CLINICAL STUDY

Usefulness of the Simplified Frailty Scale in Predicting Risk of Readmission or Mortality in Elderly Patients Hospitalized with Cardiovascular Disease

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Summary

The simplified frailty scale is a simple frailty assessment tool modified from Fried’s phenotypic frailty criteria, which is easy to administer in hospitalized patients. The applicability of the simplified frailty scale to indicate prognosis in elderly hospitalized patients with cardiovascular disease (CVD) was examined.

This cohort study was performed in 895 admitted patients ≥ 65 years (interquartile range, 71.0-81.0, 541 men) with CVD. Patients were classified as robust, prefrail, or frail based on the five components of the simplified frailty scale: weakness, slowness, exhaustion, low activity, and weight loss. The primary endpoint was the composite outcome of all-cause mortality and unplanned readmission for CVD.

Patients positive for greater numbers of frailty components showed higher risk of all-cause mortality or unplanned CVD-related readmission (P for trend < 0.001). Classification as both frail (adjusted HR: 3.27, 95% confidence interval [CI]: 1.49-7.21, P = 0.003) and prefrail (adjusted HR: 2.19, 95% CI: 1.00-4.79, P = 0.049) independently predicted the composite endpoint compared with robust after adjusting for potential confounding factors. The inclusion of prefrail, frail, and number of components of frailty increased both continuous net reclassification improvement (0.113, P = 0.049; 0.426, P < 0.001; and 0.321, P < 0.001) and integrated discrimination improvement (0.007, P = 0.357; 0.009, P = 0.038; and 0.018, P = 0.002) for the composite endpoint.

Higher scores on the simplified frailty scale were associated with increased risk of mortality or readmission in elderly patients hospitalized for CVD.

Key words: Frail, Prefrail, Prognosis, Heart failure, Cardiac surgery, Ischemic heart disease, Elderly people

The occurrence of frailty is becoming increasingly important in cardiovascular medicine due to aging of the population. Frailty is represented by reduced physiological reserve and increased vulnerability to adverse outcomes in the elderly. The prevalence rates of frailty are particularly high in patients with cardiovascular disease (CVD). Frailty results in adverse outcomes, including mortality and readmission in CVD patients. Therefore, it is essential to develop means of assessing frailty in acute clinical settings to allow the formulation of healthcare plans and for decision making regarding appropriate therapeutic interventions.

Although Fried’s phenotypic frailty criteria have been widely used in frailty research, its application in a clinical setting is not easy. Especially, physical activity assessment according to the Minnesota leisure time physical activity takes a long time and is not appropriate for hospitalized patients.

The simplified frailty scale is a simple frailty assessment tool based on Fried’s phenotypic frailty criteria, which can be applied easily in hospitalized patients. However, there have been no previous reports regarding the prognostic value of the simplified frailty scale in elderly CVD patients.

Therefore, we hypothesized that the simplified frailty scale would predict mortality and readmission among elderly patients hospitalized for CVD.

Methods

Study population: The present retrospective study included 1540 Japanese patients aged ≥ 65 years who were admitted to the Cardiovascular Center, Kitasato University Hospital, for CVD (ischemic heart disease, post-cardiac...
The stored patients aged 65 years and older with cardiovascular disease in the Kitasato University Cardiac Rehabilitation Database after the hospital discharge from June 2015 to December 2017. \( (n = 1540) \)

Excluded criteria
1. Died before assessment of handgrip strength and walking speed \( (n = 193) \)
2. Discharged before assessment of handgrip strength and walking speed \( (n = 110) \)
3. Unstable medical conditions \( (n = 112) \)
4. Severe disability \( (n = 165) \)
5. Other \( (n = 65) \)

Studied patients \( (n = 895) \)

**Figure 1.** Flow diagram of patient selection.

**Table 1.** Simplified Frailty Scale

| Component         | Assessment and question                                      | scoring |
|-------------------|-------------------------------------------------------------|---------|
| Weakness          | Handgrip strength                                           | 1 = Men < 26 kg Women < 18 kg, 0 = other         |
| Slowness          | Usual gait speed                                            | 1 = < 1.0 m/second, 0 = others                 |
| Exhaustion        | In the past two weeks have you felt tired without a reason?  | 1 = Yes, 0 = No                                |
| Low activity level| 1) Do you engage in moderate levels of physical exercise or sports aimed at health?  | 1 = “No” to both questions, 0 = others          |
|                   | 2) Do you engage in low levels of physical exercise aimed at health? | 1 = Yes, 0 = No                                |
| Weight loss       | Have you lost two kg or more in the past six months?         | 1 = Yes, 0 = No                                |

surgery, heart failure, and others) and who participated in the inpatient cardiac rehabilitation program between June 2015 and December 2017. After applying exclusion criteria, 895 patients were finally enrolled (Figure 1). The study was approved by the Ethics Committee of Kitasato University Hospital and was performed in accordance with the Declaration of Helsinki.

**Data collection:** Patient characteristics, including age, sex, weight, height, body mass index (BMI), type of CVD (ischemic heart disease, heart failure, and cardiac surgery), duration of hospitalization, blood pressure (systolic and diastolic), smoking habit (current or not), cardiac function (left ventricular ejection fraction), biochemical data, comorbidities (hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation, prior myocardial infarction, prior angina pectoris, prior heart failure, and chronic kidney disease (CKD) according to estimated glomerular filtration rate (eGFR) < 60 (mL/minute/1.73 m²)) just before discharge from the hospital were obtained from the electronic medical records. The eGFR was defined according to the formula of the Japanese Society of Nephrology: men: 194 × (serum creatinine)\(^{1.094} \times (\text{age})^{0.287}\); women: 194 × (serum creatinine)\(^{1.044} \times (\text{age})^{0.287} \times 0.739\). Left ventricular ejection fraction was evaluated by Simpson’s method on two-dimensional echocardiography.

**Frailty phenotype according to the simplified frailty scale:** The simplified frailty scale, named the Japanese version of the Cardiovascular Health Study criteria, consists of five components, i.e., slowness, weakness, exhaustion, low activity, and weight loss (Table 1), and can be used to classify patients as frail, prefrail, or robust according to the presence of at least three, one to two, or none of these five components, respectively.\(^7,8\) Slowness was defined as usual gait speed < 1.0 m/second at hospital discharge, measured over the middle 10 m of a 16-m walkway using the patient’s customary walking aid if necessary.\(^11\) Weakness was defined as handgrip strength less than the sex-specific criteria of < 26 kg for men and < 18 kg for women at hospital discharge.\(^12\) The handgrip strength was defined as maximal isometric voluntary contraction of the hand for 3 seconds measured twice for each hand in the sitting position with the elbow joint at 90° flexion, using a digital dynamometer (TKK 5101 Grip-D; Takei, Tokyo, Japan). The analyses were performed using the greatest strength measurement expressed as an absolute value in kilograms. A self-reported comprehensive health checklist developed by the Japanese Ministry of Health, Labour and Welfare (Kihon Checklist) was used to identify exhaustion.\(^13\) Patients who responded “Yes” to the question “In the last two weeks, have you felt tired for no reason?” were defined as positive for exhaustion. Patients who responded “No” to both of the questions “Do you engage in moderate levels of physical exercise or sports aimed at health?” and “Do you engage in low levels of physical exercise aimed at health?” were classified as positive for low activity.\(^11\) Patients answering “Yes” to the question “Have you lost two kg or more in the past six months?” were classified as positive for weight loss.\(^13\) Exhaustion, low activity, and weight loss were determined at first cardiac rehabilitation.
Table II. Baseline Characteristics

| Variable                             | Overall (n = 895) | Robust (n = 101) | Prefrail (n = 407) | Frail (n = 387) | P-value |
|--------------------------------------|-------------------|------------------|--------------------|----------------|---------|
| Age (years)                          | 76.0 [71.0 – 81.0]| 73.0 [68.0 – 76.0]| 74.0 [70.0 – 79.0]| 79.0 [74.0 – 85.0] | < 0.001 |
| Men (%)                              | 541 (60.4)        | 74 (73.3)        | 279 (68.6)         | 188 (48.6)      | < 0.001 |
| Body mass index (kg/m²)              | 21.5 [19.5 – 23.7]| 22.3 [21.1 – 23.9]| 22.1 [19.9 – 24.2]| 20.3 [18.3 – 22.9] | < 0.001 |
| Weight (kg)                          | 54.5 [46.7 – 62.8]| 59.1 [53.1 – 65.9]| 57.5 [50.4 – 64.8]| 49.6 [43.0 – 57.1] | < 0.001 |
| Height (cm)                          | 160.0 [151.5 – 165.3]| 163.6 [157.8 – 167.0]| 161.5 [154.4 – 167.0]| 156.0 [148.0 – 162.0] | < 0.001 |
| Systolic blood pressure (mmHg)      | 114.0 [98.0 – 128.0]| 114.0 [104.0 – 127.0]| 117.0 [101.0 – 132.0]| 111.0 [96.0 – 123.8] | < 0.001 |
| Diastolic blood pressure (mmHg)     | 63.0 [54.0 – 74.0]| 69.0 [59.0 – 77.0]| 65.0 [56.0 – 76.5]| 60.0 [52.0 – 69.0] | < 0.001 |
| Left ventricular ejection fraction (%)| 56.5 [44.0 – 66.0]| 56.0 [42.9 – 66.3]| 57.3 [45.0 – 66.0]| 56.0 [41.2 – 66.0] | 0.685  |
| Estimated glomerular filtration rate (mL/minute/1.73 m²) | 49.0 [33.0 – 61.0]| 54.0 [46.0 – 64.9]| 52.0 [40.0 – 63.0]| 41.0 [28.0 – 56.7] | < 0.001 |
| Duration of hospitalization (days)   | 18.0 [11.0 – 28.0]| 13.0 [8.0 – 19.0]| 17.0 [11.0 – 25.0]| 20.0 [13.0 – 30.0] | < 0.001 |
| Current smoker (%)                   | 122 (13.6)        | 15 (14.9)        | 66 (16.2)          | 41 (10.6)       | 0.065  |
| Heart failure (%)                    | 323 (36.1)        | 21 (20.8)        | 114 (28.0)         | 188 (48.6)      | < 0.001 |
| Ischemic heart disease (%)           | 223 (24.9)        | 37 (36.6)        | 107 (26.3)         | 79 (20.4)       | 0.002  |
| Cardiac surgery (%)                  | 207 (23.1)        | 22 (21.8)        | 111 (27.3)         | 74 (19.1)       | 0.023  |
| Hypertension (%)                     | 627 (70.1)        | 67 (66.3)        | 292 (71.7)         | 268 (69.3)      | 0.512  |
| Diabetes mellitus (%)                | 589 (65.8)        | 68 (67.3)        | 275 (67.6)         | 246 (63.6)      | 0.466  |
| Dyslipidemia (%)                     | 373 (41.7)        | 48 (47.5)        | 177 (43.5)         | 148 (38.2)      | 0.146  |
| Atrial fibrillation (%)              | 206 (23.0)        | 20 (19.8)        | 82 (20.1)          | 104 (26.9)      | 0.057  |
| Prior myocardial infarction (%)      | 108 (12.1)        | 6 (5.9)          | 41 (10.1)          | 61 (15.8)       | 0.006  |
| Prior angina pectoris (%)            | 121 (13.5)        | 10 (9.9)         | 49 (12.0)          | 62 (16.0)       | 0.138  |
| Prior heart failure (%)              | 262 (29.3)        | 19 (18.8)        | 96 (23.6)          | 147 (38.0)      | < 0.001 |
| Chronic kidney disease (%)           | 654 (73.1)        | 64 (63.4)        | 282 (69.3)         | 308 (79.6)      | < 0.001 |
| Frailty assessment                   |                   |                  |                    |                |         |
| Handgrip (kg)                        | 22.3 [17.1 – 28.4]| 30.0 [26.1 – 34.6]| 25.4 [20.0 – 30.6]| 17.8 [14.3 – 22.7] | < 0.001 |
| Usual gait speed (m/second)          | 0.96 [0.70 – 1.14]| 1.22 [1.10 – 1.31]| 1.08 [0.89 – 1.18]| 0.73 [0.55 – 0.91] | < 0.001 |
| Exhaustion (%)                       | 378 (42.2)        | 0 (0.0)          | 117 (28.7)         | 261 (67.4)      | < 0.001 |
| Low activity level (%)               | 414 (46.3)        | 0 (0.0)          | 137 (33.7)         | 277 (71.6)      | < 0.001 |
| Weight loss (%)                      | 247 (27.6)        | 0 (0.0)          | 73 (17.9)          | 174 (45.0)      | < 0.001 |

Values are median [interquartile range] or number (%).

Outcome: Information on all-cause mortality and CVD-related unplanned readmission was obtained from the death and readmission registry at the hospital. The primary endpoint was the composite outcome of all-cause mortality and unplanned readmission for CVD at hospital discharge (first to occur).

Statistical analysis: Continuous variables are expressed as the median (interquartile range). Categorical variables are expressed as n (%). Patients were divided into three groups based on their baseline characteristics (robust, prefrail, and frail) according to the simplified frailty scale and were compared by one-way analysis of variance or χ² test.

The cumulative probabilities of all-cause mortality or unplanned readmission for CVD were evaluated with the Kaplan-Meier method. The differences were evaluated by the log-rank test. Cox regression analysis was used to analyze the frailty phenotype and all-cause mortality or unplanned readmission by constructing two predictive models, i.e., model 1: age, sex, BMI; model 2: model 1 + current smoker, prior heart failure, hypertension, diabetes mellitus, dyslipidemia, CKD, duration of hospitalization, heart failure, ischemic heart disease, and cardiac surgery.

To investigate whether frailty phenotype and number of components of frailty based on simplified frailty scale complemented the predictive capability, a logistic model was constructed for all-cause mortality or unplanned readmission using adjusted variables that were presented as independent predictors of outcome except frailty phenotype and number of components of frailty (clinical model). The areas under the curves (AUCs), continuous net reclassification improvement (cNRI), and integrated discrimination improvement (IDI) were constructed for all-cause mortality or unplanned readmission to compare the clinical model with the clinical model + prefrail, frail, and number of components of frailty. The method of DeLong et al. was used to compare the AUCs, and the cNRI and IDI were used as more sensitive statistical methods for quantification of the improvements associated with the addition of a new variable to an existing clinical model.

Statistical analyses were performed with JMP® Pro 14.1 (SAS Institute Inc., Cary, NC) and R version 3.2.1 (R Foundation for Statistical Computing, Vienna, Austria). In all analyses, a two-tailed P-value < 0.05 was taken to indicate statistical significance.

Results

Patient characteristics: The study population consisted of 895 patients, all of whom were stratified into one of three groups according to frailty phenotype determined using the simplified frailty scale, i.e., robust, prefrail, and frail. Table II shows the baseline characteristics of the three groups. The median age of the study population was
76.0 years (range 71-81 years), and 60.4% were men. Of all patients, 11.3% were robust, 45.5% were prefrail, and 43.2% were frail. At baseline, frail individuals were significantly likely to be older, included a higher percentage of women, had lower BMI and eGFR, have a higher percentage of comorbidities (atrial fibrillation, prior myocardial infarction, prior heart failure, and CKD), prolonged hospital stay, and had a higher percentage of heart failure.

Figure 2 shows the prevalence rates of robust, prefrail, and frail across age and sex categories. The prevalence rate of frail increased with age ($P$ for trend < 0.001 for both sexes), whereas that of prefrail decreased with age ($P$ for trend < 0.001 for both sexes). Female patients had a significantly higher prevalence rate of frail than male patients (56% versus 35%, respectively, $P$ < 0.001).

**Association between frailty phenotype according to the simplified frailty scale and prognosis:** During a median follow-up of 289 (range 128-463) days, 184 (20.6%) patients were positive for all-cause mortality or unplanned readmission associated with CVD after discharge. Figure 3 shows the cumulative probabilities of all-cause mortality or unplanned readmission based on frailty phenotype or number of components of frailty using Kaplan-Meier survival curves.

There were significant differences in cumulative events for all-cause mortality or unplanned readmission for CVD between the groups (log rank: $P < 0.001$). The results of univariate and multivariate Cox regression analyses for all-cause mortality or unplanned readmission for CVD are shown in Table III. In univariate Cox regression analysis, the crude hazard ratios (HRs) for prefrail and frail were 2.45 (95% confidence interval [CI] 1.12-5.35) and 5.42 (95% CI 2.52-11.65), respectively, compared with that for robust. Even after adjusting for age, sex, BMI, current smoker, prior heart failure, hypertension, diabetes mellitus, dyslipidemia, CKD, duration of hospitalization, heart failure, ischemic heart disease, and cardiac surgery, the adjusted HRs for prefrail and frail were 2.19 (95% CI 1.00-4.79) and 3.27 (95% CI 1.49-7.21), respectively, compared with that for robust (model 2).

Greater number of frailty components was progressively associated with higher risk of all-cause mortality or unplanned readmission for CVD ($P$ for trend < 0.001), and the risk was significantly greater among those with > 1 frailty criteria in comparison with 0 frailty criteria, after even adjusting for age, sex, BMI, current smoker, prior heart failure, hypertension, diabetes mellitus, dyslipidemia, CKD, duration of hospitalization, heart failure, ischemic heart disease, and cardiac surgery ($P$ for trend < 0.001).

**Additive prognostic predictive capabilities of the simplified frailty scale:** The AUCs on receiver operating characteristic (ROC) curve analysis for the clinical model only and clinical model plus prefrail, frail, or number of components of frailty were 0.746 (95% CI 0.706-0.787) versus 0.755 (95% CI 0.717-0.793), 0.757 (95% CI 0.718-0.796), and 0.767 (95% CI 0.730-0.805), respectively. The AUC for the clinical model plus number of components of frailty was significantly greater than that for the clinical model only ($P = 0.018$). In addition, inclusion of prefrail, frail, or number of components of frailty in the clinical model showed associations with significant increases in both cNRI and IDI for all-cause mortality or unplanned readmission for CVD, respectively (Table IV).
USEFULNESS OF THE SIMPLIFIED FRAILTY SCALE

III. Associations of Simplified Frailty Scale with All-Cause Mortality or Unplanned Readmission for Cardiovascular Disease

| Number of components of frailty | Univariate Cox regression |  | Multivariate Cox regression |  |  | Model 1 |  | Model 2 |  |
|---------------------------------|---------------------------|---|-----------------------------|---|---|-----------------|---|-----------------|---|
|                                 | HR 95% CI                  | P-value | HR 95% CI                  | P-value | HR 95% CI                  | P-value |
| 5                               | 6.98 (2.74–17.76)          | < 0.001 | 6.29 (2.45–16.13)          | 0.003   | 3.94 (1.40–9.94)          | 0.008   |
| 4                               | 6.16 (2.78–13.65)          | < 0.001 | 5.42 (2.39–12.27)          | 0.002   | 3.80 (1.67–8.67)          | 0.002   |
| 3                               | 4.69 (2.13–10.33)          | < 0.001 | 4.24 (1.90–9.46)           | < 0.001 | 3.07 (1.37–6.90)          | 0.007   |
| 2                               | 3.37 (1.52–7.50)           | 0.002   | 3.11 (1.39–6.94)           | 0.005   | 2.88 (1.29–6.45)          | 0.010   |
| 1                               | 1.59 (0.67–3.72)           | 0.285   | 1.53 (0.65–3.59)           | 0.350   | 1.52 (0.64–3.58)          | 0.332   |
| 0                               | 1.00 [Reference]           | [Reference] | 1.00 [Reference]           | [Reference] | 1.00 [Reference]     | [Reference] |
| P for trend                     | < 0.001                   |        | < 0.001                   |        | < 0.001                   |        |
| Frail                           | 5.42 (2.52–11.65)          | < 0.001 | 4.71 (2.16–10.29)          | < 0.001 | 3.27 (1.49–7.21)          | 0.003   |
| Prefrail                        | 2.45 (1.12–5.35)           | 0.023   | 2.29 (1.05–5.01)           | 0.037   | 2.19 (1.00–4.79)          | 0.049   |
| Robust                          | 1.00 [Reference]           | [Reference] | 1.00 [Reference]           | [Reference] | 1.00 [Reference]     | [Reference] |
| P for trend                     | < 0.001                   |        | < 0.001                   |        | < 0.001                   |        |

Table IV. Predictive Value Analyses for All-Cause Mortality or Unplanned Readmission for Cardiovascular Disease

| Model                        | AUC 95% CI | P-value | cNRI 95% CI | P-value | IDI 95% CI | P-value |
|------------------------------|------------|---------|-------------|---------|------------|---------|
| Clinical model               | 0.746      | 0.706–0.787 | [Reference] | [Reference] | [Reference] | [Reference] |
| + Prefrail                   | 0.755      | 0.717–0.793 | 0.110 | 0.113 | 0.001–0.226 | 0.049 | 0.007 | 0.001–0.013 | 0.037 |
| + Frail                      | 0.757      | 0.718–0.796 | 0.104 | 0.426 | 0.266–0.584 | < 0.001 | 0.009 | 0.001–0.018 | 0.038 |
| + Number of components of frailty | 0.763  | 0.730–0.805 | 0.018 | 0.321 | 0.162–0.481 | < 0.001 | 0.018 | 0.007–0.030 | 0.002 |

Clinical model: age, sex, body mass index, current smoker, prior heart failure, hypertension, diabetes mellitus, dyslipidemia, chronic kidney disease, duration of hospitalization, heart failure, ischemic heart disease, and cardiac surgery. AUC indicates area under the receiver operating characteristic curve; cNRI, continuous net reclassification improvement; and IDI, integrated discrimination improvement.

Discussion

The results of the present study indicated that frail and prefrail, defined according to the simplified frailty scale, were independent predictors of all-cause mortality or unplanned readmission for CVD in hospitalized patients with CVD. In hospitalized CVD patients, the inclusion of prefrail, frail, and number of components of frailty based on the simplified frailty scale to the clinical model had complementary prognostic predictive capability.
Moreover, risk became progressively higher with positivity for greater numbers of components of the simplified frailty scale.

Recent studies estimated the prevalence rates of prefrailty and frailty to be approximately 34.6%-50.9% and 4.9%-27.3%, respectively, in community-dwelling populations and 27.5%-38.5% and 20%-52.8% in hospitalized CVD patients. Using the simplified frailty scale, Satoh et al. reported that the prevalence rates of prefrailty and frailty in 16,251 community-dwelling older people were 51.9% and 11.2%, respectively. The prevalence rates of prefrailty and frailty in 777 outpatients with chronic diseases were reported to be 21.6% and 57.9%, respectively. In addition, the prevalence rates of frailty and prefrailty were shown to increase with age. In the present study, the prevalence rates of frailty and prefrailty among hospitalized CVD patients were 43% and 45%, respectively. The prevalence rate of frailty increased whereas that of prefrailty decreased with age. These observations indicated that a number of prefrail patients transitioned to frailty with increasing age. Therefore, it will be necessary to increase awareness of frailty and prefrailty among hospitalized CVD patients and to develop effective preventive strategies.

A previous study showed that a diagnosis of frailty according to the simplified frailty scale was also an independent predictor for incident disability in community-dwelling older adults. The present study indicated that the simplified frailty scale can provide independent prognostic information in elderly hospitalized CVD patients. Several studies showed that frailty or prefrailty status is associated with risk of mortality and readmission in patients with heart failure, ischemic heart disease, and cardiac surgery, and in hospitalized elderly patients. Several review articles have also indicated that prognosis is poorer among frail CVD patients than in their robust counterparts. Frailty has been reported to be a predictor of mortality and readmission in hospitalized CVD patients. However, the study populations in these two studies were much smaller than in the present study (450 and 497 versus 895, respectively), and patients with prefrailty were included in the robust groups in both studies. Therefore, patients at risk may have been overlooked in these previous studies. Our study further supports existing data showing that diagnoses of frailty and prefrailty according to the simplified frailty scale were significant and independent predictors of the composite endpoint even in the fully adjusted model. To our knowledge, this is the first report that frailty and prefrailty defined according to the simplified frailty scale show incremental prognostic value in hospitalized elderly CVD patients.

The AUC for the composite endpoint was highest with the addition of the simplified frailty scale to the clinical model (age, sex, BMI, current smoker, hypertension, diabetes mellitus, dyslipidemia, prior heart failure, CKD, duration of hospitalization, heart failure, ischemic heart disease, and cardiac surgery), although the P-value did not reach statistical significance. However, the inclusion of frailty and prefrailty according to the simplified frailty scale in cNRI and IDI analyses added prognostic information and improved prediction of the primary end-point, i.e., the composite outcome of all-cause mortality and unplanned readmission for CVD, compared with the clinical model alone. The results of the present study indicated that frailty, prefrailty, and increasing number of components of frailty according to the simplified frailty scale can provide independent prognostic information in elderly hospitalized patients with CVD.

The risk of developing frailty is increased by both clinical and subclinical CVD. CVD adversely affects multiple organ systems and therefore contributes to the development of frailty. Activated inflammatory pathways play important roles in the occurrence of both frailty and CVD. Such inflammatory processes lead to a catabolic state with reduced levels of anabolic hormones, which results in the development of sarcopenia. These observations suggest an association between frailty and poor prognosis in CVD patients, although the precise underlying mechanism has yet to be determined.

Assessment of frailty is also important for management of CVD because improved physical function associated with frailty has been reported to reduce the risk of adverse outcomes in CVD. Interventions, such as physical exercise and nutritional recommendations, can reduce the number of cases of transition from frailty to disability and mortality in frail patients. The results of the present study indicated that the number of patients classified as prefrail or frail according to the simplified frailty scale transiting to frail increased with age. The simplified frailty scale can be used for clinical assessment of frailty and prefrailty in elderly hospitalized patients with CVD and may be useful in determining prognosis as well as in the development of preventive strategies.

The present study had several limitations. First, this was a retrospective study performed in a single center. Second, patients in whom it was not possible to evaluate walking speed and handgrip strength were excluded. Therefore, the frequency of frailty in elderly patients hospitalized for CVD and the actual rates of all-cause mortality and readmission were likely underestimated. Third, the use of multiple testing in this study may have increased the risk of false positives. Finally, unmeasured factors, such as socioeconomic status and cognitive impairment, may have been confounders in this study.

Conclusions

Frailty assessment according to the simplified frailty scale provided independent predictors of prognosis in hospitalized elderly CVD patients. The simplified frailty scale was shown to be useful for risk stratification of older CVD patients in clinical practice.

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Disclosure

Conflicts of interest: The authors have no conflicts of in-
terest to disclose.

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