Simplified clinical frailty scale design, validation, and adaptation in older patients

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Abstract. – OBJECTIVE: The clinical frailty scale (CFS) evaluates the level of frailty based on clinical examination, comorbidities, and functional and activity levels of older patients. However, there are many difficulties for internists in evaluating frailty with this scale. Therefore, simplifying the CFS with good design and application is required for better treatment outcomes. Our study was conducted to design and evaluate the correlation of a simplified clinical frailty scale (sCFS) with CFS in older patients.

PATIENTS AND METHODS: We undertook a cross-sectional analysis involving 279 older patients, which comprised two steps. Step 1 involves the implementation of sCFS, a protocol that has been endorsed by the Geriatrics Professional Council (GPC). Step 2 entails the enrollment of older patients for frailty assessment using sCFS, comparing it with CFS.

RESULTS: The study was conducted on 279 older patients; the average age was 75.7 ± 8.4 (years old), and men accounted for 34.8%. There was a high correlation between the sCFS and CFS (Pearson's r = 0.996; *p* < 0.001). The similarity of the sCFS to the CFS was very high, with Kappa coefficient = 0.984 (*p* < 0.001). Compared with the CFS, the sCFS had a Youden index of 98% with 100% sensitivity and 98% specificity assessed through the receiver operating characteristic (ROC) with the CFS threshold of 5.

CONCLUSIONS: The sCFS can be used to assess frailty with high sensitivity and specificity.

Key Words:
 Clinical frailty scale, CFS, Simplified clinical frailty scale, sCFS, Older patients.

Introduction

Frailty is one of the most important geriatric syndromes in older patients[1,2]. Frailty develops as a consequence of the aging of physiological systems in older patients, leading to vulnerability to environmental changes and difficulty in recovery[3-5]. There were many scales to assess health in older patients, such as comprehensive geriatric assessments (CGAs), simple frailty questionnaire (FRAIL) scale, the Edmonton scale, the Geriatric Depression Scale long form with 30 items (GDS-30), frailty index (FI), and Zulfiqar Frailty Scale (ZFS). However, there is still no consensus on the assessment scale for older patients[3,5-8].

The majority of frailty screening studies[9-11] chosen by clinicians use the clinical frailty scale (CFS). The CFS scale was designed in 2005, researched, and developed by Rockwood et al[12]. Although geriatricians widely apply the CFS to assess frailty, non-geriatric clinicians face many difficulties due to its terminologies. Therefore, to facilitate the clinical assessment of older people's health by non-geriatric doctors before examination, simplifying the clinical frailty scale is a necessary issue. In this study, we designed a simplified clinical frailty score. Our study designed and evaluated the correlation of a simplified clinical frailty scale (sCFS) with the CFS in the frailty status of hospitalized patients at least 60 years old.

Patients and Methods

Study Population

Our study enrolled older patients at the Geriatrics Department of Gia Dinh People's Hospital, from November 2022 to February 2023.

Inclusion Criteria

Patients ≥ 60 years old who were newly hospitalized at the Geriatrics Department of Gia Dinh People's Hospital and agreed to participate in the study were included.

Exclusion Criteria

Patients were excluded if they were incompetent to answer the interview (mental disorder, severe dementia, severe acute illness), if they had no relatives or relatives did not know clearly about the patient's condition.

Study Design

The study comprises two steps. Step 1 involves the implementation of sCFS, a protocol endorsed by the Geriatrics Professional Council (GPC). Step 2 entails enrolling older patients for a frailty assessment using sCFS, and comparing it with CFS. This is a cross-sectional analysis study employing convenient and continuous sampling.

Data Collection Methods

Step 1: First, the authors simplified the CFS, then sent a survey to 20 doctors in different specialties about the understandability and applicability of the scale, and recorded comments and terms that needed to be edited. Then, the GPC revised it to produce the final sCFS.

Step 2: Patients who met the criteria were included in the study. Researchers interviewed patients based on a set of pre-prepared questions, combined with medical records to complete a data collection form including age, gender, education, height, weight, living condition, marital status, functional and daily living activities, number of medications, number of comorbidities, and impairments. Frailty was assessed independently using two sCFS and CFS at two different time points. The geriatrician will assess frailty using the CFS and the Internist will assess the frailty using the sCFS (Figure 1).
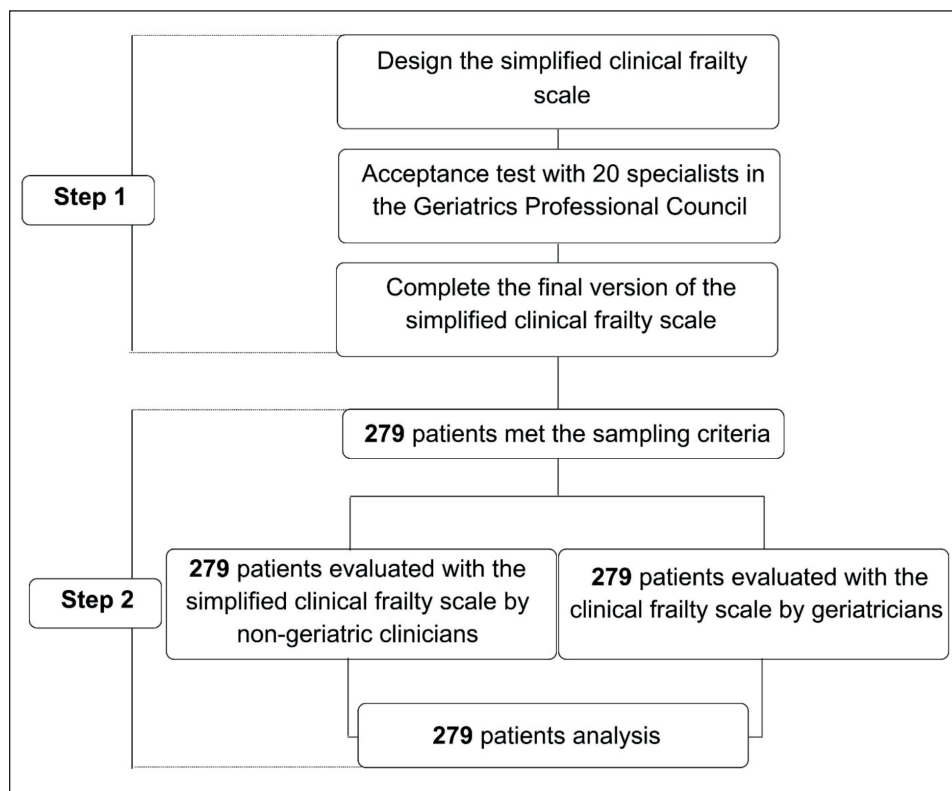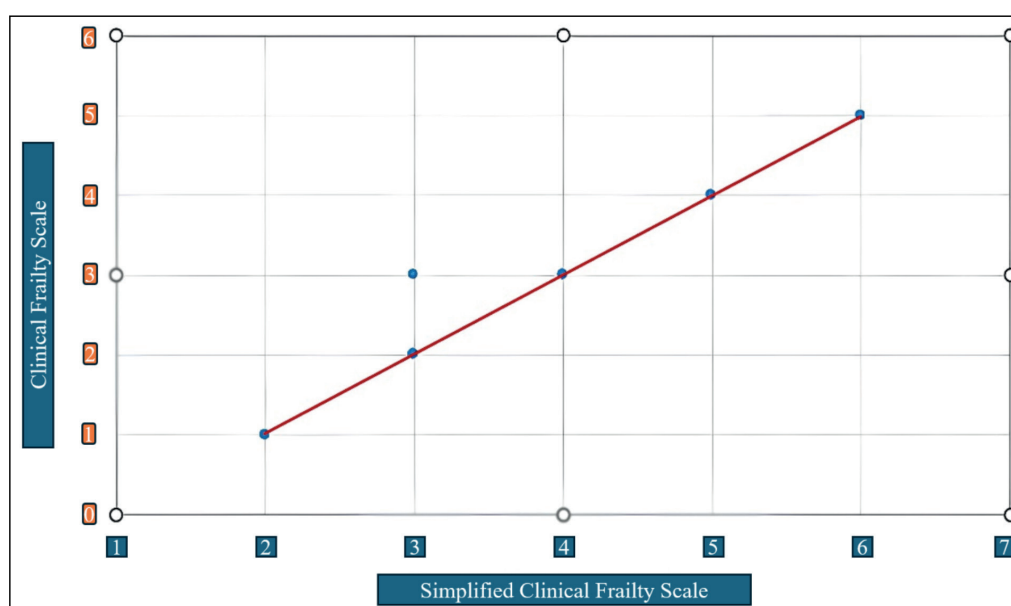

Figure 1. Study flowchart.

Table I. The simplified clinical frailty scale.

Simplified Clinical Frailty Scale			
Stage	Levels	Characteristic	
Healthy	Very healthy	Very active and regularly exercising	Evaluation purpose: Coordination + Awareness + Physical **Daily living activities:** phone using, cook, do laundry, clean the house, shop, use transportation, money spending, and distribute drugs **Daily basic activities:** bathing, combing hair, dressing, going to the toilet, eating, and moving around the house.
	Healthy	Less active, infrequent exercise	
	Stable healthy	Less active and rarely exercise	
Pre-frailty	Pre-frailty	Slowness in daily activities and often tired during the day	
Frailty	Mild frailty	Need help with some daily living activities	
	Moderate frailty	Need help with one or several daily basic activities	
	Severe frailty	Need help with all basic activities	
	Very severe frailty	Severe frailty and could not recover even from a minor illness.	
Terminally ill	Life expectancy < 6 months		Regardless of the level of frailty

Figure 2. Correlation between the simplified Clinical Frailty Scale with the Clinical Frailty Scale.

Data Variables

Frailty assessed according to the CFS includes 9 levels: (1) very healthy, (2) healthy, (3) stable health, (4) pre-frailty, (5) mild frailty, (6) moderate frailty, (7) severe frailty, (8) very severe frailty, and (9) terminally ill. Frailty assessed according to the sCFS includes 9 levels: (1) very healthy, (2) healthy, (3) stable healthy, (4) pre-frailty, (5) mild frailty, (6) moderate frailty, (7) severe frailty, (8) very severe frailty (9) terminally ill. Education level is an ordinal variable including values: illiterate, primary school (grades 1-5), secondary school (grades 6-9), high school (grades 10-12), university, and postgraduate. Living arrangements consist of two options: residing with family or living alone. Number of medicine taken is a quantitative variable, the total number of drugs the patient is currently using. The number of comorbidities is a quantitative variable, which is the total number of diseases the patient currently has. Activities of daily living were assessed according to the Lawton scale. Basic daily functional activities were assessed using the Katz scale.

Table II. Study population characteristics.

Characteristics		Prevalence (%)
Age (years) (Mean ± SD)		75.7 ± 8.4
Age groups	60 - 69	83 (29.7)
	70 - 79	94 (33.7)
	≥ 80	102 (36.6)
Sex	Male	97 (34.8)
	Female	182 (65.2)
Education level	Illiterate, primary school, and secondary school	208 (74.6)
	high school, university, and postgraduate	71 (25.4)
Living condition	Alone	7 (2.5)
	With family or others	272 (97.5)
Marital status	Living with spouse	124 (44.4)
	Widowed/Single/Divorced	155 (55.6)
BMI (kg/m²)		20.9 ± 3.6
BMI Groups	< 18.5	60 (21.5)
	18.5 - 24.9	181 (64.9)
	25 - 29.9	34 (12.2)
	≥ 30	4 (1.4)
Number of medicines taken		4.3 ± 2.7
Multi-medicine taken	No	134 (48.0)
	Yes	145 (52.0)
Comorbidities		3.3 ± 1.6
Multi-comorbidities	No	79 (28.3)
	Yes	200 (71.7)
Comorbidities	Hypertension	233 (83.5)
	T2DM	91 (32.6)
	CKD	31 (11.1)
	Stroke	31 (11.1)
	Osteoarthritis	53 (19.0)
	Anemia	28 (10.0)
	IHD	78 (28.0)
	PAD	18 (6.5)
	HF	13 (4.7)
	Cancer	19 (6.8)

BMI: Body mass index, CKD: Chronic kidney disease, IHD: Ischemic heart disease, SD: Standard deviation , PAD: Peripheral artery disease, HF: Heart failure , T2DM: Type 2 Diabetes mellitus.

Ethical

This study was approved by the Ethics Committee in Biomedical Research, University of Medicine and Pharmacy at Ho Chi Minh City. HCM, No. 957/2022/HDĐD-DHYD, dated November 28, 2022, and Ethics Council in Biomedical Research of Gia Dinh People's Hospital No. 159/NDGD-HDĐD dated December 28, 2022.

Statistical Analysis

Data were processed using SPSS 26 (IBM Corp., Armonk, NY, USA). Binary and ordinal variables are presented as frequencies and proportions. Continuous variables are presented as mean ± standard deviation (SD) or median and interquartile range (IQR).

The Chi-square (or Fisher) assessed the difference of qualitative variables. The *t*-test was used to assess the difference in means between two quantitative variables. The difference is considered statistically significant when $p < 0.05$. Use the Pearson correlation coefficient and Kappa similarity assessment coefficient to evaluate the correlation of the two scales. The area under (AU) the ROC curve (ROC) with CFS as the gold standard determines the sensitivity and specificity through the Youden index to evaluate the appropriateness of the sCFS.

Results

The Simplified Clinical Frailty Scale

Through the survey of 20 doctors, including 10 geriatricians and 10 doctors from other specialties, it was found that assessment of frailty in older patients is still very limited, and most doctors think that the CFS is too long, difficult to remember (55%) and takes a lot of time to perform (15%). 75% of physicians believed that the sCFS was easier to understand, and 80% of physicians agreed that the sCFS was easier to use than the CFS. All physicians agreed on the sCFS and would use it to assess frailty in older patients (90%), with 9 levels respectively: (1) Very healthy: a very active person, regularly exercising; (2) Healthy: less active, infrequent exercise; (3) Stable health: People who are less active and or rarely exercise; (4) Pre-frailty: being slowness in daily activities and often tired during the day; (5) Mild frailty: people who need help with some daily living activities such as the ability to use the phone, cook, do laundry, clean the house, shop, use transportation, money spending, and distribute drugs; (6) Moderate

Table III. Frailty assessment in the simplified Clinical Frailty Scale compared with the Clinical Frailty Scale.

Frailty assessment		CFS (n = 279)	sCFS (n = 279)	p
Healthy		21 (7.5)	21 (7.5)	< 0.001
Pre-frailty		Pre-frailty	76 (27.2)	
Frailty	Mild	117 (41.9)	119 (42.7)	
	Moderate	53 (19.0)	53 (19.0)	
	Severe	7(2.5)	10 (3.6)	
	Very severe	3 (1.1)	0 (0.0)	
Terminally ill		0 (0.0)	0 (0.0)	

p: Chi-squared, CFS: Clinical Frailty Scale, sCFS: Simplified Clinical Frailty Scale.

frailty: people who need help with one or several basic activities for themselves such as bathing, combing hair, dressing, going to the toilet, eating, and moving around the house; (7) Severe frailty: are people who need assistance with all basic activities for themselves; (8) Very severe frailty: severe frailty and could not recover even from a minor illness; (9) Terminally ill stage: person who is expected to live less than 6 months, regardless of the level of impairment (Table I). Compared to the CFS, the sCFS has no difference in subgroups. However, the sCFS uses simpler, more concise, and easier-to-remember terminology.

Study Population Characteristics

This study enrolled 279 older patients who met the sampling criteria during the study period. Among them, the average age was 75.7 ± 8.4 (years old); men accounted for 34.8%, and women accounted for 65.2%. The comorbidities with the highest prevalence were hypertension (83.5%), diabetes (32.6%), and ischemic heart disease (28%) (Table II).

Assessing the Correlation of the Simplified Clinical Frailty Scale Compared with the Clinical Frailty Scale

There were 182 patients with frailty according to the sCFS (accounting for 65.3%) and 180 cases (accounting for 64.5%) were assessed using the CFS. The severe frailty group assessed using the sCFS and CFS accounted for 3.6% (10 cases) and 2.5% (7 cases), respectively, with a small difference between the two scales (Table III).

Pearson correlation between the sCFS and the CFS showed a strong correlation with Pearson's coefficient r = 0.996 ($p < 0.001$). The similarity of the sCFS to the CFS was very high, with the Kappa coefficient = 0.984 ($p < 0.001$) (Figure 2).

The AUC of the sCFS was very high: AUC, 95% CI = 0.99, 0.98 - 1. Youden index is 98% with 100% sensitivity and 98% specificity at the threshold of CFS = 5 (Figure 3).
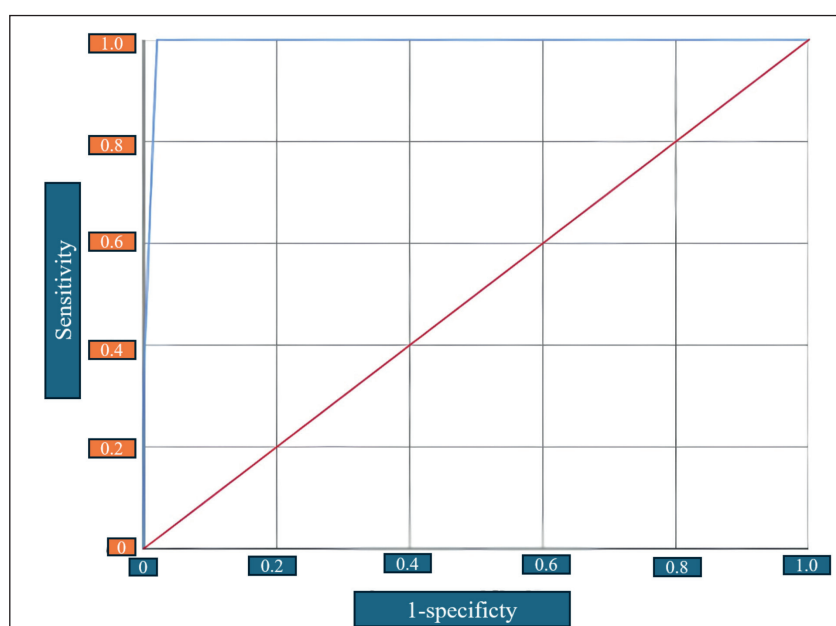

Figure 3. Receiver operating characteristic curve between the simplified Clinical Frailty Scale with the Clinical Frailty Scale.

Discussion

Through a survey of 20 internists and geriatricians about the sCFS compared to the CFS, most doctors in both groups believed that the sCFS was more concise and easier to assess the frailty of newly hospitalized older people quickly. Our scale allows internists to easily assess frailty in older patients without the need for additional equipment. The scale evaluated frailty through functional activities rather than mental health, so the dementia patient group was not included in this study (Table I).

Our study population has an average age of 75.7 ± 8.4 (years old), the majority were female (65.2%), and the highest rate of comorbidity was hypertension (83 .5%), diabetes mellitus (32.6%), and ischemic heart disease (28%), mean BMI was 20.9 ± 3.6 (Table II), similar to other studies[6,7,13,14], which evaluated using other scales on older populations in Korea, France, China, and Singapore.

The proportion of severe frailty assessed by the sCFS was equal to the total rate of severe and very severe frailty groups assessed by the CFS. Therefore, the sCFS and CFS were equal in clinical frailty assessment although sCFS was assessed by internists and CFS was assessed by geriatricians. Our research results showed that there was a very high correlation between the sCFS and the CFS, with r = 0.996 ($p < 0.001$). The AUROC of the sCFS was 0.99 (95% CI: 0.98 - 1). Our research results also showed that the similarity of the sCFS with the CFS was very high, with a Kappa coefficient of 0.984 ($p < 0.001$). The Youden index was 98% with 100% sensitivity and 98% specificity at the CFS threshold = 5. This initial result shows that the sCFS can be used for quick assessment by non-geriatric physicians in clinical practice with appropriateness in clinical practice.

Many studies[7,13] have also simplified the CFS for a quicker assessment of frailty at the hospitalization moment in older patients. They have also noted the suitability of the CFS scale after being simplified compared to the original CFS. Jung et al[7] study (2021) in Korea, evaluating the suitability of the CFS scale and comprehensive geriatric assessments (CGAs), recorded good outcomes with CFS cut-off = 4, with 93.9% sensitivity and 79.8% specificity with AUROC, 95% CI = 0.905, 0.833 - 0.977. The study by Liang et al[13] (2019) in China evaluated the effectiveness of 4 Fried frailty scales, simple frailty questionnaire (FRAIL) scale, Edmonton, and frailty index (FI) with the evaluation standard of CFS scale ≥ 5. The results showed that the sensitivity and specificity of the scales were: Fried frailty scale with 94.1% and 85.2%; FRAIL with 63.0% and 97.0%, Edmonton with 71.9% and 88.6% and frailty index (FI) with 77.8% and 94.2%. Zulfiqar et al[14]'s study (2022) in France, evaluating the suitability of the Zulfiqar Frailty Scale (ZFS), compared with the CFS scale in patients ≥ 75, showed that there was an average association between the ZFS compared to the CFS (r = 0.674, 95% CI: 0.565-0.760, $p < 0.001$). The area under the ROC curve of the ZFS was AUC, 95% CI = 0.88, 0.83 - 0.94 with a Youden index of 54% with sensitivity of 67% and specificity of 87% at CFS threshold = 3. The study by Chong et al[6] (2019) in Singapore, evaluating the appropriateness of the CFS and the Clinical Frailty Scale algorithm (CFS-A), compared to the FI on 210 older patients, recorded the AUC of FI was AUC, 95% CI = 0.91, 0.86 - 0.95, $p < 0.001$ and the CFS-A was AUC, 95% CI = 0.89, 0.84 - 0, 95, $p < 0.001$. With our designed sCFS, the results were much more optimal than previously researched scoring scales, with higher Pearson correlation, sensitivity, specificity, AUC, and Youden coefficient. Therefore, the sCFS scale of our study can be applied in clinical practice, helping non-geriatric physicians to evaluate patients more quickly and appropriately.

Conclusions

The simplified clinical frailty scale can be used by non-geriatric physicians to quickly assess the frailty status of older patients at hospitalization moment with high sensitivity and specificity compared to the original clinical frailty scale origin.

Authors' Contributions

Conceptualization: Nguyen Van Tri, Nguyen Tran To Tran, Tran Minh Giao; methodology: Nguyen Van Tri, Le Thi Hong Hoa; software: Tran Lam Thai Bao, Le Thi Hong Hoa, Ngo Hoang Toan; formal analysis: Nguyen Van Tri, Nguyen Hong Ha; data curation: Nguyen Tran To Tran, Nguyen Van Tri. Writing original draft preparation: Nguyen Hong Ha, Nguyen Trung Kien; writing review and editing: Nguyen Van Tri, Nguyen Tran To Tran, Tran Minh Giao, Nguyen Hong Ha, Nguyen Trung Kien. All authors have read and agreed to the published version of the manuscript.

Ethics Approval

This study was approved by the Ethics Committee in Biomedical Research, University of Medicine and Pharmacy at Ho Chi Minh City, HCM, No. 957/2022/HDĐD-DHYD, dated November 28, 2022, and Ethics Council in Biomedical Research of Gia Dinh People's Hospital No. 159/ND-GD-HDĐD dated December 28, 2022.

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