Original Article

Validating a Standardised Approach in Administration of the Clinical Frailty Scale in Hospitalised Older Adults

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Abstract

Introduction: We developed a Clinical Frailty Scale algorithm (CFS-A) to minimise inter-rater variability and to facilitate wider application across clinical settings. We compared the agreement, diagnostic performance and predictive utility of CFS-A against standard CFS. Materials and Methods: We retrospectively analysed data of 210 hospitalised older adults (mean age, 89.4 years). Two independent raters assessed frailty using CFS-A. Agreement between CFS-A raters and with previously completed CFS was determined using Cohen's Kappa. Area under receiver operator characteristic curves (AUC) for both measures were compared against the Frailty Index (FI). Independent associations between these measures and adverse outcomes were examined using logistic regression. Results: Frailty prevalence were 81% in CFS and 96% in CFS-A. Inter-rater agreement between CFS-A raters was excellent (kappa 0.90, *P* <0.001) and there was moderate agreement between CFS-A and standard CFS (kappa 0.42, *P* <0.001). We found no difference in AUC against FI between CFS (0.91; 95% CI, 0.86-0.95) and CFS-A (0.89; 95% CI, 0.84-0.95; *P* <0.001). Both CFS (OR, 3.59; 95% CI, 2.28-5.67; *P* <0.001) and CFS-A (OR, 4.31; 95% CI, 2.41-7.69; *P* <0.001) were good predictors of mortality at 12 months. Similarly, CFS (OR, 2.59; 95% CI, 1.81-3.69; *P* <0.001) and CFS-A (OR, 3.58; 95% CI, 2.13-6.02; *P* <0.001) were also good predictors of institutionalisation and/or mortality after adjusting for age, sex and illness severity. Conclusion: Our study corroborated the results on inter-rater reliability, diagnostic performance and predictive validity of CFS-A which has the potential for consistent and efficient administration of CFS in acute care settings.

Ann Acad Med Singapore 2019;48:115-24

Key words: Assessment, Frailty, Geriatric, Inpatient, Risk

Introduction

Singapore is ageing at an exponential rate. Commensurate with the worldwide trend of population ageing, 13% of residents were aged 65 years and older in 2017 with a life expectancy of 83.1 years.[1] By 2030, the aged population is projected to constitute approximately 25% of its total population with the cost of providing care to older adults rising to US$49 billion (S$66 billion) annually and an average cost of US$37,427 for each older person.[1,2] Therefore, it is imperative that healthcare services across Singapore become frailty-ready to face and embrace the growing challenges of caring for older adults.[3]

Frailty—a modern geriatric giant—is defined as a state of reduced strength and physiological malfunctioning that increases a person's susceptibility to increased dependency, vulnerability and even death.[4,5] Its rising prevalence is leading to greater healthcare needs and costs that will impact on government, community and individuals.[6] From a public health perspective, frailty in a population is now increasingly used as an indicator of healthcare utilisation and successful ageing.[7] Hence, greater emphasis on identifying frailty is needed to facilitate early detection, intervention and appropriate resource allocation in hospitals and community.

Various frailty tools have been developed and validated to screen and assess frailty.[5] While this has improved frailty identification, it has also led to great variability in frailty classification and heterogeneity in predictive abilities.[5,8] For example, kappa coefficients ranged from 0.3 to 0.58 for agreement between 2 widely used seminal approaches of frailty index (FI)[9] and Fried's physical phenotype.[10]

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The harmonisation of frailty assessment is especially salient in acute settings since hospitalised older adults have a high prevalence of frailty, are vulnerable to adverse outcomes and consume a disproportionately large amount of healthcare resources.[11] A recent local study of hospitalised older adults similarly reported that while frailty tools have good predictive outcomes, they are not equivalent in terms of frailty prevalence estimates, diagnostic performance (against the FI) and predictive validity for different outcomes.[12] This underscores the importance of developing a global tool which provides a common language for frailty identification and grading of severity that is akin to the Clinical Dementia Rating in dementia evaluation. The latter has found widespread utility as a severity-ranking global assessment scale in many studies of Asian populations.[13]

Against this backdrop, the Clinical Frailty Scale (CFS) is attractive as a global synthesis assessment tool that allows frailty to be defined and graded using simple clinical descriptors which are available from routine clinical assessment.[14] CFS is a well validated measure for frailty that has been shown to predict adverse outcomes in older adults.[5,15,16] The 9-point scale allows classification across the frailty continuum that ranges from 1 (very fit) to 9 (terminally ill). A score of 5 to 8 is considered frail. Each CFS category has a brief description and visual depiction to aid the classification of frailty. CFS requires some clinical judgement in its scoring and trained assessors are needed for accurate classification.[5] Although 1 study reported CFS predicted adverse health outcomes when administered by junior medical staff,[15] studies that specifically examined the reliability and diagnostic performance of CFS in real-world settings are sparse. Various algorithm-based approaches have been developed to simplify the evaluation of CFS for research purposes and they ranged from telephonic administration to multinational survey analyses.[15-18] However, to our knowledge, there is no standardised approach to aid rapid administration of CFS in busy clinical settings. This provides the impetus to develop a standardised algorithmic approach to ensure accurate and consistent scoring of CFS. The algorithm simplifies the process by making the key nodal decision points explicit and it minimises arbitrary and tentative synthetic assessment and scoring of CFS.

This study compares the agreement, diagnostic performance and predictive utility of CFS algorithm (CFS-A) against the standard approach of completing a detailed assessment, or comprehensive geriatric assessment (CGA), prior to rating an individual's CFS score[14] in older adults admitted to an acute hospital. We aim to establish the usefulness of CFS-A as a tool that provides accurate and consistent identification of frailty in a feasible manner and its potential for wider administration across acute care settings and by non-physicians.

Materials and Methods

Study Design and Eligibility Criteria

Our earlier study had increased our understanding of the diagnostic and predictive performance of 3 frailty measures (Tilburg Frailty Indicator,[19] FRAIL[20] and CFS) against the "gold-standard" FI. For this study, we proceeded to examine the usefulness of CFS-A by using the database of collected variables.

A total of 210 older adults who were consecutively admitted to the Department of Geriatric Medicine at Tan Tock Seng Hospital in Singapore in 2015 were examined. We collected data on patient demographics, comorbidities and severity of illness using the modified Charlson's comorbidity index (CCI) and modified severity of illness index, respectively.[21,22] Each subject was scored on CFS by an independent rater based on clinical information. As stipulated by the exclusion criteria, individuals with CFS 9 were excluded from the study. Further details of the study methods, including how frailty assessment was performed using FI, were described previously.[12]

Informed consent was obtained from the patient or from a legally acceptable representative (in individuals who lack capacity to provide consent). Ethics approval was obtained from the Domain Specific Review Board of the National Healthcare Group of Singapore.

Frailty Assessment Using a Standardised Approach

We developed a standardised algorithmic approach to aid assessors to perform rapid frailty screen (see Appendix 1). It includes the following information: 1) brief description of CFS, 2) definition of premorbid frailty status, 3) step-by-step guide to score CFS-A, 4) original descriptors of CFS, and 5) list of basic and instrumental activities of daily living (ADL).

Two independent raters were assigned to score CFS-A. They were asked to retrospectively score each patient's premorbid frailty status using CFS-A based on information from the database. The variables included: 1) demographics (age and gender), 2) CCI, 3) self-reported symptoms of fatigue or difficulties in ambulation, 4) premorbid basic and instrumental ADLs, and 5) self-reported change in general health, increasing breathlessness or significant weight loss. Both assessors were blinded to each other's scores as well as original CFS scores in our previous study.[12]

Due to limited information available to the assessors from the database, it was decided that it would be challenging for them to distinguish between CFS stages 1 to 3 and stages 7 to 8 without access to relevant information about each patient's overall fitness and anticipated clinical outcomes and prognoses. Therefore, we combined CFS stages 1 to 3 and 7 to 8 in the final rating which resulted in 5 frailty categories: robust (CFS 1 to 3), vulnerable (CFS 4), mildly frail (CFS

5), moderately frail (CFS 6) and severely frail (CFS 7 to 8). Discordant CFS ratings were resolved through discussion between the 2 assessors and any further disagreement was adjudicated by a third independent assessor.

Outcome Measures

We compared inter-rater agreement of CFS-A and agreement with prior clinically-rated CFS ratings ("standard CFS"). Next, we compared the diagnostic performance of CFS-A and standard CFS against the "gold standard", our locally validated 37-item FI. Details of the FI were described previously.[12] Finally, we compared the predictive performance of standard CFS and CFS-A against the outcomes of hospital stay, mortality, institutionalisation and functional decline (defined as incremental Katz ADL[23] dependency at discharge compared to premorbid) up to 12 months post-enrolment. To accommodate the larger number of moderately frail (CFS 6) patients in our study population of hospitalised older adults, we selected a cutoff score of CFS 5 or less for group 1 versus CFS 6 or more for group 2. This provides a more meaningful clinical comparison between established degrees of frailty in patients who are not frail or are mildly frail in acute care settings.

Statistical Analyses

Data was gathered using standardised forms which were then entered into an electronic database. We expressed continuous variables as mean ± standard deviation (SD) or median (interquartile range). Categorical variables were expressed as counts and percentages. Area under receiver operator characteristic curves (AUC) for CFS and CFS-A were compared against FI to determine their diagnostic performance in identifying frailty. A CFS score of 5 or more and FI ratio of 0.25 or more were used as cutoff scores for frailty diagnosis. Cohen's kappa and Gwet's agreement coefficient were used to measure agreement between CFS-A raters and between CFS and CFS-A.

We then analysed outcomes at 3 different time points: initial hospitalisation, 6 months and 12 months post-enrolment. For specific outcomes of interest, we performed univariate analyses for a comparison between group 1 (CFS 1 to 5) and group 2 (CFS 6 to 8), chi-square test for categorical variables (mortality, institutionalisation and functional decline) and Mann-Whitney U-test for non-parametric data (length of hospitalisation). For analysis of outcomes of institutionalisation and functional decline, a participant who died during the specified period was counted as a case according to the statistical method used in our earlier study.[14] We also performed logistic regression analysis—adjusted for a priori defined covariates of age, sex and severity of illness—to investigate the independent association between moderate-severe frailty and adverse outcomes of interest.

Statistical analysis was performed using SPSS version 19.0 (SPSS, Chicago, IL) and STATA version 12.0 (Stata Corp, College Station, TX) assuming a two-sided test at 5% level of significance.

Results

Of the 210 participants,[12] 4 were lost to follow-up leaving a total of 206 patients for follow-up analyses. Their mean age was 89.4 ± 4.6 years and there was a preponderance of females (69.5%) and Chinese (81.4%). Frailty prevalence estimates for CFS and CFS-A were 81.0% (robust, 10.0%; vulnerable, 9%; mildly frail, 23.3%; moderately frail, 30.5%; and severely frail, 27.1%) and 95.7% (robust, 1.9%; vulnerable, 2.4%; mildly frail, 28.6%; moderately frail, 50.5%; and severely frail, 27.1%), respectively. Median CFS score for both measures was 6.

Age, sex and ethnicity were similar for both groups on either measure. We observed significantly higher severity of illness, functional dependency, dementia and delirium in group 2 (CFS 6 to 8) on both measures (Table 1). Comorbidities were significantly higher in group 2 than in group 1 (CCI, 3.0 vs 2.0; P <0.001) when measured using CFS.

In our earlier study,[12] there was good inter-rater reliability of CFS between 2 blinded independent assessors on 20 consecutive participants from our cohort (kappa, 0.78; P <0.001). For this study, the inter-rater reliability of CFS-A between the 2 blinded independent assessors was excellent (kappa, 0.90; P <0.001; Gwet's AC1 0.93; 95% confidence interval [CI], 0.89-0.97). There were only 11 (5.2%) cases where initial CFS-A scored by both independent raters were discordant. Of these, 10 had a CFS-A discordance of 1 point. They comprised 5 cases between CFS 5 to 6, 2 cases between CFS 4 to 5, another 2 between CFS 1 to 3 and 4 and 1 between CFS 6 to 7. The 2-point discordance in the remaining case was between CFS 4 to 6. In contrast, inter-measurement reliability between CFS and CFS-A was only moderate (kappa, 0.42; P <0.001; Gwet's AC1 0.48; 95% CI, 0.40-0.57).

AUC for CFS and CFS-A against the gold standard FI for diagnosis of frailty were 0.91 (95% CI, 0.86-0.95; P <0.001) and 0.89 (95% CI, 0.84-0.93; P <0.001), respectively. There was no significant difference between CFS and CFS-A (P = 0.56) on receiver operating characteristic contrast (Fig. 1).

Table 2 shows CFS and CFS-A were significantly associated with mortality at initial hospitalisation (0.0% vs 6.6%, P = 0.013 and 0.0% vs 5.7%, P = 0.044, respectively) and up to 12 months (7.9% vs 41.3%, P <0.001 and 7.2% vs 36.9%, P <0.001, respectively). Both CFS and CFS-A were also significantly associated with institutionalisation and/or mortality up to 12 months (12.8% vs 47.5%, P <0.001 and 10.6% vs 43.6%, P <0.001, respectively).

Table 1. Baseline Characteristics of CFS and CFS-A Participants

	CFS			CFS-A		
	Group 1 (CFS 1 to 5) n = 89	Group 2 (CFS 6 to 8) n = 121	*P* Value	Group 1 (CFS 1 to 5) n = 69	Group 2 (CFS 6 to 8) n = 141	*P* Value
Demographics						
Age (mean ± SD)	88.7 ± 3.8	89.9 ± 5.1	0.588	88.4 ± 4.1	89.9 ± 4.8	0.658
Male gender (%)	31 (34.8)	33 (27.3)	0.240	24 (34.8)	40 (28.4)	0.343
Chinese ethnicity (%)	75 (84.3)	96 (79.3)	0.705	62 (89.9)	109 (77.3)	0.101
Median CCI (IQR)	2.0 (1.0 – 3.0)	3.0 (2.0 – 4.0)	0.027	2.0 (1.0 – 3.0)	3.0 (2.0 – 4.0)	0.015
SII						
Level 1 (%)	3 (3.4)	0 (0.0)	0.026	2 (2.9)	1 (0.7)	0.026
Level 2 (%)	71 (79.8)	87 (71.9)		58 (84.1)	100 (70.9)	
Level 3 (%)	15 (16.9)	34 (28.1)		9 (13.0)	40 (28.4)	
Median Katz ADL (IQR)	6.0 (5.0 – 6.0)	0.0 (0.0 – 1.0)	<0.001	6.0 (6.0 – 6.0)	1.0 (1.0 – 3.0)	<0.001
Cognitive function						
Median AMT (IQR)	7.0 (5.0 – 8.0)	0.0 (0.0 – 4.0)	<0.001	6.0 (4.0 – 8.5)	1.0 (0.0 – 6.0)	<0.001
Dementia (%)	16 (18.0)	78 (64.5)	<0.001	12 (17.4)	82 (58.2)	<0.001
Delirium on admission (%)	7 (7.9)	35 (28.9)	<0.001	6 (8.7)	36 (25.5)	0.004
Admitting diagnosis						
Sepsis (%)	45 (50.6)	75 (62.0)	0.027	36 (52.2)	84 (59.6)	0.051
Fall/syncope/seizure (%)	14 (15.7)	15 (12.4)		12 (17.4)	17 (12.1)	
Delirium/dementia (%)	2 (2.2)	8 (6.6)		1 (1.4)	9 (6.4)	
Other medical (%)	27 (30.3)	18 (14.9)		20 (29.0)	25 (17.7)	
Surgical (%)	1 (1.1)	5 (4.1)		0 (0.0)	6 (2.9)	

ADL: Activities of daily living; AMT: Abbreviated mental test; CCI: Charlson's comorbidity index; CFS: Chronic frailty scale; CFS-A: Chronic frailty scale algorithm; IQR: Interquartile range; SD: Standard deviation; SII: Severity of illness index

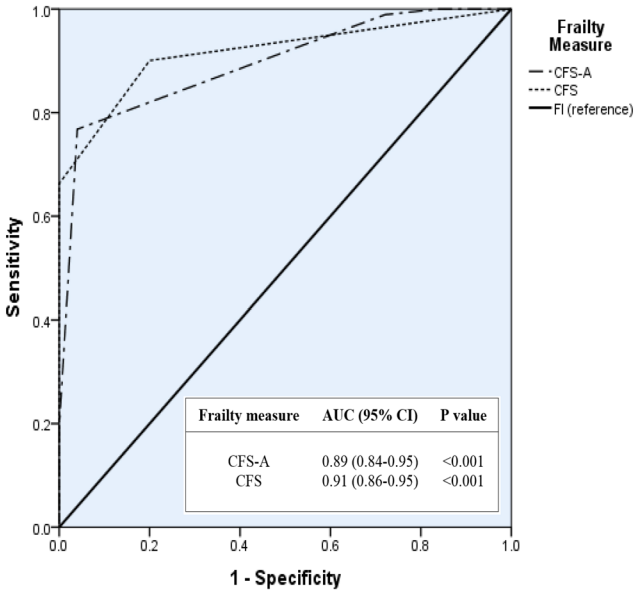

Fig. 1. Graph showing the AUC for CFS and CFS-A against FI in diagnosis of frailty. AUC: Area under receiver operating characteristic curves; CFS: Clinical frailty scale; CFS-A: Clinical frailty scale algorithm; CI: Confidence interval; FI: Frailty index. Receiver operating characteristic curve contrast: CFS-A vs CFS, $P = 0.522$. Inter-rater reliability: kappa, 0.903; $P < 0.001$; Gwet's AC1, 0.93; 95% CI, 0.89-0.97. Inter-measurement reliability (CFS-A and CFS): kappa, 0.422, $P < 0.001$; Gwet's AC1, 0.48; 95% CI, 0.40-0.57.

Only CFS-A was significantly associated with functional decline and/or mortality at 6 months (37.9% vs 57.9%, $P = 0.007$) and 12 months (39.4% vs 55.7%, $P = 0.029$). CFS-A was also significantly associated with increased length of hospitalisation (7 days vs 10 days, $P = 0.025$) but not CFS (8 days vs 10 days, $P = 0.051$).

AUC analysis was used to investigate whether group 2 (CFS 6 to 8) patients were at greater risk of adverse outcomes (Table 3). CFS (AUC, 0.78; 95% CI, 0.72-0.85; $P < 0.001$) and CFS-A (AUC, 0.73; 95% CI, 0.66-0.81; $P < 0.001$) performed well in predicting mortality. The same observation was seen in institutionalisation and/or mortality at 12 months post-hospitalisation for CFS (AUC, 0.75; 95% CI, 0.68-0.81; $P < 0.001$) and CFS-A (AUC, 0.71; 95% CI, 0.64-0.79; $P < 0.001$). However, both performed poorly at predicting functional decline and/or mortality (Fig. 2).

We performed logistic regression analyses after adjusting a priori for age, sex and severity of illness (Table 4). CFS (OR, 3.59; 95% CI, 2.28-5.67; $P < 0.001$) and CFS-A (OR, 4.31; 95% CI, 2.41-7.69; $P < 0.001$) were found to predict mortality at 12 months post-hospitalisation. Over the same period, CFS (OR, 2.59; 95% CI, 1.81-3.69; $P < 0.001$) and CFS-A (OR, 3.59; 95% CI, 2.13-6.02; $P < 0.001$) also

Table 2. Adverse Outcomes between CFS and CFS-A at Initial Hospitalisation and 6-Month and 12-Month Follow-Up

Frailty Measure	Mortality			Institutionalisation and/or Mortality			Functional Decline and/or Mortality		
	Initial Hospitalisation	6 Months	12 Months	Initial Hospitalisation	6 Months	12 Months	Initial Hospitalisation	6 Months	12 Months
CFS									
Group 1 (CFS 1 to 5)	0/89 (0.0%)*	4/89 (4.5%)†	7/89 (7.9%)†	2/89 (2.2%)*	7/86 (8.1%)†	11/86 (12.8%)†	29/89 (32.6%)	42/86 (48.8%)	41/86 (47.7%)
Group 2 (CFS 6 to 8)	8/121 (6.6%)*	38/121 (31.4%)†	50/121 (41.3%)†	11/121 (9.1%)*	44/120 (36.7%)†	57/120 (47.5%)†	37/121 (30.6%)	64/120 (53.3%)	63/120 (52.5%)
Unadjusted OR (95% CI)	–	9.73 (3.33 – 28.5)	8.25 (3.52 – 19.35)	4.25 (0.94 – 20.14)	6.53 (2.77 – 15.4)	6.17 (2.98 – 12.8)	0.91 (0.51 – 1.64)	1.19 (0.69 – 2.08)	1.21 (0.68 – 2.11)
CFS-A									
Group 1 (CFS 1 to 5)	0/69 (0.0%)*	3/69 (4.3%)†	5/69 (7.2%)†	0/69 (0.0%)*	4/66 (6.1%)†	7/66 (10.6%)†	22/69 (31.9%)	25/66 (37.9%)*	26/66 (39.4%)*
Group 2 (CFS 6 to 8)	8/141 (5.7%)*	39/141 (27.7%)†	52/141 (36.9%)†	13/141 (9.2%)*	47/140 (33.6%)†	61/140 (43.6%)†	44/141 (31.2%)	81/140 (57.9%)*	78/140 (55.7%)*
Unadjusted OR (95% CI)	–	8.41 (2.48 – 28.33)	7.48 (2.83 – 19.80)	–	7.83 (2.69 – 22.84)	6.51 (2.78 – 15.25)	0.97 (0.52 – 1.80)	2.25 (1.24 – 4.10)	1.94 (10.7 – 3.51)

CFS: Clinical frailty scale; CFS-A: Clinical frailty scale algorithm; CI: Confidence interval; OR: Odds ratio
Four patients were lost to follow-up and excluded from 6-month and 12-month analyses.
*P <0.05 (between group 1 and group 2).
†P <0.001 (between group 1 and group 2).

Table 3. Comparison of AUC in Predicting Adverse Outcomes between CFS and CFS-A at Initial Hospitalisation and 6-Month and 12-Month Follow-Up

Frailty Measure	Initial Hospitalisation	6 Months	12 Months
	AUC (95% CI)	AUC (95% CI)	AUC (95% CI)
Mortality			
CFS	0.77 (0.65 – 0.88)*	0.77 (0.70 – 0.85)†	0.78 (0.72 – 0.85)†
CFS-A	0.72 (0.57 – 0.86)*	0.73 (0.65 – 0.81)†	0.73 (0.66 – 0.81)†
Institutionalisation and/or mortality			
CFS	0.63 (0.49 – 0.78)	0.74 (0.66 – 0.81)†	0.75 (0.68 – 0.81)†
CFS-A	0.67 (0.56 – 0.78)*	0.72 (0.64 – 0.80)†	0.71 (0.64 – 0.79)†
Functional decline and/or mortality			
CFS	0.49 (0.40 – 0.57)	0.53 (0.46 – 0.61)	0.58 (0.50 – 0.66)*
CFS-A	0.45 (0.37 – 0.52)	0.56 (0.48 – 0.64)	0.59 (0.52 – 0.67)*

AUC: Area under receiver operating characteristic curves; CFS: Clinical frailty scale; CFS-A: Clinical frailty scale algorithm; CI: Confidence interval
Four patients were lost to follow-up and excluded from 6-month and 12-month analyses. Composite outcomes of institutionalisation and/or mortality and functional decline and/or mortality were used as mortality and assumed to lead to either outcome. All receiver operating characteristic curve (ROC) contrasts were not significant (see Figure 2 for ROC diagrams).
*P <0.05.
†P <0.001.

predicted institutionalisation and/or mortality. CFS-A, but not CFS, significantly predicted functional decline and/or mortality (OR, 1.65; 95% CI, 1.13-2.40; P = 0.01) at 12 months post-hospitalisation.

Discussion

A recent study which used a large English inpatient database reported that frailty accounted for almost one-half of all hospitalisation days even when only one-fifth of patients were frail.[11] This highlights the pressing need to incorporate systematic and early identification of frailty in acute care settings to facilitate appropriate patient-centred care plans for this at-risk group.[24] Disconcertingly, a recent scoping review of frailty studies in acute care reported that two-thirds of studies identified participants as frail without measuring frailty and there was great variability in tools used.[25] Of note, CFS is increasingly used in acute settings to identify frailty and to grade its severity to help formulate care plans and improve shared decision-making.[26-28] Our study adds to the body of evidence by corroborating inter-rater reliability, diagnostic performance and predictive validity of CFS-A.

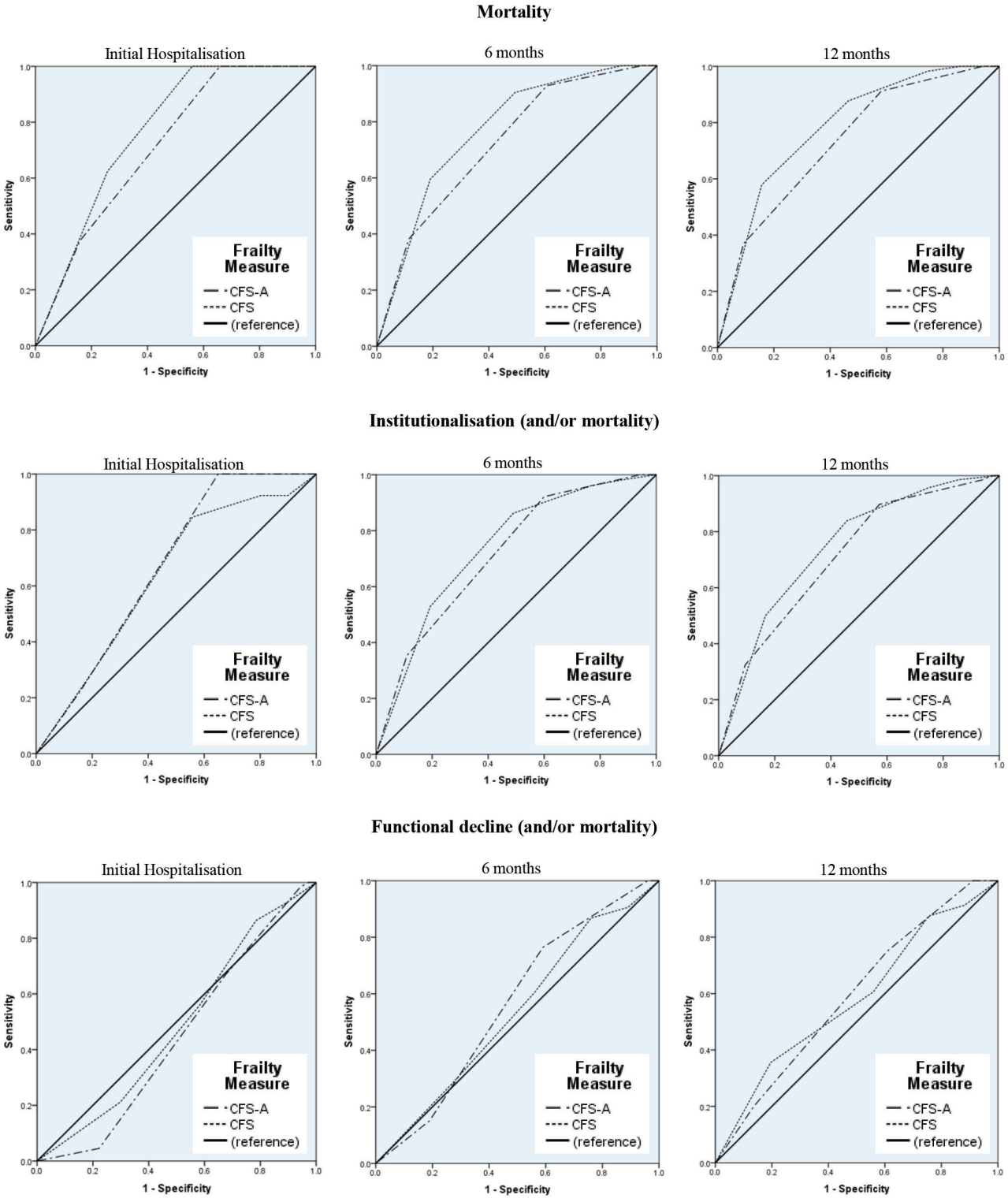

Fig. 2. Graphs showing the AUC for CFA and CFS-A in predicting adverse outcomes at initial hospitalisation and 6-month and 12-month follow-up. AUC: Area under receiver operating characteristic curves; CFS: Clinical frailty scale; CFS-A: Clinical frailty scale algorithm.

Table 4. Comparison between CFS and CFS-A in Predicting Adverse Outcomes

Frailty Measure	Initial Hospitalisation	6 Months	12 Months
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Mortality			
CFS	3.74 (1.15 – 12.10)*	3.19 (1.98 – 5.17)†	3.59 (2.28 – 5.67)†
CFS-A	3.39 (1.05 – 10.97)*	3.76 (2.08 – 6.82)†	4.31 (2.41 – 7.69)†
Institutionalisation and/or mortality			
CFS	1.57 (0.88 – 2.81)	2.45 (1.67 – 3.60)†	2.59 (1.81 –3.69)†
CFS-A	2.70 (1.10 – 6.64)*	3.63 (2.09 – 6.32)†	3.58 (2.13 – 6.02)†
Functional decline and/or mortality			
CFS	1.02 (0.79 – 1.29)	1.09 (0.87 – 1.36)	1.25 (0.99 – 1.57)
CFS-A	0.86 (0.59 – 1.24)	1.35 (0.94 – 1.93)	1.65 (1.13 – 2.40)*

CFS: Clinical frailty scale; CFS-A: Clinical frailty scale algorithm; CI: Confidence interval; OR: Odds ratio
Adjusted for age, gender and severity of illness. Four patients were lost to follow-up and excluded from 6-month and 12-month analyses.
*P <0.05.
†P <0.001.

The initial study of the 7-point CFS showed an intra-class correlation coefficient (ICC) of 0.97 (P <0.001) between 2 measures at different times.[14] Subsequent studies have demonstrated high inter-rater reliability when CFS was administered by clinicians (kappa, 0.76; 95% CI, 0.68-0.84; n = 104),[29] nurses (ICC, 0.97; 95% CI, 0.94-0.98; n = 30)[30] and even when administered telephonically (kappa, 0.69; P = 0.002; first 20 ratings).[16] However, there is still a paucity of data on the accuracy of CFS scoring by different clinicians in a busy acute care setting. Although previous studies have shown that CFS is quick and easy to use, no large-scale study has compared the accuracy of these scores against those scored following a CGA. Recently, a small study reported a Cohen's kappa coefficient of 0.64 when CFS scores were compared between an interview-based CFS and a chart review data score.[31] In our study, we demonstrated greater inter-rater agreement when CFS is scored by expert clinicians using a standardised algorithmic approach (CFS-A). We will, however, need to evaluate if these results can be replicated by other non-expert healthcare professionals.

The excellent inter-rater agreement attests to the inter-rater reliability of CFS-A. This is attributed to the standardised and systematic algorithmic approach to frailty identification via 6 key questions of the patient's health status that reduces assessor variability which can be caused by different interpretations of each CFS category descriptors. In our study, the independent raters found that CFS-A was easy to use and were generally able to assign CFS scores within 1 to 2 minutes. Hence, by providing a user-friendly and systematic approach to frailty identification and severity grading, there is potential for scalability to other acute non-ward-based care settings such as the emergency department, intensive care units and evaluation by non-physicians. The finding of lower agreement with standard CFS may pertain more to the limitations of retrospective scoring of CFS-A that used database variables and it would require further evaluation in real-world comparative studies.

Our findings also suggest that frailty is highly prevalent in the acutely ill hospitalised oldest-old (>80 years). This corroborates the findings of previous studies that reported increasing age as a strong predictor of frailty.[32,33] In contrast to CFS, the higher detection rate of frailty by CFS-A was likely due to the fact that it was designed to detect the slightest impairment in physical functioning. In CFS-A, the loss of at least 1 basic ADL suggests moderate frailty (CFS 6) and the loss of all basic ADLs would suggest severe to very severe frailty (CFS 7 or 8).

Similar to previous studies, frailty measured by CFS was found to be an independent predictor of adverse health outcomes following acute hospitalisation.[12,15,27,34] However, CFS-A appears to better predict mortality, institutionalisation and length of hospital stay in individuals with moderate to severe frailty compared to those who are robust to mildly frail. One plausible explanation for this observation is that CFS-A can better discriminate between mild (CFS 5) and greater severity of frailty (CFS 6 and above) since it takes into account the basic ADLs of an individual. In previous studies, the loss of independence in personal care is strongly associated with poorer health outcomes.[35-38] Thus, the ability of CFS-A to clearly distinguish between these 2 pivotal categories may explain partly why it is a better predictor of adverse health outcomes than standard CFS.

A recent commentary has emphasised the need for more comprehensive and coordinated inclusion of frailty into clinical management protocols and models of care.[39]

It is therefore important that CFS assessments—when performed rapidly and in the absence of a CGA—are done accurately. This is because information generated from CFS (frailty identification and severity grading) has potential to help formulate individualised care plans and improve shared decision-making in acute care settings. For instance, specific interventions may be designed to prevent iatrogenic disability[40] in prefrail and mildly frail older adults while conversations about advance care planning should be initiated with those who have severe frailty. However, it is also important to recognise that interventions should go beyond targeted individuals to include redesigning hospital infrastructure, remodelling care processes and bringing together multiple stakeholders in the community, healthcare sector, academia, and policymaking to create a frailty-ready healthcare system.[3,39]

Our study had a number of limitations. First, CFS was originally designed as a global synthetic tool that is best scored following CGA by a trained assessor.[5,15] As such, the reductionist approach of an algorithm may result in the loss of some finesse of global judgement in CFS scoring. This consideration may be especially salient in complex cases. Nevertheless, both measures provide comparable diagnostic and predictive performances. This suggests that either approach can be used effectively. However, CFS-A offers more rapid administration and a possibility of lower inter-rater variability.

Second, the retrospective nature of scoring CFS-A based on database variables from our earlier study—and the fact that we needed to reduce the number of CFS categories to 5 instead of 9—may have reduced variability between raters and potentially overestimated CFS-A's inter-rater agreement. Third, both scores were completed by expert clinicians in geriatric medicine and it is unclear whether the high level of agreement can be replicated by other healthcare workers.

Fourth, our study is limited to acutely ill hospitalised oldest-old patients. As such, we cannot generalise the finding of the reliability and diagnostic performance of CFS-A to younger and more robust populations. Finally, 4 participants were lost to follow-up and were excluded from follow-up analyses. Nonetheless, this low dropout rate had no material impact on the results of our study and we were able to determine their mortality status from local hospital electronic medical records.

Conclusion

In conclusion, our study supports the effectiveness of the use of a standardised approach to assess frailty in acutely ill hospitalised older adults. CFS-A shows potential for consistent and efficient administration of CFS across various acute care settings. Moving forward, we aim to conduct a prospective study to validate CFS-A in community-dwelling individuals to be administered by various healthcare workers with the hope to encourage its wider use beyond acute hospital care.

Acknowledgement

The authors would like to thank Kenneth Rockwood for his support and permission to use and modify the Clinical Frailty Scale. They would also like to thank the research team of Esther Ho, Jewel Baldevarona-Llego and Lynn Wu for their contributions in data collection. Lastly, the authors would like to express their gratitude to Laura Tay who contributed greatly to the initial concept and design of the study.

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Appendix

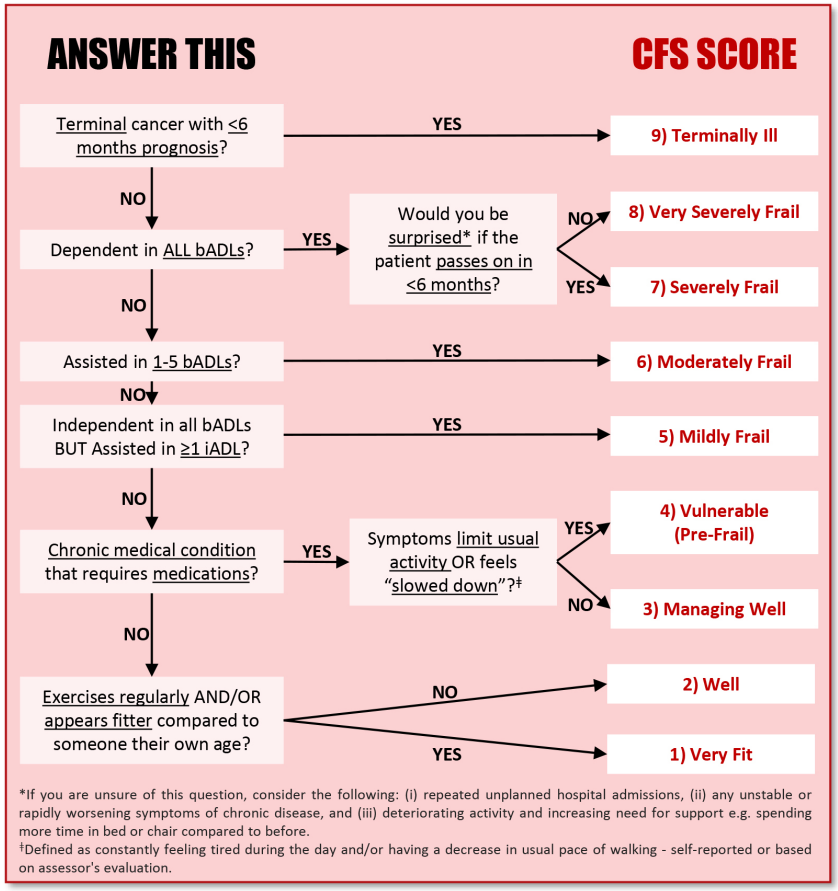
GUIDE TO SCORING

CLINICAL FRAILTY SCALE

The Clinical Frailty Scale (CFS) is a 9-point clinical assessment tool designed to assist healthcare professionals in evaluating a person's frailty status across various clinical settings.
It serves to assist clinicians in identifying frailty, risk stratification, and guide clinical management.

IDENTIFYING PREMORBID FRAILTY STATUS

1. When hospitalized, it is important to identify a patient's **premorbid frailty status.**
2. Premorbid frailty status should be a reflection of the patient's overall health **at least 2 weeks prior** to their acute illness and/or functional decline.



*If you are unsure of this question, consider the following: (i) repeated unplanned hospital admissions, (ii) any unstable or rapidly worsening symptoms of chronic disease, and (iii) deteriorating activity and increasing need for support e.g. spending more time in bed or chair compared to before.
‡Defined as constantly feeling tired during the day and/or having a decrease in usual pace of walking - self-reported or based on assessor's evaluation.

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CFS CATEGORIES

1 Very Fit – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.

2 Well – People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g. seasonally.

3 Managing Well – People whose medical problems are well controlled, but are not regularly active beyond routine walking.

4 Vulnerable – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up", and/or being tired during the day.

5 Mildly Frail – These people often have more evident slowing, and need help in high order iADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

6 Moderately Frail – People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.

7 Severely Frail – Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~6 months).

8 Very Severely Frail – Completely dependent, approaching end of life. Typically, they could not recover even from a minor illness.

9 Terminally Ill – Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.

Basic ADL (DE²ATH)

Dressing
Eating (feeding self)
Evacuation (bladder/bowel)
Ambulation (walking/transfer)
Toileting
Hygiene (bathing)

Instrumental ADL (SHAFT²)

Shopping
Housekeeping
Accounting
Food preparation
Transportation
Takes own medications

Guide to Scoring Clinical Frailty Scale. Version 2.0 (13th April 2018) Produced by the Department of Geriatric Medicine, Tan Tock Seng Hospital