Frailty prevalence and associated factors in the elderly in Southern Brazil, 2014*

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Abstract

Objective: to analyze frailty prevalence and associated factors in the elderly in the city of Pelotas, RS, Brazil, in 2014. **Methods:** this was a cross-sectional, population-based study of a sample of individuals aged 60 years old or older; a modified version of the Edmonton Frail Scale was used to assess frailty; prevalence ratios (PR) and their 95% confidence intervals (95%CI) were estimated using Poisson regression. **Results:** frailty prevalence was 13.8% and was higher among individuals aged 75 years or older (PR 4.33 – 95%CI 2.94;6.39), those of the female gender (PR 1.46 – 95%CI 1.06;2.03) and those living without a partner (PR 1.54 – 95%CI 1.16;2.04); epilepsy (PR 3.58 – 95%CI 2.19;5.85), ischemia (PR 2.56 – 95%CI 2.00;3.28), and heart failure (PR 2.48 – 95%CI 1.92;3.19) were the morbidities most highly associated with frailty. **Conclusion:** frailty was associated with older individuals, the female gender, those living without a partner and those affected by multiple morbidities.

Keywords: Aged; Cross-Sectional Studies; Frailty; Frail Elderly; Epidemiology; Health of the Elderly.

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Introduction

Population aging, a phenomenon found in high-income countries, is increasing rapidly in middle- and low-income countries'. In Brazil the number of individuals aged 60 or over increased from 15.5 million (9.0%) in 2001 to 23.5 million (12.1%) in 2011.[1] Aging is associated with frailty, although they cannot be considered to be synonymous. Frailty is a multidimensional syndrome involving biological, physical, psychological, cognitive, social, economic and environmental factors. It makes the elderly vulnerable to adverse events, increasing their disability and risk of functional dependence.[2,3] Reduction in the autonomy of elderly people is related to reduction in quality of life and increased risk of dependency, institutionalization and premature death.[4]

> *Frailty is a multidimensional syndrome involving biological, physical, psychological, cognitive, social, economic and environmental factors.*

In Brazil frailty prevalence among the elderly varied between 8.7 and 47.2%[2,5-10] in the period from 2009 to 2017. National and international studies indicate that higher levels of frailty are found among older individuals,[5,9,11-13] who are female,[9-12,14,15] widowed or without a partner,[11-13] of non-White race/skin color[12] and who have less schooling.[9] Moreover, the greater the number of morbidities, the greater the susceptibility of the elderly to frailty.[11,13]

Epidemiological studies conducted in Brazil[6-8,15] have used Fried's Frailty Phenotype to assess frailty in the elderly. This phenotype is considered to be a biological syndrome involving decline in reserves and decline in resistance to stressors.[16] Notwithstanding, the broader concept of frailty involves psychological, social and environmental elements, in addition to the physical component. The Edmonton Frail Scale[2,17] can be used in order to perform an assessment that includes all these aspects for clinical detection of frailty in the elderly. This scale was developed by researchers of the Canadian Initiative on Frailty and Aging (CIF-A). The Edmonton Scale is low-cost and easy to administer and is an alternative for screening for frailty in health care services.[2,17]

Despite the importance of frailty among the elderly population, there are few studies on the subject in low-income countries. With the aim of providing guidance for planning and implementing health policies for the elderly, including preventive and rehabilitation actions for frail individuals, the objective of this study was to analyze frailty prevalence and associated factors among elderly people living in the municipality of Pelotas, Rio Grande do Sul, Brazil.

Methods

The data used were provided by the COMO VAI? (How are you?) study – this being an acronym for the Master's Degree Consortium Geared to Valuing Care of the Elderly (*Consórcio de Mestrado Orientado para a Valorização da Atenção ao Idoso*). It was a cross-sectional population-based study conducted in Pelotas, RS, between January and August 2014. Its target population was comprised of non-institutionalized individuals aged 60 years or over living in that city.

According to the Brazilian Institute of Geography and Statistics (IBGE),[18] in 2010 Pelotas had 328,275 inhabitants, 46,099 of whom were elderly. Sampling was performed in two stages in order to select the individuals to be studied. In the first stage, 133 of the 488 census tracts of the city of Pelotas were selected systematically and classified according to head of household's average income. This strategy ensured the inclusion of neighborhoods of differing economic status. We then counted the number of occupied households in the selected census tracts and estimated a ratio of approximately one elderly person per three households. Thirty-one households per census tract were then systematically selected, totaling 4,123 households. In each selected household, all dwellers aged 60 or over were eligible for the study. The exclusion criteria were: being institutionalized; or having cognitive impairment and no carer.

The final sample size for estimating frailty prevalence was 857 elderly people. This was based on an expected prevalence outcome of 30%[2] with a 4% margin of error, a 95% confidence interval and a 1.5 design effect (DEFF), plus 10% for losses and refusals. Our analysis of association used a 5% significance level and 80% statistical power, plus 10% for losses and refusals and a further 10% for controlling confounding factors. We considered that 1,323 elderly people would be

the largest sample needed to estimate (i) association between morbidity score taking a non-exposed / exposed ratio of 1:4, and (ii) frailty taking a prevalence ratio greater than 1.5.

The households were visited by a group of 23 interviewers with complete high school education. They received 40 hours of training in administering the questionnaire. The questionnaire was tested beforehand by means of a pilot study with elderly people from the same population. Initially the interviewers identified household dwellers (name, age, sex) and checked whether there was an eligible dweller. Following this, standardized electronic questionnaires were administered using notebook computers. If there was no one at home, at least three further attempts were made in order to carry out the interviews at each household.

The dependent variable was frailty, which was assessed by means of items based on the Portuguese version of the Edmonton Frail Scale (EFS).[2,17] The nine EFS domains were assessed: cognition, general health status, functional independence, social support, medication use, nutrition, mood, continence and functional performance of the elderly. EFS assesses the 'cognition' domain using the so-called "clock test"; however, this test may classify individuals with low schooling as having cognitive problems and for this reason we opted to assess this item according to self-reported ability of the elderly person to answer the questionnaire unassisted, with the help of a carer, or the questionnaire being answered only by the carer if the elderly person was unable to answer on their own. These options received a score of zero, 1 or 2 respectively. All the remaining domains were assessed according to the EFS model: the scale uses one to two questions for each domain and generates a 17-point score. Based on the score obtained, the individuals were classified according to degree of frailty: not frail (0-4 points), vulnerable (5-6 points), mild frailty (7-8 points), moderate frailty (9-10 points) or severe frailty (11-17 points). The following dichotomous variable was used for the dependent variable (frailty): not frail (0-6 points) or frail (7-17 points).

The independent variables observed were:
a) Demographic characteristics
- sex (male; female);
- age (in full years: 60-64; 65-69; 70-74; 75 or over);
- race/skin color, as observed by the interviewer (White; other [Black, brown, yellow or indigenous]); and
- marital status (has a partner; does not have a partner).

b) Socio-economic characteristics
- family income (in minimum wages: up to R$724.00 [≤1]; R$724.00-R$2172.00 [1,1-3]; R$2,172.01-R$3,620.00 [3,1-5]; R$3,620.01-R$7,240.00 [5,1-10]; R$7,241.01 or over [>10]);
- economic status, according to the classification used by the Brazilian Association of Survey Companies (Associação Brasileira de Empresas de Pesquisa - ABEP)[19] for the year 2010 (divided into three categories: A/B; C; D/E); and
- schooling (in completed years of study: none; 1-3; 4-7; 8-11; and 12 or over).
c) Self-reported morbidities
In reply to the question "Has a doctor or a health worker ever told you that you have...", the following morbidities were self-reported: systemic arterial hypertension, diabetes *mellitus*, heart problems, heart failure, emphysema, ischemia or stroke, arthritis or rheumatism, Parkinson's disease, kidney failure, epilepsy or convulsions, osteoporosis, glaucoma and cancer. A score was given for the number of morbidities affecting the interviewee: none; 1-3; 4 or more.
d) Behavioral characteristics
- tobacco smoking (no; yes; former smoker);
- CAGE[20] (Cut down, Annoyed by criticism, Guilty and Eye-opener), used in relation to the person's perception of their dependence on alcoholic drink: negative: up to 1 positive reply; positive: two or more positive replies); and
- physical activity during leisure time, as assessed by the International Physical Activity Questionnaire (IPAQ)[21] and dichotomized into insufficiently active (up to 150 minutes a week) or active (more than 150 minutes a week).

Initially we described the prevalence of the independent variables and the prevalence of the 'frailty' outcome. We then performed crude and adjusted analysis to assess association between the independent variables and the dichotomous outcome. We used Poisson regression with robust variance to calculate the prevalence ratios (PR) and their respective 95% confidence intervals (95%CI), taking design effect into consideration. We performed the multiple analysis using a hierarchical model[22] with backward selection, with the demographic variables on the first level, the socio-economic variables on the second level, the morbidity score on the third level and the behavioral

variables on the fourth level (Figure 1). Statistical association was assessed using the Wald heterogeneity and linear trend tests. Variables having significant association with the outcome in the crude analysis were included in the multiple model. Associations having a p value less than or equal to 0.05 were considered to be significant; independent variables associated with the outcome having a p value less than 0.2 were kept in the multiple model to control for confounding factors. The analyses were performed using Stata 12.1 (Stata Corp., College Station, TX, USA).

The COMO VAI? study was approved by the Federal University of Pelotas Faculty of Medicine Research Ethics Committee: Opinion No. 472.357, Certificate of Submission for Ethical Appraisal (CAAE) No. 24538513.1.0000.5317, on November 28th 2013. In order to take part in the interview, each subject signed a Free and Informed Consent Form. The confidentiality of the information provided and the right to refuse to take part in the study were guaranteed.

Results

3,799 of the 4,123 households selected were visited. 1,379 of these households had dwellers aged 60 or over, whereby 1,844 elderly individuals eligible for the study were identified. 1,451 elderly individuals were interviewed, 1,399 of whom answered the questions on the outcome, thus enabling the frailty score to be calculated. Losses and refusals totaled 21.3%, the majority of whom were female (60.0%). This proportion was similar to the proportion of female respondents (63.0% – 95%CI 60.5;65.5) and to the proportion of those in the 60-69 age group (59.0%), but was higher than the proportion of elderly participants (52.3% – 95%CI 49.7;54.9).

63.2% of the interviewees were female, 52,7% were aged up to 69 years old, 83.7% were of White race/skin color and 53.1% lived with a partner. 42.8% of the interviewees had family income of between R$724.01 and R$2,172.00, 52.6% were of economic status C (ABEP/2010 classification) and 13.6% had no schooling. 25.4% of all the elderly had four or more morbidities, 12.6% were smokers and 33.3% were former smokers, and 1.0% had a positive CAGE assessment; 81.6% of the elderly were considered to be insufficiently active in their leisure time (Table 1).

Prevalence of some degree of frailty was 13.8% (95%CI 12.0;15.6). With regard to degree of frailty, 69.5% of the participants were classified as 'not frail', 16.7% as 'vulnerable', 8.6% as 'mildly frail', 4.0% as 'moderately frail' and 1.2% as 'severely frail' (Table 1).
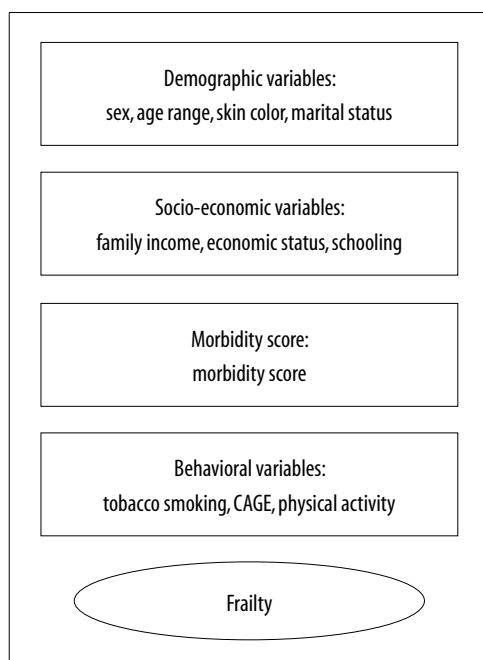

Figure 1 – Hierarchical model

Table 1 – Sample description according to outcome variables and exposures, Pelotas, Rio Grande do Sul, 2014

Characteristics	n	%
Sex (n=1,399)		
Male	515	36.8
Female	884	63.2
Age range (in full years) (n=1,398)		
60-64	387	27.7
65-69	350	25.0
70-74	265	19.0
≥75	396	28.3
Race/skin color (n=1,398)		
White	1.170	83.7
Other	228	16.3
Marital status (1,398)		
Has a partner	743	53.1
Does not have a partner	655	46.9
Family income (in BRL) (n=1,315)[a]		
Up to R$724.00	139	10.6
R$724.01 - R$2,172.00	563	42.9
R$2,172.01 - R$3,620.00	278	21.1
R$3,620.01 - R$7,240.00	195	14.8
R$7,241.01 or more	140	10.6
Economic status[b] (ABEP[c]) (n=1,333)		
A/B	470	35.2
C	701	52.6
D/E	162	12.2
Schooling (in completed years of study) (n=1,390)		
None	189	13.6
1-3	323	23.2
4-7	431	31.0
8-11	140	10.1
≥12	307	22.1
Morbidities[d] (n=1,391)		
None	146	10.5
1-3	892	64.1
≥4	353	25.4
Tobacco smoking (n=1,398)		
No	756	54.1
Yes	176	12.6
Former smoker	466	33.3

a) National minimum wage: R$724.00 (US$303.00 on 01/01/2014).
b) Economic status: variable with the greatest number of missing values (79).
c) ABEP: Brazilian Association of Survey Companies, 2010.
d) Morbidities: systemic arterial hypertension, diabetes *mellitus*, heart problems, heart failure, emphysema, ischemia, arthritis, Parkinson's disease, kidney failure, epilepsy, osteoporosis, glaucoma and cancer.
e) CAGE: Cut down, Annoyed by criticism, Guilty and Eye-opener.
f) IPAQ: International Physical Activity Questionnaire.

Table 1 – Sample description according to outcome variables and exposures, Pelotas, Rio Grande do Sul, 2014

Characteristics	n	%
CAGE[e] (n=1,391)		
Negative	1.377	99.0
Positive	14	1.0
Physical activity (IPAQ[f]) (n=1,353)		
Insufficiently active	1.104	81.6
Active	249	18.4
Frailty (n=1,399)		
Not frail	973	69.5
Vulnerable	233	16.7
Mild frailty	120	8.6
Moderate frailty	56	4.0
Severe frailty	17	1.2

a) National minimum wage: R$724.00 (US$303.00 on 01/01/2014).
b) Economic status: variable with the greatest number of missing values (79).
c) ABEP: Brazilian Association of Survey Companies, 2010.
d) Morbidities: systemic arterial hypertension, diabetes *mellitus*, heart problems, heart failure, emphysema, ischemia, arthritis, Parkinson's disease, kidney failure, epilepsy, osteoporosis, glaucoma and cancer.
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When comparing by sex, females had greater differences of frailty with regard to mild frailty (10.6% compared to 5.1% among males) and moderate frailty (4.9% compared to 2.5% among males), while males were more severely frail (1.4%, compared to 1.1% among females). Greater frailty was found among the elderly who did not live with a partner (19.6%), in relation to those who did live with a partner (8.8%); however, this difference was greater for mild and moderate frailty in comparison to severe frailty. Elderly people with more morbidities were found to be frailer (no morbidities, 4.1%; 4 or more morbidities, 29.5%), whereby the differences in the proportions for moderate and severe frailty were greater (Table 2).

Epilepsy (PR 3.58 – 95%CI 2.19;5.85), ischemia (PR 2.56 – 95%CI 2.00;3.28), heart failure (PR 2.48 – 95%CI 1.92;3.19), Parkinson's disease (PR 2.06 – 95%CI 1.22;3.47) and diabetes *mellitus* (PR 2.04 – 95%CI 1.59;2.67) were the diseases most associated with frailty, after adjustment for sociodemographic variables (Table 3). Glaucoma, arthritis and emphysema were not found to have statistically significant association following adjustment.

In the crude analysis, being aged 75 or over, being female, not living with a partner, having less schooling and lower family income, reporting a greater number of morbidities and having insufficient physical activity were factors associated with frailty. In the multivariate analysis, according to the hierarchical model, age continued to have direct association with frailty, whereby prevalence was four times greater in the elderly aged 75 years or over (PR 4.33 – 95%CI 2.94;6.39), when compared to those aged 60-64 years old. Females (PR 1.46 – 95%CI 1.06;2.03) and individuals who did not live with a partner (PR 1.54 – 95%CI 1.16;2.04) had around 50% more likelihood of being frail. Schooling was inversely associated with the outcome. The morbidity score was found to have direct association with frailty, and prevalence among the insufficiently active elderly was twice that found among active elderly people (PR 2.37 – 95%CI 1.29;4.35) (Table 4).

Discussion

This study found frailty prevalence of 13.8% among elderly people. Prevalence was higher among females, those who were older, those who did not live with a partner, had less schooling, self-reported four or more morbidities and those who were insufficiently active in their leisure time. Morbidities most associated with frailty were epilepsy, ischemia, heart failure, Parkinson's disease and diabetes *mellitus*.

Table 2 – Frailty level prevalence according to final model variables, Pelotas, Rio Grande do Sul, 2014

Independent variable	Frailty				
	Not frail	Vulnerable	Mild	Moderate	Severe
	n (%)	n (%)	n (%)	n (%)	n (%)
Sex (n=1,399)					
Male	403 (78.2)	66 (12.8)	26 (5.1)	13 (2.5)	7 (1.4)
Female	570 (64.5)	167 (18.9)	94 (10.6)	43 (4.9)	10 (1.1)
Age range (in full years) (n=1,398)					
60-64	314 (81.2)	52 (13.4)	14 (3.6)	7 (1.8)	0 (0.0)
65-69	264 (75.4)	51 (14.6)	26 (7.4)	7 (2.0)	2 (0.6)
70-74	198 (74.7)	37 (13.9)	20 (7.6)	8 (3.0)	2 (0.8)
≥75	196 (49.5)	93 (23.5)	60 (15.1)	34 (8.6)	13 (3.3)
Marital status (n=1,398)					
Has a partner	571 (76.8)	107 (14.4)	40 (5.4)	17 (2.3)	8 (1.1)
Does not have a partner	401 (61.2)	126 (19.2)	80 (12.2)	39 (6.0)	9 (1.4)
Schooling (in completed years of study) (n=1,390)					
None	90 (47.7)	49 (25.9)	32 (16.9)	14 (7.4)	4 (2.1)
1-3	206 (63.8)	61 (18.9)	33 (10.2)	17 (5.2)	6 (1.9)
4-7	300 (69.6)	77 (17.8)	33 (7.7)	15 (3.5)	6 (1.4)
8-11	111 (79.3)	18 (12.9)	6 (4.3)	5 (3.5)	0 (0.0)
≥12	260 (84.7)	25 (8.2)	16 (5.2)	5 (1.6)	1 (0.3)
Morbidities[a] (n=1,391)					
None	131 (89.7)	9 (6.2)	5 (3.4)	1 (0.7)	0 (0.0)
1-3	690 (77.3)	123 (13.8)	56 (6.3)	16 (1.8)	7 (0.8)
≥4	148 (41.9)	101 (28.6)	58 (16.4)	38 (10.8)	8 (2.3)
Physical activity (IPAQ[b]) (n=1,353)					
Insufficiently active	743 (67.3)	204 (18.5)	98 (8.9)	45 (4.1)	14 (1.2)
Active	216 (86.8)	23 (9.2)	9 (3.6)	1 (0.4)	0 (0.0)
Total	973 (69.5)	233 (16.7)	120 (8.6)	56 (4.0)	17 (1.2)

a) Morbidities: systemic arterial hypertension, diabetes *mellitus*, heart problems, heart failure, emphysema, ischemia, arthritis, Parkinson's disease, kidney failure, epilepsy, osteoporosis, glaucoma and cancer.
b) IPAQ: International Physical Activity Questionnaire.

The frailty prevalence rate we found diverges from the rate found in previous studies conducted in Brazil using the Edmonton Frail Scale (31 to 47.2%).[2,5,9,10] However, our sample was comprised of elderly people who were younger and therefore less frail than the subjects of those studies. As commented above, the "clock test" was discarded because of its ability to overestimate frailty prevalence, classify elderly people with low levels of schooling as having cognitive problems and, consequently, cause a positive classification error with regard to frailty.[2] We consider that self-reporting of ability to answer the questionnaire was adequate for assessing the 'cognition' domain,

given the inclusion in the study of people of low economic status.

When assessing frailty among elderly people living in diverse Brazilian cities in 2008-2009 using Fried's Frailty Phenotype, the FIBRA research network (Frailty among Elderly Brazilians)[7] found prevalence of 9.1%. Also according to the FIBRA study, frailty prevalence was 17%[6] in the Northeast region and 9%[8] in the Southeast region of Brazil. Frailty prevalence in high-income countries, assessed using different instruments, varies between 4.0 and 59.0%.[23] Variability in the scales used limits the comparability of the findings, as scales with a broader approach, such as EFS, tend to find higher

Table 3 – Morbidity prevalence and crude and adjusted analysis of their association with frailty, Pelotas, Rio Grande do Sul, 2014

Morbidities	%[a]	Crude analysis		Adjusted analysis	
		PR[b] (95%CI[c])	p-value[d]	PR[e] (95%CI[c])	p-value[d]
Arterial hypertension			<0.001		<0.001
No	33.3	1.00		1.00	
Yes	66.7	1.80 (1.30;2.48)		1.62 (1.20;2.19)	
Diabetes *mellitus*			<0.001		<0.001
No	76.3	1.00		1.00	
Yes	23.7	1.92 (1.51;2.44)		2.04 (1.59;2.67)	
Heart problem			<0.001		<0.001
No	68.2	1.00		1.00	
Yes	31.8	2.50 (1.95;3.21)		2.04 (1.55;2.67)	
Heart failure	<0.001		<0.001		
No	89.6	1.00		1.00	
Yes	10.4	2.78 (2.14;3.62)		2.48 (1.92;3.19)	
Ischemia/stroke			<0.001		<0.001
No	88.7	1.00		1.00	
Yes	11.3	3.21 (2.49;4.14)		2.56 (2.00;3.28)	
Parkinson's disease			<0.001		0.007
No	98.6	1.00		1.00	
Yes	1.4	2.98 (1.71;5.18)		2.06 (1.22;3.47)	
Kidney failure			<0.001		0.005
No	96.0	1.00		1.00	
Yes	4.0	2.31 (1.52;3.52)		1.96 (1.23;3.13)	
Epilepsy			<0.001		<0.001
No	97.0	1.00		1.00	
Yes	3.0	2.47 (1.56;3.90)		3.58 (2.19;5.85)	
Osteoporosis			<0.001		<0.001
No	74.8	1.00		1.00	
Yes	25.2	2.21 (1.71;2.84)		1.78 (1.38;2.29)	
Cancer			0.001		<0.001
No	89.7	1.00		1.00	
Yes	10.3	1.73 (1.25;2.40)		1.89 (1.38;2.60)	

a) Morbidity prevalence.
b) PR: crude prevalence ratio.
c) 95%CI: 95% confidence interval.
d) p-value: Wald's heterogeneity test.
e) PR: prevalence ratio adjusted for sex, age and family income in minimum wages.

frailty prevalence rates when compared to instruments with a biological focus. Notwithstanding, lower frailty prevalence rates found in high-income countries and in Southeast Brazil suggest that aging in places with better socio-economic conditions is accompanied by better quality of life, including health systems better prepared to cope with the increased number of elderly people in the population and their health needs.

"Older" elderly people are frailer both in high-income countries and also in low- and middle-income countries.[5,9,11-13] Such frailty arises from biological, psychological, cognitive and social factors caused by the physiological process of aging and medical conditions. It is essential to seek to achieve healthy aging, in which loss of functionality is slight and does not prevent the elderly from remaining independent or affect their quality of life.[24]

Table 4 – Prevalence and crude and adjusted analysis of frailty in elderly people (n=1399) according to exposure variables, Pelotas, Rio Grande do Sul, 2014

Independent variable	%[a]	Crude analysis		Adjusted analysis	
		PR[b] (95%CI[c])	p-value[d]	PR[b] (95%CI[c])	p-value[d]
Level 1					
Sex			<0.001		0.023
Male	8.9	1.00		1.00	
Female	16.6	1.86 (1.36;2.55)		1.46 (1.06;2.03)	
Age range (in full years)	<0.001[e]		<0.001[e]		0,023
60-64	5.4	1.00		1.00	
65-69	10.0	1.84 (1.10;3.09)		1.76 (1.05;2.95)	
70-74	11.3	2.09 (1.25;3.47)		2.02 (1.21;3.37)	
≥75	27.0	4.98 (3.39;7.32)		4.33 (2.94;6.39)	
Marital status			<0.001		0.003
Has a partner	8.8	1.00		1.00	
Does not have a partner	19.5	2.23 (1.72;2.91)		1.54 (1.16;2.04)	
Level 2					
Schooling (in completed years of study)	<0.001[e]		0.001[e]		0,023
None	26.5	3.69 (2.30;5.94)		2.30 (1.43;3.73)	
1-3	17.3	2.42 (1.50;3.91)		2.05 (1.31;3.23)	
4-7	12.5	1.75 (1.08;2.83)		1.61 (1.04;2.51)	
8-11	7.9	1.10 (0.55;2.18)		1.13 (0.59;2.19)	
≥12	7.2	1.00		1.00	
Level 3					
Morbidities [f]			<0.001 [e]		<0.001[e]
None	4.1	1.00		1.00	
1-3	8.9	2.16 (0.96;4.83)		1.96 (0.89;4.32)	
≥4	29.5	7.17 (3.24;15.8)		5.19 (2.32;11.57)	
Level 4					
Physical activity (IPAQ[g])	<0.001		0.005		0,023
Insufficiently active	14.2	3.54 (1.93;6.50)		2.37 (1.29;4.35)	
Active	4.0	1.00		1.00	

a) Frailty prevalence.
b) PR: prevalence ratio.
c) 95%CI: 95% confidence interval.
d) p-value: Wald's heterogeneity test.
e) p-value: Wald's linear trend test.
f) Morbidities: systemic arterial hypertension, diabetes *mellitus*, heart problems, heart failure, emphysema, ischemia, arthritis, Parkinson's disease, kidney failure, epilepsy, osteoporosis, glaucoma and cancer.
g) IPAQ: International Physical Activity Questionnaire.

According to the 2010 Demographic Census, females account from some 56.0% of the Brazilian population aged 60 or over.[1] They live longer than men but are frailer. The findings of our study in relation to this are consistent with the literature.[9,11,12] Females have an intrinsically higher risk of frailty because they have less lean body mass than males in the same age range; as well as having an extrinsically higher risk of frailty because of poor eating habits which make them more vulnerable to the effects of sarcopenia.[16] Males, in turn, are more subject to fatal diseases and have more severe disabilities which are attributed to chronic health problems,[25] thus increasing the risk of levels of severe frailty found by our study.

Low levels of schooling, which were associated in our study with increased prevalence of the outcome,

are related to poor sanitation conditions and reduced access to basic infrastructure and health services. This favors the development of diseases[6] and increases the occurrence of frailty. The presence of a partner or family member serves as a stimulus for elderly people to remain active for longer.[27] Elderly people who live alone and have no support from family members become more susceptible to falls and disabilities that arise from them.[28]

Comorbidities fuel the cycle of frailty and hinder the performance of routine activities, thus reducing the autonomy of the elderly.[13] In our study, alterations to the health status of the elderly, such as diabetes *mellitus*, cardiovascular disease, kidney disease, osteoporosis and cancer, were associated with frailty and this finding is consistent with the literature.[9,11] Association between morbidities and frailty can, however, also be affected by reverse causality. The morbidities we found to be most related to frailty were epilepsy, ischemia, heart failure and Parkinson's disease, some of which do not appear in previous studies, either because of a probable variability in the morbidities analyzed, or because of the absence in other studies of adjustment for sociodemographic variables which was done in our study. It is important to place emphasis on arterial hypertension: despite not appearing as one of the morbidities with greater magnitude of association, in view of its high prevalence among the elderly it should be considered as part of the group of morbidities most related to frailty and which should be prioritized when screening for this condition among the elderly.

Healthy habits, such as being active during leisure time, bring benefits that are capable of avoiding or delaying possible frailty.[29] Notwithstanding, frail elderly people may be physically limited in terms of doing exercises, so that it is not clear whether the more active elderly are less frail or whether those that are frailer are unable to do exercise, thus characterizing possible reverse causality.

The replacement of the "clock test" as part of the Edmonton Frail Scale to assess the ability to answer the questionnaire appeared to be adequate, considering the high prevalence of low-income people in the sample analyzed. This replacement does however limit assessment of the consistency of the findings compared to previous studies. Losses were greater in the younger age ranges (60-69

years), resulting in a possible selection bias – as well as possible underestimation of frailty prevalence among the younger elderly. However, taking into consideration the direct relationship between frailty prevalence and increased age, the impact of this loss this would be low. Another limitation of our study relates to assessing morbidities using interviewee self-reported medical diagnosis, whereby the data may be subject to possible information bias; here too there is the possibility of prevalence rates being underestimated in the sample: individuals of lower economic status, with less access to health services, tend to be diagnosed less or diagnosed late.

Our study reinforces the adequacy of the actions provided for in the National Policy on Elderly People's Health (PNSPI)[30] which aim to avoid frailty, identify individuals in the initial stages of frailty and encourage their rehabilitation, without them losing their autonomy. These actions prioritize older elderly individuals, in particular females, those who do not live with a partner, those with less schooling and those who have comorbidities and who therefore have high risk of developing frailty. Nevertheless, when recommending the use of Fried's Frailty Phenotype, PNSPI places emphasis on assessing the physical component.

We consider it to be important to include psychological, social and environmental elements in the assessment of frailty. The Edmonton Frailty Scale, used in our assessment, has shown itself to be easy to administer and has the potential to be included in health service routines as a tool for analyzing different levels of frailty among the elderly. Moreover, the domains assessed according to this scale can guide health professionals in rehabilitation strategies and thus ensure better quality of life for the elderly.

Authors' contributions

Farías-Antúnez S and Fassa AG took part in the conception and design of the study, as well as contributing to data analysis and interpretation. Farías-Antúnez S wrote the first version of the manuscript. Fassa AG critically reviewed and edited the contents of the manuscript. Both authors approved the final version and assume responsibility for all aspects of the paper, including the guarantee of its precision and integrity.

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