Research, Society and Development, v. 11, n. 15, e510111537534, 2022
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Components of the frailty phenotype as predictors of mortality among older adults after four years of hospital discharge

Componentes do fenótipo de fragilidade como preditores de mortalidade entre idosos após quatro anos de alta hospitalar

Componentes del fenotipo fragilidad como predictores de mortalidad en adultos mayores después de cuatro años del alta hospitalaria

Received: 11/06/2022 | Revised: 11/16/2022 | Accepted: 11/18/2022 | Published: 11/24/2022

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Abstract
Objective: to verify the association between impairment of frailty phenotype components as predictors of mortality among older adults after four years of hospital discharge. Methodology: Prospective and longitudinal investigation, carried out with hospitalized older adults, at baseline, and followed up after hospital discharge. Of the 163 older adults included in the study, 43 died during follow-up and 92 completed the four-year follow-up. The following instruments were used: Mini Mental State Examination, a form for characterizing sociodemographic, economic and health data; and Fried's frailty phenotype. Survival analysis was performed using the Kaplan-Meier method and Cox regression to estimate the risk ratio (Hazard Ratio) of mortality among older adults with impairment in each component of the phenotype, considering p<0.05. Results: The impairment in the components of the frailty phenotype slow gait speed (HR: 3.27; 95%CI: 1.655-6.475; p<0.001); decreased muscle strength (HR:3.09; 95%CI: 1.605-5.959; p=0.001); self-reported exhaustion and/or fatigue (HR: 2.97; 95%CI: 1.508-5.853; p=0.002) and low level of physical activity (HR: 3.22; 95%CI: 1.693-6.138; p<0.001) remained as predictors of mortality, after adjustment; and represented a lower probability of survival. Conclusion: Impairment in the components of gait speed, muscle strength, exhaustion and/or fatigue and physical activity at baseline represented a higher risk for mortality among the elderly at follow-up. Thus, there is the possibility of targeting interventions in risk groups to improve the condition of frailty and, consequently, increase survival.
Keywords: Frail elderly; Longitudinal studies; Patient discharge; Mortality.

Resumo
Objetivo: verificar a associação entre comprometimento dos componentes do fenótipo de fragilidade como preditores de mortalidade entre idosos após quatro anos de alta hospitalar. Metodologia: Investigação prospectiva e longitudinal, realizada com idosos internados, no *baseline*, e acompanhados após a alta hospitalar. Dos 163 idosos incluídos no estudo, 43 foram a óbito ao longo do seguimento e 92 completaram o *follow-up* de quatro anos. Foram utilizados como instrumentos: Mini Exame do Estado Mental, formulário para caracterização dos dados sociodemográficos, econômicos e de saúde; e o fenótipo de fragilidade de Fried. Procedeu-se à análise de sobrevivência pelo método de Kaplan-Meier e regressão de Cox para estimar a razão de risco (*Hazard Ratio*) de mortalidade entre idosos com comprometimento em cada componente do fenótipo, considerando p<0,05. Resultados: O comprometimento nos componentes do fenótipo de fragilidade lentidão na velocidade de marcha (HR: 3,27; IC95%: 1,655-6,475; p<0,001); diminuição da força muscular (HR:3,09; IC95%: 1,605-5,959; p=0,001); autorrelato de exaustão e/ou fadiga (HR:2,97; IC95%: 1,508-5,853; p=0,002) e baixo nível de atividade física (HR: 3,22; IC95%: 1,693-6,138; p<0,001) permaneceram como preditores de mortalidade, após o ajuste; e representaram menor probabilidade de sobrevida. Conclusão: O comprometimento nos componentes velocidade de marcha, força muscular, exaustão e/ou fadiga e atividade física no *baseline* representaram maior risco para mortalidade entre idosos no *follow-up*. Assim, há possibilidade de direcionamento de intervenções nos grupos de risco para melhora da condição de fragilidade e, consequentemente, aumento da sobrevida.
Palavras-chave: Idoso fragilizado; Estudos longitudinais; Alta do paciente; Mortalidade.

Resumen

Objetivo: verificar la asociación entre el deterioro de los componentes del fenotipo de fragilidad como predictores de mortalidad entre adultos mayores después de cuatro años del alta hospitalaria. Metodología: Investigación prospectiva y longitudinal, realizada con adultos mayores hospitalizados, al inicio y con seguimiento posterior al alta hospitalaria. De los 163 adultos mayores incluidos en el estudio, 43 fallecieron durante el seguimiento y 92 completaron el seguimiento de cuatro años. Se utilizaron los siguientes instrumentos: Mini Examen del Estado Mental, formulario para caracterizar datos sociodemográficos, económicos y de salud; y el fenotipo de fragilidad de Fried. El análisis de supervivencia se realizó mediante el método de Kaplan-Meier y la regresión de Cox para estimar la razón de riesgo (Hazard Ratio) de mortalidad entre los adultos mayores con deterioro en cada componente del fenotipo, considerando p<0,05. Resultados: El deterioro en los componentes del fenotipo fragilidad velocidad de marcha lenta (HR: 3,27; IC95%: 1,655-6,475; p<0,001); disminución de la fuerza muscular (HR:3,09; IC95%: 1,605-5,959; p=0,001); agotamiento y/o fatiga autoinformados (HR: 2,97; IC 95%: 1.508-5.853; p=0,002) y bajo nivel de actividad física (HR: 3,22; IC 95%: 1.693-6.138; p<0,001) como predictores de mortalidad, después del ajuste; y representó la menor probabilidad de supervivencia. Conclusión: El deterioro en los componentes de velocidad de la marcha, fuerza muscular, agotamiento y/o fatiga y actividad física al inicio del estudio representó un mayor riesgo de mortalidad entre los ancianos en el seguimiento. Así, existe la posibilidad de focalizar las intervenciones en grupos de riesgo para mejorar la condición de fragilidad y, consecuentemente, aumentar la supervivencia.

Palabras clave: Anciano frágil; Estudios longitudinales; Alta del paciente; Mortalidad.

1. Introduction

During population aging, there is a portion of older adults with a substantial accumulation of deficits in multiple systems, physiological and homeostatic changes, which result in negative health outcomes such as frailty syndrome (Fried et al., 2001; Nguyen et al., 2016).

Frailty syndrome is defined as "Medical syndrome with multiple causes, characterized by decreased strength, muscle endurance and reduced physiological function, which results in an increase in the individual's vulnerability to developing dependence or death" (Morley et al., 2013, p.393) and the operationalization occurs through the frailty phenotype including five components: unintentional weight loss, self-reported exhaustion and/or fatigue, slow gait speed, decreased muscle strength and low level of physical activity (Fried et al., 2001). The older adult with impairment in three or more of these components is considered frail; while in one or two pre-frail and the absence of impairment classifies the older individual as robust or non-frail (Fried et al., 2001).

When analyzing frailty it is important to consider the initial research environment because different contexts influence the health condition of older individuals (Pereira et al., 2017). In this sense, hospitalization is considered an outcome of the frailty syndrome (Fried et al., 2001; Morley et al., 2013) and also represents a higher risk of mortality after discharge (Lin et al., 2016; Hao et al., 2019) when compared to older adults who were not hospitalized (Lee et al., 2014; Alencar et al., 2015).

During hospitalization, older patients may experience worsening of a certain disease (Romero-Ortuno et al., 2016), postoperative complications (Han et al., 2019) and immobility and/or functional limitations (Sourdet et al., 2015). These events end up making it difficult for this age group to recover after discharge (Heppenstall et al., 2018) which increases the risk of mortality during follow-up. In addition, alterations of the frailty syndrome such as sarcopenia, immune system dysfunction and neuroendocrine dysregulation (Pereira et al., 2017) are identified and accentuated in older adults with impairment of the components of the frailty phenotype, which increases the risk of mortality (Ferrucci & Fabbri, 2018; Wang et al., 2019; Bowden Davies et al., 2019).

It is noted that mortality is considered an adverse outcome related to frailty (Fried et al., 2001) and this association was identified in Brazilian prospective studies with community-dwelling older individuals (Diniz et al., 2018) and in outpatient follow-up (Leme et al., 2019). However, these investigations were not carried out with older adults after hospital discharge and used a different scale from the present research to assess frailty (Diniz et al., 2018) or adaptation of the frailty phenotype (Leme et al., 2019).

Research carried out in New York with older adults after being admitted to the Intensive Care Unit identified a high mortality rate (41%) after six months of discharge and the impairment of each component of the frailty phenotype was associated with a three times greater risk of death at follow-up (Baldwin et al., 2014). Therefore, when considering the frail older adult with a higher risk of mortality (Pereira et al., 2017) and, therefore, presenting three or more components of the frailty phenotype, it is necessary to understand the role of each of these criteria in mortality after hospital discharge.

Identifying the impairment of the components of the frailty syndrome among older adults in the hospital environment contributes to increasing the chances of survival of these individuals during hospitalization and after discharge (Cheung et al., 2017). From this, there is the possibility of preventive actions (Wang et al., 2019), directing clinical and care decisions, discussions between a multidisciplinary team about risks and benefits of possible treatments, and with this, reduction of negative outcomes (Theou et al., 2018), such as mortality after discharge (Lin et al., 2016).

Therefore, the aim of the present study was to verify whether the impairment of the frailty phenotype components are predictors of mortality among older adults after four years of hospital discharge.

2. Methodology

Study design and participants

Quantitative, analytical, prospective and longitudinal study. It was developed in a city in the interior of Minas Gerais (Brazil), with a four-year follow-up after hospital discharge. The study population used in the analysis consisted of older patients who were hospitalized in the medical and surgical units of a university hospital from April 2013 to March 2014.

To calculate the sample size, a prevalence of frailty of 30.0% was considered, according to other studies among older individuals in the hospital environment (33.2%) (Khandelwal et al., 2012) (37%) (Purser et al., 2006). With an accuracy of 5% and a 95% confidence interval for a finite population of 1455 eligible older adults, a sample of 265 individuals was arrived at. Considering a 50% sampling loss, the maximum number of interview attempts was 530. The recruitment process was carried out by systematic random sampling with an interval of k=2.

The sample consisted of older adults who met the following inclusion criteria: individuals aged 60 years or more; having been admitted to the MC and SC units from April 2013 to March 2014; be able to walk, being allowed to use a walking aid device (cane, crutch or walker); live in the research municipality and have participated in the four moments: hospitalization, one, three and four years after hospital discharge. At the hospital, older adults with restriction to walk due to surgery or surgical procedure were interviewed the next day.

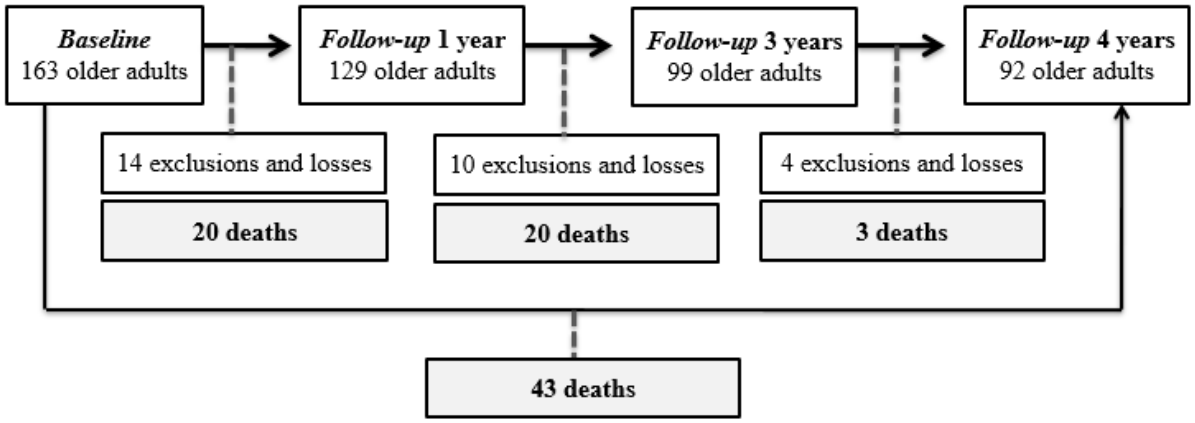
During hospitalization and follow-up home visit older adults who had severe sequelae cardiovascular accident (CVA), with localized loss of strength and aphasia; with a severe or unstable stage of Parkinson's disease associated with severe involvement of motor skills, speech or affectivity that made evaluations impossible; terminally older adults; a severe vision or hearing deficit; those with cognitive decline without a companion or decline with PFEFFER equal or greater than 6 points, who were hospitalized again in the units and who had already been interviewed during the data collection period were excluded. After hospital discharge and at all stages of the follow-up, it was considered as loss: not being located after three attempts by the interviewer; refusals; death; change of city and being hospitalized at the time of the interview.

During the baseline, carried out from April 2013 to March 2014, 445 hospitalized older adults who met the inclusion criteria were included. Among these, the losses and exclusions were: refusals (n=75), presence of cognitive decline without a companion (n=57), decline with PFEFFER equal to or greater than six (n=44) and unable to perform physic evaluation (n=14). Therefore, 255 older individuals participated, among which 97 belonged to the Medical Clinic and 158 to the Surgical Clinic.

One year after hospital discharge, 174 elderly people lived in the research city and, of these, 168 met the inclusion criteria of living in the urban area, while five did not meet all the components of the frailty phenotype, resulting in 163 older adults at this stage. The exclusions and losses of the follow-up periods between one, three and four years after hospital discharge were described in the flowchart of Figure 1.

A total of 28 exclusions and losses were observed during the follow-up periods while deaths were identified in 20 older adults after one year, 20 after three years and three after four years. In the total follow-up, that is, from baseline to four years after hospital discharge, 43 deaths were identified (Figure 1).

Figure 1 - Flowchart of follow-ups and deaths after one, three and four years of hospital discharge among older adults.



Source: Authors (2022).

For data collection, the researchers opted for the direct interview and in the first stage (baseline), data were collected among older adults admitted to the inpatient sectors of Medical and Surgical Clinics of a university hospital. This first moment of data collection was carried out from April 2013 to March 2014, in a reserved space in the hospitalization sectors, while the follow-up was carried out one out one, three and four years after hospital discharge, in the house of older adults.

All stages of the study were carried out by the researcher, with previous experience and training in data collection and ethical issues in conducting the research. Interviews were reviewed to identify completeness and consistency of data.

Measures

At baseline and follow-up, cognitive screening was performed using the Mini Mental State Examination (MMSE) translated and validated in Brazil, considering the cutoff points of Bertolucci, Brucki, Campacci and Juliano (1994). If the older adult showed cognitive decline in the MMSE assessment, the participation of a companion, called an informant, who knew how to provide information about the interviewee, was requested. The interview ended when there was no companion at the time of data collection. The PFEFFER Functional Activities Questionnaire (Brazil, 2007) was applied to the companion, which is a scale developed in Brazil that verifies the presence and severity of cognitive decline based on the assessment of functionality and the need for assistance from other people. If the result was below six, the interview was carried out with the older adult and information supplemented, if necessary, by the companion; if the result was equal to or greater than six, the interview was conclude.

To characterize the socio-demographic, economic and health data, a structured form was used, which was prepared by the Collective Health Research Group of the Federal University of Triângulo Mineiro (UFTM), based on the literature and the expertise of the researchers. The identification of death after hospital discharge occurred through a question elaborated by the

researcher and was evaluated in all follow-up periods. In the item of the related form "Condition of the older adult after hospitalization", death was evaluated by answering "yes" or "no" and the date of death. This information was obtained from the family member's report or, if this was not possible, through registration on the website of the municipal government, which is in the public domain.

The assessment of the frailty syndrome was performed using the frailty phenotype according to Fried et al. (2001), that consists of five objective and measurable components. (a) Unintentional weight loss: impairment was assessed using the following question: "*In the past year, have you lost more than 4.5 kg unintentionally (without diet or exercise)*?"; (b) Decrease in muscle strength: verified based on handgrip strength, using a manual hydraulic dynamometer, model SAEHAN® and following the recommendations of the American Society of Hand Therapists. Three measurements were obtained, presented in kilograms/force (Kgf), with an interval of one minute between them, considering the average value of the three measurements; and the cutoff points proposed by Fried et al. (2001), adjusted for sex and body mass index; (c) Self-report of exhaustion and/or fatigue: assessed using two questions from the Brazilian version of the Center for Epidemiological Studies (CES-D) depression scale (Batistoni, Neri, & Cupertino, 2007), items seven and 20. Older adults who obtained a score of two or three in any of the questions met the frailty criterion for this component; (d) Slow walking speed: assessed through the gait time spent to cover a distance of 4.6 meters. Three measurements were taken, presented in seconds, considering the mean value of the three measurements. The cutoff points proposed by Fried et al. (2001) adjusted for sex and height; (e) Low level of physical activity: verified by weekly energy expenditure in Kcal and measured using the long version of the International Physical Activity Questionnaire (IPAQ), adapted for older adults by Benedetti, Mazo, and Barros (2004). The classification used for this component followed the recommendations of the American College of Sports Medicine and the American Heart Association, which consider active those who spend 150 minutes or more of weekly physical activity and inactive those who spend zero to 149 minutes of weekly physical activity (Pate et al., 1995). Older adults with three or more impairments were classified as frail, those with one or two as pre-frail, and those with all negative tests were considered robust or non-frail (Fried et al., 2001).

The study variables were: gender (male and female), age group, in years (60|-70; 70|-80; 80 years and over), marital status (without a partner, with a partner), schooling, in years of study (no schooling; 1|-4; ≥5), living arrangement (alone, with a partner), individual income, in minimum wages (no income; 0┤1 and >1); death (yes and no). Phenotype components: unintentional weight loss; decreased muscle strength; self-report of exhaustion and/or fatigue; slow walking speed and low level of physical activity; being classified as with and without impairment. Classification: non-frail (score zero), pre-frail (score one or two) and frail (score three to five).

Statistical analysis

An electronic database was built, in the Excel® program, for data processing on a microcomputer, by two people, in double entry. Subsequently, the consistency of the databases was analyzed by checking wrong typing, so that inconsistent data were checked in the original interview and corrected. For data analysis, the database was imported into the “Statistical Package for Social Sciences” (SPSS) version 20.0 software.

Descriptive statistical analysis was performed, using absolute frequencies and percentages for categorical variables. Survival analyzes were performed using the Kaplan-Meier method and Cox proportional hazards models to determine the hazard ratios (HRs) of mortality among older adults with impairment of frailty phenotype components, adjusting for the variables: sex; age; marital status, housing arrangement and number of morbidities. A significance level of 5% (p<0.05) and a 95% confidence interval (CI) were considered.

The project was approved by the Ethics and Research with Human Beings Committee of the University (number 2511/2012) and obtained approval from the departments of Clinical Medicine and Surgery and the Teaching and Research

Management of the hospital. At baseline and follow-up, contact was made with the older adult and presentation of the objectives and the Informed Consent Form. The interview was conducted only after the interviewee's consent and the signing of the aforementioned Term, for which a copy was given to the respondent and another one remained with the interviewer, following the precepts established by Resolution 466/12 of the Ministry of Health (Brazil, 2012).

3. Results

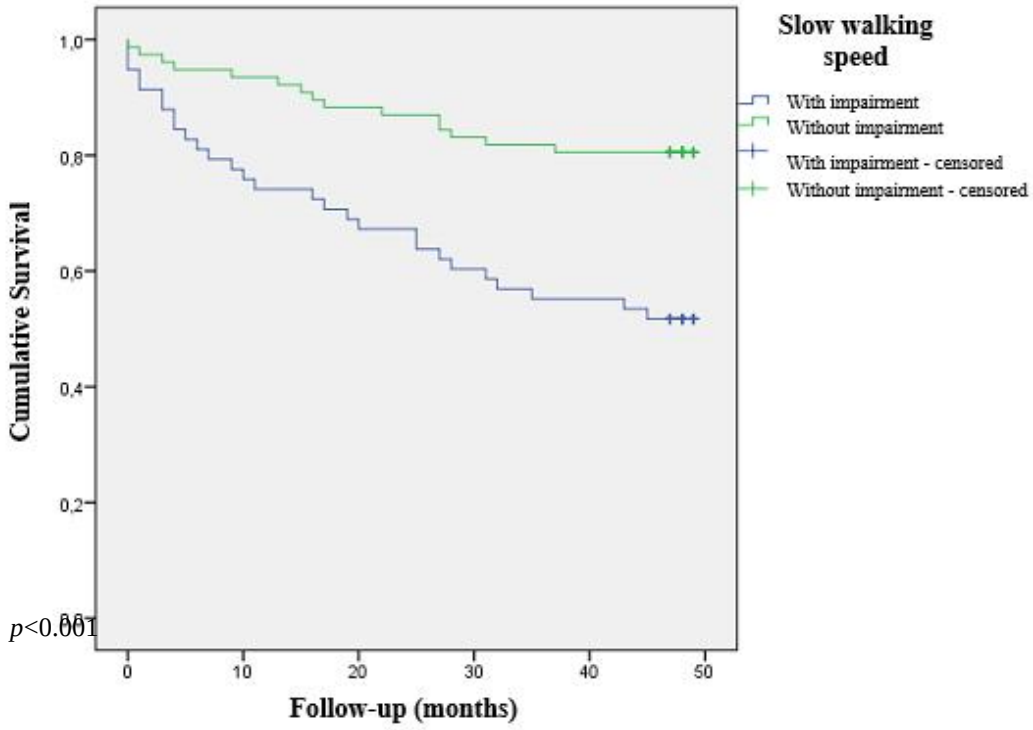
Among the 43 older adults who died in full follow-up, baseline up to four years after hospital discharge, higher percentages were identified among frail (63.2%), followed by pre-frail (24.7%) and non-frail (7.1%).

Regarding sociodemographic characteristics among those who died, most were male (65.1%), aged 60|-70 years (53.5%); with 1-4 years of schooling (55.8%); with a partner (51.2%); living accompanied (76%) and with an individual monthly income of 0-| 1 minimum wage (65.1%).

In the survival analysis, it was found that older adults with impairment in the following components: slow gait speed (p<0.001) (Figure 2); decreased muscle strength (p <0.001) (Figure 3); self-report of exhaustion and/or fatigue (p =0.011) (Figure 4) and low level of physical activity (p<0.001) (Figure 6) had a lower probability of survival, compared to those who did not show impairment in these components, after four years hospital discharge. For the unintentional weight loss components (p=0.148), no significant association was identified (Figure 5).

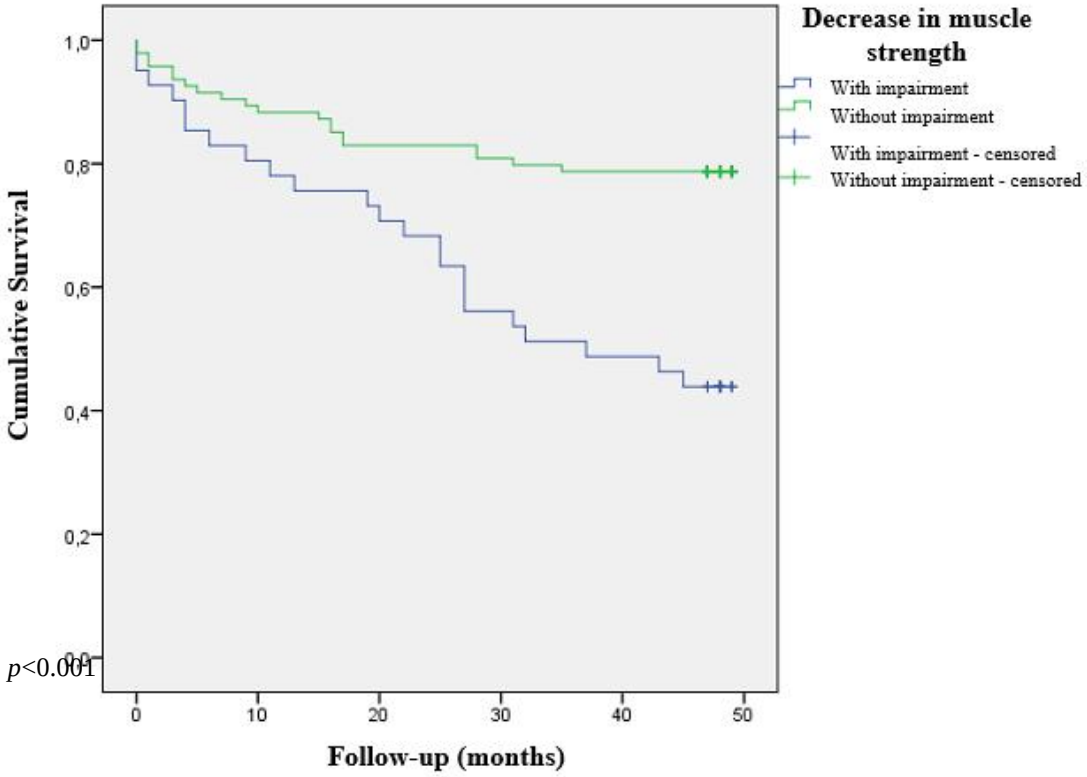
Figures 2, 3, 4, 5 and 6 show the survival curves related to the event of death after four years of hospital discharge, considering the five components of the frailty phenotype assessed at admission (baseline) and characterized as impairment or non-impairment.

Figure 2 - Survival curve (deaths), using Kaplan Meier, in the period of four Years after hospital discharge according to the component slow walking speed at baseline.



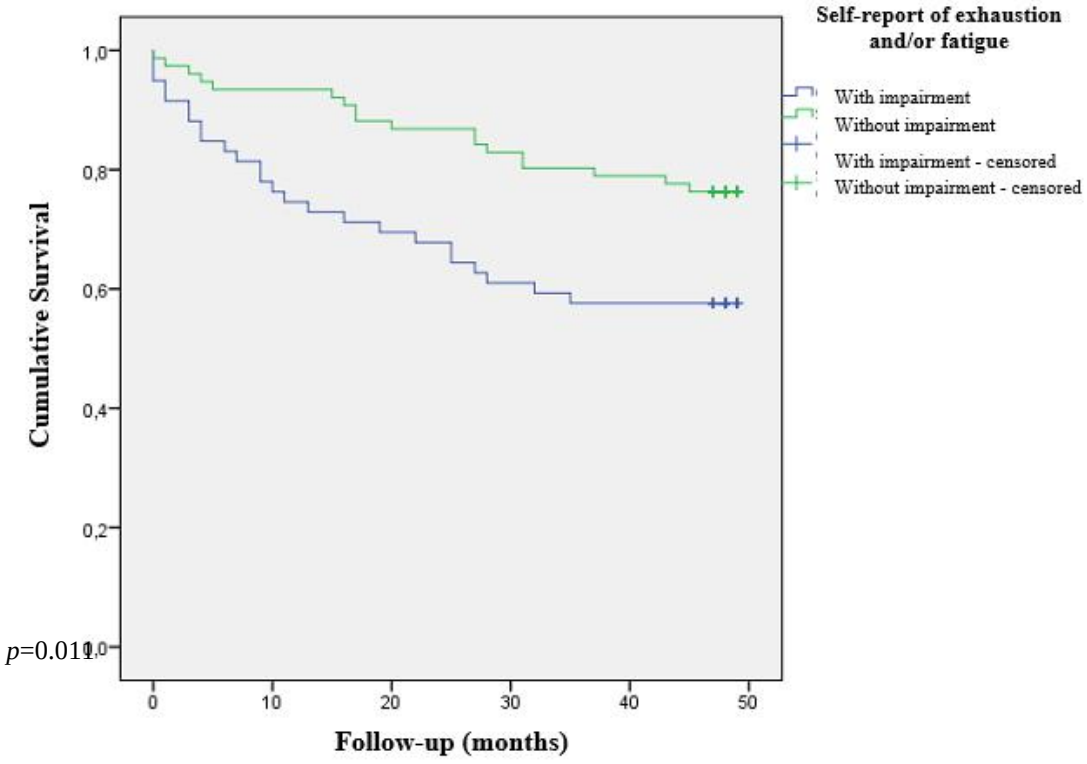
Source: Authors (2022).

Figure 3 - Survival curve (deaths), using Kaplan Meier, in the period of four years after hospital discharge according to the component decrease in muscle strength at baseline.



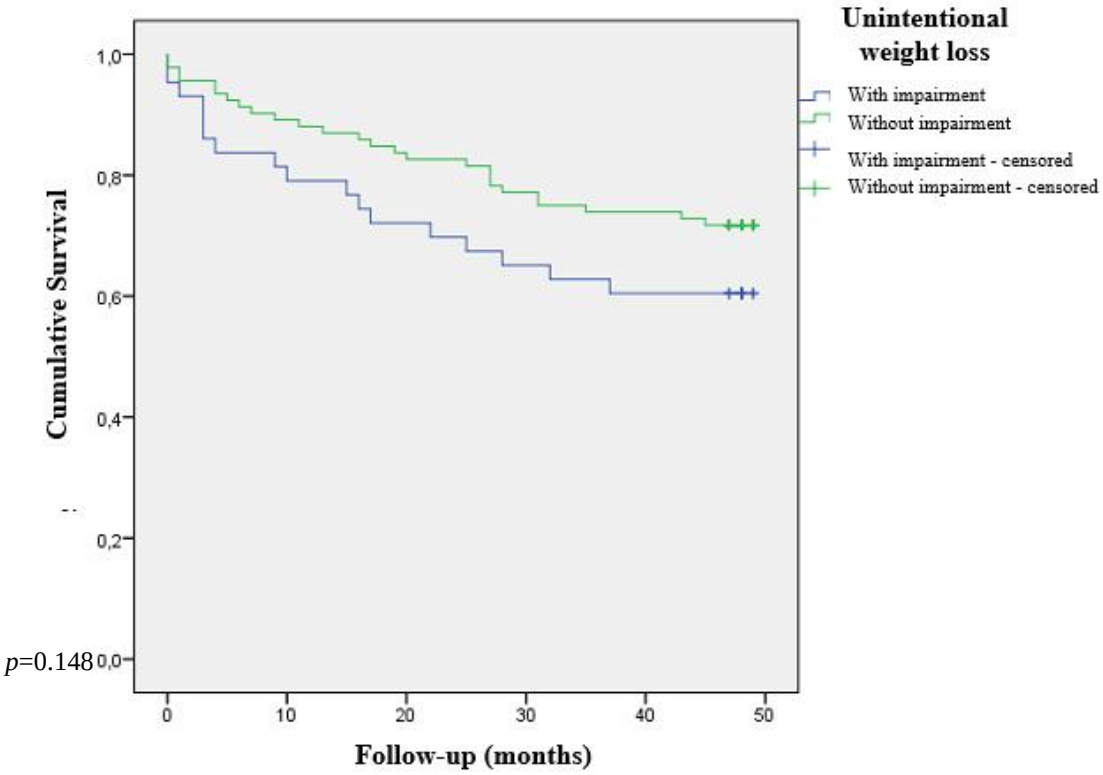
Source: Authors (2022).

Figure 4 - Survival curve (deaths), using Kaplan Meier, in the period of four months after hospital discharge according to the component self-reported exhaustion and/or fatigue at baseline.



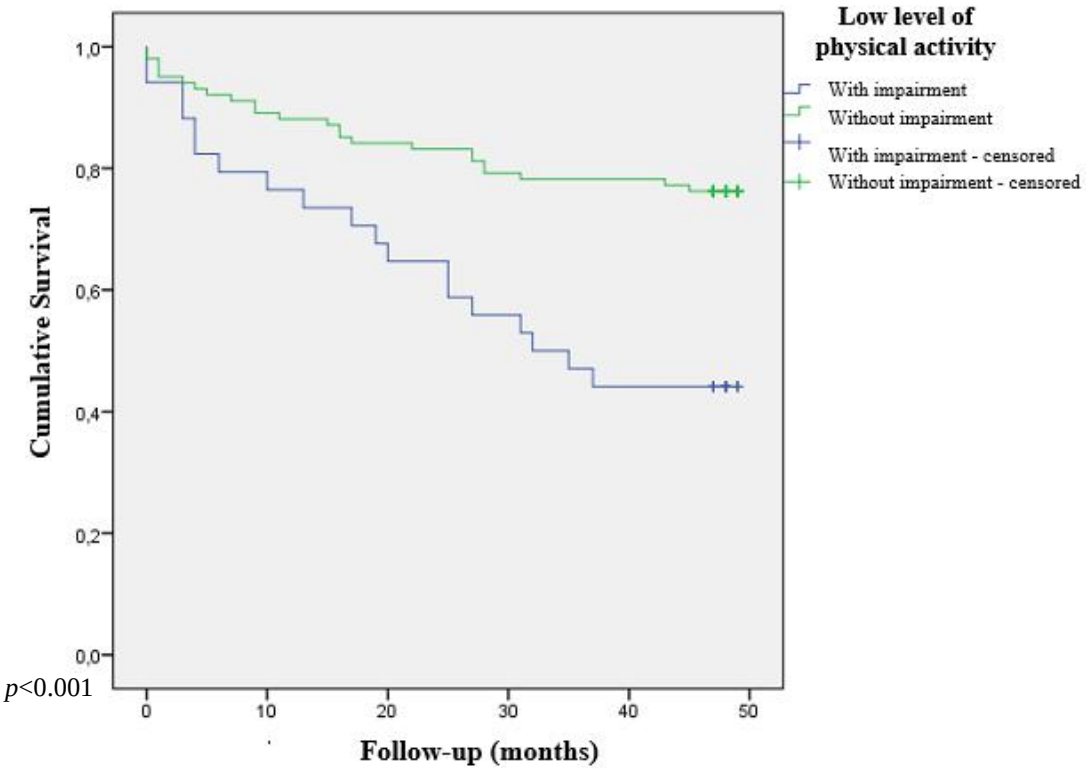
Source: Authors (2022).

Figure 5 - Survival curve (deaths), using Kaplan Meier, in the period of four years after hospital discharge according to the component unintentional weight loss at baseline.



Source: Authors (2022).

Figure 6 - Survival curve (deaths), using Kaplan Meier, in the four-year period after hospital discharge according to the component low level of physical activity at baseline.



Source: Authors (2022).

After survival analysis, results were adjusted for possible confounding variables and Cox regression multivariate analysis was performed to obtain mortality risk. The impairment of the frailty phenotype components: slow gait speed (HR: 3.27; 95%CI: 1.655-6.475; p<0.001); decreased muscle strength (HR: 3.09; 95%CI: 1.605-5.959; p=0.001); self-report of exhaustion and/or fatigue (HR: 2.97; 95%CI: 1.508-5.853; p=0.002) and low level of physical activity (HR: 3.22; 95%CI: 1.693-6.138; p<0.001) were predictors of risk for death (mortality), while unintentional weight loss was not considered a risk predictor for death (HR:1.81; 95%CI: 0.955-3.455; p=0.069) (Table 1).

Table 1 shows the results of the Cox regression model and the impairment of the frailty phenotype components among older adults after four years of hospital discharge.

Table 1 - Cox regression model between components of the frailty phenotype of older adults at baseline and the risk for the occurrence of death after four years of follow-up.

	Mortality		
Phenotype Components	**HR***	**CI95%****	***p******
Slow walking speed			
Not adjusted	3.015	1.609-5.651	**0.001**
Adjusted	3.274	1.655-6.475	**<0.001**
Decrease in muscle strength			
Not adjusted	3.110	1.705-5.672	**<0.001**
Adjusted	3.092	1.605-5.959	**0.001**
Self-report of exhaustion and/or fatigue			
Not adjusted	2.145	1.169-3.935	**0.014**
Adjusted	2.971	1.508-5.853	**0.002**
Unintentional weight loss			
Not adjusted	1.561	0.847-2.878	0.153
Adjusted	1.816	0.955-3.455	0.069
Low level of physical activity			
Not adjusted	2.851	1.559-5.213	**0.001**
Adjusted	3.223	1.693-6.138	**<0.001**

Notes: *HR: Hazard ratio; **95%CI: Confidence Interval; ***p<0.005; Adjusted for sex, age, marital status, housing arrangement and number of morbidities; 92 survivors and 43 deaths; Reference category: no impairment in the phenotype component. Source: Authors (2022).

4. Discussion

The highest percentage of frail older adults, followed by pre-frail, who died during the follow-up is consistent with international (Chang & Lin, 2015; Wang et al., 2019) and Brazilian (Diniz et al., 2018; Leme et al., 2019) studies. However, these investigations were carried out with older adults who were not hospitalized at baseline, and therefore, they present lower percentages when compared to the present research. This may be related to the association between hospitalization and frailty, and the worsening of negative health outcomes such as mortality (Lin et al., 2016; Cheung et al., 2017; Pereira et al., 2017).

Regarding the investigations with older adults that evaluated the five components of the frailty phenotype it was observed in the United States that the impairment in each component of the frailty phenotype was associated with a higher risk

of mortality after a six-year follow-up after hospital discharge (OR: 3.0 95%CI 1.4-6.3) (Baldwin et al., 2014), which is consistent with the results of this study. It is important to highlight that although the follow-up of the present research is lower than that of the aforementioned study, it is possible to verify the similarity between the results in view of the characteristics of the studied population. In the survey carried out in Taiwan only self-reported exhaustion and/or fatigue (HR: 1.88 95%CI 1.03-3.42; p<0.05), decreased muscle strength (HR: 1.65 95%CI 1.16-2.33; p<0, 01) and slow gait speed (HR: 2.60 95%CI 1.76-3.83; p<0.001) were predictors of death after a six-year follow-up (Wang et al., 2019).

With a shorter follow-up time, a prospective study with older adults in 24 British regions identified that the impairment of the components slow walking speed (HR: 2.90 95%CI 1.84-4.56; p<0.05), low level of physical activity (HR: 2.17 95%CI 1.40-3.36; p<0.05) and unintentional weight loss (HR: 3.88 95%CI 2.44-6.16; p<0.05) were predictors of mortality after three years of follow-up (Papachristou et al., 2017). It is noteworthy that the impairment of weight loss as a predictor of mortality does not corroborate the results of the present investigation. Divergent data were also verified in an international investigation with older adults after one year of hospital discharge, in which slow gait speed and decreased handgrip strength were not associated with mortality (p=0.3) (Green et al., 2012).

It should be noted that most prospective Brazilian studies that assessed the relationship between frailty and mortality among older adults (Diniz et al., 2018; Leme et al., 2019) were not carried out after hospital discharge and did not analyze the components of the phenotype of frailty as predictors of mortality risk. Because of this, it is possible that the clinical and health characteristics of these older adults are different, especially regarding the impairment of the physical components of the phenotype and the use of different instruments to assess frailty.

Concerning the increased risk of mortality in the components of the frailty phenotype analyzed individually, an international systematic review with meta-analysis identified that the baseline impairment of slow walking speed was a predictor of mortality among older adults (HR: 1.89 95%CI 1.46- 2.46) (Liu et al., 2016), which is consistent with the results of this investigation. It is noteworthy that gait speed is considered an indicator of survival in older adults (Chang & Lin, 2015), it is used as a clinical screening tool and proposed as the sixth vital sign (Fritz & Lusardi, 2009) in the health of this age group. This facilitates the early diagnosis of the frailty condition (Chang & Lin, 2015), predicts adverse health outcomes and is able to detect those at higher risk of death (Liu et al., 2016).

When there is a change in the older adults gait, such as slow speed, this is associated with increased inflammatory biomarkers and oxidative stress of endothelial cells (Gardner et al., 2016), which can negatively impact muscle function and sarcopenia, and decrease the chances of survival this age group (Ferrucci & Fabbri, 2018). Furthermore, these modifications can occur due to an acute clinical condition or as a result of frailty (Peel et al., 2013), resulting in greater vulnerability to hospitalization. This context of hospitalization concomitant with slow gait speed can result in negative outcomes after discharge, such as physical disability (Duan-Porter et al., 2019), physical inactivity (Abe et al., 2019) and inclusion of these individuals in the cycle of negative feedback from frailty and increase the risk of mortality (Lin et al., 2016).

Thus, health professionals, especially nurses, should perform the assessment of gait speed as a routine in clinical practice in the hospital admission of the older adult and in their follow-up in primary care, since its correct performance and screening can help in the identification of groups risk (Liu et al., 2016) and development of individualized health care plans.

Similar results to the current research were found in prospective studies that observed an association between decreased muscle strength and increased risk of mortality among older adults in Jerusalem (HR: 1.71 95%CI 1.07-2.73) (Stessman et al., 2017) and Korea strength (HR: 2.81 95%CI 2.12) -3.73) (Bae et al., 2019). It is important to emphasize that these studies were carried out with older adults from developed countries, which represents different characteristics from those in developing countries, such as Brazil. Furthermore, no Brazilian study was identified in the scientific literature that carried out this association, especially among older adults after hospitalization. In this context, the assessment of handgrip strength is a

tool for the health care of the older adults due to its association with functional disability, morbidities, sarcopenia (Syddall et al., 2017) and the ability to measure, in a non-invasive way, the loss of muscle mass (Stessman et al., 2017), which is a valuable diagnostic component of the frailty syndrome (Dudzińska-Griszek et al., 2017).

Furthermore, muscle strength is associated with skeletal muscle mass, one of the main tissues responsible for the elimination of glucose from the blood and a reservoir of amino acids. With aging there is a reduction in the body's protein reserve and metabolic dysregulation (Puthucheary et al., 2018), causing a decrease in muscle strength. This is a reflection of a deficiency in the nutritional and health status (Jochem et al., 2019) resulting in decreased survival rate. High levels of CRP (C-reactive protein) and worsening of muscle function also characterize the impairment of this component. These contribute to a state of chronic inflammation, identified in the frailty syndrome cycle, and increase the risk of hospitalized older adult's mortality (Dudzińska-Griszek et al., 2017).

The association between mortality risk and decreased muscle strength demonstrates the need for assessment and monitoring of older adults (Bae et al., 2019; Jochem et al. 2019), especially in a hospital environment (Jochem et al., 2019). Thus, there is the possibility of identifying individuals in a situation of greater vulnerability, managing health care (Jochem et al.. 2019) and postponing and/or staging the impairment of this component, increasing the survival of older individuals (Bae et al., 2019). The nurse, through education strategies for health promotion and prevention actions, has the role of providing information to older adults about the adverse effects of decreased strength, explaining the positive aspects that the change in lifestyle, adequate nutrition and physical activity has on that component. Furthermore, it is necessary to use the strength test in primary care as a method of early screening of older adults at higher mortality risk (Bae et al., 2019).

A result similar to that of the current research was found in a prospective study carried out in Brazil, in which the low level of physical activity was associated with mortality after a follow-up of approximately 2.6 years, regardless of health condition and functional capacity (Bielemann et al., 2020). Also, a longitudinal investigation with hospitalized older adults in Poland observed that impairment in this component was associated with mortality (OR: 6.00; 95%CI 1.35-26.53; p=0.018) after a two-year follow-up (Dudzińska-Griszek et al., 2017).

During the aging process, there is a decrease in motor neurons that innervate the muscles of the lower limbs of older adults, suggesting that there is adaptation of the motor unit as a normal process with advancing age (Piasecki, Ireland, Jones, & McPhee, 2016). However, for older individuals this adjustment is often performed inefficiently and leads to low levels of physical activity, which is a component of the frailty phenotype and considered the fourth main risk factor for mortality worldwide (Who, 2011). This impairment causes deleterious effects on health, such as: increased inflammation and anabolic resistance, loss of aerobic fitness and skeletal muscle atrophy with decreased glucose uptake, inducing insulin resistance (Bowden Davies et al., 2019).

Because of this context, physical activity is considered a determinant of health (Bielemann et al., 2020) for older adults, as its maintenance during the aging process enables improvement in functional capacity; decrease in the progression of diseases, disabilities and in the risk of mortality (Cunningham et al., 2020). Therefore, it is necessary to monitor those with a low level of physical activity by a multidisciplinary team and gradually and progressively introduce activities with the objective of improving the chances of survival (Cunningham et al., 2020).

Regarding self-report of exhaustion and/or fatigue, a prospective investigation in England identified that individuals who reported high levels of fatigue had a higher risk of mortality in the follow-up (Basu et al., 2016). In Jerusalem, the self-report of fatigue among older adults also represented a higher risk for mortality (HR: 1.60 95%CI 1.22-2.05) after an 18-year follow-up (Moreh et al., 2010), corroborating the present research.

It is noteworthy that studies are still needed to help understand the pathophysiology of fatigue (Azzolino et al., 2020) and its effect on mortality among older adults. There is the possibility that fatigue is a symptomatic expression mechanism of

an underlying morbidity (Basu et al., 2016; Azzolino et al., 2020), such as depression, functional disability and comorbidities (Moreh et al., 2010; Basu et al., 2016). Also, changes in nutritional, body composition and sleep disorders can result in changes in the mechanisms of inflammation and mitochondrial dysfunction, increasing the perception of fatigue (Azzolino et al., 2020). Thus, identifying the origin of these mechanisms and the pathophysiology of fatigue becomes essential for the development of appropriate intervention and treatment strategies (Azzolino et al., 2020), resulting in the possibility of increased survival in older adults.

Despite discrepancies and inconsistencies about the role of frailty phenotype components in older adults mortality (Liu et al., 2016), it is important to recognize some obstacles to comparing the results between studies as the initial study environment, different follow-up times, population, measurement of each component and its cutoff points (Chang & Lin, 2015; Liu et al., 2016).

Study limitations

The present study has as a limitation the use of compromised components of the frailty phenotype at baseline, considering that changes may have occurred during the four-year follow-up after discharge. In addition, the diagnosis was not considered when older adults was admitted, which may represent a greater risk of mortality.

5. Conclusion

Older adults with baseline impairment of the frailty phenotype components: slow gait speed, decreased muscle strength, self-reported exhaustion and/or fatigue and low level of physical activity had a lower probability of survival and were predictors of risk for death after four years of hospital discharge.

Identifying the mortality risk of the frailty phenotype components helps in directing intervention strategies for older adults at higher risk. It also enables preventive actions in the hospital environment, referral of Tertiary Care for monitoring in Primary Care with the aim of increasing the survival of these individuals and promoting aging with quality of life. Thus, it is essential to develop prospective studies, with longer follow-up and with a population-based design, so that it becomes possible to identify risk factors among elderly people who were hospitalized and enable early interventions to reduce the risk of mortality.

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