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Impacts of frailty on the negative health outcomes of elderly Brazilians

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Abstract

Objective: to verify the association between frailty and the occurrence of falls, hospitalization and death among Brazilian elderly persons. *Methods:* a representative sample of elderly persons from the city of Juiz de Fora, Minas Gerais, Brazil, who had been evaluated with regard to frailty, socio-demographic conditions and health in 2009, were reevaluated in terms of negative health outcomes between 2014 and 2015 (n=304). *Results:* The results revealed a greater incidence of falls, hospitalization, and death among frail elderly persons. The frail group also had an increased risk (1.5, crude estimate) of death during the follow-up period than the robust individuals. The pre-frail elderly had a 55% (crude) and 58% (adjusted) greater risk of falls, and an 89% (crude) greater risk of death than robust individuals. *Conclusion:* frailty, as well as pre-frailty, can increase the risk of adverse events in the health of the elderly.

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INTRODUCTION

Frailty is characterized as a syndrome with multiple causes and contributors resulting in declining physiological reserves and increased individual vulnerability. This profile is related to a high index and risk of falls, hospitalizations, functional incapacity and death among frail elderly persons[1,2]. Epidemiological studies have shown that frail elderly persons are up to 3.35 times more likely to fall than robust elderly persons[3], and have a 10.5 times greater risk of death[4].

It is known that genetic, physical, psychological, social and environmental factors, and the interactions between them, have considerable potential to elucidate the triggering of frailty and the aggravation of its consequences[1,5]. However, while evidence with elderly individuals of different nationalities suggests frailty has a considerable impact on the risk of negative health outcomes, there are no records of longitudinal studies on this subject involving the Brazilian elderly.

Therefore, the objective of the present study was to investigate whether negative health events among the elderly (falls, hospitalization and death) are influenced by the frailty syndrome during longitudinal follow-up.

METHOD

A longitudinal follow-up study was carried out of a population of elderly people evaluated in 2009 by the FIBRA (Frailty among Brazilian Elderly) network in Juiz de Fora[6]. All procedures performed in the study involving human participants were in accordance with the ethical standards of the national research committee and with the 1964 Declaration of Helsinki and its subsequent amendments and comparable ethical standards.

The baseline of the FIBRA study was determined from a sample obtained from a complex sampling design for a self-weighted two-stage household survey. The first stage involved the Territorial Units of the municipal region, and the second stage was the Census Sectors, both according to the criteria of the Brazilian Institute of Geography and Statistics.

Individuals over 65 years of age, with the physical-functional capability to perform the frailty tests and who were able to answer the questions alone, and who did not have severe cognitive deficits or received palliative care were involved. In total, 424 community-dwelling adults responded to the interview and performed the tests proposed during a home visit.

Some data from the FIBRA study were only considered in the present study for the sample characterization of the baseline. These included sociodemographic (age, gender, ethnicity, illiteracy, housing and income), clinical (presence of comorbidities previously diagnosed by physicians), functional (Lawton and Brody Instrumental Activities of Daily Living Scale[7]) and frailty factors.

Frailty was assessed according to the protocol established by Fried et al.[8] For this, muscle strength, gait speed, level of physical activity, exhaustion and unintentional weight loss were analyzed. Individuals who scored positively in three or more tests were classified as frail, in one or two as pre-frail and in none as robust.

The individuals who were evaluated in 2009 were subsequently traced by telephone from October 2014 to January 2015 using information from the database. A request for the longitudinal follow-up was approved by the Research Ethics Committee of the Universidade Federal de Juiz de Fora (Juiz de Fora Federal University), under approval number 715.314.

The elderly persons or those responsible for them, when located, were invited to respond to a telephone interview with questions regarding the occurrence of falls, hospitalizations and mortality since the first interview. When they did not answer after three attempts, or the number was found to be non-existent or not connected to the wanted party, relatives or those close to the elderly person (according to the FIBRA database) were called, or a new number was sought in the local phone book (2014-2015) or in a database of local health systems.

A free and informed consent form was read before the interview began (documented by recording the phone call).

Excluded at this stage of the research were elderly persons who were not located, those who did not agree to respond to the interview by telephone or did not allow the recording of the phone call and, in cases where there was a need for help with answers (death or disability), relatives who did not agree to respond to the interview or did not allow the phone call to be recorded. Elderly persons or their relatives who did not reach the minimum score in the cognitive deficit screening tool, The Six Item Screener[9], were also excluded.

When not located, even after all the actions described, information on the possible death of the elderly was sought in the National Death Registry (CNF). For this the site www.falecidosnobrasil.org.br was accessed, with the full name of the elderly person being used in the search field.

For baseline descriptive analyzes, mean, median, percentage, and standard deviation (when appropriate) were used. Chi-squared and Fisher-dependent tests of subgroup size were used in the analysis of the categorical variables. For the continuous variables, the difference between groups was tested by the t-test or ANOVA Analysis of Variance, followed by Tukey Post Hoc. The same tests were used in the comparison between the group at baseline and the follow-up group to rule out any bias.

Survival analysis models were used exclusively in longitudinal analyzes to verify the impact of frailty and other variables of interest on the health outcomes. Estimates were made using crude or adjusted models for potential confounders (gender, age, comorbidities and functional capacity).

Poisson regression models were created to verify the rate of incidence of events for which it was impossible to obtain the exact time of occurrence (falls and hospitalization) and Cox regression was applied in the analysis of the mortality risk ratio. Cumulative incidence curves for mortality were plotted according to the Kaplan-Meier estimator.

A 95% confidence level was adopted for the presentation of the respective confidence intervals. The p-values were interpreted together with these intervals, following recommendations in literature[10-12].

RESULTS

Table 1 shows the data relating to the baseline descriptions of the sample and the divisions between frail, pre-frail and robust. Frail elderly persons had a significantly older mean age than the other categories of elderly persons, and there was a greater prevalence of women in this group. In addition, it was verified that not currently working and lower functional capacity were associated with frailty.

After an average period of 66.6 months (±1.88 months), approximately five and a half years, information was obtained on 304 elderly people, representing 72.4% of the participants in the first stage (186 interviews answered by the elderly, 102 interviews answered by relatives or those responsible, 19 elderly persons located by the site). The remaining elderly individuals were not included because they refused to participate (12 elderly), did not answer the telephone after the maximum number of attempts were made (25 elderly), the telephone number was found to be non-existent (70 elderly) or they were excluded from cognitive analysis (10 elderly).

Although 27.6% of the elderly did not participate in the second stage, it is important to note that there was no decharacterization of the sample (selection bias). The baseline and follow-up groups were similar in aspects traditionally referred to as confounders [age (p=0.275), gender (p=0.732), comorbidities (p=0.138), functional capacity (p=0.112), and frailty status (p=0.620)]. There were significant differences only in the item *living alone*, with a higher prevalence of this situation among those who were not found (p=0.02).

Regarding the outcomes analyzed, information was obtained from 237 elderly people regarding the occurrence of falls. Table 2 shows that frail individuals exhibited a greater incidence of falls than the robust population. In addition, pre-frail individuals had the highest occurrence of falls during the analyzed period.

In addition to the analysis of falls, history of and duration of hospitalizations for all causes were identified based on the responses from 237 respondents. The results are shown in table 2, which reveals the highest frequencies of hospitalization were among the frail group. Descriptively, the incidence

of hospitalization is almost twice as high as among robust individuals. In addition, there was a high prevalence of intercurrences in the pre-frail group.

Table 3 shows the data relating to regression analysis for the risk of falls and hospitalization. It can be seen that pre-frail individuals had a 55% greater risk of falls than robust individuals, while in analyzes adjusted by potential confounders this risk rose to 58%. Frail elderly persons, meanwhile, had a 69% (adjusted analysis) greater risk of falls, representing a warning regarding the potential dangers of this situation. In terms of hospitalization, the odds were 84% higher for frail individuals in comparison with robust elderly persons. Although p values were greater than the usual 5%, confidence intervals of 95% are much more inclined towards increased risk, resulting in a fourfold effect.

Table 1. Sociodemographic and clinical data of sample of elderly persons, stratified by frailty and total. Juiz de Fora, Minas Gerais. 2009.

Variables n (%)	Robust (n=143)	Pre-frail (n=241)	Frail (n=40)	Total (n=424)	p
Female	87 (60.8%)	174 (72.2%)	35 (87.5%)	295 (69.8%)	0.002
Age (years), mean (±standard deviation)	71.9 (±5.8)	75.1 (±6.8)	79.0 (±4.0)	74.46 (±6.8)	0.001*
Age (years)					
65 to 69	59 (41.2%)	59 (24.4%)	3 (7.5%)	121 (28.5%)	
70 to 79	66 (46.1%)	115 (47.7%)	22 (55%)	203 (47.8%)	0.001
80 or more	18 (12.5%)	67 (27.8%)	15 (37.5%)	100 (23.5%)	
Ethnicity					
White	97 (67.8%)	175 (72.6%)	32 (80.0%)	304 (71.7%)	
Black	16 (11.1%)	23 (9.5%)	2 (5%)	41 (9.7%)	0.719**
Mixed Race	30 (20.2%)	40 (16.6%)	6 (15.0%)	75 (17.7%)	
Ethnicity - Outros	0	3 (1.2%)	0	3 (0.7%)	
Currently working	27 (18.8%)	24 (9.9%)	1 (2.5%)	52 (12.3%)	0.005
Literacy	28 (19.6%)	49 (20.4%)	14 (35.0%)	91 (21.46%)	0.134
Functional Capacity (Instrumental Activities of Daily Living)	20.6 (± 0.8)	19.8 (2.0)	16.5 (3.9)	19.7 (±2.2)	0.001
Comorbidities	39 (27.2%)	71 (29.4%)	11 (27.5%)	121 (28.5%)	0.890

* Older frail individuals than Pre-frail and Robust; Pre-frail older than Robust; **Fisher Test.

Table 2. History and consequences of falls during follow-up period. Total values and stratified by frailty. Juiz de Fora, Minas Gerais. 2015.

Variables N (%)	Robust (n=90) (n=104)*	Pre-frail (n=131) (n=174)*	Frail (n=16) (n=26)*	Total (n=237) (n=304)*	p
Hospitalization	40 (38.8%)	70 (53.4%)	11 (68.7%)	115 (48.4%)	0.027
Number of hospitalizations	1.97 (2.3%)	1.98 (2.67%)	2.27 (2.83%)	2.00 (2.58%)	0.938
Total duration of hospitalizations (days), mean (±standard deviation)	13.42 (±21.3)	16.02 (±25.5)	27.72 (±26.1)	16.38 (±24.55)	0.224
Falls	30 (33.3%)	68 (51.9%)	7 (43.7%)	105 (44.30)	0.024
Need for medical services due to fall	15 (50.0%)	44 (64.7%)	5 (71.4%)	64 (60.95%)	0.327
Need for hospitalization due to fall	4 (13.3%)	13 (19.2%)	3 (42.86%)	20 (19.05%)	0.201
Duration of hospitalization due to fall, mean (± standard deviation)	9.60 (±12.5)	19.57 (±35.3)	24 (±21.5)	17.90 (±29.5)	0.770
Death*	14 (13.4%)	43 (24.7%)	10 (38.4%)	67 (22%)	0.010

* Data refers to analysis of mortality

Table 3. Rate ratio of incidence of falls and hospitalization and mortality risk ratio between the pre-frail and frail groups and the robust group over five and a half years of follow-up (Juiz de Fora, Minas Gerais. 2015).

Variables	Rate Ratio of Incidence							
	Pre-Frail				Frail			
	Crude (95% CI)	p	Adjusted (95% CI)	p	Crude (95% CI)	p	Adjusted (95% CI)	p
Falls*	1.55 (1.01 – 2.39)	0.043	1.58 (1.02 – 2.46)	0.038	1.31 (0.57 – 2.98)	0.517	1.69 (0.70 – 4.09)	0.238
Hospitalization*	1.37 (0.91 – 2.06)	0.125	1.43 (0.94 – 2.16)	0.091	1.76 (0.89 – 3.48)	0.099	1.84 (0.83 – 4.05)	0.127
Mortality**	1.89 (1.03 – 3.46)	0.038	1.49 (0.80 – 2.80)	0.206	2.52 (1.09 – 5.84)	0.030	1.32 (0.48 – 3.61)	0.589

*Poisson Regression; **Cox Regression; Adjusted: Model Adjusted by age, gender, comorbidities and functional capacity;

Finally, Table 2 also shows that the incidence of mortality among the 304 elderly persons for whom information was obtained was 22%, with a prevalence of mortality among frail individuals approximately three times greater than that found among the robust elderly. With respect to pre-frail cases, the incidence was close to twice that of robust individuals.

Complementing the findings, the cumulative mortality incidence curves according to the Kaplan-Meier model are shown in figure 1. The risk of incidence for the three categories of frailty can be determined, especially from the 20th month, where there is an increase in the rhythm of events that clearly differentiates the frail and pre-frail from the robust. Thus, we can conclude that the frail elderly die at an increasingly rapid rate in comparison with elderly persons in other categories. Cumulative incidence at the end of the follow-up differed by 15% between frail and robust individuals.
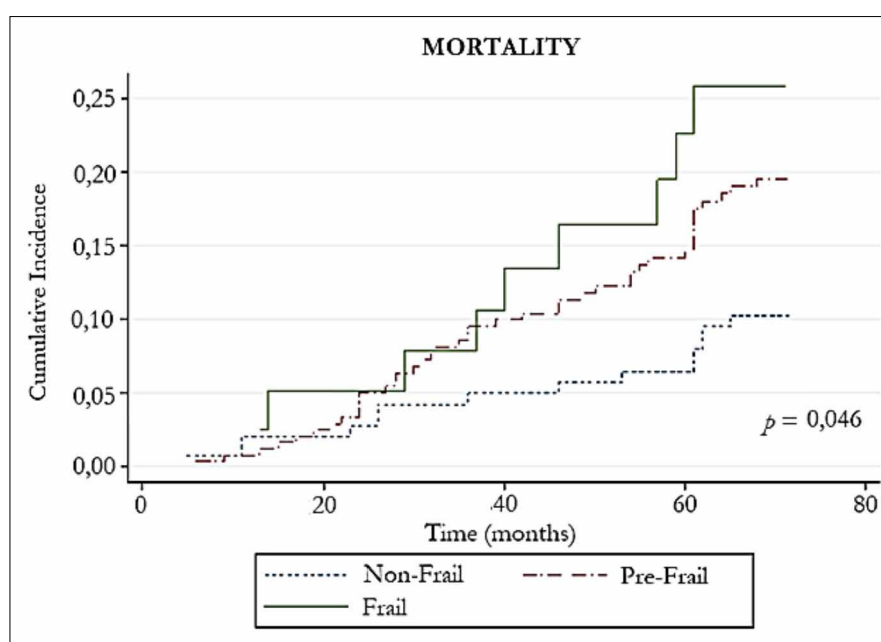

Figure 1. Cumulative incidence of mortality according to frailty status, Juiz de Fora, Minas Gerais, 2015.

In addition, in crude Cox regression analysis frail patients had a 2.5 times greater chance of dying during follow-up than robust individuals. Pre-frail patients, meanwhile, had an 89% greater risk of dying than robust individuals in the same period of time (Table 3).

DISCUSSION

It should be emphasized that the prevalence of frailty is similar to findings from other studies produced in Brazil, according to the multicenter data presented by Neri et al.[13]. An estimated national average shows values close to 9.0%, while the present study verified a prevalence of 9.4%. Compared with international studies, the figures found were lower than in Germany (12.1%), Denmark (12.4%), France (15.0%), Italy (23.0%) and Spain (27.3%)[14].

Neuromuscular changes, neuroendocrine dysregulation and immune system dysfunctions are common in the elderly and, individually or in combination, may result in frailty. As such, the current consensus is that frailty is one of the main syndromes related to aging, a fact corroborated by the results of the present study[15].

Also corroborating our results is a comprehensive systematic review conducted by Collard et al.[16] that revealed a significantly higher mean frailty among women than for men. This greater frequency was

justified mainly by lower muscle mass and strength and greater life expectancy, time burdened by chronic diseases and psychosocial problems, which could trigger the cycle of frailty[17].

The relationship between working practices and frailty is also demonstrated in literature. Studies have shown the protective effect of work on the syndrome, either through cooperation and interactivity or from daily demands that require maintenance of physical-functional qualities and certain levels of skill[18,19].

Finally, the relation between frailty and functional incapacity is explained, according to literature, by cognitive, proprioceptive, neurological and musculoskeletal disorders, as well as physical inactivity and medications[20].

The longitudinal analyzes of the present study found that the pre-frail have a higher incidence and risk of falls than robust or frail individuals. Tom et al.[3], based on a one-year follow-up of 48,154 European individuals over 55 years of age, found similar values in age-adjusted analyzes. Pre-frail individuals had a 57% greater risk of falling in up to one year than robust individuals. In a follow-up of approximately two years, pre-frail elderly in the Technology Research for Independent Living (TRIL) study also showed a risk for falls that was close to our findings, being 50% greater than robust individuals[21].

We believe that the reduction in the number of falls between pre-frail and frail individuals can be due to a lack of confidence and consequent restriction of physical, social or work activities and deteriorating health conditions, which exposes individual to a risk of falling, as reported by Fhon et al.[22].

Being frail was associated with higher incidences of hospitalization during the follow-up period. These results were found by other scientific evidence, especially as we verified a prevalence ranging from 50% to 80% of frailty among hospitalized elderly[23-25]. The greater number and length of hospitalizations found in our research is also evidenced in other studies. As revealed by Khandelwal et al.[26] in an analysis of hospitalized elderly patients, the average frequency of hospitalization among frail patients was three times higher than among robust individuals, and the mean time in hospital was nearly twice as

high. These results were similar to those of the present study.

However, unlike a significant number of studies on the subject, the risk of hospitalization found in the present study was not statistically significant for frail or pre-frail patients in comparison with robust individuals[27]. A plausible explanation for the differences between our findings on risk of hospitalization and those of other studies could be the fact that when the elderly person died, relatives were not questioned about previous hospitalizations (respecting ethical issues).

In terms of mortality, an increased risk of death was found among frail elderly persons. A recent systematic review by Chang and Lin[28], based on a sample of 35,538 elderly persons, found that the risk of mortality ratio of frail elderly persons was twice that of robust subjects over a mean follow-up period of six years (CI: $1.72 - 2.36$; p=0.001). The mortality risk found in our study was greater than eight of the 11 articles selected in our review. However, when the result of the adjusted analysis was considered the risk ratio loses its statistical significance due to the smaller sample in our study, although a similar degree of risk is maintained.

In spite of losing statistical power when adjusted, pre-frail elderly individuals had, in crude analysis, an 89% greater risk of dying than robust individuals. Chang and Lin[28] also found that pre-frail individuals had a 33% greater chance of dying than robust ones. It is therefore suggested that the elderly tend to aggravate their frailty at the beginning of the cycle.

It is also important to emphasize that frail and pre-frail elderly people die more quickly than robust individuals. A similar effect was observed by other authors, explained by the imbalance in homeostasis and increased individual vulnerability (mainly acute stresses) characteristic of the syndrome[18,29].

Despite the relevance of the study, it is necessary to highlight its limitations. In addition to the well-known biases for follow-ups of this type, the increase in telephone fraud in Brazil, especially among the elderly, may have meant respondents felt unsafe, so influencing their responses in some way and adding to the number of denials.

In closing, we emphasize that the present study represents an addition to a restricted group of longitudinal analyzes relating to frailty and negative outcomes in health, being to the best of our knowledge the first with such characteristics to be performed among the Brazilian elderly. From these results, it is recommended that strategies are implemented to prevent or reverse frailty. To this end, the elderly should be provided with opportunities for adequate health monitoring. It is also suggested that frailty is debated and considered in more detail within health teams. Complementary courses and materials should be used to continuously improve the knowledge of professionals, not only on frailty, but also other syndromes or common geriatric complications.

ACKNOWLEDGEMENTS

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