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Profile of Frailty and the occurrence of falls in older adults*

Perfil de fragilidad y ocurrencia de caídas en ancianos

Perfil de Fragilidade e ocorrência de quedas em idosos

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ABSTRACT: The study aimed to analyze the prevalence of frailty syndrome and correlate with the occurrence of falls, in a sub-sample of Rede Fibra, composed of 318 older adults aged 65 and over. It was found a high prevalence of pre-frail older adults and a high incidence of falls among them. However, there was no statistically significant difference. Further studies are needed to identify the frailty syndrome and to present an intervention to prevent and rehabilitate adverse effects such as falls.
Keywords: Aging; Frailty Syndrome; Falls.

RESUMEN: *El estudio tuvo como objetivo analizar la prevalencia del síndrome de fragilidad y correlacionar con la ocurrencia de caídas, en una submuestra de Rede Fibra, compuesta por 318 ancianos de 65 y más años. Se encontró una alta prevalencia de ancianos prefrágiles y una alta incidencia de caídas entre ellos. Sin embargo, no hubo diferencias estadísticamente significativas. Se necesitan más estudios para identificar el síndrome de fragilidad y presentar una intervención para prevenir y rehabilitar efectos adversos como las caídas.*
Palabras clave: *Envejecimiento; Síndrome de fragilidade; Caídas.*

RESUMO: O estudo teve como objetivo analisar a prevalência da síndrome da fragilidade e correlacionar com a ocorrência de quedas, em uma sub-amostra do Rede Fibra, composta por 318 idosos com 65 anos ou mais. Foi encontrada uma alta prevalência de idosos pré-frágeis e uma alta incidência de quedas entre eles. No entanto, não houve diferença estatisticamente significativa. São necessários mais estudos para identificação da síndrome da Fragilidade e apresentação de uma intervenção para prevenção e reabilitação dos efeitos adversos, como as quedas.

Palavras-chave: Envelhecimento; Síndrome da fragilidade; Quedas.

Introduction

Changes in the morbidity and mortality profile have led to an increase in the older adult population. Population aging is a universal phenomenon in both developed and developing countries. Older adults are expected to make up 35% of the total population in Europe and 27% in North America by 2050, while in Brazil, this population can reach or exceed 29% according to data from the Brazilian Institute of Geography and Statistics (Piexac, *et al*., 2012; Veras 2009).

At the same time, to the changes observed in the population pyramid, there is the emergence of aging diseases, among them the Frailty Syndrome. The frailty is characterized, from a biomedical point of view, by its clinical and multifactorial nature, and by presenting an increased vulnerability to stressors, leading to decreased physiological reserves and imbalance of multiple systems (Lima Costa, & Veras 2003; Vieira, *et al*., 2013; Xue, 2011).

The frailty phenotype selected in this article follows the definition presented by Fried (2001), because: Frailty is a definable clinical condition that contains multiple signs and symptoms; The clinical manifestations of frailty, in theory, can be organized in a self-perpetuating cycle of naturally progressive events; The manifestations presented are consistent with a syndromic presentation (Fried, *et al*., 2001; Xue 2011).

Fried and colleagues (2001) proposed a phenotype based on data from the Cardiovascular Health Study (CHS), in which there is a consensus that markers of frailty include clinical components such as unintentional weight loss, muscle weakness, low physical activity, and decreased gait speed (Fried, *et al*., 2001; Vieira, *et al*., 2013). According to these markers, the older adult can be classified as frail when there are three of them, pre-frail when

one or two occur and non-frail when they do not have any of the proposed markers (Fried, *et al.*, 2001; Silva, *et al*., 2009).

Although frailty is associated with age, it is not exclusive to the aging process, as most older people do not necessarily become frail. We know that it related to the presence of comorbidities since there is an accumulation of chronic diseases in the later stages of life (Macedo, *et al*., 2008).

It is assumed that the main age-related changes underlying the syndrome are neuromuscular changes (mainly sarcopenia), neuroendocrine dysregulation and immune system dysfunction (Macedo, *et al.*, 2008).

Due to these changes, frail older adults are more likely to develop adverse clinical outcomes such as falls, hospitalization, and mortality (Ensrud, *et al*., 2007).

Falls can be defined as "an unintended event that results in the individual's position shifting to a lower level relative to his or her initial position." (Tinetti, *et al*., 1988).

Most falls result from predisposing factors, which refer to risk factors such as advanced age, female gender, functional disability, poor physical fitness, balance deficit, gait disturbances, and decreased muscle strength; and precipitating factors that are related to reckless behavior and misperception of space in the face of environmental obstacles. It is known that there is a significant increase in the risk of falling with an increasing number of individual risk factors, and the interaction between these factors is of high relevance (Borin, 2011; Couto, & Perracini, 2012; Scila, *et al*., 2013).

Older people with frailty syndrome are more likely to develop health problems, affecting their functional capacity (Fhon, *et al*., 2013). The falls among the older adults are a public health problem due to the high frequency with which they occur, the morbidity and mortality resulting from this event, and the high social and economic cost of injuries (Cruz, *et al*., 2012).

So the present study aimed to analyze the prevalence of frailty syndrome in the older adults and correlate it episodes of falls, considering the fragility profile defined for this subsample of the REDE FIBRA (Profiles of Frailty in older adults Brazilians).

Materials and Methods

The research

The REDE FIBRA research was approved by the Research Ethics Committee of the State University of Campinas through CEP: n.° 208/2007 CAAE: 0151.1.146.000 -07. Was a

cross-sectional, multicenter and multidisciplinary observational study, carried out in several Brazilian cities, with different human development indexes.

Sampling and Participants

A simple random sampling of the urban census sectors was carried out, the number of census sectors drawn corresponded to the ratio between the number of intended older adults and the number of urban census sectors in each location. For cities with less than 1 million inhabitants, such as Poços de Caldas, the estimate was a minimum of 384 older adults for a sampling error of 5%.

Exclusion criteria

Exclusion criteria included neurological diseases, which prevented the application of the protocol, being in a wheelchair or bedridden, severe sequelae of stroke, and having a cognitive deficit indicated by a score below 17 on the Mini-Mental State Examination (MMSE).

Data collection

Data were collected in a single session, lasting 40 to 120 minutes, in schools, churches, basic health units, convenience centers, and clubs between December 2008 and December 2009.

Data collection took place in 2 phases:

In the first phase, demographic and socioeconomic data were collected through self-report questions. The MMSE was also applied in this phase.

The frailty phenotype was assessed using self-report and objective measures following the model presented by Fried, *et al.*, 2001, composed of 5 indicators:

(1) Weight loss: Considered self-reported and positive unintentional weight loss, greater than 4 kg, last year.

(2) Exhaustion: assessed by questions 7 and 20 of the Epidemiology Center Scale - Depression (CES-D); Positive score for this criterion when there were answers "most of the time" and "always" to at least one of the questions.

(3) Physical activity level: caloric expenditure assessed by Minessota's leisure activity. Women were considered fragile when they presented caloric expenditure <270kcal per week and men with expenditure <383kcal per week.

(4) Decreased muscle strength: The test was performed with the Jamar® dynamometer, with values obtained in kilogram-strength (kgf). Values below the cut-off point adjusted for sex and Body Mass Index (BMI) were considered positive. Women were considered fragile when they had strength <17 (BMI <23), <17.3 (BMI 23.1 - 26), <18 (BMI 26.1 - 29) and <21 (BMI> 29); and men, those with strength <29 (BMI <24), <30 (BMI 24.1-28) and <32 (BMI> 28) were considered fragile.

(5) Gait slowness: time spent, measured in seconds, to cover 4.6 meters, totaling 8.6 m, discounting the initial and final 2 m of acceleration and deceleration. Values above the cut-off point adjusted for sex and height were considered positive. Women were considered fragile when they took more than 7 seconds (<159cm) or 6 seconds (> 160cm), and men were considered frail when they lasted more than 7 seconds (<173cm) or 6 seconds (> 173cm).

The older adult who obtained positive results in 3, 4, or 5 items were considered frail, those who obtained positive results in 1 or 2 questions were considered pre-frail, and those who did not obtain scores in any item were considered non-frail.

These criteria provide a theoretical framework that facilitates the investigation of mechanisms underlying the development of frailty, in addition to the 5-component phenotype being easier to evaluate and apply in a clinical setting (Xue, 2011).

In the second phase of the collection, other variables were investigated: chronic diseases, signs and symptoms, sleep problems, subjective health assessment, smoking, and alcoholism, falls, and fractures, among others, through self-report questions. Only the older adults with a higher score than the cut-off in the MMSE were able to participate in the second phase.

The cut-off points used for exclusion by the MMSE were: 17 for the illiterate, 22 for the older adults with education between 1 and 4 years, 24 for education between 5 and 8 years, and 26 for those who had 9 or more years of schooling. These cut notes followed criteria based on the Brazilian Academy of Neurology (Brucki, *et al*., 2003) and were adopted due to the complexity of several instruments applied in the second phase of data collection, considering that cognitive deficits could impair the reliability of self-report responses. The data analyzed in

this article refer to the occurrence of falls in a sub-sample of the sub pole Poços de Caldas, consisting of 318 older adults who achieved a higher score than the MMSE cut-off score.

The occurrence of falls was assessed using a dichotomous question with an answer (yes x no) that investigated whether the older adults had fallen in the last 12 months. Those who answered yes were asked how many times they had fallen.

Statistical analysis

To assess the statistical dependence between frailty and gender, Pearson's chi-square test was performed, while to assess the dependence between the incidence of falls and Frailty, Fisher's exact test was used, since for these variables the chi-square test was not adequate due to the presence of an expected frequency less than 5 (Agresti, 2003) The tests were performed using the statistical software R considering a significance level of 5% (R core Team 2019).

Results

The first part of the research involved 389 older adults aged between 65 and 69 years (35%), and the prevalence of females (61%). According to the research criteria, only the older adults who scored according to their level of education at the MMSE were able to answer the question: "Did you suffer falls?"These older adults constituted a subsample of 318 people, formed mainly by older adults between 65-69 years old, with schooling between 5 to 8 years old (39%) and prevalence of women (40%), as shown in the table 1 below.

Table 1.

Sociodemographic data (n318)			
		n	**%**
Gender	Masculine	128	40
	Feminine	190	60
Age	65-69	115	36
	70-74	101	32
	75-79	65	20
	80 e +	37	12
Scholarity	0 a 4 years	80	31
	5 a 8 years	101	38
	9 years and +	81	31
Personal income in monthly minimum wage	0 a 3,0	232	78
	3,1 a 5,0	35	9
	>5,0	51	13

* Differences between frequencies in variables are due to non-responses

Regarding the level of frailty and gender (n = 318), there was a higher prevalence of pre-frail older adults (51%) and a higher prevalence of pre-frailty among women (54%). However, by Pearson's chi-square test, we obtain p-value = 0.32 (χ ^ 2 = 2.29, gl=2). Therefore there is no evidence to reject the null hypothesis of independence between the level of frailty and gender. Table 2.

Table 2.

Frailty and Gender

Gender	No Frail		Pre Frail		Frail		Total	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Male	57	45	59	46	12	9	128	100
Female	69	36	103	54	18	10	190	100
Total	126	40	162	51	30	9	318	100

Concerning frailty indicators, the most prevalent were fatigue (23%), followed by low grip strength (21%). Table 3.

Table 3.

Frailty Phenotype (n318)		
	n	**%**
Weight loss	82	22
Exhaustion	89	23
Decreased muscle strength	83	21
Gait slowness	79	20
Low level of caloric expenditure in physical activities	76	20

About advanced activities of daily living, 47% of the older adults reported having interrupted one or two ADLs in the last year, 43% said having interrupted 3 or more ADLs, and

only 10% did not interrupt any activity. To assess the ADLs, a questionnaire was used based on the literature on complex activities of daily living, which contained self-report questions about participation in ADLs and answers such as: "never did," "stopped doing" and "still does" with relation to 13 indicated social activities (Baltes, *et al*., 1993, Reuben, *et al.,* 1990).

Among the chronic diseases most cited by the older adults were hypertension (61%), arthritis (42%), depression (28%) and diabetes (27%). Concerning comorbidities 47% reported having 1 or 2 pathologies, 42% reported having 3 or more pathologies; and 11%, none.

When relating frailty profiles (not frail, pre-frail and frail) with the incidence of falls (none, one, two or more), frail older adults reported having suffered 2 or more episodes of falls (23%), in comparison with pre-frail (15%) and non-frail (9%). Despite this, we cannot conclude that the differences observed are significant since performing Fisher's exact test, we obtain p-value = 0.065. Therefore we do not reject the null hypothesis of independence between the frailty profile and the incidence of falls, as shown in the table below.

Table 4.

Frailty profile and prevalence of falls

	No Frail		Pre-Frail		Frail		Total	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
No Fall	95	75	110	68	15	50	220	69
One Fall	20	16	28	17	8	27	56	18
Two or more falls	11	9	24	15	7	23	42	13
Total	126	100	162	100	30	100	318	100

Discussion

In the present study, the prevalence of frail older adults found in the subsample was 40% non-frail, 51% pre-frail, and 9% frail. Comparing these data, it is possible to see, in a Brazilian community-based sample, worse indicators than that found in an American sample of cardiac risk study, using the same criteria established by Fried. The Cardiovascular Health Study identified 6.3% of the population evaluated as frail, 48.3% as non-frail, and 45.3% as pre-frail (Fried, *et al.*, 2001)

In 2015 Santos also found a high prevalence of pre-frail older adults (61.8%), which corroborates the data from this study. Attention should be paid to the high percentage of pre-frail older adults, highlighting the importance and urgency of diagnostic and preventive measures in the health of the older adults field to prevent the worsening of the condition from pre-frail to frail, and reduce the risks of adverse clinical outcomes (Santos, *et al*., 2015).

Regarding gender, there was a higher prevalence of women. These data agree with the data found in other studies (Costa-Paiva, 2003; Fried, *et al*., 2001; Miguel, *et al.*, 2012). This finding may be related to the fact that females are more likely to develop intrinsic frailty due to the lower amount of lean mass and lower muscle strength compared to males, in addition to being more vulnerable to extrinsic factors related to syndrome such as sarcopenia. Also, age and gender affect bone mineral density, women lose approximately half of their trabecular bone and 35% of their cortical bone during life, this loss is caused by decreased bone formation at the cellular level resulting from reduced efficiency of osteoblasts and women have longer life expectancy leading to a higher predisposition to chronic diseases (Fried, *et al.*, 2001; Miguel, *et al*., 2012, Santos-Eggimann, 2009).

Regarding the indicators of physical frailty, the most prevalent was exhaustion (23%), corroborating the data of Santos-Eggimann and collaborators (2009) who found (37%) fatigue reports in Europeans at the age of 65 years; and Braun and collaborators (2019), (28%) in a study with older adults living in Germany. It is vital that frail older adults are screened for reversible causes of fatigue, such as sleep apnea, depression, hypotension, anemia, among others (Braun, *et al*., 2019)

Indicators such as weight loss and decreased muscle strength were also widespread in studies (Carmo, *et al*., 2011). In this study, 22% of the older adults reported unintentional weight loss in the last year, Fried in 2001 found a 6% prevalence of weight loss for both men and women. In a 7-year study with Mexican-Americans, Ostir, *et al.* (2004), they reported that there were 13% of older adults with involuntary weight loss in the first year of study and 20.1% in the seventh year. It is a consensus that the involuntary weight reduction of 5 to 10%, in one year, from the 7th decade of life, should be investigated (Fried, *et al.*, 2001; Chaves, *et al.*, 2005).

The decrease in muscle strength was found in 21% of older adults. Carmo, *et al.* (2011), also found this indicator in 56.3% in older adults participants of a senior citizen center, this decrease in muscle strength may be subject to neuromuscular changes such as sarcopenia with changes in the quality of muscle and nerve fibers. The decline in muscle strength is a significant

indicator of frailty that can be influenced by physical therapy (Braun, *et al*., 2019; Carmo, *et al*., 2011).

Regarding ADLs, 47% of the older adults reported having interrupted one or two ADLs in the last year, 43% said having interrupted three or more ADLs, and only 10% did not interrupt any activity. The interruption of ADLs is an early indicator of functional loss, indicating changes in social contact and life goals (Dent, *et al*., 2007; Passos 2002); however, it is not enough to characterize functional disability or dependence (Scheibe, & Carstensen, 2010). According to Fried (2001), Frailty and functional dependence cannot be considered as the same entity. Despite the concepts being related, some fragile older adults people do not exhibit disability. Frailty can predict disability and disability can exacerbate frailty, but they have different prognoses, and specific prevention and intervention measures are needed (Fried, *et al.*, 2001).

The pathologies most cited in the study were hypertension (61%), arthritis (42%), depression (28%), and diabetes (27%).

Population studies carried out in Brazil show that the prevalence of hypertension ranges from 28.4% to 62.7% in the population aged 60 or over Veras, *et al*. (2007) reported in his study, the prevalence of 56% of older adults with arterial hypertension, and many of them misused the medication or with doses in need of adjustments. Systemic arterial hypertension has a strong connection with the occurrence of cardiovascular changes such as stroke (the most significant cause of dependence and death in the age group above 60 years), coronary artery disease, congestive heart failure (Veras, *et al*., 2007).

Concerning osteoarticular problems, 42% of the older adults declared to have arthritis. Miguel and collaborators (2012) evaluated 58 older adults, and found that frail older people with arthritis were more depressed, used more medications, had worse self-efficacy for falls, were more obese and had a worse physical function. According to studies, more than 80% of people over 55 have radiographic evidence of osteoarthritis, the most frequent of the osteoarticular complaints. Being more frequent in the hip and knee and mainly in the female gender. Some of the associated modifiable factors are overweight, muscle weakness, low estrogen, and the amount of bone mass (Miguel, *et al*., 2012; Feng, *et al*., 2014).

Frailty can be considered as a factor of development and persistence of depressive symptoms (Feng, *et al*., 2014). In this study, 28% of the older adults reported having depression, characteristic features of people with depressive symptoms such as behavioral change, activity, and social commitment can result in functional decline and fragility (Tavares, *et al.*, 2014). A

study conducted in Denmark, Sweden, and Finland found that the confluence of specific characteristics of frailty such as fatigue, slow gait speed, and disease was related to a higher risk of death, especially in older women (Brown, *et al.*, 2014). It is of great importance to screen older adults people with depressive symptoms, as well as to diagnose and treat depression to build a frailty reduction strategy (Tavares, *et al.*, 2014).

The prevalence of diabetes mellitus in this study was 27%; it is a pathology with high morbidity and can become one of the main diseases among older adults. In a cross-sectional study in 2013, with a sample of 300 older adults, a prevalence of 29.7% was found, in another study coordinated by Veras, *et al*., 2007, 14.7% older adults had diabetes (Veras, *et al.*, 2007; Amaral, *et al*., 2013).

When focusing on frailty profiles (Non-Frail, Pre-Frail, and Frail) with the incidence of falls (none, one, two or more) although there was no statistically significant difference, it shows that frail older adults reported having suffered more episodes of falls, 27% one fall and 23% two or more fall in the last year, leading to a bidirectional relationship, that is, as fall may lead to frailty syndrome, this syndrome may lead to fall (Fhon, *et al*., 2013).

The association between falls and frailty is corroborated by several studies. The authors also found in their study that the prevalence of falls was 59% higher among the older adults considered frail, compared with the non-frail, this is because of the association between changes that occur during aging, such as reduced visual acuity, body balance, mobility, physical function, and the occurrence of frailty syndrome (Fhon, *et al*., 2013; Santos, *et al*., 2015).

Older adults who have a certain degree of frailty and who suffer recurrent falls are considered a high-risk group, because the consequences of falls can be mild or severe, leading to hospitalization, disability, and death. Some older people may still have post-fall syndrome by reducing daily living activities, making them increasingly frail. Also, falls generate a high cost for society with hospitalization, treatment and rehabilitation, and a high cost for the family due to the need for adaptation of the physical environment, dependence, and care of the older adults by a family member or a private caregiver (Fhon, *et al*., 2013).

For this reasons it is essential to identify both non-frail and pre-frail older adults to indicate preventive measures or to delay the onset or progression of the syndrome. Also, pre-frail older adults seem to respond better to interventions, which can contribute to the prevention of the consequences of frailty. The investigation of the frail older adults requires a thorough look, experience on the part of the professional with the availability of material that is easy to apply, low cost, and minimal risk of bias (Regis, *et al.*, 2013).

Conclusion

Although there was no significant difference, the present study was found a higher incidence of pre-frail older adults and females are predominant in the pre-frail and frail variable; besides that, a higher prevalence of falls in frail older adults.

It is of great importance to conduct more studies to identify frailty profiles enabling early and adequate intervention at the level of prevention, or yet, to act in the rehabilitation of these older adults so that they have a better quality of life.

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