

Age-adjusted health conditions, frailty, and functionality among older adults in primary care

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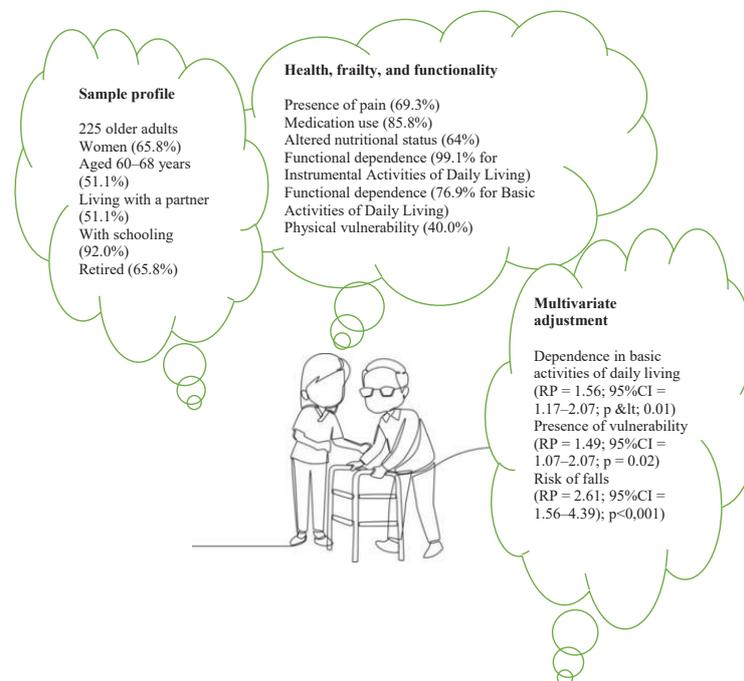
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Graphical Abstract

Highlights

- The presence of vulnerability is associated with lower age-adjusted scores.
- Dependence in basic activities of daily living is associated with lower age-adjusted scores.
- The presence of depressive symptoms is associated with lower age-adjusted scores.



Abstract

This study aimed to investigate the relationship between health conditions, frailty, functionality, and age-adjusted scores among older adults receiving primary care services. This is a descriptive exploratory study conducted with 225 older adults enrolled in primary care in the municipality of Jequié, Bahia, Brazil. Sociodemographic data, health conditions, functionality, and frailty were assessed using instruments such as the Barthel Index, the Lawton and Brody Scale, and the VES-13. The results showed a higher prevalence of women (65.8%), presence of pain (69.3%), and high levels of functional dependence (99.1% for Instrumental Activities of Daily Living and 76.9% for Basic Activities of Daily Living). After multivariate adjustment, the following associations remained statistically significant: dependence in basic activities of daily living (RP = 1.56; 95%CI = 1.17–2.07; p < 0.01), presence of vulnerability (RP = 1.49; 95%CI = 1.07–2.07; p = 0.02), risk of falls (RP = 2.61; 95%CI = 1.56–4.39; p < 0.001), and depressive symptoms (RP = 1.34; 95%CI = 1.01–1.76; p < 0.04). The findings indicate that the presence of vulnerability, functional dependence in basic activities of daily living, and depressive symptoms are associated with lower age-adjusted scores.

Keywords: Aging. Functional Dependence. Older Adults' Health. Frailty. Primary Care.

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INTRODUCTION

Demographic and epidemiological transitions, together with population aging, are interconnected processes that produce significant societal impacts. As the proportion of children decreases and the number of older adults increases steadily, the accelerated aging of the population becomes evident. This phenomenon triggers profound transformations in individuals, families, and society, requiring adaptations to adequately meet the specific needs of this population¹.

The aging process extends beyond biological considerations, as it must also be understood as a human and social phenomenon. Aging is a multifaceted experience shaped by social expressions and meanings constructed within a societal context. Therefore, it is a complex phenomenon intertwined with multiple social variables that play a fundamental role in shaping individuals' experiences of aging².

Considering the particular characteristics of the older population, there is a growing need for epidemiological studies focused on analyzing the health conditions of this group. In primary care, understanding health conditions and the variables that influence functionality is essential for guiding more precise and effective interventions, particularly in a context of inequalities in access to health services and given that most factors leading to functional decline are modifiable^{3,4}.

This study adopts the concept of age-adjusted or

adjusted age, which represents an estimate of biological or functional age based on clinical predictors. This metric allows for a more sensitive analysis of factors that accelerate or slow functional decline, as discussed by Levine⁵, who proposes the use of multivariate models to estimate functional age using health markers.

From this perspective, the present study seeks to identify the main factors influencing functional aging and to reassess the traditional understanding of aging, emphasizing the practical implications of how health conditions affect functional capacity and quality of life among older adults.

By addressing factors related to frailty and functionality, this study expands the knowledge base necessary to guide more appropriate care strategies for the older population. Understanding the connections between health conditions and adjusted age supports a deeper comprehension of older adults' functional age and its repercussions for their quality of life, thereby assisting healthcare professionals and managers in developing approaches that meet the real needs of this community. This contributes to a more comprehensive and humanized approach to gerontological care within the studied territory and in other areas with similar profiles. In this context, the present study aims to investigate the relationships between health conditions and adjusted age among older adults receiving primary care services.

MATERIALS AND METHODS

This was a descriptive cross-sectional observational study with a quantitative approach, conducted in a Family Health Unit (*Unidade de Saúde da Família* – USF) located in the municipality of Jequié, Bahia, Brazil. The sample consisted of 225 individuals aged 60 years or older registered in the USF. Individuals presenting any type of cognitive limitation were excluded from the study, with a score <17 on the Mini-Mental State Examination (MMSE) used as the cutoff criterion for exclusion.

Data were collected between April and August 2023 through the application of the Sociodemographic and Health Conditions Questionnaire, the Barthel Index, the Lawton and Brody Scale, and the Vulnerable Elders Survey (VES-13).

The MMSE, used to assess cognitive function, consists of items grouped into seven categories encompassing the domains of spatial and temporal orientation, immediate and delayed memory, calculation, language (naming, repetition, comprehension, writ-

ing), and visuoconstructive ability. Scores range from a minimum of zero to a maximum of 30 points⁶.

The sociodemographic and health condition variables analyzed included age group, sex, marital status, educational level, family income, current work status, presence of pain, pain intensity, pain location, presence of chronic diseases, medications in use, and nutritional status.

To assess basic activities of daily living (feeding, bathing, dressing, personal hygiene, bladder control, bowel control, toilet use, bed-to-chair transfer, ambulation, and stair climbing), the Barthel Index was applied. This instrument yields a score ranging from zero to 100 and categorizes individuals as follows: independent (100 points); mildly dependent (60–95 points); moderately dependent (40–55 points); severely dependent (20–35 points); and totally dependent (<20 points)⁷.

In addition to basic activities of daily living, the Lawton and Brody Scale enables the assessment of instrumental activities (telephone use, transportation,

shopping, meal preparation, housekeeping, medication management, and financial management). Scores range from zero to 21 and are categorized as: total dependence (≤ 5 points); partial dependence (>5 and <21 points); and independence (21 points)⁸.

To assess physical vulnerability, the VES-13 was used. It comprises four indicators – age, self-rated health, physical limitation, and disability (functional limitation) – totaling 13 items. The final score ranges from zero to ten points and classifies older adults into three levels of frailty risk: robust (≤ 2 points), pre-frail (3–6 points), and frail (7–10 points)⁹.

Data were analyzed using SPSS, version 21.0, employing Generalized Linear Models (GLM). A Tweedie mixed model with a log link function was applied, which was appropriate for the continuous dependent variable “adjusted age” and considered the following predictor variables: frailty, presence of pain, basic activities of daily living (BADL), and instrumental activities of daily living (IADL). In the present study,

the term adjusted age refers to the estimated chronological age expected under different conditions, generated through statistical modeling. This approach allows for the evaluation of the impact of functional and health-related conditions on the aging process, operating as a marker of functional aging.

Regression coefficients (β) were estimated along with their respective 95% confidence intervals (95%CI), and the significance level was set at $p \leq 0,05$. Results were interpreted based on the influence of predictor variables on adjusted age, highlighting statistically significant associations.

The study was approved by the Research Ethics Committee of the Faculdade Independente do Nordeste under Protocol No. 4,351,219. To participate in the study, older adults signed a free and informed consent form. This was prepared and reported in accordance with the recommendations of the STROBE statement (Strengthening the Reporting of Observational Studies in Epidemiology).

RESULTS

The findings of the present study provide a comprehensive analysis of the health conditions and functional status of older adults, highlighting key determinants of quality of life in this sample of 225 participants aged 60 years or older enrolled in a Primary Care Unit.

Table 1 presents the sociodemographic charac-

teristics of the participants. Most of the sample consisted of women (65.8%), individuals aged 60–68 years (51.1%), those living with a partner (51.1%), and individuals with access to formal education (92.0%). A predominance of retirees (65.8%) and individuals with a monthly income above two minimum wages (51.1%) was also observed.

Table 1 - Sociodemographic characteristics of older adults. Jequié, Bahia, 2025.

	N	%
Sex		
Female	148	65.8
Male	77	34.2
Age group		
60–68 years	115	51.1
>68 years	110	48.9
Marital status		
With partner	115	51.1
Without partner	110	48.9
Educational level		
No formal education	18	8.0
With formal education	207	92.0

to be continued...

continuation - Table 1.

	N	%
Family income		
Up to one minimum wage	110	48.9
Two or more minimum wages	115	51.1
Current work status		
Retired	148	65.8
Employed	77	34.2
Total	225	100.0

Notes: n = absolute frequency; % = relative frequency.
Source: Study data.

According to Table 2, which shows the health conditions of the participants, most older adults reported the presence of pain (69.3%), with intensity ranging from absent to mild (61.3%). In a substantial proportion of participants, pain was located in two or more body segments (36.4%). Furthermore, 52.4% of the sample reported having two or more

chronic diseases, and 85.8% reported regular use of medications. Functional dependence showed a high prevalence, with 99.1% of participants reporting dependence for Instrumental Activities of Daily Living and 76.9% for Basic Activities of Daily Living. Vulnerability, assessed using the VES-13 scale, was present in 60% of the sample.

Table 2 - Health conditions, functional status, and vulnerability among older adults. Jequié, Bahia, 2025.

	N	%
Presence of pain		
Yes	156	69.3
No	69	30.7
Pain intensity		
Absent to mild	138	61.3
Moderate to severe	87	38.7
Pain location		
No pain	71	31.6
One body segment	72	32.0
Two or more body segments	82	36.4
Presence of chronic disease		
One chronic disease	107	47.6
More than one chronic disease	118	52.4
Medication use		
Yes	193	85.8
No	32	14.2
Nutritional status		
Normal	81	36.0
Altered	144	64.0
IADL		
Independent	2	0.9
Dependent	223	99.1
BADL		
Independent	52	23.1
Dependent	173	76.9
VES-13		
Not vulnerable	135	60.0
Vulnerable	90	40.0
Total	225	100.0

Notes: IADL = Instrumental Activities of Daily Living; BADL = Basic Activities of Daily Living; n = absolute frequency; % = relative frequency.
Source: Study data.

In the bivariate analysis (crude PR), as shown in Table 3, statistically significant associations were observed between the outcome and the following variables: pain intensity (PR = 1.55; 95%CI = 1.15–2.10; $p < 0.01$), medication use (PR = 2.15; 95%CI = 1.10–4.20; $p = 0.02$), dependence in basic activities of daily living (BADL) (PR = 2.20; 95%CI = 1.69–2.85; $p < 0.01$), presence of vulnerability (PR = 2.32; 95%CI = 1.71–3.16; $p < 0.001$), risk of falls (PR = 3.28; 95%CI = 1.89–5.21; $p < 0.001$), and depressive symptoms (PR = 1.76; 95%CI = 1.33–2.33; $p < 0.001$). The presence of pain showed a trend toward association (PR = 1.39; 95%CI = 0.97–2.0), although without statistical significance.

After multivariate adjustment, the associations that remained statistically significant were: dependence in BADL (PR = 1.56; 95%CI = 1.17–2.07; $p < 0.01$), presence of vulnerability (PR = 1.49; 95%CI = 1.07–2.07; $p = 0.02$), risk of falls (PR = 2.61; 95%CI = 1.56–4.39; $p < 0.001$), and depressive symptoms (PR = 1.34; 95%CI = 1.01–1.76; $p < 0.04$). The remaining variables lost significance after controlling for confounding factors.

These findings suggest that functional dependence, vulnerability, risk of falls, and depressive symptoms are independently associated with the analyzed outcome, reinforcing the need for multidimensional interventions in the care of the evaluated individuals.

Table 3 - Association between clinical and psychosocial variables and the analyzed outcome, according to Poisson regression model with robust variance.

Variables	Crude PR		Adjusted PR	
	PR (95%CI)	p	PR (95%CI)	p
Presence of pain				
Yes	1.39 (0.97–2.00)	0.07	1.08 (0.71–1.64)	0.71
No	1		1	
Pain intensity				
Moderate/Severe	1.55 (1.15–2.10)	<0.01	1.15 (0.80–1.65)	0.45
Absent/Mild	1		1	
Medication use				
Yes	2.15 (1.10–4.21)	0.02	1.59 (0.85–2.98)	0.14
No	1		1	
BADL				
Dependent	2.20 (1.69–2.85)	<0.001	1.56 (1.17–2.07)	<0.01
Independent	1		1	
Vulnerability (VES-13)				
Vulnerable	2.32 (1.71–3.16)	<0.001	1.49 (1.07–2.07)	<0.02
Not vulnerable	1		1	
Risk of falls				
Present	3.28 (1.89–5.21)	<0.001	2.61 (1.56–4.39)	<0.001
Absent	1		1	
Depressive symptoms				
Present	1.76 (1.33–2.33)	<0.001	1.34 (1.01–1.76)	<0.04
Absent	1		1	

Note. PR = Prevalence Ratio; 95%CI = 95% Confidence Interval; BADL = Basic Activities of Daily Living.

DISCUSSION

The findings of the present study reinforce the complexity of the aging process, demonstrating how health and functional factors can influence the quality of life of older adults receiving primary care services. These results contribute to identifying priority determinants for clinical, social, and policy-related interventions, highlighting the importance of comprehensive and personalized approaches for

older adults.

The predominance of women in the sample reflects a global demographic pattern widely described as the “feminization of aging”, characterized by a higher proportion of women in the older adult population¹⁰. This phenomenon presents challenges for the health system, as increased longevity is also associated with higher vulnerability

and a greater risk of comorbidities, in addition to social implications related to expanded care demands^{10,11}. This is consistent with the results observed in the present study, which demonstrated a clear predominance of female participants.

The high proportion of participants with formal education may positively influence functional capacity and quality of life among older adults, considering that low educational levels are traditionally associated with greater vulnerability, poorer health conditions, and reduced self-management capacity, directly affecting autonomy and quality of life¹². Similarly, the predominance of retired individuals and those with incomes above two minimum wages may indicate lower financial instability, which can serve as a facilitating factor for access to healthcare and exert a positive impact on health and functionality¹³.

The study identified a high prevalence of pain, often mild to moderate, and frequently located in two or more body segments. Pain is commonly associated with decreased functional capacity, leading to limitations in daily activities, increased frailty, and reduced quality of life^{14,15,16,17}.

The analysis also revealed a significant association between pain and a reduction of 0.354 years in adjusted age ($p = 0.022$), suggesting earlier functional aging among older adults living with pain. Beyond being a sensory experience, chronic pain is closely linked to emotional, behavioral, and social dimensions that affect an individual's ability to perform ADLs. This finding strengthens the relevance of effective pain management to promote quality of life and maintain functional capacity among older adults¹⁸.

Frailty also showed a significant effect, with results indicating that a substantial portion of the participants were classified as frail, corresponding to a mean reduction of 0.706 years in adjusted age ($p < 0.001$). Frailty is a well-established predictor

of functional decline, institutionalization, and mortality¹⁹. The findings observed align with the results of Brazilian studies²⁰, including ELSI-Brazil³, and international evidence^{1,4}, underscoring the need for active monitoring of frailty in primary healthcare services.

Functional dependence, which was also highly prevalent, affected 99.1% of participants for IADLs and 76.9% for BADLs, and was associated with the greatest reduction in adjusted age (mean decrease of 1.106 years). This decline in functionality compromises autonomy and increases the demand for caregivers, representing a significant challenge for both families and the healthcare system¹¹. According to Aranco²¹, approximately 8 million older adults in Latin America require assistance with at least one daily activity, highlighting the magnitude of this issue.

Furthermore, longitudinal studies such as FLBRA²² have demonstrated the progressive increase in physical, cognitive, and social vulnerability with advancing age, emphasizing the importance of continuous monitoring and intersectoral public policies capable of responding to these changes.

As limitations, the cross-sectional design prevents the establishment of causal relationships, and the convenience sample, although numerically adequate, may not fully represent the older population of the studied territory. Self-reported data may also introduce recall or interpretation bias. Nonetheless, an important methodological contribution of this study is the application of "adjusted age" as a statistical metric derived from functional and clinical variables. This approach enabled the interpretation of aging beyond chronological parameters, emphasizing how health conditions affect functional age and providing a potentially useful perspective for early identification of at-risk individuals and for guiding personalized actions in primary care services.

CONCLUSION

The analysis of the association between health conditions and adjusted age among older adults revealed that functional aging is closely related to modifiable factors such as frailty, pain, nutrition, and functionality. The high prevalence of functional dependence in both BADLs and IADLs observed in this sample warrants special attention within Primary Care settings. Frailty, in particular, showed high prevalence and emerged as one of the main

factors associated with reduced adjusted age, reaffirming its role as a key indicator of early functional decline.

Given these findings, the need for targeted strategies aimed at preventing functional loss and promoting the physical and mental health of older adults becomes evident. Interventions focused on pain management, functional rehabilitation, and nutritional education should be prioritized in Pri-

mary Care services, especially in territories with populations in situations of vulnerability.

The results of this study highlight the importance of incorporating routine functional assessments into clinical practice among healthcare professionals, reinforcing the need for awareness and training

within Primary Care to support regular functional screening. Moreover, integrating clinical and functional assessments offers valuable insights for individualized care planning and for the development of public policies aimed at promoting active and healthy aging.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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