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Prevalence of frailty and associated factors in a community-dwelling older people cohort living in Juiz de Fora, Minas Gerais, Brazil: Fibra-JF Study

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Abstract *Frailty is a state of multisystem physiological vulnerability related to aging and an increased risk of adverse outcomes. This study aimed to evaluate the prevalence and associated factors of frailty in the Fibra-JF Study, Minas Gerais, Brazil. We selected a random sample of 461 individuals aged 65 years or more stratified by territorial unit, gender and age. The frailty syndrome was established by the presence of three or more of five items: a feeling of exhaustion, low handgrip strength, slow gait speed, weight loss, and low caloric expenditure. The mean age was 74.4 (SD ± 6.8) years, 69.6% were women and 71.9% white. The prevalence of frailty was 5.2%; 49.9% was from pre-frail subjects. Advanced age (OR: 6.4; CI 1.76-23.8), impairment of the basic activities of daily living (OR: 5.2, CI 1.1-23.1) and self-perception of poor health (OR: 0.13, CI 0.03-0.4) were associated with frailty. In this study, a substantial number of individuals was classified as frail, while half of the sample was at risk of progression towards this condition, suggesting that it is urgent to adopt public health measures focused on frailty prevention and reduction of associated adverse health outcomes.*

Key words *Prevalence, Frailty, Elderly, Older people, Vulnerability*

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Introduction

The epidemiological and demographic transition and the social, scientific and technological achievements brought about necessary changes in the population composition and the pattern of morbidity and mortality to the world scenario[1]. While the increased life expectancy was gradual in some countries, in Brazil, it hiked from 43 to 74 years in less than a century[2]. With 650 thousand new older people added each year, Brazil will rank sixth in the number of individuals with 60 years or more[3,4] by 2050. This process of demographic transition carries a change in the distribution profile of diseases, with a lower frequency of infectious and contagious diseases, and a higher prevalence of chronic-degenerative diseases. Currently, these represent 74% of all causes of mortality in our country and many of them are causes of dysfunctions and disabilities[5,6], among which is physiological frailty.

The frailty syndrome is a clinical condition that has been widely studied in the last decades[7]. It is recognized as a geriatric syndrome and is directly associated with undesirable outcomes, increase of cost and mortality[8-10]. Age is its main isolated risk factor, and it is estimated that 10 to 25% of the population over 65 years of age is frail[11]. For those over 85, such prevalence may reach 45%[11].

The term frailty is common, and many are its vernacular meanings. However, in the scientific literature, the term has been used in the past – and to some extent still is – to describe individuals who are dependent on others who are at substantial risk of dependency and other adverse health outcomes, as a characteristic of those with many chronic diseases or complex medical and psycho-social problems[12]. Atypical evidence of diseases, being a candidate for specialized geriatric programs and rapidly aging are other conditions described by the term frailty in the scientific literature.[12]

However, over the last two decades, the frailty syndrome has been discussed mainly around two conceptual models and their respective instruments. On the one hand, Rockwood and colleagues[13] define frailty as the set of problems – illnesses, dysfunctions, disabilities – of individuals, and proposes a comprehensive geriatric assessment as a method of identifying patients with this syndrome. On the other hand, considered as an objective manifestation of the interaction of genetic and environmental factors, the "phenotype" – also called physical frailty –proposed by Fried et al.[14] work on the assumption that, from a conceptual viewpoint, frailty is a state of age-related multisystemic physiological vulnerability associated with an increased risk of adverse health outcomes, and propose that it be diagnosed by the presence of three or more of a total of five items: feeling of exhaustion, low handgrip strength, slowing gait speed, weight loss and low caloric expenditure. The presence of one or two items would point to a borderline, intermediate status between the robust and frail individual, named by these authors as pre-frailty.

There is an understanding among researchers in the field that the frailty syndrome is something different than dependency and vulnerabilities of an economic and social nature. However, both conceptual systems identify individuals at risk of adverse health events and high mortality[12]. At least two characteristics of this condition justify this understanding: firstly, the impairment of the functional reserve of the various organic systems associated with chronological aging is relatively well reported in the literature; secondly, frail or pre-frail individuals recover, both spontaneously and through therapeutic interventions, whereas disability conditions are relatively "fixed", with fewer opportunities for recovery[12,14-16].

This study aimed to evaluate the prevalence and factors associated with frailty in the Fibra-JF study in Minas Gerais, Brazil.

Materials and methods

Sample selection

This is a cross-sectional study with 65 years old or older individuals residing in the urban area of Juiz de Fora, Minas Gerais, Brazil.

According to the Brazilian national institute of statistics [Instituto Brasileiro de Geografia e Estatística (IBGE)], Juiz de Fora is divided into 16 territorial units, based on the criteria of geographic location and socioeconomic level. In 2001, the city had 500,000 inhabitants, of which 47,379 (11.6%) were aged 60 years or older[2]. In this study, individuals of both genders aged 65 and over were selected from this population by quota sampling criteria. The sample size by gender and age group, for a sampling error of 5%, was 385 individuals. In the first step, five of the 16 units (units 1, 4, 10, 11 and 13) were randomly selected. Next, the neighborhoods were selected in each unit and streets of the selected neighborhoods. The territorial units consist of districts

subdivided into census tracts, which consist of streets defined in specific blocks. The proportionality of the older people in each region was preserved in the different districts visited. By adopting the door-to-door procedure, the houses of each street were visited, in a predetermined order, until the target for that location was reached. In total, 461 individuals were interviewed and 427 were analyzed. Thirty-four individuals were excluded from the study because of the following conditions: temporarily bedridden, residents of long-term care institutions, rural residents and people with disabilities – severe sequelae of stroke, immobility, advanced Parkinson's disease, and a score below 14 in the Mini-Mental State Examination (MMSE) (Figure 1).

Participants voluntarily completed an informed consent form and the rules of the National Research Ethics Committee of the Ministry of Health were respected. This work was supported by the National Council for Scientific and Technological Development (CNPq).

Data collection

The interviews were made face to face, at home, between January 2009 and January 2010, after team training. Participants answered a questionnaire consisting of sociodemographic; physical and mental health; health habits; self-perceived health; self-reported comorbidities (heart disease, pulmonary disease, systemic

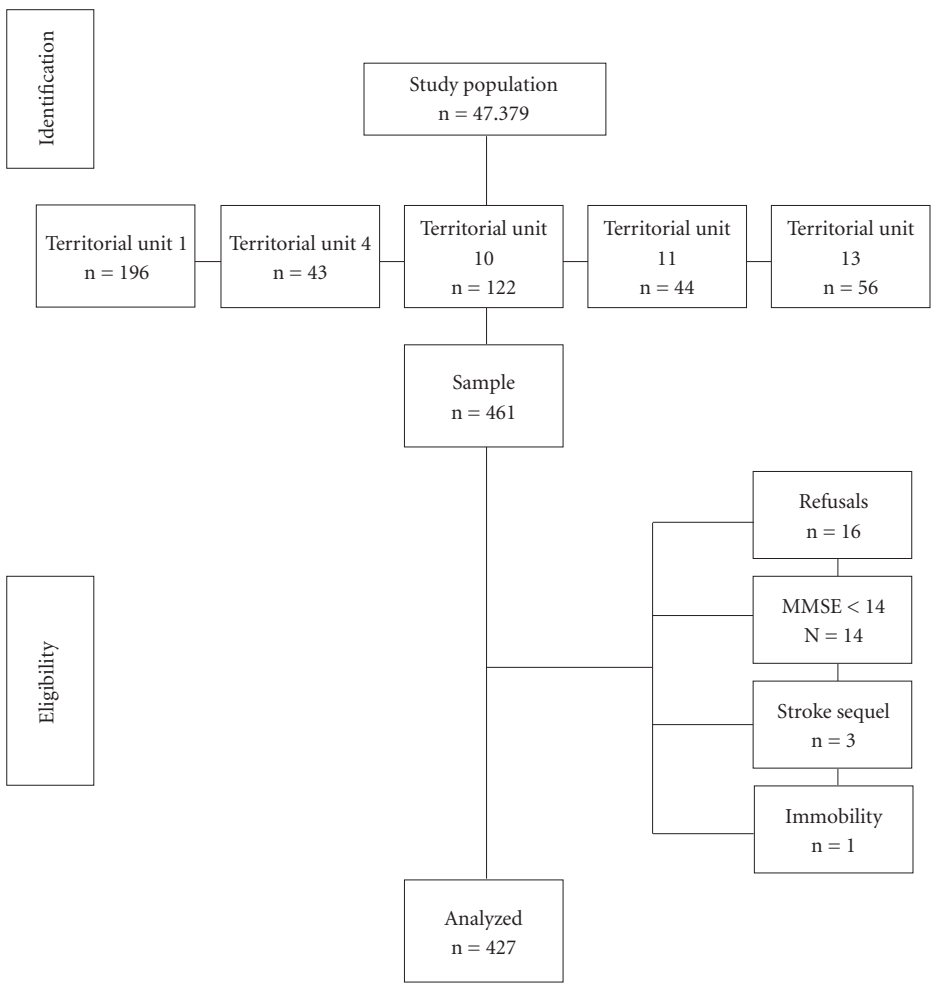

Figure 1. Sample selection by gender and age group of community-dwelling individuals aged 65 years and over living in the city of Juiz de Fora, Minas Gerais, Brazil. Fibra-JF.

arterial hypertension, diabetes mellitus, cancer, stroke, osteoporosis, osteoarthritis, and depression) variables. Participants were also submitted to functional performance tests[17,18] and cognitive screening[19]. Also, the appendicular skeletal muscle mass was calculated by the Lee formula and those of the first quintile by gender were considered as having low muscle mass[20].

The individuals were evaluated through the five items that make up the scale of Fried et al.[14,21], and the diagnosis of frailty was established using the frailty criteria proposed by these authors (Chart 1).

Statistical analysis

The distribution of the categorical variables was shown as absolute frequencies and percentages. Continuous variables were described through means and standard deviations. The variables that showed $p < 0.2$ in the univariate analysis were included in the multivariate logistic regression model by the stepwise forward method. The Hosmer-Lemeshow test was used to analyze the discriminatory capacity of the model. All descriptive statistics were calculated considering a 95% confidence interval, and a level of significance < 0.05 in the multivariate analysis. Data entry and statistical analysis were performed with SPSS version 19.9, IBM software, 2009, Chicago.

Results

The sample consisted of 427 individuals, of whom 69.6% were women, 71.9% were Caucasian, and 48% were married or lived with a partner (Table 1). The mean age was 74.4 years (± 6.8) and the educational level was 5.4 years (± 4.1). The mean income per capita expressed in minimum wages (MW) was 1.6. Of the nine self-reported comorbidities, the most prevalent were systemic arterial hypertension (37.9%), depression (14.5%), osteoporosis (10.5%) and diabetes mellitus (10.5%). Regarding falls, 32.1% of the sample had at least one fall in the previous year. The mean MMSE score was 24.55 (± 3.58).

In the present study the prevalence of frailty was 5.2%; 49.9% were pre-frail and 45% robust individuals. In Table 1, we observed that, among the non-frail, 67% were female, 71% were in the younger age group and 72% were Caucasians.

Chart 1. Frailty scale proposed by the Cardiovascular Health Study: case definition.

Item	Measure
Weight loss	For verification of weight loss, those with self-reported unintentional loss of more than 4.5 kg in the year were considered positive. At follow-up, the body mass index (BMI) was measured and when the corresponding result for the previous year for weight was ≥ 0.05 by the formula below, without report of intentional loss, it was also considered positive for weight loss. (Weight in the previous year - Current Weight / Weight in the previous year).
Muscle strength	A manual dynamometer was used in the dominant upper limb to measure muscle strength, requiring the participant to exercise the highest possible force three times. Those in the first quintile, after adjusting the result for gender and body mass index, were considered positive for the item muscle weakness.
Feeling of exhaustion	Two questions of the Center for Epidemiological Study Center Scale (CES-D) were used to verify the feeling of exhaustion, namely, items seven and 20. "I feel tired in everything I do" and "I cannot continue this way". Those who answered "yes" to any of the two questions were considered positive for the feeling of exhaustion question.
Slowing of gait score	The time spent to walk a 4.6m course in a straight line was evaluated to verify slowing of gait score and, after adjustment for height and gender, those of the first quintile were considered positive for the slowing of gait score.
Decreased physical activity	The Minnesota Leisure Time Activities (MLTA) questionnaire was used to verify the decreased physical activity and the weekly caloric expenditure was calculated for each activity performed by the individual. Those of the first quintile were considered positive for decreased physical activity.

Table 1. Sociodemographic, functional and health conditions of community-dwelling individuals over 65 years of age. Juiz de Fora, Brazil. Fibra-JF (n=427).

		Classification of Frailty						Total	
		Robust		Pre-frail		Frail			
		n	%	n	%	n	%	n	%
Gender	Male	64	33.3	59	27.7	7	31.8	130	30.4
	Female	128	66.7	154	72.3	15	68.2	297	69.6
Age	65-74	137	71.4	93	43.7	5	22.7	235	55
	> 75	55	28.6	120	56.3	17	77.3	192	45
Ethnicity	White	138	71.9	153	72.2	15	68.2	306	71.8
	Non-white	54	28.1	59	27.8	7	31.8	120	28.2
Schooling	0-4	114	59.4	137	64.3	15	68.2	266	62.3
	5-8	30	15.6	33	15.5	2	9.1	65	15.2
	>9	48	25	43	20.2	5	22.7	96	22.5
Marital status	Married	105	54.7	91	42.7	9	40.9	205	48
	Non-married	87	45.3	122	57.3	13	59.1	222	52
Income in minimum wages	0-2	100	52.1	124	58.2	14	63.6	238	55.7
	2.1-5	63	32.8	61	28.6	7	31.8	131	30.7
	> 5	29	15.1	28	13.1	1	4.5	58	13.6
Comorbidities	No	87	45.3	69	32.4	5	22.7	161	37.7
	Yes	105	54.7	144	67.6	17	77.3	266	62.3
Activities of daily living	Independent	175	91.1	177	83.1	15	68.2	367	85.9
	Dependent	17	8.9	36	16.9	7	31.8	60	14.1
Self-perceived health	Poor-Very poor/Fair	64	33.3	100	46.9	17	77.3	181	42.4
	Good-Very Good	128	66.7	113	53.1	5	22.7	246	57.6
Falls	Yes	57	29.7	70	32.9	11	50	138	32.3
	No	135	70.3	143	67.1	11	50	289	67.7
Muscle mass*	Normal	170	89	159	75	15	68	344	80.9
	Altered	21	11	53	25	7	31.8	81	19.1

* Muscle mass as per Lee (percentile 20).

Among the frail, females were predominant (68%) and 77% were older than 75 years. They also had lower schooling (68%), lower income (64%) and a substantial number of comorbidities (77%). In the item self-perceived health, 77% of frails reported that their health was poor/very poor and also had a worse score in the MMSE (mean of 21 points).

Table 2 shows that in the univariate analysis of advanced age, ADL impairment, negative self-perceived health, poor performance in MMSE, the presence of comorbidities and falls had a significant association with the dependent variable. In the multivariate analysis, only advanced age (OR: 6.4; 95% CI 1.76-23.8), impairment in ADL (OR: 5.2; 95% CI 1.1-23.1) and negative self-perceived health (OR: 0.13; CI 0.03-0.4) were shown to be associated with frailty.

Of the five items that make up the CHS frailty scale, Table 3 shows that slowing gait was the most affected item for the frails (95%). For the pre-frail, affected items were weight loss (57.7%), followed by low caloric expenditure (42.3%).

Discussion

Although circumscribing non-exclusively biological realms, instruments such as the Edmonton Frail Scale[22,23] and the Tilburg Frailty Indicator[24,25] have been shown as alternatives to identify frailty in Brazil. However, the proposal suggested by the frailty scale of Fried et al.[14] and its criteria is one of the most widely used methods of assessing frailty and prediction of adverse health events worldwide[23,25-27].

The following discussion will focus on three of these aspects: the first, the relationship between the prevalence values and the cut-off points of the items that underpin the scale used in this

Table 2. Univariate and multivariate logistic regression for frail and non-frail community-dwelling individuals older than 65 years. Juiz de Fora, Brazil. Fibra-JF (n = 214).

		Univariada			Multivariate			
		p	**OR**	**CI (95%)**	**p**	**OR**	**CI (95%)**	
Gender	Male							
	Female	0.886	1.071	0.416 2.759	0.216	0.398	0.092	1.713
Age	65-74							
	> 74	0	8.469	2.978 24.082	0.005	6.496	1.768	23.869
Ethnicity	Non-white							
	White	0.717	1.193	0.461 3.086	0.839	1.137	0.33	3.911
Marital status	Married							
	Non-married	0.224	1.743	0.712 4.271	0.265	2.32	0.529	10.178
Schooling	> 9							
	0-4	0.668	1.263	0.435 3.671	0.391	0.386	0.044	3.406
	5-8	0.607	0.64	0.117 3.511	0.201	3.101	0.547	17.587
Income	0-2							
	2.1-5	0.185	4.06	0.512 32.189	0.848	0.878	0.231	3.339
	> 5	0.284	3.222	0.379 27.413	0.079	0.087	0.006	1.327
Activities of daily living	Independent							
	Dependent	0.003	4.804	1.722 13.403	0.029	5.225	1.181	23.108
Self-perceived health	Good-Very Good							
	Fair/Poor-Very Poor	0	0.147	0.052 0.417	0.002	0.131	0.036	0.471
MMSE	MMSE_TOTAL	0	0.766	0.663 0.886	0.36	0.914	0.753	1.109
Comorbidities	Without comorbidities							
	> 1	0.05	2.817	0.999 7.945	0.189	2.324	0.661	8.166
Falls	No							
	Yes	0.058	0.422	0.173 1.029	0.504	0.675	0.214	2.135

MMSE – Mini Mental State Examination; Hosmer - Lemeshow – 0.92.

Table 3. Frequency distribution of frailty items by CHS in community-dwelling older people in Juiz de Fora (MG), Brazil. Fibra-JF (n = 427).

	Pre-frail		**Frail**		**Total**	
	n (%)		**n (%)**		**n (%)**	
Weight loss	45	57.7	12	66.7	57	43.2
Fatigue	45	21.1	14	63.6	59	13.8
Low caloric expenditure	58	42.3	9	75.0	67	24.9
Slowing of gait speed	67	31.5	21	95.5	88	20.8
Muscle weakness	64	30.0	15	68.2	79	18.5

study; the second concerns the relationship between the conceptual and operational definitions of frailty; finally, we will discuss the state of the art of intervention on risk factors, particularly interested in the case of pre-frail individuals.

In Brazil, the prevalence of frailty in community-dwelling people, using the criteria proposed by Fried et. al.[14] ranged from 5.2% to 17.1%[28-30]. Among the plausible explanations for such variability is the way in which the normality criteria were defined for each item.

In the work of Sousa et al.[30], in a sample of 391 older persons in the city of Santa Cruz, Rio Grande do Norte, Brazil, the prevalence of frailty was 17.1%. The authors suggest that such prevalence would be associated with the low socioeconomic status of this population. However, a methodological aspect should be mentioned as a central element to elucidate this high prevalence: handgrip strength and gait speed. In this work, the absolute values proposed by Fried et al.[14] were used, indeed suitable for the American population, but controversial when applied to different realities[31,32].

In Brazil, other studies used the same CHS criteria to define cut-off points for these variables – the handgrip strength and gait velocity quintile, rather than the absolute values proposed by Fried

et al.[14]. This strategy generated much lower cut-off points, finding lower prevalence and closer to those also evidenced in international studies, both in high income and middle-income countries[28,33,34]. Therefore, there is enough evidence to recommend reference values for gait speed and handgrip strength adapted to the Brazilian population.

Although it is recognized as an operational framework for the identification of the frail individual, the CHS frailty criteria still must be widely discussed as to its applicability[32,35-37]. On the one hand, concerning the operational issue, in a systematic review, Theou et al.[38] have found at least 262 different ways in which, in the last 15 years, the five CHS criteria have been clustered to establish a frailty evaluation instrument. On the other hand, regarding the conceptual definition, frailty is interpreted as a multisystemic syndrome associated with chronological aging. Therefore, changes in the items of this scale are supposed to be associated with changes in multisystemic physiological parameters, although, according to some authors, muscle mass can be an essential element in the development of frailty, either as a component of the initial stages or as an outcome undesirable by itself[35,39]. The items underlying the mentioned scale – weight loss, reduced caloric expenditure, declining handgrip strength, slower gait speed and feeling of exhaustion – suggest that this unique system, namely, the muscular system, is involved, without essential components of this pathophysiological model, such as the neurohumoral and immunological systems, are explicitly included[11].

Finally, identifying individuals at risk for undesirable outcomes is an essential concern in the field of aging, and in the case of the frailty syndrome, intervention on these factors is an essential part of the healthcare of pre-frail individuals[40]. For example, Theou et al.[41] carried out a systematic review of the effectiveness of the exercise to manage frailty. Although they did not find uniformity in the type of exercise, their work evidenced that such intervention promoted a positive impact on the management of the syndrome. Tarazona-Santabalbina et al.[42], in turn, identified that exercises with multiple components (upper limbs, lower limbs and trunk) were able to reduce the degree of frailty and improve functional capacity, gait speed, as well as cognitive, emotional and social aspects of the participants. With the objective of clarifying concerns regarding the effectiveness of a set of multidisciplinary, pharmacological and non-pharmacological procedures, Apóstolo et. al.[43] proposed a systematic review of preventive measures for the pre-frail individual. Papers that evaluate psychosocial, nutritional and physical stimulus interventions for the pre-frail and frail will be included in the analysis of these authors.

Although evidence of rehabilitation of these individuals is still based on a small number of clinical trials, the search for intervention methods is a fundamental activity to establish effective measures to prevent frailty. The potential health benefits to the older population can be estimated taking into account that almost 50% of the sample of this study consists of pre-frail individuals, theoretically those who would most benefit from preventive activities.

This study has limitations due to its cross-sectional design and, consequently, the possibility of reverse causality associated with its results. However, because it is a population-based work with a significant number of individuals from the older people population of Juiz de Fora, Minas Gerais, their findings may also be extended to populations of medium-sized Brazilian cities.

Conclusion

The prevalence of frailty in this study was 5.2% and was associated with advanced age, ADL impairment, and poorer self-perception of health.

Collaborations

RA Lourenço, VG Moreira, EFC Banhato, DV Guedes, KCA Silva, FEF Delgado and CHC Marmona contributed to the design and interpretation of the data, in addition to the writing of the paper.

References

1. Camarano A. *Os novos idosos brasileiros: muito além dos 60?* Rio de Janeiro: IPEA; 2004.
2. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa Nacional de Saúde 2013 - Percepção do estado de saúde, estilos de vida e doenças crônicas*. Rio de Janeiro: IBGE; 2014.
3. Organização Mundial da Saúde (OMS). *Envelhecimento ativo: uma política de saúde*. Brasília: Organização Panamericana de Saúde; 2005.
4. Instituto Brasileiro de Geografia e Estatística (IBGE). *Síntese de Indicadores Sociais - Uma Análise das Condições de Vida da População Brasileira*. Rio de Janeiro: IBGE; 2010.
5. Bloom DE, Cafiero ET, Jané-Llopis E, Abrahams-Gessel S, Bloom LR, Fathima S, Feigl AB, Gaziano T, Mowafi M, Pandya A, Prettner K, Rosenberg L, Seligman B, Stein AZ, Weinstein C. *The global economic burden of Noncommunicable diseases*. Geneva: Word Economic Forum; 2011.
6. World Health Organization (WHO). *Global Status Report on Noncommunicable Diseases*. Geneva: WHO; 2014.
7. Vidal EI. Frailty in older adults: perspectives for research and practice in Public Health. *Cad Saude Publica* 2014; 30(6):1133-1135.
8. Lutomski JE, Baars MA, Boter H, Buurman BM, den Elzen WP, Jansen AP, Kempen GI, Steunenberg B, Steyerberg EW, Olde Rikkert MG, Melis R. Frailty, disability and multi-morbidity: the relationship with quality of life and healthcare costs in elderly people. *Ned Tijdschr Geneeskd* 2014; 158:A7297.
9. Wallis SJ, Wall J, Biram RW, Romero-Ortuno R. Association of the clinical frailty scale with hospital outcomes. *QJM* 2015; 108(12):943-949.
10. Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. *J Am Geriatr Soc* 2007; 55(5):780-791.
11. Walston J, Hadley EC, Ferrucci L, Guralnik JM, Newman AB, Studenski SA, Ershler WB, Harris T, Fried LP. Research agenda for frailty in older adults: toward a better understanding of physiology and etiology: summary from the American Geriatrics Society/National Institute on Aging Research Conference on Frailty in Older Adults. *J Am Geriatr Soc* 2006; 54(6):991-1001.
12. Hogan DB, MacKnight C, Bergman H, Steering Committee CIoFaA. Models, definitions, and criteria of frailty. *Aging Clin Exp Res* 2003; 15(3 Supl.):1-29.
13. Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, Mitnitski A. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005; 173(5):489-495.
14. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; 56(3):M146-156.
15. Cesari M, Fielding R, Benichou O, Bernabei R, Bhasin S, Guralnik JM, Jette A, Landi F, Pahor M, Rodriguez-Manas L, Rolland Y, Roubenoff R, Sinclair AJ, Studenski S, Travison T, Vellas B. Pharmacological Interventions in Frailty and Sarcopenia: Report by the International Conference on Frailty and Sarcopenia Research Task Force. *J Frailty Aging* 2015; 4(3):114-120.
16. Cesari M, Vellas B, Hsu FC, Newman AB, Doss H, King AC, Manini TM, Church T, Gill TM, Miller ME, Pahor M; LIFE Study Group. A physical activity intervention to treat the frailty syndrome in older persons-results from the LIFE-P study. *J Gerontol A Biol Sci Med Sci* 2015; 70(2):216-222.
17. Lino VT, Pereira SR, Camacho LA, Ribeiro Filho ST, Buksman S. Cross-cultural adaptation of the Independence in Activities of Daily Living Index (Katz Index). *Cad Saude Publica* 2008; 24(1):103-112.
18. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist* 1969; 9(3):179-186.
19. Brucki SM, Nitrini R, Caramelli P, Bertolucci PH, Okamoto IH. Suggestions for utilization of the mini-mental state examination in Brazil. *Arq Neuropsiquiatr* 2003; 61(3B):777-781.
20. Lee RC, Wang Z, Heo M, Ross R, Janssen I, Heymsfield SB. Total-body skeletal muscle mass: development and cross-validation of anthropometric prediction models. *Am J Clin Nutr* 2000; 72(3):796-803.
21. Lourenço RA SM, Moreira VG, Ribeiro PCC, Perez M, Campos GC, Blavatsky I, Teldeschi ALG. Fragilidade em Idosos Brasileiros - FIBRA-RJ: metodologia de pesquisa dos estudos de fragilidade, distúrbios cognitivos e sarcopenia. *Revista Hospital Universitário Pedro Ernesto* 2015; 14(4):10.
22. Fabricio-Wehbe SC, Schiaveto FV, Vendrusculo TR, Haas VJ, Dantas RA, Rodrigues RA. Cross-cultural adaptation and validity of the 'Edmonton Frail Scale - EFS' in a Brazilian elderly sample. *Rev Lat Am Enfermagem* 2009; 17(6):1043-1049.
23. Fabricio-Wehbe SC, Cruz IR, Haas VJ, Diniz MA, Dantas RA, Rodrigues RA. Reproducibility of the Brazilian version of the Edmonton Frail Scale for elderly living in the community. *Rev Lat Am Enfermagem* 2013; 21(6):1330-1336.
24. Santiago LM, Luz LL, Mattos IE, Gobbens RJJ. Adaptação transcultural do instrumento Tilburg Frailty Indicator (TFI) para a população brasileira. *Cad Saude Publica* 2012; 28(9):1795-801.
25. Coelho T, Santos R, Paul C, Gobbens RJ, Fernandes L. Portuguese version of the Tilburg Frailty Indicator: Transcultural adaptation and psychometric validation. *Geriatr Gerontol Int* 2015; 15(8):951-960.
26. Keevil VL, Romero-Ortuno R. Ageing well: a review of sarcopenia and frailty. *Proc Nutr Soc* 2015; 74(4):337-347.
27. Santiago LM, Luz LL, Mattos IE, Gobbens RJ, van Assen MA. Psychometric properties of the Brazilian version of the Tilburg frailty indicator (TFI). *Arch Gerontol Geriatr* 2013; 57(1):39-45.

28. Moreira VG, Lourenco RA. Prevalence and factors associated with frailty in an older population from the city of Rio de Janeiro, Brazil: the FIBRA-RJ Study. *Clinics (Sao Paulo)* 2013; 68(7):979-985.
29. Costa TB, Neri AL. Indicators of physical activity and frailty in the elderly: data from the FIBRA study in Campinas, Sao Paulo State, Brazil. *Cad Saude Publica* 2011; 27(8):1537-1550.
30. Sousa AC, Dias RC, Maciel AC, Guerra RO. Frailty syndrome and associated factors in community-dwelling elderly in Northeast Brazil. *Arch Gerontol Geriatr* 2012; 54(2):e95-e101.
31. Lourenco RA, Perez-Zepeda M, Gutierrez-Robledo L, Garcia-Garcia FJ, Rodriguez Manas L. Performance of the European Working Group on Sarcopenia in Older People algorithm in screening older adults for muscle mass assessment. *Age Ageing* 2015; 44(2):334-338.
32. Filho ST, Lourenco RA, Moreira VG. Comparing indexes of frailty: the cardiovascular health study and the study of osteoporotic fractures. *J Am Geriatr Soc* 2010; 58(2):383-385; author reply 5-6.
33. Vieira RA, Guerra RO, Giacomin KC, Vasconcelos KS, Andrade AC, Pereira LS, Dias JM, Dias RC. Prevalence of frailty and associated factors in community-dwelling elderly in Belo Horizonte, Minas Gerais State, Brazil: data from the FIBRA study. *Cad Saude Publica* 2013; 29(8):1631-1643.
34. Yassuda MS, Lopes A, Cachioni M, Falcao DV, Batistoni SS, Guimaraes VV, Neri AL. Frailty criteria and cognitive performance are related: data from the FIBRA study in Ermelino Matarazzo, Sao Paulo, Brazil. *J Nutr Health Aging* 2012; 16(1):55-61.
35. Landi F, Calvani R, Cesari M, Tosato M, Martone AM, Bernabei R, Onder G, Marzetti E. Sarcopenia as the Biological Substrate of Physical Frailty. *Clin Geriatr Med* 2015; 31(3):367-374.
36. Campbell AJ, Buchner DM. Unstable disability and the fluctuations of frailty. *Age Ageing* 1997; 26(4):315-318.
37. Wyrko Z. Frailty at the front door. *Clin Med* 2015; 15(4):377-381.
38. Theou O, Cann L, Blodgett J, Wallace LM, Brothers TD, Rockwood K. Modifications to the frailty phenotype criteria: Systematic review of the current literature and investigation of 262 frailty phenotypes in the Survey of Health, Ageing, and Retirement in Europe. *Ageing Res Rev* 2015; 21:78-94.
39. Cruz-Jentoft AJ, Landi F, Topinková E, Michel J-P. Understanding sarcopenia as a geriatric syndrome. *Curr Opin Clin Nutr Metab Care* 2010 Jan 1; 13(1):1-7.
40. Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, Cesari M, Chumlea WC, Doehner W, Evans J, Fried LP, Guralnik JM, Katz PR, Malmstrom TK, McCarter RJ, Gutierrez Robledo LM, Rockwood K, von Haehling S, Vandewoude MF, Walston J. Frailty consensus: a call to action. *J Am Med Dir Assoc* 2013; 14(6):392-397.
41. Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, Vandervoort AA, Jones GR. The effectiveness of exercise interventions for the management of frailty: a systematic review. *J Aging Res* 2011; 2011:569194.
42. Tarazona-Santabalbina FJ, Gomez-Cabrera MC, Perez-Ros P, Martinez-Arnau FM, Cabo H, Tsaparas K, Salvador-Pascual A, Rodriguez-Mañas L, Viña J. A Multicomponent Exercise Intervention that Reverses Frailty and Improves Cognition, Emotion, and Social Networking in the Community-Dwelling Frail Elderly: A Randomized Clinical Trial. *J Am Med Dir Assoc* 2016; 17(5):426-433.
43. Apostolo J, Cooke R, Bobrowicz-Campos E, Santana S, Marcucci M, Cano A, Vollenbroek M, Holland C. Effectiveness of the interventions in preventing the progression of pre-frailty and frailty in older adults: a systematic review protocol. *JBI Database System Rev Implement Rep* 2016; 14(1):4-19.

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