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Original Article

Frailty and its relationship to mortality among older adults from a Brazilian community: A cohort study

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ABSTRACT

Background/Purpose: People are living longer. However, the aging process, coupled with lifestyle and health conditions, may lead to what is known as frailty syndrome. There is a consensus among researchers in the field that frailty is associated with adverse health outcomes, such as functional decline, dependency, recurrent falls, fractures, institutionalization, hospitalization and death. The aim of the present study was to analyze the relationship between frailty and mortality in a population of older people living in a Brazilian community.

Methods: A prospective cohort study was conducted through two assessments in the city of Ribeirão Preto, state of São Paulo, with a mean follow-up period of 5.6 years. The sample was made up of 515 (75.37±7.28) older adults who were assessed in 2007/2008, and 262 (79.31±6.34) who were assessed in 2013. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) 22.0; the Wilcoxon test, Cox regression and Kaplan-Meier survival analysis were also used.

Results: We verified that most older people were considered non-frail in 2007/2008 (59.5%); 22.9% were identified as apparently vulnerable, and 17.6% were frail. In 2013, 28.7% were considered non-frail, 20.9% apparently vulnerable; and 50.4% were frail (an increase of 186%). A total of 24.7% died during the follow-up period; 45.7% were considered frail according to the Edmonton Frail Scale. The survival analysis showed that frail older people were more likely to die.

Conclusion: Frailty developed during the period under study, in association with mortality: a greater proportion of non-frail older people were among the survivors. In the present study, frailty was considered an important predictor of mortality.

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INTRODUCTION

Population aging is a topic increasingly discussed in recent decades. People are living longer. However, the aging process, coupled with lifestyle and health conditions, may lead to what is known as frailty syndrome.

Frailty can be screened by measuring phenotypic indexes or checking for multidimensional aspects.[1] Phenotypic indexes provide physical signs of frailty, defined as a clinical syndrome in which individuals experience a decrease in muscle mass, along with changes in immunological and hormonal axes. When associated with extrinsic factors, these conditions may lead to a vicious cycle of decreased energy, increased dependency,

and vulnerability to aggressors, which mainly concern the biological aspects of individuals;[2] multidimensional aspects, in turn, include both physical and psychosocial elements, which are the focus of the present study. Social, psychosocial and cognitive aspects are assessed through a multidimensional scale, the Edmonton Frail Scale (EFS). Its questions address the biological, cognitive and behavioral spheres, which enable broader assessment that is coherent with the practice of nurses.[3]

Validity and feasibility were assessed by comparing the eight frailty scales with mortality rates, while prevalence and ability to predict all causes of mortality in older adults were estimated. The EFS presented feasibility and a prevalence of 7.6%; this is one of the most precise unweighted scales for predicting all causes of mortality.[4]

There is a consensus among researchers in the field that frailty is associated with adverse health outcomes, such as functional decline, dependency, recurrent falls, fractures, institutionalization, hospitalization and death.[5,6]

Research on the topic has attracted the attention of researchers from various countries and distinct fields of knowledge; in Brazil, most analyses that have addressed older people have been cross-sectional studies. The identification of frailty and frailty-related mortality is important for assessing health indicators of older people; however, such studies are still incipient, which justifies the present study. Its aim was to analyze the relationship between frailty and mortality in a population of older people living in a Brazilian community.

METHODS

Study design and settings

This prospective cohort study was conducted with older adults living in the city of Ribeirão Preto, located in the northwest region of the state of São Paulo, Brazil, in a five-year follow-up study. The study was approved by the Ethical Committee at the College of Nursing at Ribeirão Preto at the University of São Paulo, CAAE: 09236612.4.0000.5393.

Participants

Two-stage cluster sampling was carried out in 2007. In the first stage, a census sector was considered the primary sampling unit. Thirty census sectors were selected from among the 600 sectors in the city, with probability computed proportionally to the number of households. In the second stage, a set number of households were visited to ensure a self-weighting sample. This involved randomly selecting the streets and blocks where the search process would be initiated, and locating neighborhoods and streets with a minimum of 110 households of the older people who would constitute the sample.

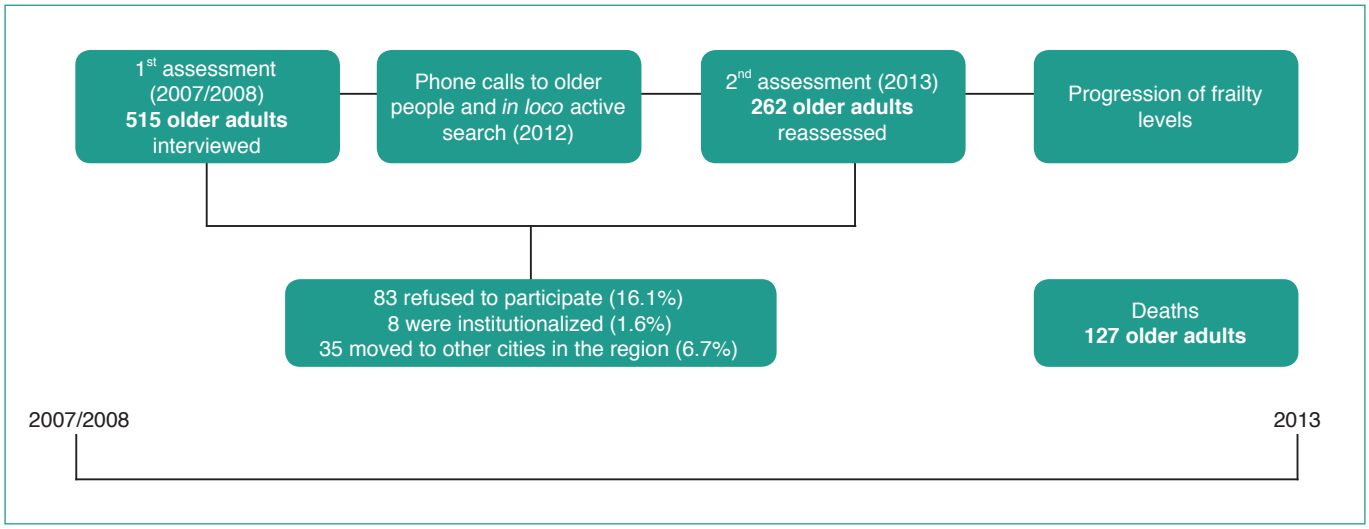
A total of 993 people were selected, taking into account potential refusals or non-responses. This number was adjusted for an expected response rate of 80%. Of these, 515 older adults took part in the first assessment in 2007 and 2008. In 2013, after an average follow-up of 5.6 years, a second assessment was performed with 262 older adults.

The first of the two assessments was performed in July 2007 and March 2008; the second was conducted from May to October 2013. In 2012. before the second assessment was initiated, the families were contacted by telephone to verify whether the individuals were at home, had died or moved away. An active search for address changes and updated data was conducted in connection with the reevaluation. In the period from May to October 2013, the researchers reassessed those who had taken part in the first assessment.

Questionnaires

The following instruments were used, with the consent of their authors:

Figure 1. Flowchart for the cohort study of the project "Frailty and its relationship to mortality among older adults from a Brazilian community: a cohort study"



1) Sociodemographic profile: age (in years) categorized in younger-old individuals (65-79 years old) and older-old individuals (over 80 years old); gender (male and female); marital status (single, married, divorced, separated, widowed); education (in years); monthly income (in dollars); and type of income source (retirement, pension, rental income, donations, remuneration and/or others).

2) Self-reported morbidities: arterial hypertension, back problems, diabetes mellitus, urinary incontinence, eye problems.

3) Edmonton Frail Scale,[3] validated for Brazilian Portuguese.[7,8] Nine domains represented by 11 items are assessed, among which are: cognitive by means of the clock-drawing test, in which the older adult is instructed to place numbers inside a circle in the correct positions and then insert the clock hands showing the time of 10 minutes after 11; overall health state; functional independence; emotional support; use of medication; nutrition; mood; urinary continence; and functional performance with the 3-meter Timed Up and Go test. The scores are classified as: 0 to 4- does not represent frailty; 5 and 6-apparently vulnerable; 7 and 8-mild frailty; 9 and 10-moderate frailty; 11 or more -severe frailty. Individuals who scored above seven were considered frail.

4) Mortality: Information was collected from death certificates when possible or during interviews held in the older person's home with family, friends or neighbors in order to determine the date of death. Data from the Mortality Information System at the Health Department of Ribeirão Preto was used when the families did not have a death certificate.

Statistical analysis

Data from the first and second assessments were entered into a Microsoft Excel® for Windows spreadsheet and transferred to the Statistical Package for the Social Science (SPSS) for Windows version 22.0 for statistical analyses. In the univariate analysis of data, distribution of absolute (n) and relative frequencies (%) was used for the qualitative data, while central tendency (mean) and dispersion (standard deviation) measures were used for the quantitative variables.

Bivariate analysis was conducted for frailty over death, including estimating the survival curve with the Kaplan-Meier method. Since frailty was the preferable predictor, the analysis was adjusted for potential confounding variables, such as gender (male or female), age category (younger-old or older-old adult), marital status (with or without a partner) and number of diseases. Death was the dependent variable, and Cox regression analysis was also used. A confidence interval (CI) of 95% and a significance level of α=5.0% were considered in all the tests.

RESULTS

Members of the initial sample of 515 older adults (2007/2008) were 75.4 years old on average (SD=7.3). Most were women (67.4%); had five or more self-reported diseases (57.5%); were married (44.3%); and had 4.7 years of education on average (SD=4.7). With regard to self-reported diseases, most presented five or more diseases, with 5.6 diseases on average (SD=3.3).

After an average period of 5.6 years of follow-up (in 2013), 262 individuals were reassessed. These individuals were 79.3 years old on average (SD=6.3); most were women (66.4%); had five or more diseases (52.7%); were widowed (44.3%); and had an average of 5.0 years of education (SD=4.9). With regard to self-reported diseases, most reported five or more diseases, with 5.1 on average (SD=3.5).

Comparison of the prevalence of frailty between the two assessments, showed that most older people were considered non-frail in 2007/2008 (59.5%), 22.9% were apparently vulnerable and 17.6% were frail, considering the three levels of frailty, i.e., mild, moderate or severe. In 2013, most individuals were frail (50.4%), 28.7% were considered non-frail and 20.9% were apparently vulnerable. A significant increase in the prevalence of frailty was found between the two assessments ($p < 0.001$), which showed evidence of an increase in the proportion of frailty among the followed-up older adults.

A total of 127 (24.6%) individuals, aged 79.2 years old on average (SD=7.9), died in the period under study. Most were women (63.8%); were widowed (45.7%); and had six diseases on average (SD=3.2). With regard to frailty, 45.7% were considered frail (Table 1).

The log-rank test showed a significant difference between the proportion of survivors according to the frailty variable,

Figure 1. Survival curve for the frailty variable categorized in older adults

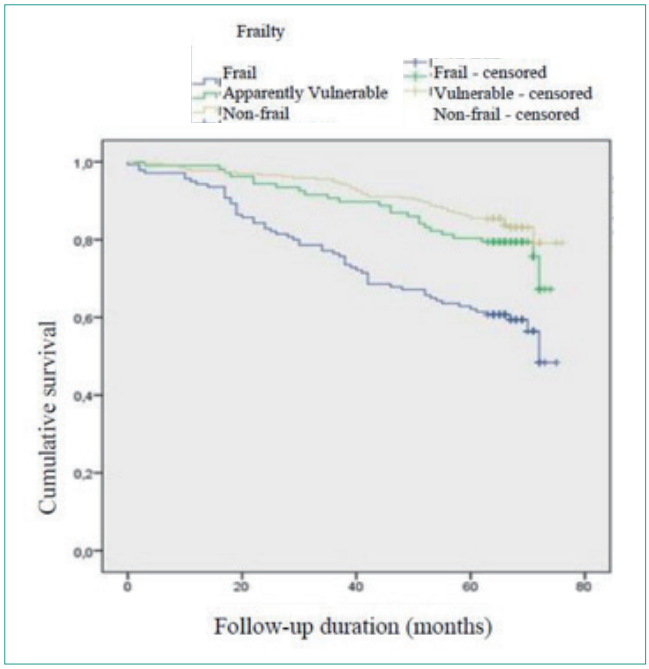


Table 1. Sociodemographic and health characteristics of older adults during the cohort follow-up: first assessment, second assessment and deaths (Ribeirão Preto-SP, Brazil)

Variables	Assessment 2007/2008 (n=515)		Assessment 2013 (n=262)		Death (n=127)		p
	n	%	n	%	n	%	
Sex							
Male	168	32.6	88	33.6	46	36.2	
Female	347	67.4	174	66.4	81	63.8	
Age							
Mean (=SD)	75.37 (7.28)		79.31 (6.34)		79.18 (7.88)		
Marital status							
Single	45	8.7	25	9.5	15	11.8	
Married	228	44.3	106	40.5	46	36.2	
Divorced	27	5.2	12	4.6	6	4.7	
Separate	5	1.0	3	1.1	1	0.8	
Widowed	206	40.0	116	44.3	58	45.7	
Others	4	0.8	-	-	1	0.8	
Education							
Mean (=SD)	4.70 (4.67)		5.00 (4.95)		-		
Income							
Mean (=SD)	289,53 (419,67)		474,52 (559.63)		275.45 (347.45)		
Number of diseases							
Mean (=SD)	5.56 (3.35)		5.16 (3.51)		-		
None	19	3.7	15	5.7	-		
1 to 4	200	38.8	110	42.0	-		
5 or more	296	57.5	137	52.3	-		
Frailty							
Non-Frail	156	59.5	75	28.7	45	35.4	
Apparently vulnerable	60	22.9	55	20.9	24	18.9	<0.001
Frail	46	17.6	132	50.4	58	45.7	
Wilcoxon test; p <0.05							

Table 2. Prevalence of frailty according to the EFS in older adults living in the community in the two assessments, between 2007/2008 (n=262) and 2013 (n=262) (n=262 in both years)

	Assessment 2013				
Assessment 2007/2008	Non-frail	Apparently vulnerable	Frail	Total	p
	n (%)	n (%)	n (%)	n (%)	
Non-frail	69 (44.2)	36 (23.1)	51 (32.7)	156 (59.5)	<0.001[a]*
Apparently vulnerable	6 (10.0)	14 (23.3)	40 (66.7)	60 (22.9)	
Frail	0 (0)	5 (10.9)	41 (89.1)	46 (17.6)	
Total	75 (28.7)	55 (20.9)	132 (50.4)	262 (100.0)	
[a]Wilcoxon test; *p <0.05					

Table 3. Cox multivariate regression for overall mortality in a cohort of older adults (n=515)

Variables	HR (95% IC)	p
Male gender (vs. female gender)	1.41 (0.93-2.15)	0.103
Older-old (vs. younger-old)	2.34 (1.62-3.38)	<0.001*
Without a partner (vs. with a partner)	1.20 (0.79-1.83)	0.382
Apparently vulnerable (vs. non-frail)	1.10 (0.64-1.89)	0.709
Frail (vs. non-frail)	2.21 (1.37-3.58)	<0.001*
Number of diseases	0.98 (0.92-1.04)	0.649
HR=hazard ratio; 95% CI=confidence interval; *p <0.05.		

that is, the proportion of non-frail survivors was significantly greater than the proportion of apparently vulnerable and frail survivors, as shown in Figure 1 (p <0.001).

In the analysis of the remaining predictor variables adjusted for mortality, being older than 80 years of age and frail were independently associated with a greater risk of death. According to the results of the Cox regression, age and frailty were statistically significant predictors of death. In fact, those above the age of 80 years old were 2.3 times more likely to die than those in the younger-old group.

When assessing older people according to frailty categories, the frail older people were 2.2 times more likely to die than those who were non-frail. In an alternative model, gross scores of frailty showed that the probability of death increased 17% for each additional point in the raw score for frailty, meaning that frailty was an important predictor of death in 2007/2008 (Table 2).

DISCUSSION

The results of a prospective cohort study with this sample show that the characteristics of population aging are similar to those found in other regions of Brazil and other countries, i.e., most are women, are 65 and 79 years old, have low educational levels, are retired, and present multiple morbidities.[9-12] Note that frailty significantly increased during the follow-up period.

The variables frailty and age were considered the most important predictors of mortality. Population aging and its association with frailty is a social challenge faced by health systems. This is an emergent geriatric syndrome, with key domains that include physical function, nutritional status, mental health and cognition.[13] Various definitions have been used to diagnose frailty, but further studies are needed to establish an operational definition.

The concept of frailty is multidimensional and represents a transition to a situation of greater vulnerability and loss of resistance to external factors, resulting in increased risk of adverse outcomes.[14] There is, however, a lack of consensus regarding what domains should be included and assessed, while different scales have been developed by researchers from different countries for specific environments. For these reasons, it is difficult to estimate the prevalence of real frailty, since each instrument assesses different domains. Nonetheless, it is already known that greater frailty is related to lower educational levels, lower income, perceptions of worse health, and a larger number of comorbidities.[13]

The literature[2,8] shows that the prevalence of frailty varies according to criteria, type of research method, and the instrument(s) used, in addition to the setting of data collection and the participants. Studies using the EFS have reported a prevalence of frailty ranging from 14.9% to 39.2%. All these studies employed a cross-sectional design[11,15-16] and addressed only older women.[17] The lowest rate of prevalence was reported by a study conducted in Taiwan (14.9%),[15] while in Brazil,[16] 39.1% of the studies reported different levels of frailty: 18.3% mild frailty; 11.3% moderate frailty; and 9.6% severe frailty. In Brazil,[17] 39.2% of older women were considered to be frail: 23.5% presented mild fragility; 7.8%, moderate; and 7.8%, severe.

The present study monitored older adults for 5 to 6 six years and employed the EFS to assess frailty. The prevalence of frailty significantly increased, from 17.6% in 2007/2008, to 50.4% in 2013. Hence, acknowledging this increase is a step toward helping prevent the occurrence of adverse outcomes, such as death. The results showed a rate of 24.7% of deaths during the follow-up, which lasted 5.6 years on average; most deaths were among women. Similar results were found in a meta-analysis of 11 studies, which included 35,538 older adults living in communities: 7,994 died (22.5%), and there was an average of 6.05 years of follow-up.[18] In one study, adults more than 70 years old were assessed to identify any association between frailty and mortality, functional impairment and hospitalization at a 952-day follow-up; the rate of death was 18.4%.[19]

Another study conducted in Hamburg, with a follow-up that lasted 8.7 years on average, reported the death of 1,121 older adults (mostly men), a number that represented 11.3% of the sample.[20] In this study, 45.7% of those who died presented some level of frailty, 18.9% were vulnerable, and 35.4% were non-frail.

One study conducted in three French cities monitored 6,078 older people for a four-year period; it assessed the frailty phenotype and reported a mortality incidence rate of 5.2%. Cumulative mortality was 11.5% for frail older people; 5.5% for the pre-frail; and 4.4% for the non-frail.[21] After adjusting for the variables, the relative risk of death among frail and pre-frail older people was significantly higher than among non-frail individuals, showing that frailty increases the risk of death among older individuals.[22]

The same was found in a meta-analysis[18] in which older people presented a greater risk of death, compared to non-frail and pre-frail older individuals. Men were at greater risk, while age was not a predictor of mortality. This leads to the

conclusion that frailty is associated with shorter survival times.

When the risk of mortality was assessed between sexes, the risk of death was greater for frail older individuals compared to pre-frail individuals, regardless of sex, though no statistical difference was found. However, when frail and non-frail individuals were compared, the risk of death was significantly greater for male older people. This analysis clearly shows that the frail older individuals are more likely to die, which has also been shown by other studies addressing the phenotype of frailty.

Frailty is a geriatric syndrome associated with decreased survival. Increased risk of death is associated with an increased number of frailty components. The association between frailty and decreased survival has been shown to be significant in both women and men.[23] With regard to the association between frailty and survival, it has been shown that frailty is generally associated with decreased survival and that the relationship is stronger among those with more of the deficits that are associated with greater risk of adverse outcomes, including impairment, hospitalization, and institutionalization.[23] This effect has generally persisted during five or six years of follow-up. The strongest association between frailty and mortality was found in a four-year follow-up period and, even though the strength of the association decreased with longer periods of follow-up, the lowest being found in an 11-year follow-up period, the association remained.[23]

The number of deficits was more closely related to survival than to age in the analysis of relative risks adjusted for gender and age.[24] In calculating the Frailty Index, every additional deficit represented an increment of 1.13 in the average, while age increased the average by 1.09. The Frailty Index used by Chinese researchers showed that older adults presented greater cumulative deficits when compared to individuals assessed in studies conducted in the West.[24]

Comparisons between the findings of the present study with those reported in the literature[18,21-24] show that the mortality rate was greater in the Brazilian population, but the risk of death was similar among the frail older individuals.

This study has some limitations. One is that morbidities were self-reported and not confirmed by medical diagnoses; however, this type of self-reported data is widely used in epidemiological studies as an important indicator of health. Additionally, data concerning the first assessment were collected through face-to-face interviews in the presence of caregivers, which may have affected what the participants reported. Finally, there were losses in the number of participants over the course of the follow-up due to refusals, changes of address, or relocation to another city.

CONCLUSION

Frailty increased during the follow-up period and was associated with mortality; that is, the proportion of survivors was significantly higher among the non-frail older people, so in the present study, frailty was considered an important predictor of mortality.

Cohort studies facilitate the understanding of issues involving this topic and observing how frailty progresses, both in terms of healthcare workers and society, as well as aiding the establishment of better frailty-related outcomes. It is worth noting that the topic "frailty and adverse outcomes" should be part of clinical assessment protocols used by geriatric nurses to assess older adults.

CONFLICTS OF INTEREST STATEMENT

None of the authors have any conflicts of interest to declare related to this manuscript. There was no financial support or other benefits from commercial sources received for the work reported on in the manuscript.

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