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Cluster of factors associated with physical frailty in community-dwelling elderly people

Agregamento de fatores associados à fragilidade física em idosos residentes na comunidade

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Abstract - Frailty is characterized as a set of factors related to the body structure that lead the subject to a process of physical vulnerability, increasing their dependence. The study aims to investigate the aggregation of factors related to physical frailty (PF) in elderly residents of a city with a low Human Development Index (HDI). This is a cross-sectional study carried out in the city of Ibicuí, state of Bahia, Brazil, and including a random 270 elderly people aged ≥ 60 years. The physical frailty condition was identified according to the criteria proposed by Fried and collaborators. In the data analysis, descriptive statistics, cluster analysis, and multinominal logistic regression procedures were used. The highest prevalence of aggregation was identified when the four risk factors were combined: weight loss, strength, walking speed and physical activity levels (O/E = 4.36; CI = 4.04 - 4.68). It was identified that older people (80 years old or more) with a lower level of education (unlettered) were more likely to have three or more risk factors for physical frailty (p <0.05). As for sociodemographic variables, those who were older and had lower levels of education were more likely to have three or more risk factors. The development of actions that encourage a healthier lifestyle to favor the prevention and treatment of physical frailty, as well as to increase health literacy and knowledge, may reduce the problems related to this condition in older adults, mainly thinking about the next generations.

Keywords: Aging; Cluster analysis; Frail elderly.

Resumo - *A fragilidade é caracterizada como um conjunto de fatores relacionados à estrutura corporal que levam o sujeito a um processo de vulnerabilidade física, aumentando sua dependência. O estudo tem como objetivo investigar a agregação de fatores relacionados à fragilidade física (FP) em idosos residentes em um município com baixo Índice de Desenvolvimento Humano (IDH). Trata-se de um estudo transversal realizado na cidade de Ibicuí, estado da Bahia, Brasil, e incluiu aleatoriamente 270 idosos com idade ≥ 60 anos. A condição de fragilidade física foi identificada de acordo com os critérios propostos por Fried e colaboradores. Na análise dos dados, foram utilizadas estatísticas descritivas, análise de cluster e procedimentos de regressão logística multinominal. A maior prevalência de agregação foi identificada quando os quatro fatores de risco foram combinados: perda de peso, força, velocidade de caminhada e níveis de atividade física (O/E = 4,36; IC = 4,04 - 4,68). Identificou-se que idosos (80 anos ou mais) com menor escolaridade (analfabetos) apresentaram maior probabilidade de apresentar três ou mais fatores de risco para fragilidade física (p <0,05). Quanto às variáveis sociodemográficas, aqueles que eram mais velhos e com menor escolaridade tinham maior chance de apresentar três ou mais fatores de risco. O desenvolvimento de ações que estimulem um estilo de vida mais saudável para favorecer a prevenção e o tratamento da fragilidade física, bem como aumentar a alfabetização e o conhecimento em saúde, pode reduzir os problemas relacionados a essa condição nos idosos, principalmente pensando nas próximas gerações.*

Palavras-chave: *Análise por conglomerados; Envelhecimento; Idoso fragilizado.*

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INTRODUCTION

In the current scenario of the Covid-19 pandemic, measures of social isolation contribute to the reduction of mobility[1-3], and may increase the presence of this condition, especially among older people. Among the negative conditions associated with loss of mobility, fragility syndrome stands out.

The characterization of physical frailty (PF) can be performed using different methods, among them is the criterion of Fried et al.[4] that defines the frailty syndrome from the conditions of weight loss, strength, exhaustion, walking speed, and physical activity levels. According to this criterion, PF can be understood as a set of factors related to the body structure that leads the individual to a process of physical vulnerability to decrease their quality of life.

Studies conducted in Brazil showed the prevalence of PF varying between 9.3% among elderly riverside people from Amazon[5], and 50.4% among elderly people living at home in the interior of São Paulo[6]. Surveys carried out in other countries have identified a prevalence of PF between 6.9% of elderly people from four communities in the United States[4], and 65% among the elderly population living in rural communities in eastern Nepal[7].

Despite the increase in the number of investigations on the prevalence, incidence, and factors associated with PF, studies that sought to analyze the combination of risk factors related to this condition are still incipient. The evaluation of the aggregation of factors related to PF may allow the verification of simultaneous behavior between variables, which suggests the presence of subtypes of the syndrome[8]. In addition, when considering a series of behavior related to PF and connecting those behavioral patterns to health-related outcomes, how cluster analysis can contribute to decision-making in Primary Health Care and the application of more appropriate methods for the management and prevention of health risks[9,10].

In this context, the present study aims to investigate the aggregation of factors related to PF in elderly residents of a municipality with low HDI, located in the Center-south of Bahia, Brazil to assist in the identification of latent or unobservable groups of risk for the occurrence of PF in the elderly, as well as providing evidence that promotes the promotion of measures of objective measures in the care of this public.

METHOD

Study design

This is a cross-sectional, community-based study conducted in February 2014 with individuals aged ≥ 60 years, living in the municipality of Ibicuí-BA and registered in the municipality's Family Health Strategy. Ibicuí is located in the southwest of Bahia (Brazil), and had a Human Development Index (HDI) of 0.584. This city had an estimated population of 15,785 inhabitants, with a 13% (n = 2,125) of the elderly population[11]. In the period of the study, a total of 525 participants were registered in the Family Health Strategy Program-ESF.

Sample selection criteria

The study sample was defined according to the criteria for finite populations established by Luiz and Magnanini[12]. Exclusion criteria included elderly bedridden, with Alzheimer's disease and other neurological diseases diagnosed and recorded in medical records at the Family Health Unit that affect cognition, added to the losses (moved from the municipality, not found in the FHS or home more than three times and refusals). The final sample was 310 elderly people, registered in the municipality's Family Health Strategy (FHS). For the present study, participants with no information on physical behavior were removed, who integrate some of the criteria used to define PF, accounting for a sample of 270 individuals.

Ethics

The study was submitted to evaluation and approval by the Research Ethics Committee (CEP) of the State University of Southwest Bahia according to protocol nº 613.364 and complied with the ethical principles in force in the Declaration of Helsinki and Resolution nº 466/2012 of the National Health Council All participants signed the Free and Informed Consent Form (ICF), allowing voluntary action in this study.

Dependent variables

Data collection was performed using an IASI Health Assessment Instrument for the Older populations, validated by Pedreira et al.[13]. This instrument was applied in the form of an individual interview, followed by an anthropometric and functional assessment conducted by previously trained research team.

Before applying the instrument, all participants were informed about the relevance and objectives of the study and about the right to withdraw at any time without prejudice

The PF was assessed according to the criterion proposed by Fried et al.[4], composed of five items: weight loss, strength, exhaustion, walking speed, and physical activity levels, shown in Table 1.

Table 1. Description of the criteria used to define the PF.

Factors	Research evaluation	Applied definition
Weight loss	Evaluated through the question: Have you lost weight without dieting in the last 12 months?	Unintentional weight loss of 3 kg or more
Strength	Handgrip strength test measured by the Electronic Hand hydraulic dynamometer (E.Clear – Model: EH101)[14]	Handgrip strength, adjusted by specific body mass index for the elderly and by sex, in the lowest 20%
Exhaustion	Observed by the following questions: a) Did you feel that you had to make an effort to cope with your usual tasks? and b) Were you unable to move things forward?	Verified through affirmative answers to the questionnaire questions.
Walking speed	2.44m walk test[15]	Identified with the time it took the elderly to leave the sitting position, walk 2.44 meters and sit again, this according to sex and height, from the 20th percentile.
Physical activity levels	Leisure Time Physical Activity was evaluated using the following question: How would you rate your leisure-time physical activity?[16]	Those who said that they did not practice physical activity (mild, moderate, or intense) during leisure time were classified as insufficiently active.

Independent variables

These sociodemographic variables were included: age: in full years and categorized as 60 to 79 years (young elderly) and 80 years or older (long-lived); sex: male and female; race/color: measured self-reported and categorized as white and not white (black, brown, yellow and indigenous), marital status: with a partner (married and in a stable relationship) and without a partner (widowed and single); income (<1 minimum wage / ≥1 minimum wage at the time, equivalent to the US$ 127.53); education: incomplete years of study categorized into literate and non-literate.

Statistics

In the data analysis, descriptive statistics procedures (mean and standard deviation) and measures of association for categorical variables (Pearson's chi-square test) were used through the statistical program IBM SPSS® Statistics, version 22.0. For the analysis of the simultaneous presence or cluster of factors related to the frailty syndrome, the joint probability of the presented behaviors was calculated, in which the presence of grouping was verified using a comparison between the observed (O) and expected (E) prevalence. Aggregation is considered when the O / E ratio> 1.0[17]. Multinomial logistic regression analysis was performed to assess the association between the number of factors related to the frailty syndrome and the independent variables.

RESULTS

270 elderly people with a mean age of 71.07 ± 7.81 years were investigated. Most of them were between 60 and 79 years old (85.9%), women (58.1%), literate (56.7%), and living without a partner (52.6%). The prevalence of physical activity levels, walking speed, strength, exhaustion, and weight loss was 70.0%, 20.4%, 18.1%, 16.3%, and 15.9%, respectively (Table 2).

Table 2. Association between sociodemographic characteristics and FF indicators. MONIDI Study, Ibicui-BA, 2014.

Variables	Total Sample		Walking speed		Physical activity levels		Exhaustion		Strength		Weight loss	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Total	270		55	(20.4)	189	(70.0)	44	(16.3)	49	(18.1)	43	(15.9)
Sex				p = 0.218		p = 0.170		p = 0.890		p = 0.871		p = 0.999
Female	157	(58.1)	36	(22.9)	115	(73.2)	26	(16.6)	29	(18.5)	25	(15.9)
Male	113	(41.9)	19	(16.8)	64	(65.5)	18	(15.9)	20	(17.7)	18	(15.9)
Dichotomized age				p < 0.001		p = 0.819		p = 0.702		p = 0.001		p = 0.159
60-79 years old	232	(85.9)	34	(14.7)	163	(70.3)	37	(15.9)	35	(15.1)	34	(14.7)
80 years old or more	38	(14.1)	21	(55.3)	26	(68.4)	7	(18.4)	14	(36.8)	9	(23.7)
Schooling				p = 0.013		p = 0.102		p = 0.756		p = 0.230		p = 0.143
Not literate	117	(43.3)	32	(27.4)	88	(75.2)	20	(17.1)	25	(21.4)	23	(19.7)
Literate	153	(56.7)	23	(15.0)	101	(66.0)	24	(15.7)	24	(15.7)	20	(13.1)
Marital status				p = 0.002		p = 0.089		p = 0.300		p = 0.808		p = 0.033
Without partner	142	(52.6)	39	(27.5)	93	(65.5)	20	(14.1)	25	(17.6)	29	(20.4)
With partner	128	(47.4)	16	(12.5)	96	(75.0)	24	(18.8)	24	(18.8)	14	(10.9)

Longer-lived elderly (80 years or older), who lived without a partner and were not literate, had a higher prevalence of walking speed (p <0.05). Among the elderly aged 80 and over, a higher frequency of strength was observed, and those who reported living without a partner had a greater occurrence of weight loss (p <0.05) (Table 2).

Table 3 shows the result of the relationship between the observed and expected prevalence of all possible combinations of the five risk behaviors for PF in the elderly. The highest prevalence of aggregation was identified when the four risk factors were combined: weight loss, strength, walking speed and physical activity levels (O/E = 4.36; CI = 4.04 - 4.68).

Table 3. Prevalence of cluster of factors related to frailty syndrome in the elderly. MONIDI Study, Ibicui-BA, 2014

Risk Factors	Weight loss	Strength	Exhaustion	Walking speed	Physical activity levels	O(%)	O/E	CI 95%
5	+	+	+	+	+	0.0	0.0	-
4	-	+	+	+	+	0.4	1.13	(0.49 - 1.77)
4	+	-	+	+	+	0.7	2.31	(1.86 - 2.76)
4	+	+	-	+	+	1.5	4.36	(4.04 - 4.68)
4	+	+	+	-	+	0.0	0.0	-
4	+	+	+	+	-	0.0	0.0	-
3	-	-	+	+	+	1.5	0.94	(0.61 - 1.26)
3	-	+	-	+	+	4.4	2.42	(2.23 - 2.61)
3	-	+	+	-	+	0.7	0.51	(0.04 - 0.97)
3	-	+	+	+	-	0.4	2.63	(2.07 - 3.20)
3	+	-	-	+	+	0.4	0.26	(-0.40 - 0.91)
3	+	-	+	-	+	2.2	1.86	(1.59 - 2.13)
3	+	-	+	+	-	0.4	3.08	(2.53 - 3.63)
3	+	+	-	-	+	1.1	0.82	(0.44 - 1.20)
3	+	+	-	+	-	0.4	2.71	(2.15 - 3.17)
3	+	+	+	-	-	0.0	0.0	-
2	-	-	-	+	+	8.1	0.98	(0.87 - 1.10)
2	-	-	+	-	+	5.6	0.90	(0.75 - 1.04)
2	-	-	+	+	-	0.0	0.0	-
2	+	-	-	-	+	5.9	0.97	(0.83 - 1.11)
2	+	-	-	+	-	0.0	0.0	-
2	+	-	+	-	-	0.7	1.38	(0.92 - 1.84)
2	+	+	-	-	-	0.4	0.70	(0.04 - 1.35)
2	-	+	-	-	+	4.4	0.62	(0.46 - 0.78)
2	-	+	-	+	-	1.1	1.41	(1.03 - 1.79)
2	-	+	+	-	-	1.1	1.86	(1.48 - 2.24)
1	-	-	-	-	+	33	1.03	(1.02 - 1.04)
1	-	-	-	+	-	1.1	0.31	(-0.05 - 0.67)
1	-	-	+	-	-	2.6	0.97	(0.73 - 1.21)
1	+	-	-	-	-	2.2	0.85	(0.58 - 1.11)
1	-	+	-	-	-	2.2	0.72	(0.46 - 0.98)
0	-	-	-	-	-	17.4	1.26	(1.20 - 1.33)

Note: CI: confidence interval; + presence of risky behavior; - an absence of risky behavior; O: Observed prevalence; O / E: Relationship between observed and expected prevalence.

There was no record of the simultaneous prevalence of the five factors and the absence of risk factors was 1.26 times higher than expected. When three simultaneous risk factors were analyzed, a greater grouping was observed for the combination of weight loss, exhaustion and walking speed (O/E = 3.08; CI = 2.53 - 3.63). For the combination of two factors, the highest score was identified for the combination of strength and exhaustion (O/E = 1.86;

CI = 1.48 - 2.24). In assessing the presence of a risk factor without the presence of other factors, physical activity levels had a higher prevalence (O/E = 1.03; CI = 1.02 - 1.04) (Table 3).

The analysis of the association between sociodemographic variables and the number of risk factors for PF was presented in Table 4. It was identified that older individuals (80 or more) and with a lower level of education (illiterate) were more likely to have three or more risk factors for PF (p <0.05).

Table 4. Association between the number of factors related to frailty syndrome and sociodemographic characteristics in the elderly. MONIDI Study, Ibicui-BA, 2014.

	One risk factor a		Two risk factors a		Three risk factors a		Four and five risk factors a	
	n (%)	OR CI (95%)[b]	n(%)	OR CI (95%)[b]	n(%)	OR CI (95%)[b]	n(%)	OR CI (95%)[b]
Age (Years)								
80 years or more	6(15.8)	1.00	14(36.8)	1.00	13(34.2)	1.00	6(2.6)	1.00
60-79	105(45.3)	1.35 (0.36-5.25)	60(25.9)	0,36 (0.10-1.20)	18(7.8)	0,11(0.03-0.44)	1(2.6)	0.49(0.04-5.50)
Sex								
Female	69(43.9)	1.00	39(24.8)	1.00	20(12.7)	1.00	6(3.8)	1.00
Male	42(37.2)	1.93(0.94-3.95)	35(31.0)	1.37(0.64-2.94)	11(9.7)	2.52(0.91-6.98)	1(0.9)	5.76(0.61-53.8)
Marital status								
With partner	59(46.1)	1.00	36(28.1)	1.00	13(10.2)	1.00	1(0.8)	1.00
Without partner	52(36.6)	0.49(0.24-1.02)	38(26.8)	0.59(0.27-1.28)	18(12.7)	0.51(0.18-1.42)	6(4.2)	2.59(0.27-24.3)
Schooling								
Literate	65(42.5)	1.00	44(28.8)	1.00	9(5.9)	1.00	3(2.0)	1.00
Not literate	46(39.3)	1.68(0.80-3.52)	30(25.6)	1.50(0.68-3.29)	22(18.8)	4.94(1.75-13.92)	4(3.4)	2.44(0.47-12.69)

Note: OR: Odds ratio; CI: Confidence interval; [a]The Reference category: zero risk factor; [b]Adjusted analysis for all independent variables.

DISCUSSION

The present study aimed to investigate the aggregation of factors related to physical frailty in elderly residents of a municipality with a low HDI. The results showed that the presence of five risk factors for the frailty phenotype was not identified. The highest cluster score was observed for the combination of weight loss, strength, walking speed and physical activity levels.

The practice of physical activities, such as walking, for example, has effects on the various organic systems such as heart, lungs, circulatory, nervous and musculoskeletal systems, requiring energy, movement control, and support during its performance[18]. A low level of physical activity has implications for the ability to perform activities of daily living (ADLs) and the risk of falling in the elderly[3], due to the low resistance and energy associated with this condition[2]. Additionally, the progressive decrease in mass, strength, and function muscle, resulting from its reduction and physiological changes suffered by the musculoskeletal system with advancing age[19], indicate damage to health, quality of life, and survival of the elderly[18].

A study carried out in Paraiba identified a prevalence of functional disability 2.70 times higher among elderly people who did not exercise regularly[20], showing the attention that should be paid to the low level of physical activity recorded in this study (70.0%). It is important to highlight that the combination of an insufficient level of physical activity and excessive time spent on sedentary

behavior can accentuate physiological and metabolic changes[21] and contribute to a greater risk of morbidity and mortality from chronic and infectious diseases, especially among the oldest among them[22].

In the current pandemic situation, social isolation, especially among the elderly, who are at risk for Covid-19, reduced the possibility of commuting and physical activity practices, especially in environments such as parks, gyms, etc. This reduction can accentuate the physical and functional losses among the elderly[1-3]. In this sense, stimulating the practice of physical activity in the domestic environment in times of pandemic is an alternative for maintaining the regular level of physical activity, functional performance, and prevention of physical frailty among the elderly, especially among the oldest and least schooling, the results of which showed a greater chance of presenting three or more risk factors for frailty.

The positive relationship between age and physical frailty observed agrees with findings from previous studies, in which results confirm a greater occurrence of the frailty syndrome in the oldest old[4,23]. In a previous finding, it was observed that the prevalence of frailty increased with age in both sexes, with greater expressiveness among women[24].

The increase in the occurrence of this syndrome, according to the progression of aging[25], can be explained by the decline in the physiological reserve in organic systems, typical of the senescence process, which contributes to the development and worsening of frailty[26].

The present study also identified that, among sociodemographic factors, the low level of education was a significant predictor in the occurrence of physical frailty in the elderly, evidence also verified in other studies[27]. This finding highlights the impact of the level of formal education on access to health information[28]. This relationship favors a decrease in self-care and continuous brain activity, increasing the decline in cognitive functions[27].

It should be noted that health literacy is associated with non-frailty and favors healthy aging and self-care of the subjects[28]. In this sense, access to higher levels of education can improve satisfaction with life and avoid health problems, so that, according to this, not having a formal education doubles the chances of the individual being categorized as fragile[29]. Thus, low education interacts with the condition of frailty while contributing to the increased risk of future vulnerability and attributes to the elderly worse cognitive scores and decreased functional skills, especially at older ages[23,29].

Income is also shown to be a relevant aspect for the faster development of frailty[23,30]. In this context, the high socioeconomic vulnerability, related to factors such as lower purchasing power, low education, and limited access to health services, emerges in the literature as a condition related to the grouping of risk factors for frailty and worse living and health conditions in the elderly. Thus, there is a need for investigations that enable a broad situational diagnosis of the frail elderly and the socioeconomic, cultural, and health situation in which he finds himself.

This study had among its limitations the fact that some variables are self-reported, causing possible memory bias, since the elderly may have relative difficulty in remembering and interpreting certain information. Another limitation is its transversal character, which prevents the determination of a causal relationship between the factors. Although this study has limitations, it appears to be timely, since internationally, there is little research using cluster

analysis and, nationally, as far as is known, this is the first Brazilian study to use the cluster to analyze data regarding physical frailty in the elderly.

Therefore, this research can favor the creation of interventionist actions that are more directed to the factors that enhance physical fragility with the support of cluster analysis[9]. The identification of the simultaneity between these factors, in health services, may have implications for decision making regarding risk management and prevention and health promotion actions for this population.

CONCLUSION

The results showed a high prevalence of four, three, and two simultaneous risk factors. Longer-lived elderly people with lower levels of education were the most exposed to the presence of three or more risk factors, a criterion used as a cut-off point to define the presence of frailty.

From the study of the prevalence of physical frailty and the simultaneity of factors, it is possible to think of strategies that are effective in coping with the impacts of frailty, such as the development of specific preventive policies aimed at the pre-frail public to reduce risk factors, especially the low resistance and energy and low level of physical activity, and delay the evolution of this condition. The development of actions that encourage a healthier lifestyle and encourage the practice of physical activities may favor the prevention and treatment of frailty, as well as reducing the problems related to this condition in older adults.

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COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

Ethical approval was obtained from the local Human Research Ethics Committee – Southwest State University of Bahia according to protocol 613,364, and it was written in accordance with the standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conception and design of the experiment: SVR, CAS, HLRM. Conducting the experiments: SVR, CAS, HLRM. Data analysis: SVR, MAS, ISMS, CAS, HLRM. Contribution with reagents/research materials/analysis tools: Rocha, S.V; Santos, C.A. Article writing: SVR, MAS, ISMS, CAS, MAS, MLOS, GEF, HLRM. All authors read and approved the final version of the manuscript.

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