technical analysis of prescriptions, the items patient identification, frequency of administration, dose, dosage regimen, absence of abbreviated medication names, use of "EV" rather than "IV," prophylaxes, and the metric system for expressing doses were met in 100% of prescriptions.

In one case, treatment was not correctly indicated. Four prescriptions contained nonstandard medications, three of which used brand names rather than the Brazilian Common Denomination (DCB) or International Nonproprietary Name (INN). Information such as type and volume of diluent, infusion time, and the use of nonstandard abbreviations was not fully compliant in all prescriptions evaluated.

The MRP analysis of the 113 prescriptions evaluated for the eight patients revealed a predominance of events associated with pharmacotherapeutic safety, especially those related to incorrect administration technique and route (Chart 1). Some prescriptions contained medications prescribed by the oral route for patients with a formal contraindication against oral administration, constituting a potential risk of bronchoaspiration. Additionally, MRPs related to dosage were also observed, including the need for adjustment according to renal function, as well as prescription inconsistencies, such as the use of nonstandard medications and inappropriate nomenclature.

After checking the indication and conformity of modifications of the SODFs against the references used, consensus was that, of the 44 tablets investigated, 65.9% were crushable. Restrictions were found for 9% of medications (Chart 2). No information was found in any of the three references for two medications (apixaban and cilostazol). Notably, 43.18% of medications had alternative dosage forms available, suggesting potential underuse of safer options (Figure 2).

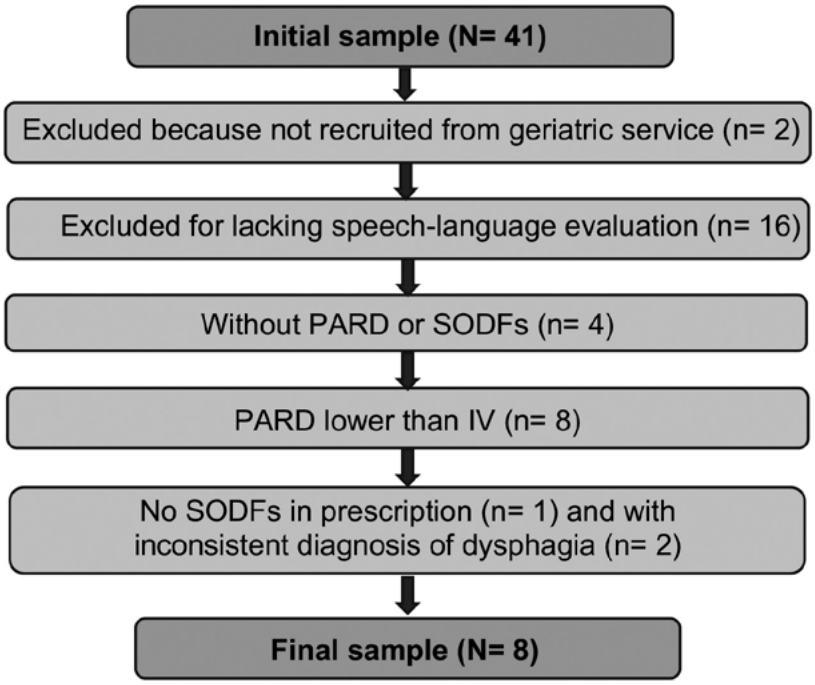


Figure 1. Selection process of patients for assessment in the study. Recife, Pernambuco state, 2025.

PARD: Brazilian Speech-Language Pathology Protocol for Swallowing Risk Assessment; FOIS: Functional Oral Intake Scale; SODFs: Solid Oral Dosage Forms. **Source:** Author elaboration, 2025.

Chart 1. Classification of nonconformities and medication-related problems identified in 113 prescriptions analyzed from eight older patients with dysphagia, based on Ministry of Health Protocol for Safety in Prescribing, Use, and Administration of Medications and Pharmacotherapy Workup method of Cipolle, Strand, and Morley[18,21]. Recife, Pernambuco state, 2025.

Type of problem	Description
Checklist items for safe medication prescribing	Treatment without correct indication for the patient (n = 1) Chemical formulas included (n = 1) Micrograms not written out in full (n = 7)
Dosage regimen, dilution, infusion rate, infusion time, and route of administration	Allergies not highlighted (n = 1) Treatment duration not specified (n = 6) Lack of information such as weight and creatinine clearance in prescription (n = 8) Incorrect route of administration (n = 6)
Treatment duration	No description of treatment duration (n = 6)
Transition points	Discrepancy between points of care (n = 1)
MRP need	Prescription of unneeded medication (n = 1)
MRP effectiveness	Incorrect medication administration technique and route (n = 6)
MRP safety	Excessive dose prescribed (n = 6)
MRP adherence	No problems identified

MRPs: Medication-related problems. **Source:** Author elaboration 2025.

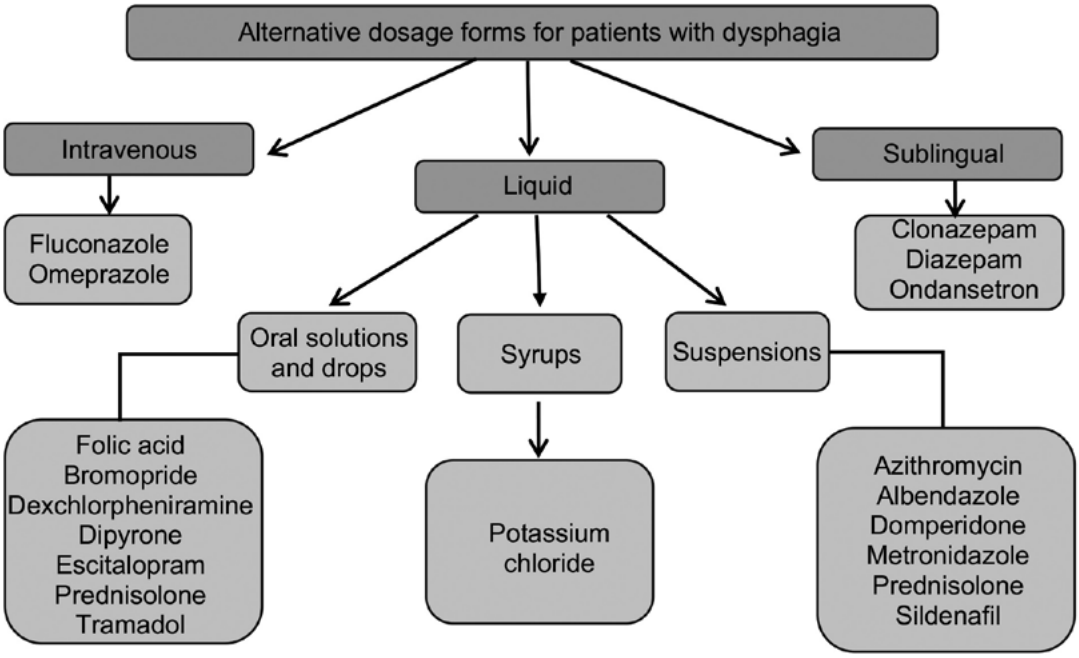


Figure 2. Alternative dosage forms available for administration in patients with dysphagia. Recife, Pernambuco state, 2025.

Source: Author elaboration 2025.

Conflicting information was identified for five drugs (Chart 3), highlighting inconsistencies in the literature and difficulties in clinical decision-making.

In two cases, no information on adaptation was found, indicating relevant gaps in the available knowledge. Of all medications, methotrexate was found in only one of the manuals and without recommendation for crushing, but rather for dissolving in water, because it is classified as a "hazardous drug, known as carcinogenic" by the National Institute for Occupational Safety and Health (NIOSH)[29].

Chart 2. Medications with restrictions on dosage form modification, rationale, and administration options. Recife, Pernambuco state, 2025.

Medication	Rationale
Bisacodyl	"Enteric-coated tablet, designed to resist gastric juice and be released only in the colon. When crushed, it loses this protection and the active ingredient is inactivated"[25].
Omeprazole	"Capsule containing enteric-coated granules. The granules are not soluble in water and do not disperse well, with high risk of tube obstruction; if crushed, they lose the coating and medication is inactivated"[25]. "The capsule contents may be dissolved in 10 mL of 8.4% bicarbonate (...) This solution may be administered via nasogastric, duodenal, or jejunal tube without risk of obstruction or loss of efficacy"[24].
Pantoprazole	"Tablet with gastro-resistant coating and high risk of tube obstruction"[25] "The tablet may be crushed and dissolved in 10 mL of 8.4% bicarbonate for administration via nasogastric tube"[24].
Azithromycin	"Use of suspension dosage form is recommended"[25]

Source: Adapted from references 24 and 25.

Chart 3. Conflicting information found in references used in the study. Recife, Pernambuco state, 2025.

Medication	Handbook of Drug Administration via Enteral Feeding Tubes [24]	*Manual para administração de medicamentos por acessos enterais*[25]
Hydralazine	Not recommended due to lack of information on administration via enteral tube	May be crushed
Isosorbide	Not recommended due to lack of information on administration via enteral tube	5 mg: yes. 20 mg: not recommended. Risk of tube obstruction.
Ivermectin	Medication not listed in handbook	May be crushed
Mirtazapine	Risk of tube obstruction and irregular medication doses when dissolved in water	May be crushed
Morphine	Not recommended	Immediate-release tablets may be crushed, diluted, and administered

Source: Adapted from references 24 and 25.

DISCUSSION

The results of this study highlight the complexity of pharmacotherapy management in older adults with dysphagia. This complexity stems from the fact that swallowing disorders are multifactorial clinical conditions related to aging, its accompanying increase in chronic diseases, and associated comorbidities, hence representing some of the risk factors for dysphagia in this population[5,6,30,31].

These findings are in line with previous reports in the related literature, considering dysphagia a geriatric syndrome, not only for its considerable prevalence (ranging from 10% to 33%, depending on the reference consulted), but also because of its negative psychological and social impacts on older adults[9,10,32]. From a pharmaceutical perspective, the combination of these factors with chronic drug use increases the risk of MRPs, especially in high-complexity hospital settings such as that of the present study.

The predominance of SODFs in prescriptions, even among patients with contraindications to the oral route, reinforces the practical difficulty of replacing them, whether due to the unavailability of other dosage forms or of therapeutic alternatives. This finding is consistent with the literature, showing persistent use of tablets and capsules even in unfavorable clinical contexts. Moreover, the predominance of MRPs involving safety, especially those associated with incorrect technique and route of administration, reinforces the existence of shortcomings in the prescribing process, in communication among professionals, and in patient safety practices.

In this context, the adaptation of tablets and capsules ultimately becomes the only means of carrying out pharmacotherapy in older adults with dysphagia. However, the absence of instructions for adapting these dosage forms, observed in almost all prescriptions analyzed, constitutes a critical finding. This gap exposes patients to avoidable risks, such as pharmacokinetic alterations, adverse events, and loss of therapeutic effectiveness.

In cases of NET use, a lack of certain information in prescriptions was noted, such as tube flushing before and after administration to avoid obstruction, whether pauses in the diet are needed, and the existence of possible interactions between the medication and enteral diet. Fluid balance is also affected, because it must be calculated considering the amount of water used when these drugs are administered through this feeding route[33].

This difficulty in including so many details and points in prescriptions to be considered for the transformation and administration of SODFs, both via NET and the oral route, may be associated with the fact that information on how to manage medications in these situations is not included in package inserts and monographs. Moreover, there is still a lack of materials on the topic in databases, while information that does exist is often restricted and requires paid access[34].

Another relevant aspect observed in this study was the existence of divergent information among the sources consulted regarding the possibility of crushing and administering certain medications via the enteral route. While some references described certain dosage forms as adaptable depending, for example, on tube location, others contraindicated their modification or failed to provide sufficient information to support clinical practice, often justifying the lack of recommendations by the scarcity of studies proving their efficacy and safety through this route of administration.

In addition, some drugs have important pharmaceutical restrictions related to changes in the release profile of the active ingredient, loss of stability, risk of tube obstruction, and occupational exposure during handling. These findings highlight the absence of a consolidated consensus in the literature on this issue and demonstrate the difficulty health professionals face in accessing up-to-date, standardized information applicable to clinical practice.

A factor that warrants note is the fact that many books and institutional manuals were published in the 2010s and remain the main sources of consultation, despite limitations related to periodic updating of the evidence. Even more specialized and restricted-access resources, such as Don't Rush to Crush®, UpToDate® and Micromedex®, may present divergent recommendations or lack information for certain medications, underscoring the need to develop institutional protocols and more robust clinical studies on dosage form adaptation in patients with dysphagia.

The results suggest that medication administration for patients with dysphagia poses a challenge for the health team, whereby determining which SODFs may or may not be modified and how to perform this adaptation requires complex technical, pharmacological, and clinical information. Some strategies may be devised to address these issues, such as the preparation of manuals, algorithms, and even mobile phone applications[13,15,32].

Finally, this study has some limitations, including the small sample size, since the 113 prescriptions analyzed corresponded to only eight patients, plus the retrospective single-center design and use of secondary data. These characteristics limit the generalizability of the results and prevent causal inference. Hence, the results reported here should be extrapolated with caution to other settings. Nevertheless, the current findings expose important gaps in care practice and reinforce the need for future investigations with greater methodological robustness.

CONCLUSION

This study found that hospitalized older patients with dysphagia presented challenges related to pharmacotherapy safety, mainly due to the presence of MRPs associated with inadequate administration technique, incompatibility between the prescribed route and patient's clinical condition, and the absence of standardized instructions for adapting SODFs. Therefore, the evaluation of prescriptions revealed the need for greater integration among health professionals and for the creation of evidence-based institutional strategies to guide the safe modification and administration of these medications, as a way of ensuring the effectiveness and safety of health care for older adults with dysphagia.

AUTHOR CONTRIBUTIONS

- Maria Érika da Silva Vilela – Study conception and design; development of the data collection instrument; methodology; data collection and curation; formal analysis; validation; writing -- original draft, review, and editing; visualization; final approval of the version to be published.
- Rafael da Fonseca Carvalho – Study conception and design; development of the data collection instrument; methodology; formal analysis; validation; critical review of the article; responsibility for all aspects of the work; final approval of the version to be published.
- Karina Perrelli Randau – Study conception and design; writing, critical review, and editing of the article; responsibility for all aspects of the work; formal analysis; validation; supervision; final approval of the version to be published.

Editado por: Cristian Arnecke Schröder

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