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A FRAILTY SCREENING QUESTIONNAIRE (FSQ) TO RAPIDLY PREDICT NEGATIVE HEALTH OUTCOMES OF OLDER ADULTS IN EMERGENCY CARE SETTINGS

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Abstract: *Background:* Frailty, at the core of geriatric medicine, is an important concept underpinning health problems but the rapid and valid measurement of frailty for older adults in the Emergency Department (ED) is lacking in China. The Frailty Screening Questionnaire (FSQ), has been shown to be a simple, rapid and practical tool to identify frailty in both community and inpatients settings, yet its utility in acute care settings is not well understood. *Objective:* To determine whether FSQ is useful to identify frailty and predict adverse outcomes in an emergency care setting. *Design and Participants:* This prospective study included 350 adults aged 60 and over and admitted to the ED. *Measurements:* The FSQ questionnaire which assessed self-reported slowness, weakness, inactivity, exhaustion, and weight loss was used to rapidly recognize frailty. FRAIL, Clinical frailty score (CFS), activities of daily living (ADL) and nutrition risk screening 2002 were also assessed. Outcome measures included all-cause 28-day mortality, ADL dependency, mechanical ventilation, length of hospital stay, and ICU readmissions 30 and 90 days after discharge. Cox proportional hazard model was used for survival comparison. *Results:* The prevalence of FSQ frailty and prefrailty in older adults were 44.6% and 30.9% respectively in the emergency setting. FSQ frailty was associated with increasing age, chronic diseases, malnutrition risk, poor physical function and worse outcomes indicated by higher 28-d mortality, ADL dependency, mechanical ventilation, length of hospital stay, and ICU readmissions after discharge. The Kappa coefficient between the FSQ and FRAIL was 0.552. FSQ score was negatively correlated with grip strength and positively correlated with Barthel index, length of hospital stay and CFS score. Cox regression adjusted by epidemiological variables and chronic diseases showed FSQ and all components predicted mortality except weight loss. *Conclusion:* The FSQ is a rapid and useful tool to screen frailty and an effective tool to predict mortality in busy emergency settings.

Key words: Frailty, emergency, screening.

Introduction

The number of older adults has increased significantly worldwide because of increases in life expectancy and the reduction in birth rate. The proportion of adults aged 60 years and over is expected to reach 22% by the year 2050 (1), which comes with a great burden on the healthcare system, especially emergency care. Older adults should undergo a specific geriatric assessment before receiving emergency treatment. Geriatric screening tools such as the Identification of Seniors At Risk (ISAR) were recommended in emergency settings, but applying them is not always feasible in busy emergency departments (ED) with growing number of older patients. Furthermore, systematic reviews showed ISAR to have limited predictive validity for composite adverse outcomes (2, 3). There are no pragmatic, accurate, and reliable instruments for geriatric ED patients (4).

Aging does not affect all older adults equally. Frailty, not chronological age, is one of the strongest predictors of poor health outcomes. Frailty is an emerging geriatric syndrome characterized by increased vulnerability resulting from the decline of physiological reserves (5), leading to an increase of adverse events such as falls, hospitalization, disability, and death. Early identification of frailty through targeted screening can facilitate the process of comprehensive geriatric assessment (CGA) and may improve outcomes for older inpatients. The impact of frailty on outcomes in acute care settings has been studied extensively in recent years. The rapid detection of frailty in ED is related to awareness and risks of an increased length of stay (LOS), more adverse effects, increased readmissions and mortality (6). However, most studies conducted in ED identified participants as frail without actually measuring frailty, thus there is a need for an established frailty assessment tool (7).

Given that there is no uniform definition for frailty worldwide, various frailty assessment tools have been developed, and among them two conceptual models dominate the field: the Frailty Phenotype (FP) and Frailty Index (FI). However, these are difficult to use in everyday practice in ED because of their complexity and emergency physicians have less time to manage them. New self-reported tools could potentially improve the quality of assessment of older ED

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patients. An ideal frailty screening tool in ED would be short and efficient. However, there is as yet no frailty screening tool used for older adults on admission in ED in China. The Frailty Screening Questionnaire (FSQ) is based only on five self-reported components from FP (5, 8). The original FSQ, designed in the Beijing Longitudinal Study of Aging (BLSA), was used to identify frailty in individuals aged 60 and older in community settings. Frailty defined by FSQ was associated with poor physical function and predicted mortality (8). The accuracy of FSQ with FP was good (AUC = 0.879) in the China Health and Retirement Longitudinal Survey (CHARLS) (9). These results indicated FSQ could be used to identify older adults with high risk of adverse health outcomes (8). The reliability and construct validity of FSQ has been established (10), but its utility in the acute care setting is yet to be determined. We aimed to determine whether the FSQ is useful to identify frailty and predict adverse outcomes in an emergency setting.

Materials and Method

Participants

Data were from Physiological Model for Frailty and Resilience Study (SMART). This study included 350 older individuals aged ≥ 60 years admitted to the ED between January 2019 and December 2019. Those who needed emergency surgery, underwent only medical management, refused to participate in the study, or were unable to complete the assessment were excluded. This study was approved by the institutional review board of Xuanwu Hospital Capital Medical University.

Study protocol

Comprehensive medical histories and frailty measurements of all patients were obtained by trained staff. On admission, information on demographic characteristics was collected, and chronic disease, activities of daily living (ADL), Clinical Frailty Scale (CFS), nutrition risk screening (NRS) 2002, and grip strength were assessed. Patients were then asked to complete two self-report instruments: FRAIL and FSQ. Medical records and medication lists were reviewed, and a battery of standardized assessments was completed within 24 hours of admission.

Frailty assessment

The FSQ includes five self-reported components based on modified Fried FP criteria (8, 10): weight loss, exhaustion, slowness, weakness, and inactivity. Weight loss was defined as an unintentional loss of body weight of at least 4.5 kg in the past year. Exhaustion was determined by a "yes" response to either of two questions: "Everything I did was an effort" or "I could not get going." Slowness was defined as being unable to walk for 250 meters. Weakness was defined as experiencing difficulty in lifting or carrying a weight of 5 kilograms. Inactivity was identified as exercise <3 hours per week. The total scores ranged between 0-5. Those with ≥ 3 were classified as frail, and the others were nonfrail (0, robust; 1-2, prefrail).

The CFS is a brief scale widely used and has been validated in ED to predict LOS, mortality and admission, but not readmission (11). FRAIL scale was used to identify frailty considering a score of 3 and above as frail (12).

Outcome Measures

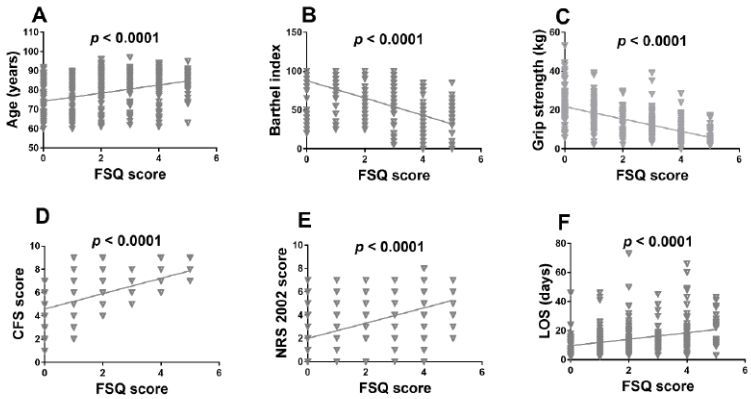
All-cause mortality within 28 days was the primary outcome. Secondary outcomes were ADL dependency, mechanical ventilation, LOS in hospital, and ICU readmissions 30 and 90 days after discharge.

Statistical analysis

Statistical analyses were performed using SPSS version 11.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism 7.0

Figure 1

Correlation of FSQ total score with age, physical function, nutrition and length of stay in hospital



Analysis of the correlation between FSQ total score and age (A), Barthel index (B), grip strength (C), clinical frailty scale score (D), NRS 2002 score (E) and length of stay in hospital (F) among the participants, analyzed by the Spearman rank correlation. FSQ, frailty screening questionnaire; CFS, clinical frailty scale; NRS, nutrition risk screening; LOS, length of stay.

software (GraphPad Software Inc., CA, USA). Continuous variables were expressed as means ± standard deviations or medians and interquartile ranges; categorical data were expressed as numbers with percentages. The differences in characteristics between groups were evaluated by chi-square tests for categorical variables, Kruskal-Wallis comparisons for the non-normally distributed continuous variables, and independent t-tests for normally distributed continuous variables. Agreement between FSQ and FRAIL was calculated using Cohen's kappa. Spearman rank correlation was used for to determine the association of FSQ score with age, physical function, and LOS. Cox proportional hazard model and Kaplan-Meier curves were used for survival comparison. All p-values refer to two-tailed tests of significance; $p < 0.05$ was considered significant.

Results

A total of 350 adults aged 60 and above admitted to ED were recruited, 65.7% of whom were older than 75, and 52.3% of whom were male. The average age of participants was 78.77±9.57 years, and the median hospital stay was 12 (7, 17) days. The demographic characteristics and basic health status of participants are shown in Table 1. The main causes of admission were pneumonia (156, 44.6%), cerebral ischemic stroke, AECOPD, heart failure, sepsis, acute myocardial infarction, and unstable angina. The three most common chronic diseases were hypertension (64.3%), IHD (42.3%), and diabetes (38.3%). About 163 participants (55.1%) were functionally independent (Barthel index 61-100). The average grip strength was 14.77±9.19 kg. Around 152, 144, 183 and 81 individuals complained of vision impairment, hearing impairment, memory loss and weight loss respectively.

There were 156 participants who had an FSQ score of 3 or greater, yielding a prevalence of frailty rate of 44.6%. Frailty defined by the FSQ was associated with older age, low education level, poor marital status, more malnutrition risk, worsening physical function indicated by lower grip strength, and more chronic diseases such as IHD and COPD. Moreover, patients with FSQ frailty had a higher CFS score (Table 2). We further analyzed the correlation between FSQ score with age and physical function. Figure 1 shows that FSQ score was negatively correlated with grip strength (r=-0.6237) and Barthel index (r=-0.6344), and positively correlated with age (r=0.3618), NRS 2002 score (r=0.5182), CFS score (r=0.734) and LOS in hospital (r=0.3674), all $p < 0.0001$. Next, we used kappa to determine the agreement between FSQ and well-used FRAIL scale and found that kappa coefficient was 0.552 ($p < 0.001$).

Table 1
Participant characteristics

Characteristic	Value
Demographic	
Age (years)	78.77±9.57
Age	
<75	120(34.3)
≥75	230(65.7)
Sex	
Male	183(52.3)
Female	167(47.7)
Education (years)	
≤ 1	78(22.3)
>1	272(77.7)
Marriage	
Live with spouse	196(56.0)
Live alone	154(44.0)
Never smoking	191(54.6)
Diagnosis	
Unstable angina	5(1.4)
Acute myocardial infarction	21(6.0)
Heart failure	51(14.6)
AECOPD	54(15.4)
Pneumonia	156(44.6)
Cerebral ischemic stroke	55(15.7)
Sepsis	24(6.9)
Chronic disease	
Hypertension	225(64.3)
Diabetes	134(38.3)
IHD	148(42.3)
COPD	67(19.1)
Chronic kidney disease	31(8.9)
Stroke	74(21.1)
Liver disease	8(2.3)
Dementia	3(0.9)
SBP (mmHg)	139.65±27.87
DBP (mmHg)	78.87±18.58
Comprehensive geriatric assessment	
FSQ	
Robust	86(24.6)
Prefrail	108(30.9)
Frail	156(44.6)
BMI (kg/m^2)	24.11±13.11
Barthel index	
61-100	163(55.1)

Table 1 (continued)
Participant characteristics

Characteristic	Value
41-60	65(18.6)
≤40	92(26.3)
Grip strength (kg)	14.77±9.19
NRS 2002 score	3.42±2.17
Vision impairment	152(43.4)
Hearing impairment	144(41.1)
Memory complaints	183(52.3)
Weight loss	81(23.1)

Data were expressed as mean ±standard deviation or n (%); Abbreviations: AECOPD, acute exacerbation of chronic obstructive pulmonary disease; IHD, ischemic heart disease; COPD, chronic obstructive pulmonary disease; SBP, systolic blood pressure; DBP, diastolic blood pressure; FSQ, frailty screening questionnaire; BMI, body mass index; NRS, nutrition risk screening.

The 28-day mortality was 9.4% (n=33) and 30-day and 90-day ICU readmission was 14.6% (n=51) and 24.0% (n=84), respectively. Mechanical ventilation was used for 34 patients (9.7%) during hospital admission. Table 3 shows the association between FSQ frailty and higher overall mortality at 28-day (16.7% vs 3.6%), ADL dependency, mechanical ventilation, LOS, and ICU readmission at 30 and 90 days (all p<0.01).

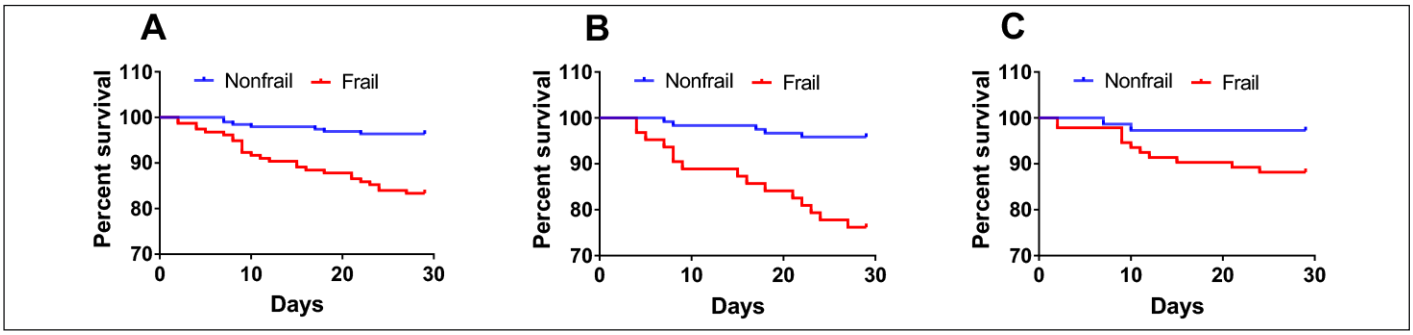
Kaplan-Meier survival curve showed FSQ predicted 28-d mortality in total (HR=4.928[2.139-11.356], p<0.001), male (HR=6.327[2.299-17.416], p<0.001) and female (HR=4.529[1.004-20.435], p=0.049) (Fig.2). Each component (slowness, inactivity, exhaustion, weakness, and weight loss) could predict mortality (HR 2.294-4.985). Slowness shows the strongest and weight loss the weakest prediction role. Multivariate analysis confirmed the role of FSQ frailty (HR=4.280[1.810-10.122], p=0.033) and each component in predicting mortality except weight loss, adjusted by age, sex, marriage, education, smoking, and chronic diseases (Table 4).

Discussion

The present study showed that FSQ can identify frailty and predict short term mortality in older adults in ED, which is in accordance with our previous findings in BLSA and CHARLS that frailty was associated with poor physical function and long-term mortality (8). Frailty is the main risk factor for poor outcomes among older adults undergoing emergency surgery (13), therefore assessing frailty with established tools is useful in creating care plans and making treatment decisions (7). A previous study showed that both FP and CFS predicted poor discharge outcomes in ED (14), which indicates that screening for frailty can improve prognosis by targeting careful discharge planning in older ED patients. As we discussed before, there are two broadly accepted methods (FP and FI) to measure frailty. Both of them predict increased risk of hospitalization, prolonged LOS, and death. Due to limited and time-intensive resources needed for ED, CGA, FI and FP are difficult to use in the initial screening and identification, and hence it is important to select self-reported tools.

In this study, the Kappa coefficient between the FSQ and FRAIL was 0.552 (p < 0.001), which was similar to our previous results in a study with inpatients where the kappa coefficient between the FSQ and FP was 0.431 (10). FSQ and FRAIL tools are based on FP. Furthermore, we found that FSQ score was negatively correlated with physical function, and positively correlated with LOS and CFS score. A systematic review showed that the most commonly used tools in acute settings were CFS, FI and FP (7). Recently, an ED frailty index (FI-ED) using 24 variables was developed, where a 0.1 unit increase in FI-ED was associated with admission, death, prolonged LOS, discharge to long-term care and need for CGA (OR = 1.30-1.55), thus could be used to identify patients with higher risk of adverse outcomes in ED (15). However, the complexity of the variables limits its application. When comparing the three short frailty screening tools (CFS, ISAR, and the Programme on Research for Integrating Services for the Maintenance of Autonomy 7 item questionnaire (PRISMA-7)) with CGA, 58% were frail and the most accurate tool for

Figure 2
The comparison of overall survival between older adults with and without frailty defined by FSQ in ED



Kaplan-Meier survival curve for comparison overall 28-day survival in total (A), male (B) and female (C). The total sample in the analysis was 350. FSQ, frailty screening questionnaire.

Table 2
FSQ frail versus nonfrail older adults

	Nonfrail (n=194)	Frail (n=156)	P value
Age (years)	70.88±7.76	77.13±8.95	<0.001
Sex			
Male	120(61.9)	63(40.4)	
Female	74(38.1)	93(59.6)	<0.001
Education (<1 year)	29(14.9)	49(31.4)	<0.001
Marriage (Live alone)	63(32.5)	91(58.3)	<0.001
Smoking	94(48.5)	65(41.7)	0.205
Chronic disease			
Hypertension	124(63.9)	101(64.7)	0.873
Diabetes	78(40.2)	56(35.9)	0.410
IHD	67(34.5)	81(51.9)	0.001
COPD	28(14.4)	39(25.0)	0.013
Chronic kidney disease	17(8.8)	14(9.0)	0.945
Stroke	40(20.6)	34(21.8)	0.789
Liver disease	5(2.6)	3(1.9)	0.684
Dementia	1(0.5)	2(1.3)	0.439
BMI (kg/m^2)	24.44±3.95	23.71±19.17	0.604
Grip strength (kg)	18.20(12.15, 23.35)	8.25(5.1, 13.5)	<0.001
Nutrition risk	136(70.1)	144(92.3)	<0.001
CFS score	5(4, 6)	7(6, 8)	<0.001

Data were expressed as mean ±standard deviation, median (interquartile range) or n (%); Abbreviations: IHD, ischemic heart disease; COPD, chronic obstructive pulmonary disease; BMI, body mass index; CFS, clinical frailty scale; FSQ, frailty screening questionnaire.

Table 3
Primary and secondary outcome measures

	Nonfrail group	Frail group	P value
28-d mortality	7(3.6)	26(16.7)	<0.001
In hospital			
ADL dependency	52(26.8)	105(67.3)	<0.001
Mechanical ventilation	7(3.6)	27(17.3)	<0.001
LOS (days)	10(6, 15)	13(8.25, 21.75)	<0.001
Discharge			
30-d ICU readmission	19(9.8)	32(20.5)	0.005
90-d ICU readmission	29(14.9)	55(35.3)	<0.001

Data were expressed as median (interquartile range) or n (%); Abbreviations: ADL, activity of daily living; LOS, length of stay; ICU, intensive care unit.

identifying frailty was the PRISMA-7 followed by the CFS, and the ISAR, AUC 0.88, 0.83, and 0.78 respectively (16). Another study showed CFS was as accurate as FP in predicting poor outcomes (14), but it has the benefit of being extremely simple, quick and easy to perform (17), thus more practical for use in busy clinical settings. However, given the relatively subjective nature of CFS, particularly when used in ED, where staff only have a brief impression of patients, FSQ might be more suitable since it could also predict mortality even when adjusted by multiple variables including chronic diseases in this study.

We found that the prevalence of frailty and prefrailty among older adults in ED was 44.6% and 30.9% respectively,

Table 4
Predictive models of 28-day mortality of FSQ

	Model 1			Model 2		
	HR	**95% CI**	**P value**	**HR**	**95% CI**	**P value**
FSQ frailty	4.928	2.139-11.356	<0.001	4.280	1.810-10.122	0.033
Components						
Slowness	4.985	2.164-11.487	<0.001	4.227	1.785-10.014	0.001
Inactivity	4.353	1.797-10.545	0.001	3.558	1.450-8.729	0.006
Exhaustion	3.090	1.394-6.852	0.005	2.850	1.279-6.350	0.010
Weakness	3.265	1.518-7.025	0.002	2.782	1.250-6.194	0.012
Weight loss	2.294	1.141-4.612	0.020	-	-	0.059

Reference: Robust; Model 1: Unadjusted Cox proportional hazard analysis; Model 2: Fully adjusted Cox proportional hazard analysis. Adjusted by age, sex, marriage, education, smoking, and chronic diseases (Hypertension, diabetes, ischemic heart disease, chronic obstructive pulmonary disease, chronic kidney disease, stroke, liver disease and dementia); Abbreviations: HR, hazard ratio; FSQ, frailty screening questionnaire.

according to FSQ. Frailty prevalence varied due to different assessment tools. A study showed that the prevalence of frailty was 30.4%, 43.7% and 9.7% using Fried, CFS, and SUHB scales respectively in adults over 65 in the ED (14). We showed FSQ frailty was associated with older age, chronic diseases, worse physical function and lower ADL. Frailty increases the odds of failure to rescue by threefold in emergency surgery, and thus it is important that it is identified before making goals for care (18).

This is the first study on frailty screening in emergency settings in China. Emergency medical care is an intersection for community care, inpatient care, and long-term care, therefore assessing older individuals accessing urgent care is a useful first step to ensuring that the most vulnerable received timely and precise care. We have previously proposed a two-step pathway for frailty identification and management in older adults: a quick frailty screening for initial identification using self-reported tools as the first step, then further frailty assessment and management using complex instruments, such as the CGA as the second step (19). FSQ is one of the tools used to screen frailty in the first step. A recent study showed 6 screening-tools were overall adequate for measuring frailty, but require accurate knowledge of medical history or blood test results, which are not always available or too time-consuming to be used routinely in ED (20). In busy emergency settings where there is no geriatrician, a screening tool that can be rapidly and easily applied, without relying on comprehensive documentation or equipment is required. The FSQ is one of the shortest frailty screening tools based on FP, which allows clinicians to assess the overall functioning condition, regardless of the acute illnesses. Another important advantage is that the responses to the items of FSQ can also be obtained from the caregiver if the patient is unstable or unresponsive because of their emergency condition, while other commonly used quick tools do not cover most of the potential population, and thus are not acceptable to acute care teams (21).

The main limitation of this study is that the population assessed was from a single-center, and the sample size was small. Another limitation is the absence of long-term follow-up. However, none of the outcome data were missing in this study.

Conclusion

Frailty is at the core of geriatric medicine and there is a growing importance of frailty in public health, yet its utility in emergency clinical practice has not been well understood. This study showed that FSQ is effective in identifying frailty and predicting mortality in older adults in emergency settings, indicating that it is feasible to screen frailty routinely among older patients on ED admission, and self-reported FSQ is useful to accurately predict negative outcomes in ED. Rapid and accurate frailty identification in a busy emergency environment would allow for more focused use of time and resources to the patients that need it the most, and further help in providing integrated care to older people across settings.

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Competing financial interests: The authors declare no competing financial interests.

Conflict of interest: None.

Ethical Standards: The present study followed the ethical guideline of the declaration of Helsinki and was approved by the Ethics committees.

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