Translation and validation of the Korean version of the clinical frailty scale in older patients

Ryoung-Eun Ko1†, Seong Mi Moon2†, Danbee Kang3,4, Juhee Cho3,4,5, Chi Ryang Chung1, Yunhwan Lee6,7, Yun Soo Hong8, So Hee Lee9, Jung Hee Lee10 and Gee Young Suh1,11*

Abstract

Background: Frailty is a multidimensional syndrome that leads to an increase in vulnerability. Previous studies have suggested that frailty is associated with poor health-related outcomes. For frailty screening, the Clinical Frailty Scale (CFS) is a simple tool that is widely used in various translated versions. We aimed to translate the CFS into Korean and evaluated its contents and concurrent validity.

Methods: Translations and back-translations of the CFS were conducted independently. A multidisciplinary team decided the final CFS-K. Between August 2019 and April 2020, a total of 100 outpatient and inpatient participants aged ≥65 years were enrolled prospectively. The clinical characteristics were evaluated using the CFS-K. The CFS-K scores were compared with those of other frailty screening tools using Pearson’s correlation coefficient and Spearman’s rank correlation. The area under curve (AUC) for identifying the Eastern Cooperative Oncology Group Performance Status (ECOG PS) grade 3 or more was calculated for the CFS-K and other screening tools.

Results: The mean age of the participants was 76.5 years (standard deviation [SD], 7.0), and 63 (63%) participants were male. The mean CFS-K was 4.8 (SD, 2.5). Low body mass index (p = 0.013) and low score on the Korean version of the Mini-Mental State Examination (p < 0.001) were significantly associated with high CFS-K scores, except for those assigned to scale 9 (terminally ill). The CFS-K showed a significant correlation with other frailty screening tools (R = 0.7742–0.9190; p < 0.01), except in the case of those assigned to scale 9 (terminally ill). In comparison with other scales, the CFS-K identified ECOG PS grade 3 or more with the best performance (AUC = 0.99). Patients assigned to scale 9 on the CFS-K (terminally ill) had similar frailty scores to those assigned to scale 4 (vulnerable) or 5 (mildly frail).

(Continued on next page)
Background
Frailty is a multidimensional syndrome involving loss of reserves (energy, physical ability, cognition, and health) accompanied by an increase in vulnerability to increased dependency and/or mortality when exposed to a stressor [1, 2]. Frailty is either physical or psychological or a combination of both [2]. Physical frailty is characterized by diminished strength and endurance and reduced physiologic function [1] and associated with increased health-related outcomes in older populations, including hospitalization, nursing home admission, re-admission, and mortality [3–10]. Therefore, for physicians, frailty screening is useful for risk stratification, goal setting and advanced care planning, and frailty-targeted interventions [1, 11–13].

A recent consensus conference which was attended by the international societies and experts in the area of frailty recommended screening for frailty in all older persons and individuals with significant weight loss due to chronic disease [1]. They also suggested instruments for several screening tests such as the Fatigue, Resistance, Ambulation, Illness, and Loss of weight (FRAIL) questionnaire, Cardiovascular Health Study (CHS) frailty screening, and Clinical Frailty Scale (CFS) [1, 14]. Among them, the CFS is the most widely applied assessment tool [15]. The CFS is a simple, rapid screening test proposed by Rockwood and colleagues [2]. The CFS was based on the theoretical model of fitness, frailty, and function; it was developed as a grading tool with seven scales in 2005 [2] and revised in 2008 to include a total of nine scales. The CFS is composed of visual and written charts for frailty with nine graded pictures [2] and it takes less than 5 min to complete [14]. The CFS was developed to measure the frailty based on clinical judgement [2, 14], and studies have shown that CFS is useful to predict clinical outcomes in various clinical settings such as emergency department, intensive care units or postoperative [5, 16–19]. Because of its usefulness, the original English version of the CFS has been translated in different languages [12, 20, 21].

In Korea, The Eastern Cooperative Oncology Group Performance Status (ECOG PS) scale, the Korean version of FRAIL (K-FRAIL), Korean Cancer Study Group Geriatric Score (KG-7), and Korean Frailty Index are commonly used to assess frailty due to lack of appropriate measures [22–25]. However, these tools require more time for completion than the CFS, and most are limited to cancer patients. Herein, we aimed to validate the Korean version of the CSF (CSF-K). Specifically, we translated the CSF into Korean and evaluated its contents validity. In addition, we also evaluate specificity and sensitivity of the CSF-K and concurrent validity by comparing with other scales.

Methods
Participants
We prospectively enrolled 100 patients aged ≥65 years who visited an outpatient clinic or were admitted to the general ward or intensive care units of the Samsung Medical Center and Samsung Changwon Hospital between August 2019 and April 2020. The patients were eligible to participate if they or their guardians, who were closely involved in their care, gave informed consent to measure frailty. Patients diagnosed with dementia were excluded. The Institutional Review Board of the Samsung Medical Center (IRB No. 2019–02–028-004) and Samsung Changwon Hospital (IRB No. 2019–06-003) approved this study, and each participant provided informed written consent.

Transation of clinical frailty scale to Korean
Original CFS in English consists of a scale from 1 (very fit) to 9 (terminally ill), which is scored by clinical judgment; hence, the last group is technically not frail [2] (Fig. 1). To develop the CFS-K, we obtained copyright permission from Dr. Rockwood, who developed the original CFS. Three bilingual experts translated the CFS to Korean independently; then, it was back translated to English by three independent bilingual experts [26]. After this process, a multidisciplinary team of experts, including intensivists, intensive care unit nurses, an expert in geriatric medicine, behavioral scientists, and clinicians, reviewed and confirmed the instruments’ content (Fig. 1). In addition, a pilot test with five patients confirmed the content validity of the scale (data not shown).

Measurements
To assess the baseline cognitive function, we used the Korean version of the Mini-Mental State Examination (K-MMSE) [27]. Other demographic and clinical

Conclusions: In conclusion, the CFS-K is a valid scale for measuring frailty in older Korean patients. The CFS-K scores were significantly correlated with the scores of other scales. To evaluate the predictive and prognostic value of this scale, further larger-scale studies in various clinical settings are warranted.

Keywords: Clinical frailty scale, Frailty, Translation, Validation, Korean
information including comorbidity, admitted location, and primary reason for admission were obtained from the participants' medical records.

To examine the concurrent validity, we used the ECOG PS, K-FRAIL scale, KG-7, and Korean Frailty Index [22–25, 28]. The ECOG PS scale is a measurement tool used to describe a patient’s level of functioning from 0 to 5, with increasing scores indicating increasing levels of deterioration [22]. The K-FRAIL scale is a screening tool for measuring frailty status using a five-item questionnaire, which ranged 1 to 5, with increasing scores indicating increasing frailty [23]. The KG-7 is a screening tool for geriatric assessment using seven items representing each domain of the geriatric assessment scale, which ranged 0 to 7 [24], with decreasing scores indicating increasing deterioration. The Korean Frailty Index is an eight-item questionnaire that measures frailty in older patients, with scores ranging from 0 to 8, and high scores indicating increasing levels of deterioration [25].

Statistical methods
Data analyses included descriptive statistics (frequencies, means, and standard deviations) and statistical analyses for assessing frailty. In order to measure the CFS-K’s concurrent validity, Pearson’s coefficients for correlation between CFS and the other scales including the KG-7, K-FRAIL, and Korean Frailty Index, and Spearman’s rank-order for correlation between CFS and ECOG PS were computed. In addition, we calculated the sensitivity and specificity of identifying ECOG 3 or more using the area under the curve (AUC). The performance for identifying frailty was compared between CFS-K and the K-FRAIL, KG-7, and Korean Frailty Index, with Bonferroni’s correction to adjust for multiple comparisons. For the analyses, KG-7 was recorded in reverse to achieve the same direction scores. We used the two way sided p-values to compare the AUC of CFS-K with AUC of other frailty screening tests. The significance level was set at 0.05. All analyses were performed using STATA version 15 (Stata Corp LP, College Station, TX, USA).

Results
Participant characteristics
The participants’ characteristics are demonstrated in Table 1. A total 100 outpatient (n = 10, 10.0%) and inpatient (n = 90, 90.0%) participants were recruited at two medical centers. The mean age of the study participants was 75.6 years old and 63.0% were men. The mean body mass index was 21.7 kg/m² (standard deviation [SD], 3.5 kg/m²). Among the participants, the common comorbidity was chronic lung disease including chronic obstructive pulmonary disease, asthma, and interstitial
lung disease (44%), followed by hypertension (38%) and cancer (32%). For the 90 inpatients, the primary reason for admission was pneumonia (42.2%) followed by cancer-related management (24.4%). Of the 10 outpatients, 9 visited for pulmonary disease (90%), and one visited for cardiovascular disease (10%). K-MMSE was measured in 96 (96%) patients and the mean score of the K-MMSE was 22.2 (SD 7.2).

Characteristics by clinical frailty scale-Korean
All of the participants completed the CFS-K, and the mean score was 4.8 (SD, 2.5). The characteristics of the participants are grouped by CFS-K scale (Table 2). Except for patients assigned to scale 9 (terminally ill), the mean age and proportion of males were different for each scale but without significance (P for trends 0.576 and 0.052, respectively). Body mass index was higher in patients assigned to scales 1 (very fit)–4 (vulnerable) than in those assigned to scales 5 (mildly frail)–8 (very severely frail), at a significant level (P for trend 0.013). The K-MMSE data were obtained from 96 (96%) of all the participants. The patients assigned to scale 1 (very fit) had the highest (mean (standard deviation [SD])) K-MMSE score (28.7 (2.7)) and those assigned to scale 8 (very severely frail) had the lowest K-MMSE score (12.7 (8.1)) with significant difference across the groups (P for trends < 0.001). The body mass index of patients assigned to scale 9 (terminally ill) was higher than that of patients assigned to scale 2 (well) and the K-MMSE score (21.0 (8.7)) of patients assigned to scale 6 (moderately frail) (18.9 (5.9)) was higher than that of patients assigned to other scales.

Table 1 Characteristics of the study participants

| Participants (N = 100) |  
|------------------------|
| Age (years) | 75.6 (7.0)  
| Sex |  
| Male | 63 (63.0)  
| Female | 37 (37.0)  
| Body mass index (kg/m²) | 21.7 (3.5)  
| Comorbidity |  
| Chronic lung disease | 44 (44.0)  
| Hypertension | 38 (38.0)  
| Cancer (oncology/hematology) | 32 (32.0)  
| Diabetes | 30 (30.0)  
| Cardiac disease (ischemic/vascular) | 26 (26.0)  
| Cerebrovascular disease | 17 (17.0)  
| Chronic kidney disease | 11 (11.0)  
| Location |  
| Outpatient | 10 (10.0)  
| Inpatient | 90 (90.0)  
| Primary admission cause in ward patients (N = 90) |  
| Pneumonia | 38 (42.2)  
| AE of underlying lung disease | 11 (12.2)  
| Cardiac disease | 14 (15.6)  
| Other infection | 5 (5.6)  
| Cancer related problems | 22 (24.4)  
| K-MMSE score | 22.2 (7.2)  

Values are mean (SD) or number (%)

Table 2 Characteristics of the study participants as per Clinical Frailty Scale-Korean

| 1 Very fit | 2 Well | 3 Managing well | 4 Vulnerable | 5 Mildly frail | 6 Moderately frail | 7 Severely frail | 8 Very severely frail | 9 Terminally ill |
|-----------|-------|----------------|-------------|--------------|------------------|----------------|---------------------|----------------|
| No. of patients | 10    | 12             | 11           | 15           | 16              | 13             | 10                  | 11             | 8              |
| Age, years   | 73.2 (6.6) | 78.7 (8.3)    | 74.3 (3.6)   | 72.8 (6.9)   | 76.7 (7.0)      | 77.8 (7.9)     | 76.9 (8.0)       | 75.5 (7.7)      | 75.8 (4.6) |
| Male, n      | 7 (70.0)  | 9 (75.0)      | 5 (45.5)     | 13 (81.2)    | 9 (75.0)        | 5 (50.0)       | 3 (30.0)          | 5 (45.5)        | 7 (87.5)   |
| Body mass index (kg/m²) | 23.5 (1.1) | 21.6 (4.2)    | 22.8 (2.7)   | 22.4 (2.9)   | 20.3 (3.3)      | 21.2 (3.9)     | 21.0 (5.3)        | 19.8 (2.3)      | 23.0 (3.0) |
| K-MMSE       | 28.2 (2.7) | 23.5 (7.9)    | 24.5 (4.0)   | 25.8 (3.5)   | 24.4 (3.6)      | 18.9 (5.9)     | 18.3 (7.3)        | 12.7 (8.1)      | 21 (8.7)   |

Values in the Table are mean (SD), median (IQR), or number (%)

P for trends for body mass index (p = 0.013) and K-MMSE (p < 0.001) were statistically significant. p for trends for age (p = 0.576) and sex (p = 0.052) were not significant. We excluded participants who were assigned to scale 9 (terminally ill) on the Clinical Frailty Scale-Korean.
Correlation between frailty measures and clinical frailty scale-Korean and validation
The frailty scores by CFS-K are summarized in Table 3. The patients assigned to scale 1 (very fit) had the highest KG7 score (6.7 (0.7)) and the lowest scores on the K-FRAIL (0.3 (0.5)) and Korean Frailty Index (1.2 (1.3)). All of the patients with CFS-K 1 (very fit) showed ECOG PS grade 0 (80%) or 1 (20%). In contrast, the patients assigned to scale 8 (very severely frail) had the lowest KG7 score (0.8 (1.0)) and the highest score of K-FRAIL (3.7 (0.5)) and Korean Frailty Index (6.8 (1.1)). Patients with CFS-K 8 showed ECOG PS grade 3 (30%) or 4 (70%). Regarding patients assigned to scale 9 (terminally ill), the mean (SD) of KG7 (3.9 (2.0)), K-FRAIL (2.9 (1.2)), and Korean frailty index (4.9 (1.5)) were similar to those assigned to scale 4 (vulnerable) or 5 (mildly frail). The ECOG PS scores were inconsistent among patients assigned to scale 9 (terminally ill). The CFS-K scores were positively correlated with K-FRAIL (R = 0.8053) and Korean Frailty Index (R = 0.7742), ECOG PS (R = 0.9190) scores and negatively correlated with KG-7 (R = −0.8846) scores, except in the case of patients assigned to scale 9 on the CSF-K (terminally ill).

Regarding the receiver operating characteristic (ROC) curve for identifying ECOG PS grade 3 or more, the CFS-K showed better performance (AUC = 0.99) than the KG-7 (AUC = 0.96; p = 0.08), K-FRAIL (AUC = 0.89; p < 0.01), and Korean Frailty Index (AUC 0.87; p < 0.01) (Fig. 2). In addition, the CFS-K has a sensitivity of 90.6% and a specificity of 97.0% for identifying ECOG PS grade 3 or more.

Discussion
In this study, we translated the CFS into Korean and evaluated the content and concurrent validity by comparing it with other scales, namely the ECOG PS, K-FRAIL, KG-7, and Korean Frailty Index. The patients were subjected all of the scales regardless of age or sex. High scores on the CFS-K were correlated to low body mass index and low K-MMSE score. The CFS-K scores

Table 3 Performance of K-CFS against that of K-FRAIL, KG-7, Korean frailty index, and ECOG and Pearson’s correlations between K-CFS and other scales

| K-FRAIL | 1 Very fit | 2 Well | 3 Managing well | 4 Vulnerable | 5 Mildly frail | 6 Moderately frail | 7 Severely frail | 8 Very severely frail | 9 Terminally ill |
|---------|-----------|-------|-----------------|--------------|--------------|-------------------|-----------------|---------------------|----------------|
| Mean (SD) | 0.3 (0.5) | 0.7 (0.8) | 0.8 (1.3) | 1.3 (0.9) | 3.3 (0.9) | 3.8 (0.4) | 3.5 (1.0) | 3.7 (0.5) | 2.9 (1.2) |
| Median (IQR) | 0 (0–1) | 0.5 (0–1) | 0 (0–1) | 1 (1–2) | 3.5 (3–4) | 4 (4–4) | 4 (3–4) | 4 (3–4) | 3 (2–3.5) |

| KG-7 | 1 Very fit | 2 Well | 3 Managing well | 4 Vulnerable | 5 Mildly frail | 6 Moderately frail | 7 Severely frail | 8 Very severely frail | 9 Terminally ill |
| Mean (SD) | 6.7 (0.7) | 5.4 (1.2) | 5.5 (1.0) | 4.3 (1.1) | 3.4 (0.7) | 1.8 (1.0) | 1.2 (1.0) | 0.8 (1.0) | 3.9 (2.0) |
| Median (IQR) | 7 (7–7) | 5.5 (5–6.5) | 6 (5–6) | 4 (3–5) | 3.5 (3–4) | 1.5 (1–2) | 1 (0–1) | 1 (0–1) | 3.5 (2–5.5) |

| Korean frailty index | 1 Very fit | 2 Well | 3 Managing well | 4 Vulnerable | 5 Mildly frail | 6 Moderately frail | 7 Severely frail | 8 Very severely frail | 9 Terminally ill |
| Mean (SD) | 1.2 (1.3) | 3.3 (1.4) | 2.2 (1.4) | 4.3 (1.4) | 5.8 (1.1) | 5.2 (0.9) | 6.2 (1.2) | 6.8 (1.1) | 4.9 (1.5) |
| Median (IQR) | 1 (0–2) | 3 (2–5) | 3 (1–3) | 4 (3–5.5) | 6 (5.5–6) | 5.5 (4–6) | 6.5 (5–7) | 7 (6–8) | 5 (3.5–6) |

| ECOG PS | 1 Very fit | 2 Well | 3 Managing well | 4 Vulnerable | 5 Mildly frail | 6 Moderately frail | 7 Severely frail | 8 Very severely frail | 9 Terminally ill |
| 0 | 8 (80.0) | 3 (25.0) | 2 (18.2) | 1 (6.3) | 0 | 0 | 0 | 0 | 1 (12.5) |
| 1 | 2 (20.0) | 9 (75.0) | 9 (81.8) | 13 (81.3) | 1 (8.3) | 1 (8.3) | 0 | 0 | 2 (25.0) |
| 2 | 0 | 0 | 0 | 0 | 2 (12.5) | 8 (66.7) | 8 (66.8) | 2 (20.0) | 0 | 4 (50.0) |
| 3 | 0 | 0 | 0 | 0 | 3 (25.0) | 8 (80.0) | 8 (80.0) | 3 (30.0) | 1 (12.5) |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 (70.0) | 0 |

K-CFS Clinical Frailty Scale-Korean, K-FRAIL Korean version of the fatigue, resistance, ambulation, illness, and loss of weight, KG-7 Korean Cancer Study Group Geriatric Score, ECOG PS Eastern Cooperative Oncology Group Performance Status
R and R* were calculated using Pearson correlation and Spearman correlation, respectively
P for trends for all the variables were statistically significant (p < 0.001)
We excluded participants who were assigned to scale 9 (terminally ill) on the Clinical Frailty Scale-Korean
*p < 0.01
were significantly correlated with the scores of other scales and showed the best assessment of frailty. The CFS-K was found to be a useful screening tool of frailty in Korean older patients. In this study, the newly translated Korean version of CFS recognized frail patients more effectively than other scales. Previous studies have suggested the CFS is a useful screening tool based on clinical judgement for measuring frailty [8, 14]. The translated version was also administered successfully. Moreover, the CFS-K correlated well with other scales including the ECOG PS, K-FRAIL, KG-7, and Korean Frailty Index, which are already used in clinical settings. Previous study showed that CFS has a sensitivity of 56.0% and a specificity 98.4% for identifying frail according to the definition of CHS frailty screening. In this study, the CFS-K also investigated concurrent validity. With the AUC of 0.99, a sensitivity 90.6%, and a specificity of 97.0%, the CFS-K showed excellent performance for identifying ECOG PS grade 3 or more. As the CFS has predictive and prognostic features with regard to clinical outcomes in various clinical settings [5, 16, 17], the CFS-K could be a useful screening tool for frail older in South Korea and also help provide optimal management.

Interestingly, the body mass index and K-MMSE score showed significant differences across the CSF-K scales. The relationship between frailty and sarcopenia has been reported in several studies [29, 30]; this study showed consistent results. Since low body mass index is an important risk factor of poor prognosis [31, 32], high scores on the CFS-K would be associated with poor clinical outcomes. The association between frailty and cognitive decline has been reported, and the results were consistent with previous findings [33, 34]. As important clinical characteristics can be distinguished by quick assessment with the CFS-K, it can be a valuable tool for frailty screening.

The patients assigned to scale 9 (terminally ill) showed unique characteristics. Because of the definition, for patients who were not evidently frail but had less than 6 months’ life expectancy, the scores of frailty indexes were between scale 4 (vulnerable) and scale 5 (mildly frail) and the ECOG PS score also ranged from 0 to 3; their body mass index and K-MMSE scores were also relatively high. In this study, the patients diagnosed with advanced solid or hematologic malignancy with high tumor burden were assigned to scale 9 (terminally ill). Nowadays, the life expectancy is increasing due to improvement in cancer treatment, organ transplantation, and critical care with organ-supporting systems [35–39]. Further studies regarding scale 9 (terminally ill) patients’ clinical outcomes and prognosis are warranted.

This study has some limitations. First, the validation of the CFS-K was performed with a relatively small number of participants. Second, this study included outpatients and inpatients, not a community-based population. Moreover, only patients who gave consent were enrolled. These factors might have caused selection bias. Further
large-scale studies with general population and patients in various clinical settings are warranted.

Conclusions
In conclusion, the CFS-K is a valid scale for measuring frailty in older Korean patients. The CFS-K scores were significantly correlated with the scores of other scales. To evaluate the predictive and prognostic value of this scale, further larger-scale studies in various clinical settings are warranted.

Abbreviations
FRAIL: Fatigue, Resistance, Ambulation, Illness, and Loss of weight; CHS: Cardiovascular Health Study; CFS: Clinical Frailty Scale; ECOG PS: Eastern Cooperative Oncology Group Performance Status; K-FRAIL: Korean version of the fatigue, resistance, ambulation, illness, and loss of weight; KG-7: Korean Cancer Study Group Geriatric Score; CFS-K: Korean version of Clinical Frailty Scale; K-MMSE: Korean version of the Mini-Mental State Examination; AUC: Area under the curve; SD: Standard deviation; ROC: Receiver operating characteristic

Acknowledgments
Not applicable.

Authors’ contributions
REK.: Conceptualization, data curation, resources, formal analysis, writing of original draft, and methodology. S.M.M.: Conceptualization, data curation, resources, formal analysis, writing of original draft, and methodology. G.Y.L.: Conceptualization and review/editing. Y.L.: Conceptualization and review/editing. D.K.: Conceptualization, data curation, formal methodology. S.H.L.: Data curation and reviewing/editing. J.H.L.: Data curation and reviewing/editing. D.K.: Conceptualization, data curation, formal analysis, writing of original draft, and methodology. J.C.: Conceptualization, data curation, formal analysis, writing of original draft, and methodology. C.R.C.: Conceptualization and review/editing. Y.L.: Conceptualization and review/editing. Y.S.H.: Conceptualization, methodology, and reviewing/editing. R.E.K.: Conceptualization, data curation, resources, formal analysis, writing of original draft, and methodology. All authors read and approved the final manuscript.

Funding
This research was supported by a grant of the Korea Health Technology R&D project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HI19C0481, HC19C0226). The funder had no role in the design of the study, the data collection and analysis, the interpretation of data and in writing the manuscript.

Availability of data and materials
The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Ethics approval and consent to participate
The Institutional Review Board of the Samsung Medical Center (IRB No.2019-02-028-004) and Samsung Changwon Hospital (IRB No. 2019–06-003) approved this study, and each participant provided informed written consent.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Author details
1Department of Critical Care Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81 Irwon-ro, Gangnam-gu, Seoul 06351, Republic of Korea. 2Division of Pulmonary and Critical Care Medicine, Department of Medicine, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Republic of Korea. 3Center for Clinical Epidemiology, Samsung Medical Center, Seoul, Republic of Korea. 4Department of Clinical Research Design and Evaluation, SAIHST, Sungkyunkwan University, Seoul, Republic of Korea. 5Department of Epidemiology, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, USA. 6Department of Preventive Medicine & Public Health, Ajou University School of Medicine, Suwon, Republic of Korea. 7Institute on Aging, Ajou University Medical Center, Suwon, Republic of Korea. 8Departments of Epidemiology and Medicine, and Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, USA. 9Outpatient Nursing Team, Samsung Medical Center, Seoul, Republic of Korea. 10Medical Intensive Care Unit, Samsung Medical Center, Seoul, Republic of Korea. 11Division of Pulmonary and Critical Care Medicine, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea.

Received: 6 September 2020 Accepted: 4 January 2021
Published online: 13 January 2021

References
1. Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, et al. Frailty consensus: a call to action. J Am Med Dir Assoc. 2013;14:392–7.
2. Rockwood K, Song Y, MacKnight C, Bergman H, Hogan DB, McDowell I, et al. A global clinical measure of fitness and frailty in elderly people. CMAJ. 2005;173:282–90.
3. Kane RL, Sharlaiyan T, Talley K, Pacala J. The association between geriatric syndromes and survival. J Am Geriatr Soc. 2012;60:896–904.
4. Gilardi F, Scarcella P, Proietti MG, Capobianco G, Rocco G, Capanna A, et al. Frailty as a predictor of mortality and hospital services use in older adults: a cluster analysis in a cohort study. Eur J Pub Health. 2018;28:842–6.
5. Kapeutelli T, Rueegg M, Dreher-Hummel T, Brabrand M, Kabel-Nissen S, Carpenter CR, et al. Validation of the clinical frailty scale for prediction of thirty-day mortality in the emergency department. Ann Emerg Med. 2020;76:291–300.
6. Yoshioka N, Takagi K, Morita Y, Yoshida R, Nogai H, Kanzaki Y, et al. Impact of the clinical frailty scale on mid-term mortality in patients with ST-elevated myocardial infarction. Int J Cardiol Heart Vasc. 2019;22:192–8.
7. Garcia-Canton C, Rodenas A, Lopez-Aperador C, Rivero Y, Anton G, Morzon T, et al. Frailty in hemodialysis and prediction of poor short-term outcome: mortality, hospitalization and visits to hospital emergency services. Ren Fail. 2019;41:567–75.
8. Darvall JN, Loth J, Bose T, Braat S, De Silva A, Story DA, et al. Accuracy of the clinical frailty scale for perioperative frailty screening: a prospective observational study. Can J Anaesth. 2020;67:694–700.
9. Chen S, Wong EKC, Ward SE, Kuan D, Wong CL. The predictive value of the clinical frailty scale on discharge destination and complications in older hip fracture patients. J Orthop Trauma. 2019;33:497–502.
10. Muscedere J, Waters B, Varambally A, Bagshaw SM, Boyd JG, Maslove D, et al. The impact of frailty on intensive care unit outcomes: a systematic review and meta-analysis. Intensive Care Med. 2017;43:1105–22.
11. Basic D, Shanley C, Frailty in an older inpatient population: using the clinical frailty scale to predict patient outcomes. J Aging Health. 2015;27:670–85.
12. Geense W, Zegers M, Dieperink P, Vermeulen H, van der Hoeven J, van den Boogaard M. Changes in frailty among ICU survivors and associated factors: results of a one-year prospective cohort study using the Dutch clinical frailty scale. J Crit Care. 2020;55:184–93.
13. Pilotto A, Cell A, Pilotto A, Daragatti J, Veroneze N, Musacchio C, et al. Three decades of comprehensive geriatric assessment: evidence coming from different healthcare settings and specific clinical conditions. J Am Med Dir Assoc. 2017;18:192.e1–11.
14. Dent E, Kowal P, Hoogendijk EO. Frailty measurement in research and clinical practice: a review. Eur J Intern Med. 2016;31:3–10.
15. Pugh RJ, Ellison A, Pye K, Subbe CP, Thorpe CM, Lone N, et al. Feasibility and reliability of frailty assessment in the critically ill: a systematic review. Crit Care. 2018;22:49.
16. Gregorevic KJ, Hubbard RE, Lim WK, Katz B. The clinical frailty scale predicts functional decline and mortality when used by junior medical staff: a prospective cohort study. BMC Geriatr. 2016;16:117.
17. Reichart D, Rosato S, Nammas W, Onorati F, Dalén M, Castro L, et al. Clinical frailty scale and outcome after coronary artery bypass grafting. Eur J Cardiothorac Surg. 2018;54:1102–9.

18. Wallis SJ, Wall J, Biram RW, Romero-Ortuno R. Association of the clinical frailty scale with hospital outcomes. QJM. 2015;108:943–9.

19. Juma S, Taabazuing MM, Montero-Odasso M. Clinical frailty scale in an acute medicine unit: a simple tool that predicts length of stay. Can Geriatr J. 2016;19:34–9.

20. Abraham P, Couvoisier DS, Annweiler C, Lenoir C, Millien T, Dalmaz F, et al. Validation of the clinical frailty score (CFS) in French language. BMC Geriatr. 2019;19:322.

21. Chan DC, Tsou HH, Chen CY, Chen CY. Validation of the Chinese-Canadian study of health and aging clinical frailty scale (CSHA-CFS) telephone version. Arch Gerontol Geriatr. 2010;50:e74–80.

22. Oken MM, Creech RH, Tormey DC, Horton J, Davis TE, McFadden ET, et al. Toxicity and response criteria of the eastern cooperative oncology group. Am J Clin Oncol. 1982;5:649–55.

23. Jung HW, Yoo HJ, Park SY, Kim SW, Choi JY, Yoon SJ, et al. The Korean version of the FRAIL scale: clinical feasibility and validity of assessing the frailty status of Korean elderly. Korean J Intern Med. 2016;31:594–600.

24. Kim JW, Kim SH, Kim YJ, Lee KW, Kim KI, Lee JS, et al. A novel geriatric screening tool in older patients with cancer: the Korean cancer study group geriatric score (K-G7). PLoS One. 2015;10:e138304.

25. Hwang HS, Kwon IS, Park BJ, Cho B, Yoon JL, Won CW. The validity and reliability of Korean frailty index. J Korean Geriatr Soc. 2010;14:191–202.

26. Lent L, Hahn E, Eremenco S, Webster K, Cella D. Using cross-cultural input to adapt the functional assessment of chronic illness therapy (FACIT) scales. Acta Oncol. 1999;38:695–702.

27. Kang Y, Na DL, Hahn S. Reliability and validity of the Korean version of the way-finding effectiveness scale for persons with dementia. J Korean Neurol Assoc. 1997;15:300–8.

28. Han C, Jo SA, Jo I, Kim E, Park MH, Kang Y. An adaptation of the Korean mini-mental state examination (K-MMSE) in elderly Koreans: demographic influence and population-based norms (the AGE study). Arch Gerontol Geriatr. 2008;47:302–10.

29. Wilson D, Jackson T, Sapey E, Lord JM. Frailty and sarcopenia: the potential role of an aged immune system. Ageing Res Rev. 2017;36:1–10.

30. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis: report of the European working group on sarcopenia in older people. Age Ageing. 2010;39:412–23.

31. Hagi J, Metoki N, Saito S, Fujita A, Shiroto H, Sasaki S, et al. Low body mass index is a poor prognosis factor in Cardioembolic stroke patients with NonValvular atrial fibrillation. J Stroke Cerebrovasc Dis. 2018;27:3155–62.

32. Naffouje SA, Tulla KA, Khalaf Z, Salti GI. The impact of BMI extremes on disease-free survival and overall survival following cytoreductive surgery and hyperthermic intraperitoneal chemotherapy. J Gastrointest Oncol. 2019;10:194–202.

33. Miyamura K, Fhon JRS, Bueno AA, Fuentes-Neira WL, Silveira R, Rodrigues RAP. Frailty syndrome and cognitive impairment in older adults: systematic review of the literature. Rev Lat Am Enfermagem. 2019;27:e3202.

34. Robertson DA, Savva GM, Kenny RA. Frailty and cognitive impairment—a review of the evidence and causal mechanisms. Ageing Res Rev. 2013;12:840–51.

35. Jung KW, Won YJ, Hong BY, Lee HS, Ko TK, Lee JS, et al. Community of population-based regional Cancer R. cancer statistics in Korea: incidence, mortality, survival, and prevalence in 2015. Cancer Res Treat. 2018;50:303–16.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.