Clinical Frailty Scale in older adults admitted at Emergency Department: is baseline frailty a good predictor of Ninety-Day Mortality?

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Abstract

Objective: To evaluate the ability of the Clinical Frailty Scale (CFS) to predict 90-day mortality and other poor outcomes in older adults admitted at a Hospital Emergency Department (ED). *Method:* This is a prospective cohort study including older adults admitted at ED of a Public Hospital who spent at least one night in it. The degree of baseline frailty was assessed through the CFS, and its score was the predictor studied, through the Receiver Operator Characteristics (ROC) curve analysis. We analyzed 90-day mortality as a primary outcome. The following outcomes were considered as secondary ones: mortality, functional decline, readmittance to ED, readmission and need for home care. *Results:* 206 participants were included. Of the 127 frail older adults, 40 (31.5%) died before the 90th day compared to 5 (6.3%) in the non-frail group (p<0.001). After adjustment for demographic and clinical variables, frailty remained in the model as an independent predictor of 90-day mortality. The accuracy obtained by the ROC curve (AUROC) for predicting 90-day mortality was 0.81. For 180-day mortality, 0.80, for the need for home care, 0.77 for readmission, 0.65. For the other outcomes studied, the accuracy was not significant. *Conclusion:* Baseline frailty measured by the CFS is a good predictor of 90 and 180-day mortality and needing for home care in older adults admitted to ED. Its application in this setting might help clinical decision-making.

Keywords: Frailty. Aging. Risk factors. Mortality. Emergency Department.

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The authors declare that there is no conflict in the conception of this work.

Research funding: Coordination for the Improvement of Higher Education Personnel – Brazil (CAPES) – Funding Code 001.

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Received: June 20,2021
Approved: November 17, 2021

http://dx.doi.org/10.1590/1981-22562021024.210122

INTRODUCTION

Several risk factors have been identified as predictors of mortality[1] and functional decline in older adults admitted to Emergency Department (ED), especially advanced age and chronic diseases[2]. However, these factors alone are not sufficient predictors of unfavorable outcomes in older adults due to the heterogeneity of this population[3,4].

Frailty is a complex and multidimensional clinical syndrome characterized by reduced reserves and resistance to stress[5], influenced by genetic, environmental, dietary factors and the presence of chronic diseases. Frail older adults, markedly in their last year of life, are frequent users of pre-hospital care services[6], ED, hospital and intensive care units[7]. In these patients, the incidence of unfavorable outcomes is higher in the first three months after hospital discharge[8]. The baseline degree of frailty of older adults admitted to ED is an individual predictor of mortality and other unfavorable outcomes[9]. Frailty stratification makes it possible to recognize patients for whom more invasive treatments, possibly disproportionate to baseline health, can be avoided[10].

There is no consensus on the best operational definition of frailty or the most appropriate scale to identify frail older adults treated in ED[10–12]. In this scenario, the scales must be easy and fast to apply and have good predictive capacity[12,13]. Some frailty scales use unfeasible measures for application in overcrowded ED, where patients are bedridden, and professionals are pressured by the need for agility during care[10]. Furthermore, robust older adults, when seriously ill and in situations of acute decompensation of chronic diseases, may appear more frail than their baseline health status prior to admission[12].

Functional decline is the main frailty marker[14] and can be assessed by instruments that stratify the degree of frailty according to performance in activities of daily living (ADLs). The *Clinical Frailty Scale* (CFS)[14] considers the functional capacity to identify and stratify frailty. It has been validated in some countries for predicting mortality within 30 and 90 days of admission to the ED[15] and has shown good predictive capacity for unfavorable outcomes in patients in clinical and surgical emergencies admitted to the ED and intensive care[9,10,15–19].

The *National Institute for Health and Care Excellence* (NICE) recommends the application of CFS to all elderly people admitted on an emergency basis. A greater degree of frailty measured by the CFS in older adults admitted to the ED was associated with an increase in the in-hospital mortality rate, ranging from 2% in robust older adults to 24% in older adults with a high degree of frailty[20]. Studies involving frail older adults with COVID-19 found similar results. However, the mortality rates found were higher[21,22]. In Brazil, CFS has been studied for risk stratification in patients with COVID-19[23]. However, it has not been evaluated for predicting unfavorable outcomes in older adults admitted to ED for clinical or surgical reasons in general.

The primary objective of this study was to assess the ability of baseline frailty, as measured by CFS, to predict 90-day mortality in older adult patients admitted to a public Brazilian ED. Secondarily, we assessed the ability of the CFS to predict, during the follow-up period, other unfavorable outcomes such as mortality within 180 days of admission, readmission to the ED, readmission, functional decline and need for home care (HC) after hospital discharge. Additionally, we analyzed 90-day survival according to CFS categories.

METHODS

We developed a prospective cohort study involving older adult patients admitted to the ED of the Hospital das Clínicas of the Federal University of Minas Gerais (HC-UFMG) during two inclusion periods: from December 2019 to May 2020 and from November 2020 to January 2021 The interruption of collection was necessary in response to the hospital's restructuring to meet the demands caused by the COVID-19 pandemic.

All patients aged 60 years or older admitted to the ED for clinical or surgical emergencies and who stayed for at least one night in that unit were eligible to participate in the study. Older adults who met the inclusion criteria were invited to participate.

All participants were selected for convenience by the researcher, previously trained in the application, interpretation and understanding of the CFS. After receiving explanations about the research, all participants or their guardians (in the case of patients with cognitive impairment) who agreed to participate, signed the Informed Consent Form (ICF) and underwent the same study protocol.

Patients who were discharged from the ED or transferred to other units (operating center, inpatient or intensive care units) before being invited to the study, patients unable to communicate (patients in the active process of dying or patients with advanced dementia, unaccompanied or without a caregiver capable of consenting and providing reliable information) were excluded, as well as patients who refused to sign the consent form. In accordance with the sanitary protocols adopted by the HC-UFMG in the pandemic, patients admitted to the respiratory isolation unit were not included, in order to reduce the transmission of the new coronavirus.

Sociodemographic (age, gender, education, race/color) and clinical-functional data (comorbidities, medication use, functionality, mobility and hospitalization history) were collected from patient reports. In the case of the participant's cognitive disability, defined by the clinical evaluation and/or data from the medical record, the information was obtained from the caregivers and confirmed in the electronic medical record. The history of admission to other hospitals was asked to the participants or guardians.

Baseline frailty was defined as the degree of frailty two weeks before admission or prior to the acute illness that led to hospitalization[12]. CFS ≥5 was considered as the cutoff point for defining frailty[14]. We used the textual version of the CFS translated into Brazilian Portuguese[24] to stratify the state of baseline frailty. The older adults were classified ranging from very active (level 1) to terminally ill (level 9).

The clinical variables collected were defined from items that make up the *Criteria for Screening and Triaging to Appropriate Alternative care* (CriSTAL)[25], a scoring system developed with the objective of predicting short-term mortality in elderly admitted to the ED and which has been validated in some countries. In Brazil, its use has been studied at HC-UFMG. According to criteria adopted in CriSTAL, we consider metastatic disease and/or that refractory to treatment as advanced neoplasm; chronic kidney disease (CKD), stage 4 or 5 CKD (glomerular filtration rate < 30mL/min/1.73m2 by CKD-EPI); chronic heart failure *New York Heart Association* (NYHA) functional class III or IV; chronic obstructive pulmonary disease (COPD) *Global Initiative For Chronic Obstructive Disease* (GOLD) 3 or 4; acute cerebrovascular accident (CVA) or transient ischemic attack (TIA), history of acute myocardial infarction; moderate to severe liver disease: chronic viral hepatitis, chronic hepatitis from another cause, alcoholic liver disease with or without cirrhosis, chronic liver failure, liver fibrosis, any cirrhosis, with or without portal hypertension and/or varicose veins, liver transplant, hepatosplenic schistosomiasis). Multimorbidity was defined as the presence of two or more chronic diseases[26], which were classified according to the International Classification of Diseases (ICD-10).

Post-discharge follow-up was carried out by telephone contact with participants or their guardians between 3 and 4 months after admission to the ED. Our objective was to verify the 90-day mortality and secondary outcomes. A second telephone contact between 6 and 7 months was carried out to verify the secondary outcome of mortality up to 180 days after admission. There were delays in locating some patients, which required several attempts to contact them by phone. However, for the outcomes of mortality at 90 and 180 days, only deaths that occurred within the study period were computed.

We used a standardized follow-up questionnaire that included reclassification of current frailty level and use of health services after hospital discharge. For deceased patients, information was collected on the date, place and cause of death recorded in the death certificate.

The primary outcome was mortality within 90 days of admission to the ED. The secondary outcome was the occurrence of a measure consisting of at least one of the following: mortality within 180 days of admission, readmission to ED, readmission, need for HC after hospital discharge, and functional decline.

The sample size of 201 patients was calculated to ensure a statistical power of 80% in order to verify the hypothesis of an association between the binary independent variable baseline frailty (CFS³5) and the 90-day mortality outcome, using binary logistic regression. The prevalence of frailty in hospitalized patients at baseline was 56.7%[19] and a significance level of 0.05. A death rate in 90 days of 9.5%[8] was estimated, ranging up to 24.5%, considering an accuracy of 15%, based on the variability of this estimate found in the literature[1,8,27,28].

For descriptive statistical analysis, after checking for normality with the Shapiro-Wilk test, continuous variables were expressed as measures of central tendency and dispersion. Categorical variables were expressed as frequency distribution and data were tabulated according to frailty status. Chi-square and Fisher's exact tests were applied to examine associations between explanatory variables and 90-day mortality. To verify the effect of frailty on 90-day mortality, a multivariate binary logistic regression model was performed. The model was adjusted for potentially confounding variables, included according to clinical relevance, evidence in the literature and p-value <0.20 in the univariate analysis. In the final model, all variables that presented p-value <0.05 were maintained. Age and gender were included despite statistical significance. The retention of these variables in the model was justified by the known association of females with greater frailty and males with worse outcomes[10]. The frailty classification for the model was dichotomous. Association measures were expressed as *odds ratio* (OR) and 95% confidence interval (CI).

The clinicometric properties of the CFS were evaluated through sensitivity, specificity and the area under the *Receiver Operating Characteristics* (AUROC) curve. An AUROC ≥0.80 was considered to have good predictive accuracy.

Kaplan-Meier survival curves were calculated using the Logrank, Breslow, and Tarone-Wire test to analyze whether the risk of dying within 90 days increased with the greatest degree of baseline frailty. For this analysis, patients were stratified into five groups according to CFS categories: 1-3, robust; 4, vulnerable or pre-frail; 5, mild frailty; 6 to 8, moderate, severe and very severe frailty and 9, terminally ill. This distribution was adopted considering the degree of functional dependence and ADLs used by the scale.

Data were computed on the online platform *Research Electronic Data Capture* (REDCap)[29]. The results were presented following the STROBE methodology[30].

The study was approved by the Research Ethics Committee of UFMG, under the protocol CAAE: 23649519.0.0000.5149 and is in compliance with Resolutions 466/2012 and 510/2016 of the National Health Council.

RESULTS

During the recruitment period, 577 individuals aged 60 years and over were admitted and stayed for at least one night at the ED, meeting the eligibility criteria. A total of 371 patients were excluded. The reasons for the exclusion were documented (Figure 1). At the end of the 6-month follow-up, all but one participant had secondary outcomes verified.

Median age was 71 years, interquartile interval (IQI) from 66 to 78 years, 87 patients (42.2%) were female. The prevalence of frailty in the sample was 61.7% (95% CI 54.6 to 68.3%) and the median CFS score was 5 (IQI 4-6). Most patients (96.7%) were admitted for clinical reasons. The association between frailty and the characteristics of patients and outcomes is shown in table 1. The results suggest that frailty was associated with: female gender, not living alone, advanced cancer, acute CVA or TIA, presence of dementia or *delirium* at admission and having been hospitalized in the last year, including in the ICU.

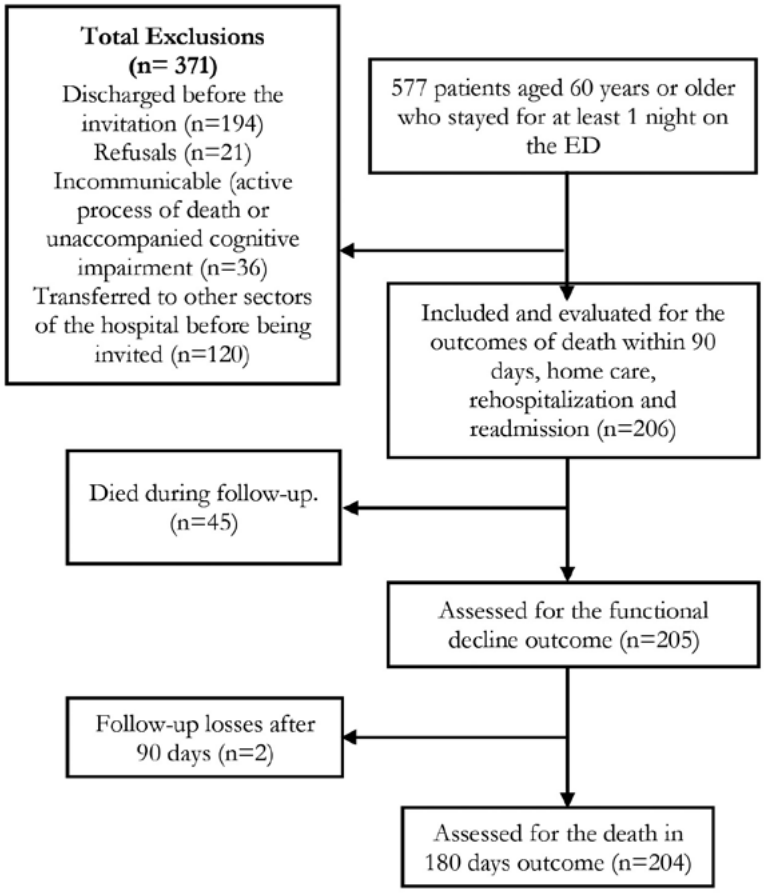

Figure 1. Study participant selection and follow-up flowchart. Belo Horizonte, MG, 2019-2021.

Table 1. Patient characteristics and outcomes according to frailty status (n= 206). Belo Horizonte, MG, 2019-2021.

Variables	CFS <5 (n = 79)	CFS ≥5 (n =127)	Total (n = 206)	*p* value
Sociodemographic characteristics				
Age, median (AIQ)	70 (64-76)	71 (66-79)	71 (66-78)	0.106
Sex, n (%)				
Female	24 (27.6)	63 (72.4)	87 (42.2)	0.007
Male	55 (46.2)	64 (53.8)	119 (57.8)	
Race/color, n (%)				
White	24 (33.3)	48 (66.7)	72 (35.0)	0.456
Brown	41 (42.3)	56 (57.7)	97 (47.1)	
Black	11 (34.4)	21 (65.6)	32 (15.5)	
Indigenous	3 (60.0)	2 (40.0)	5 (2.4)	
Education, n (%)				
Illiterate	8 (26.7)	22 (73.3)	30 (14.6)	0.199
<8 years	49 (37.4)	82 (62.6)	131 (63.6)	
Between 8 and 12 years	17 (45.9)	20 (54.1)	37 (17.9)	
>12 years	5 (62.5)	3 (37.5)	8 (3.9)	
Living alone, n (%)	18 (81.8)	4 (18.2)	22 (10.7)	<0.001

to be continued

Continuation of Table 1

Variables	CFS <5 (n = 79)	CFS ≥5 (n =127)	Total (n = 206)	*p* value
Clinical features				
Multimorbidity, n (%)	68 (35.6)	123 (64.4)	191 (92.7)	0.004
Advanced neoplasm (III/IV), n (%)	4 (9.5)	38 (90.5)	42 (20.4)	<0.001
DRC stage 4 or 5, n (%)	6 (30.0)	14 (70.0)	20 (9.7)	0.419
CHF (NYHA III / IV), n (%)	17 (44.7)	21 (55.3)	38 (18.4)	0.370
COPD GOLD 3 or 4, n (%)	2 (22.2)	7 (77.8)	9 (4.4)	0.487
Current CVA or TIA, n (%)	14 (66.6)	8 (33.4)	22 (10.7)	0.010
AMI history, n (%)	21 (46.7)	24 (53.3)	45 (21.8)	0.194
Liver disease, n (%)	3 (18.8)	13 (81.2)	16 (7.7)	0.093
Dementia, n (%)	0 (0.0)	24 (100.0)	24 (11.6)	<0.001
Delirium, n (%)	0 (0.0)	24 (100.0)	24 (11.6)	0.004
Hospitalization in the last 12 months, n (%)	44 (30.6)	100 (69.4)	144 (69.9)	<0.001
ICU in the last 12 months, n (%)	15 (25.0)	45 (75.0)	60 (29.1)	0.012
Outcomes				
90-day mortality (n=206), n (%)	5 (11.1)	40 (88.9)	45 (21.8)	<0.001
180-day mortality (n=204), n (%)	9 (14.8)	52 (85.2)	61 (29.9)	<0.001
Home care (n=206), n (%)	1 (4.5)	21 (95.5)	22 (10.7)	<0.001
Readmission (n=206), n (%)	13 (22.4)	45 (77.6)	58 (28.2)	0.003
Readmission in ED (n=206), n (%)	7 (21.9)	25 (78.1)	32 (15.5)	0.037
Functional decline (n=205), n (%)	28 (43.7)	36 (56.3)	64 (31.2)	0.301

CFS =*Clinical Frailty Scale;* CKD =chronic kidney disease; CHF = chronic heart failure;

FC NYHA =*New York Heart Association* functional class; COPD =chronic obstructive pulmonary disease; GOLD =*Global Initiative For Chronic Obstructive Disease*; CVA = stroke; TIA = transient ischemic attack; ICU = Intensive Care Unit; ED =Emergency Department.

During the total follow-up period (median 189 days, minimum 2 and maximum 226 days), 61 (29.6%) patients died. Of these, 45 deaths (21.8%) occurred within 90 days of admission to the ED. There was no record of death among participants classified as CFS 1 and 2. There was a dose-response effect between frailty and mortality, where the highest score in the CFS was associated with higher mortality (CFS 3, 6%; CFS 4, 7%; CFS 5, 13%; CFS 6, 20%; CFS 7, 44%; CFS 8, 71% e CFS 9, 70%) (Figure 2).

There was a strong positive association between baseline frailty and mortality within 90 days of admission to the ED (OR: 6.81; 95% CI 2.55-18.13; p<0.001). After adjustment for potentially confounding variables (age, sex, race/color, advanced cancer, liver disease, CVA or TIA, dementia, delirium, multimorbidity, hospitalization in the last 12 months, ICU in the last 12 months), frailty measured by CFS remained in the model as a strong independent predictor of mortality within 90 days of admission (OR: 3.84; 95% CI: 1.36 to 10.90, p=0.011). Advanced cancer, age and ICU in the last 12 months also remained in the final model. Male gender was maintained in the model due to clinical plausibility, despite statistical significance (Table 2). The performance of CFS to predict all outcomes of this study was presented as AUROC. The AUROC for mortality within 90 days of admission to the ED was 0.81 (95% CI 0.74-0.89; p<0.001), with a sensitivity of 88.9% and a specificity of 46% for the cutoff point CFS ≥5. After adjustment, the CFS maintained good predictive ability (AUROC: 0.79; 95% CI 0.71-0.86; p<0.001) (Table 2).

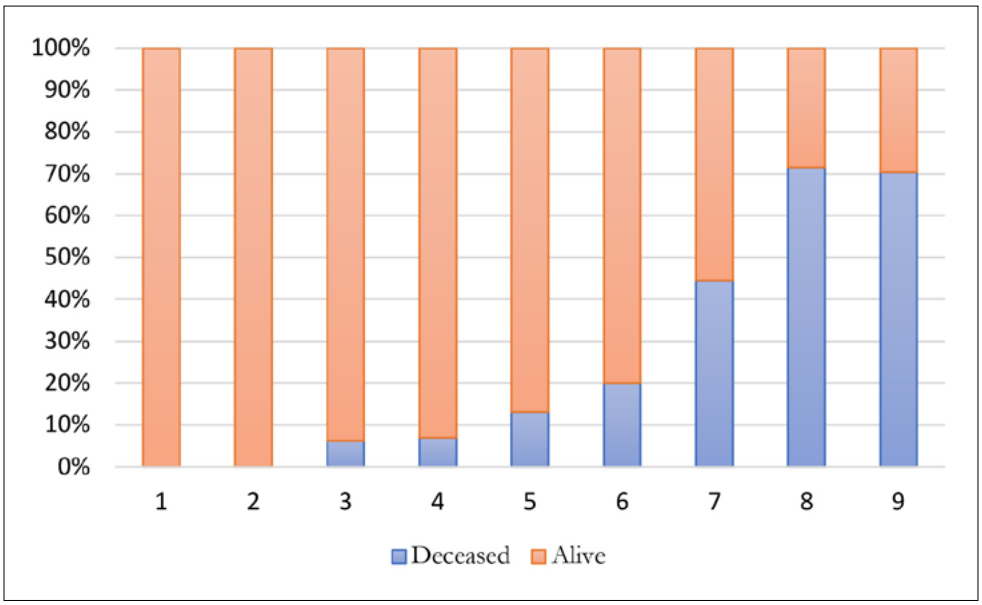

Figure 2. 90-day mortality according to CFS category (n=206). Belo Horizonte, MG, 2019-2021.

Table 2. Association between baseline frailty (CFS≥5) and death within 90 days of admission to the Emergency Department (ED). Final logistic regression model. Belo Horizonte, MG, 2019-2021.

Predictor	OR (95% CI)	*p*-value
Adjusted frailty	3.84 (1.36-10.90)	0.011
Advanced neoplasm	4.11 (1.79-9.47)	0.001
Age per year	1.06 (1.01-1.10)	0.019
ICU in the last 12 months	2.51 (1.15-5.48)	0.021
Male	1.36 (0.64-2.91)	0.425

CFS = *Clinical Frailty Scale;* AUROC = *area under Receiver Operating Characteristics curve;* ICU = Intensive Care Unit.

The analysis of the ROC curve for CFS in relation to 180-day mortality showed an AUROC of 0.80, with 95% CI from 0.73 to 0.87 (p<0.001). For HC requirements, AUROC of 0.77 (95% CI 0.69-0.86; *p*<0.001) and readmission, AUROC of 0.65 (95% CI 0.57-0.74; *p*= 0.001). We found no association between CFS score and ED readmission (AUROC: 0.56, 95% CI 0.46-0.66; *p*= 0.267) or functional decline (AUROC: 0.46, 95% CI 0.37 -0.54; *p*=0.325).

Figure 3 shows the Kaplan-Meier curves by CFS. By the *p* value referring to the Logrank test (<0.001) and also to the Breslow and Tarone-Wire tests, there is evidence that the survival curves differ in relation to the CFS groups. Patients classified as CFS 9 have a tendency to die more quickly than others, with approximately 50% probability of dying around the 37th day. The other categories follow the order of the groups themselves, only the robust group (1 to 3) coincides with the vulnerable group (4).

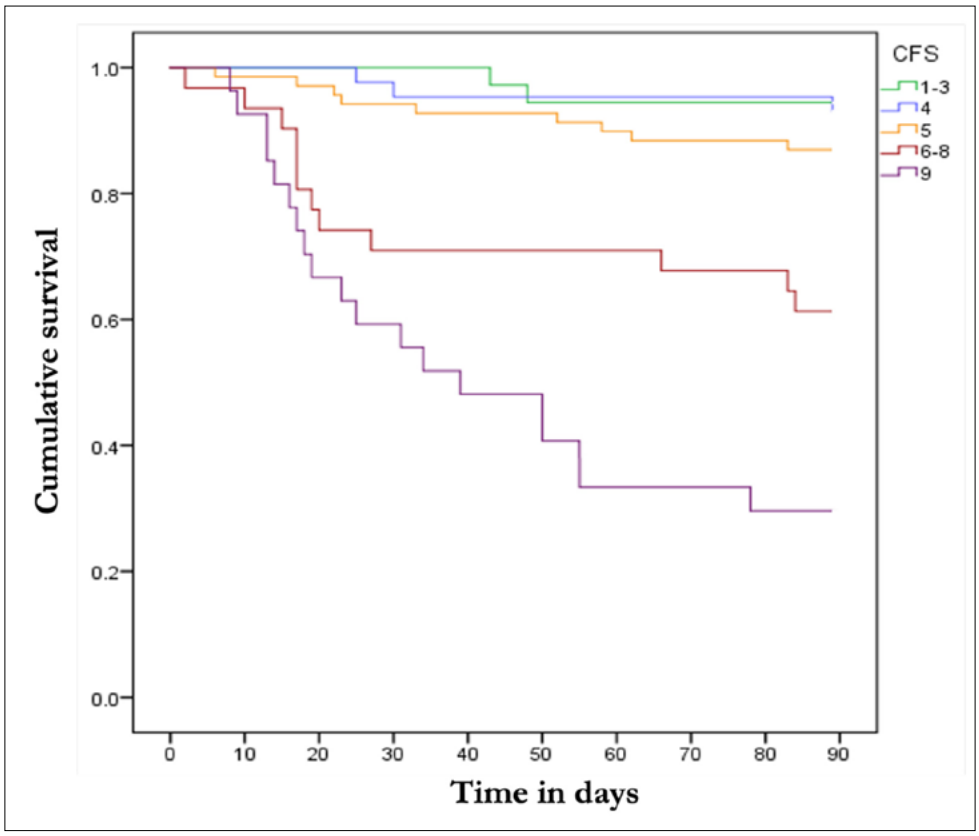

Figure 3. Kaplan-Meier survival curves over 90 days according to five CFS groups. Belo Horizonte, MG, 2019-2021.

DISCUSSION

This is the first Brazilian study that used the CFS to stratify frailty in older adult patients treated at the ED for clinical or surgical reasons, in order to assess their ability to predict unfavorable outcomes. The results of the present study showed that baseline frailty, as measured by the CFS, is a good predictor of mortality within 90 days of admission to the ED. The predictive capacity of the scale for the outcome of mortality at 90 and 180 days in our sample is comparable to that found by other studies that used the CFS[10,27] and was superior to other frailty scales[8,28]. The CFS is a valid and reliable scale[15,31], quick and easy to apply, which properly identifies and stratifies frailty. We also observed a dose-response effect between 90-day mortality and higher CFS scores, similar to what was previously demonstrated[15,32].

The prevalence of frailty in hospitalized older adults observed in our sample (61.7%) is within the wide range described in the literature (27 to 80%)[9]. This great variability is due, in part, to the frailty instrument used. When compared to studies that used the CFS to stratify older adults in the ED (between 25 and 57%)[15,16,18,19,27], the prevalence found in our sample was slightly higher. We also found a mortality rate higher than those previously described. One of the hypotheses that can be justified is related to the case mix of the ED at HC-UFMG, where care for patients with severe and advanced chronic diseases predominates and who are usually more fragile than patients treated in general hospital services, due to trauma, or cases of lesser complexity. Another possibility was the impact of the COVID-19 pandemic, which contributed substantially to higher mortality among older adults. Some of these patients became infected during the follow-up period and died from this cause.

We can hypothesize that the combination of CFS with clinical criteria of acute deterioration, such as early warning scores, will perform better risk stratification in older adult patients admitted

to the ED than the use of these assessments alone, as demonstrated previously[23,33].

In evaluating the predictive capacity of the CFS for other unfavorable outcomes, baseline frailty showed a moderate performance in predicting the need for home care after discharge. Half of the patients who required home care were classified as CFS 8 and 9. We emphasize that, in our municipality, we do not have *hospices*. However, palliative care can be provided to these patients by public home care services. We did not find studies in English or Portuguese that assessed the ability of frailty measured by the CFS to predict the need for home care in the short term.

We conducted this study in real situations, in an ED of a tertiary-level public university hospital in Brazil. In the Brazilian reality, as in other low- and middle-income countries, these units operate above their capacity, have long waiting times for hospitalization and high demand for hospital beds[34]. The results observed in this study point to the need to include the identification of frailty in the routine of evaluating older adults in the ED. In addition, in the context of public health resource management, recognizing the fragility state of the population helps to plan public policies, organize the demand for specialized services, optimize health programs and better allocate resources[35].

Prognosing is a complex task, but necessary and urgent in the current context. The assessment of the degree of baseline frailty, using simple and rapid scales, such as the CFS, can reduce prognostic uncertainty in scenarios of rapid changes in health status – such as in emergency units. Very frail older adults are readmitted to ED, notably in their last year of life, and are submitted to treatments that are not beneficial or inappropriate to their state of baseline frailty. These treatments can have a negative impact on the patient's quality of life and increase emotional and financial costs. Furthermore, they can lead to an unnecessary prolongation of the dying process, generating false expectations in patients and families, in addition to complicated grief.

CFS could be used in ED as a screening tool to identify patients who would benefit from a comprehensive geriatric and gerontological assessment and those who would not benefit from life-sustaining treatments. This would make it possible to start timely discussions with patients and families about the goals of care and post-discharge planning.

Our study has some limitations. Due to limited human resources for data collection, inclusion was only performed between 8 am and 5 pm on weekdays, which limited the sample size and led to a potential selection bias. Patients who were discharged from the ED on the same day of admission were not included. Presumably they may be less frail considering their short stay at the ED. However, it is not possible to generalize the results for these patients. The severity of patients admitted to HC-UFMG, an academic center for tertiary and quaternary care, especially for cancer and heart disease, limits the generalizability of our results to low-complexity services. Patients unable to communicate or those in the active process of dying were not included in the study, therefore, it is not possible to generalize the results to these groups of patients.

CONCLUSION

This prospective study showed that baseline frailty (relative to two weeks before admission to the Emergency Department), measured by the *Clinical Frailty Scale*, was able to identify older adults at higher risk of dying in the short term and needing home care services. The *Clinical Frailty Scale* is a valid, reliable and practical scale for predicting unfavorable outcomes in older adult patients treated in the Emergency Department. Its use to stratify the degree of frailty in older adults can help in decision making and reduce prognostic uncertainty. Other studies are needed to better clarify the role of frailty and the impact of acute conditions on mortality and other unfavorable short- and medium-term outcomes in older adult patients treated at ED in Brazil.

Edited by: Maria Helena Rodrigues Galvão

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