Clinical Frailty and Functional Trajectories in Hospitalized Older Adults: a Retrospective Observational Study

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Abstract

Aim: frailty predicts inpatient mortality and length of stay, but its link to functional trajectories is under researched. Our hospital collects the Clinical Frailty Scale (CFS) within 72 hours of admission in those aged ≥75. We studied whether the CFS links to functional trajectories in hospitalized older adults.

Methods: retrospective observational study in an English university hospital. We analysed all first episodes of county residents aged ≥75 admitted to the Department of Medicine for the Elderly (DME) wards between December 2014 and May 2015. Data was extracted from the hospital's information systems. Patients were classified as non-frail (CFS 1-4), moderately frail (CFS 5-6) and severely frail (CFS 7-8). Function was retrospectively measured with the modified Rankin Scale (mRS) at preadmission, admission and discharge.

Results: of 539 eligible patients, 46 died during admission (mortality rates: 2% in CFS 1-4, 5% in CFS 5-6, 19% in CFS 7-8). Among the 493 survivors, 121 were non-frail, 235 moderately, and 137 severely frail. The mean (95% CI) mRS of the non-frail was 1.8 (1.7-2.0) at baseline, 3.3 (3.1-3.5) on admission and 2.2 (2.0-2.3) on discharge (mean LOS 9 days). The moderately frail had mean mRS of 2.9 (2.8-3.0), 4.0 (3.8-4.1) and 3.2 (3.1-3.3) (mean LOS 15 days). The severely frail had mean mRS of 3.5 (3.3-3.6), 4.3 (4.1-4.4) and 3.7 (3.6-3.9), respectively (mean LOS 17 days).

Conclusions: in older inpatients, frailty may be linked to lower and slower functional recovery. Prospective work is needed to confirm these trajectories and understand how to influence them.

Key words

Frail Elderly

Disability

Functional trajectory

Hospital Medicine

Clinical Frailty Scale

Introduction

Frailty is a state of increased vulnerability to poor resolution of homeostasis following a stressor,[1] such as an illness or fall necessitating an admission to hospital. The frailty paradigm predicts that, "after a stressor, frailer people will experience much worse function, even if for the frailest this is less of an absolute decline, given their degree of prior impairment. Following a stressor such as a fall, people with greater frailty will also experience slower recovery than those with less frailty; in fact, those who are severely frail may never recover".[2]

The Clinical Frailty Scale (CFS) is a scale of frailty based on clinical judgment from 1 (very fit) to 9 (terminally ill, life expectancy <6 months) (http://geriatricresearch.medicine.dal.ca/clinical_frailty_scale.htm). The scoring of the CFS is based on a global assessment of patients' comorbidity symptoms, and their level of physical activity and dependency on activities of daily living. The possible scores are: 1 (very fit), 2 (well), 3 (managing well), 4 (vulnerable), 5 (mildly frail), 6 (moderately frail), 7 (severely frail), 8 (very severely frail), and 9 (terminally ill).

In inpatient populations, frailty as measured by the CFS has been shown to predict mortality and length of stay.[3-7] The association between frailty and function in hospitalized patients is still an under-researched area,[8] and functional decline in frail older patients is important because it may lead to increased need for care packages or institutionalization. We aimed to retrospectively study the association of the CFS with functional trajectories in acutely hospitalized older adults.

Methods

Study design and setting. We conducted a retrospective observational study in a large tertiary university National Health Service (NHS) acute hospital in the United Kingdom. Every year, our hospital admits over 12000 patients aged 75 or more, of which a quarter are managed by the Department of Medicine for the Elderly (DME). The DME specialist bed base consists of four 'core' geriatric wards. Core DME wards specialise in ward-based Comprehensive Geriatric Assessment (CGA) and each of them is supported by dedicated nursing, physiotherapy, occupational therapy, and social work teams, as well as by readily available input from speech and language therapy, clinical nutrition, psychogeriatric and palliative care teams. Formal multidisciplinary team meetings occur at least twice weekly. A fifth specialist DME ward, the Frailty and Acute Medicine for the Elderly (FAME) unit, became fully operational in June 2014 and has daily multidisciplinary team meetings.

Measures. The following measures were extracted from the hospital's electronic information systems:

- Age (years) and gender.
- Total length of stay (LOS, days), and LOS until the 'clinically fit date' (CFD). The CFD is used in NHS hospitals to indicate that the acute medical episode has finished and discharge-planning arrangements (often via social care providers) can commence.
- Emergency Department Modified Early Warning Score (ED-MEWS, highest recorded in the ED). MEWS scores are considered a measure of acute illness severity.[9-11] Our ED-MEWS and its scoring protocol are shown in Table 1.

- Inpatient mortality (yes or no).
- Place of residence before admission and discharge destination (own home versus others: extra sheltered accommodation, residential home, nursing home, or another inpatient facility).
- Existence of a formal care package, prior to admission and on discharge (yes or no).
- Readmission to hospital within 30 days after discharge (yes or no).
- CFS. A local CQUIN hospital payment incentive scheme (http://www.institute.nhs.uk/commissioning/pct_portal/cquin.html) implemented in 2013 mandated that all patients aged 75 years or over admitted to the Trust via the emergency pathway be screened for frailty using the CFS within 72 hours of admission. A section with the CFS and its scoring instructions (as per http://geriatricresearch.medicine.dal.ca/clinical_frailty_scale.htm) was included in the standard medical admission proforma. The admitting junior doctor usually scored the CFS on the proforma, but it could also be completed by ED nurses or by DME nurses. Training on CFS scoring was provided to medical and nursing staff on induction and at regular educational meetings.
- The modified Rankin Scale (mRS) was used as a measure of function (0: no symptoms at all; 1: no significant disability despite symptoms, able to carry out all usual duties and activities; 2: slight disability, unable to carry out all previous activities, but able to look after own affairs without assistance; 3: moderate disability, requiring some help, but able to walk without assistance; 4: moderately severe disability, unable to walk without assistance and unable to attend to own bodily needs without assistance; 5: severe disability, bedridden, incontinent and requiring constant nursing care and attention; 6: dead).[12-13] Scores were calculated

for preadmission baseline, admission, and discharge. All mRS scores were collected retrospectively (based on a review of the patients' notes) by DME physiotherapists trained in mRS scoring. The preadmission mRS was estimated based on reviewing the functional histories (self-reported or collateral) obtained by the medical and therapy teams on admission, and it aimed to capture the level of function immediately before the onset of the acute illness leading to hospitalization.

Participants. We analyzed all first admission episodes of people aged ≥75 years admitted to the Department of Medicine for the Elderly (DME) wards between 1st December 2014 and 30th May 2015. Patients from outside the county boundaries were excluded because of differences in the social care service delivery, which we believed might introduce bias in outcomes, particularly LOS. Patients with a CFS score of 9 were also excluded, as it was felt that terminal illness could be independent of frailty and could therefore bias results. We also excluded patients who died during the hospital admission, as this would be rated as a mRS of 6 and would bias the analysis of the functional trajectories.

Statistical analyses. Anonymized data was analysed with IBM SPSS Statistics (version 22) software. Descriptive statistics were given as number (with percentage) or mean (with standard deviation [SD]). To statistically test for linear trends across CFS categories, we used the Chi-squared test for trend (dichotomous variables) or the two-sided Spearman's 'rho' correlation coefficient (continuous variables).

The CFS was arbitrarily divided into three groups: no frailty (1-4), moderate frailty (5-6), and severe frailty (7-8). This was done due to the relatively low numbers of patients in individual groups, which may have underpowered the findings.

A repeated measures analysis of variance (ANOVA) design was used to assess whether there were CFS-category differences in change in mRS from baseline to admission, and from admission to discharge. Age and ED-MEWS were controlled for.

Ethics approval. This Service Evaluation Audit was registered with our center's Safety and Quality Support Department (Project Register Number 3962). Formal confirmation was received that approval from the Ethics Committee was not required.

Declaration of sources of funding. Permission to use the CFS was obtained from the principal investigator at Geriatric Medicine Research, Dalhousie University, Halifax, Canada. Funding was not required for this study.

Results

There were 663 first hospital episodes over the period. Of those, 114 (17%) had missing CFS data. Of the remaining 549, 10 had a CFS of 9 and were excluded. Of 539 eligible patients, 46 died during admission (mortality rates: 2% in CFS 1-4, 5% in CFS 5-6, 19% in CFS 7-8, p for trend <0.001). Among the 493 survivors, 121 were non-frail, 235 moderately, and 137 severely frail. Participants' characteristics are summarized in Table 2. There were statistically significant linear trends (in the expected direction) in age, mRS (baseline, admission and discharge), LOS, admission provenance, discharge destination, and existence of formal care package before and after admission. Increasing frailty seemed to be associated with higher acute illness severity on admission (p=0.003).

The repeated measures ANOVA model showed significant CFS differences in mRS change from baseline (time 0) to admission (time 1) (interaction between CFS categories and time 0-1: F=10.382, p<0.001, partial eta^2=0.042), and from admission (time 1) to discharge (time 2) (interaction between CFS categories and time 1-2: F=8.328, p<0.001, partial eta^2=0.034). The tests of between-subjects effects were also statistically significant for the CFS categories (F=78.641, p<0.001 from time 0 to time 1; and F=65.708, p<0.001 from time 1 to time 2). The estimated marginal means (with 95% confidence intervals) of the three CFS categories for baseline, admission, and discharge mRS are summarized in Figure 1 and Table 3.

Discussion

This study retrospectively examined the association of clinical frailty (as measured by the CFS) with inpatient functional trajectories in acutely hospitalized older adults. The CFS seemed to be able to stratify the sample into three increasingly complex groups with different functional trajectories. Our results suggest that while all frailty groups experienced functional decline on admission compared to pre-illness baseline, increasing frailty seemed to be associated with less of an absolute decline. A possible reason for this is that we may be seeing a ceiling effect within the mRS scale. Our results also suggest that increasing frailty seemed to be associated with a lesser degree of functional recovery, which took longer. This is consistent with the frailty paradigm,[2] and with clinical experience.

Our study has limitations, including a retrospective design and a single centre perspective. A major a limitation is that the mRS was retrospectively estimated based on chart reviews, and future studies should examine whether findings will be similar using real-time functional measures. In addition, the mRS was primarily validated in stroke patients.[12-13] Another important limitation is that almost 1/5 of the severely frail patients died during hospitalization, which could have led to selection bias in the analyses. Even though we controlled for age and ED-MEWS in the ANOVA models, it is possible that results may have been influenced by acute illness severity on presentation; in fact, our suggestion that frailer people presented with greater acute illness severity is supported by previous data from 'real world' English National Health Service acute settings.[14] In addition, some of the LOS effect across CFS categories may be due to the additional inpatient time required to source formal care packages, or the

need to change the place of residence on discharge. As Table 2 shows, differences in LOS up to the CFD were still significant, but less pronounced than when comparing overall LOS. It is possible that as this sample consisted only of patients admitted to DME wards, the effect of frailty on functional trajectory was influenced by specialist frailty (comprehensive geriatric assessment) services.[15,16] Had we been looking at areas other than specialist geriatric wards, results might have been different.

The impact of frailty with acute inpatient functional trajectories is an under-researched area and prospective work is needed to confirm these trajectories, understand their drivers, and identify ways of potentially modifying them. This is relevant in the light of previous studies in subacute rehabilitation settings suggesting that rehabilitation interventions can benefit the frail as much as the non-frail, in terms of positive functional outcomes.[17-19] However, it is possible that acute inpatient populations are different, in that patients in subacute care have usually been selected from those in acute care and identified as having a certain amount of function to regain, which was not a criterion of our observational study.

The results of our study suggest that judgments such as whether a person has the ability to recover following a stressor cannot be made in the same way regardless of a person's level of frailty. If in clinical practice judgments are made on the amount of improvement a person has made to date, then we need to take into consideration how a person's frailty may affect their rate of recovery,[20] in order to give frailer patients more time. In not doing so, we risk discriminating against frail patients by assuming that they lack rehabilitation potential, which may not necessarily be the case.[17-19] Although there

is evidence of the effect of exercise interventions in community-dwelling frail older people,[21,22] more studies need to be conducted in acute hospital settings. Our data may help a better understanding and more appropriate design of frailty pathways in the acute setting, and pave the way for further prospective research to examine the effect of interventions with particular focus on the intensity, timing and location of the rehabilitation.

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Disclosure statement

The authors declare no conflict of interest.

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Figure 1. Estimated marginal means and 95% confidence intervals of changes in the modified Rankin Scale (mRS) of patients, stratified by frailty (CFS). Time points: Baseline, Admission and Discharge.

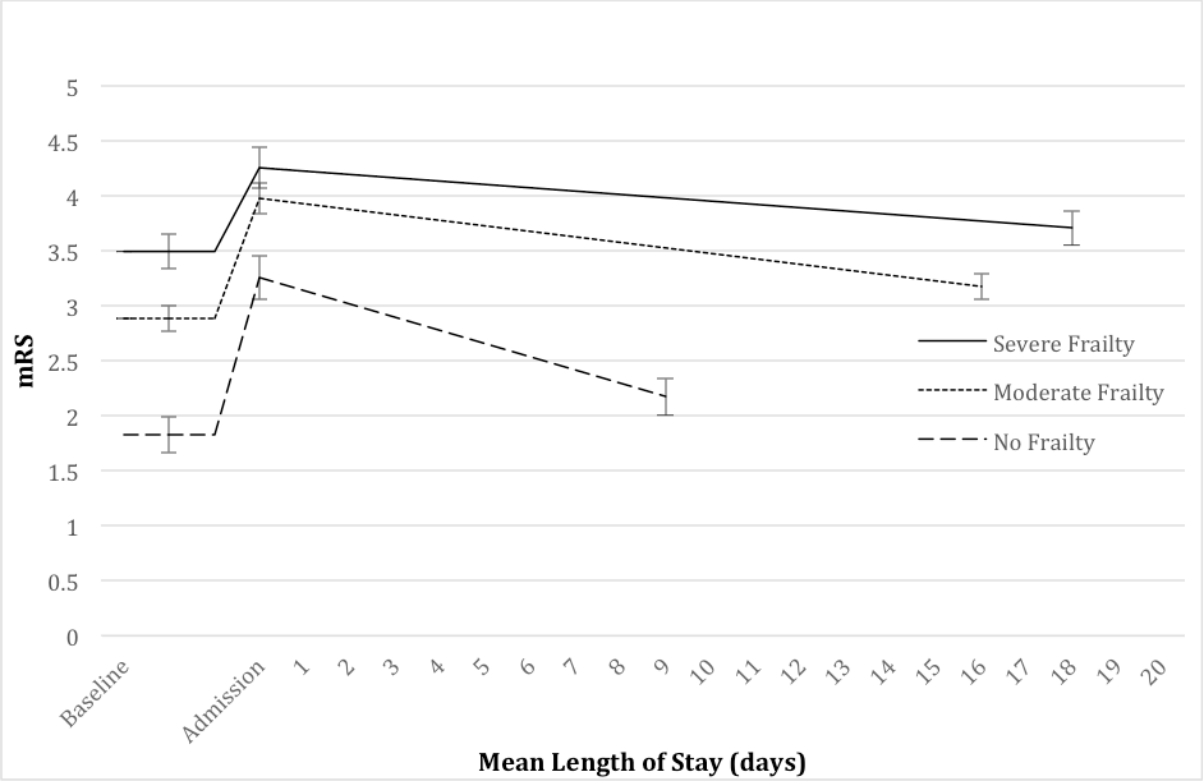

Table 1. ED-MEWS: components, scoring and escalation protocol. HR: heart rate (beats per minute); RR: respiratory rate (per minute); SBP: systolic blood pressure (mmHg); AVPU: **A**lert, responds to **V**oice, responds to **P**ain, **U**nresponsive; GCS: Glasgow Coma Scale; Temp: body temperature (degrees Celsius); minimum score = 0 points; maximum score = 15 points. The usual trigger for escalation (i.e. immediate referral to doctor for clinical review) is 4 or more points.

	3	**2**	**1**	**0**	**1**	**2**	**3**
HR	<40	41-50	51-60	61-90	91-110	111-129	≥130
RR	≤6	7-8	-	9-14	15-20	21-29	≥30
SBP	≤70	71-80	81-100	101-180	-	≥181	-
AVPU	U	P	V	A			
GCS				15	14	9-13	≤8
Temp	-	<35·0	-	35·0-38·4	-	38·5-39·0	≥39·0

Table 2. Participants' characteristics.

	No Frailty n=121	Moderate Frailty n=235	Severe Frailty n=137	Test for association	Statistical significance of association
Age, years (SD)	84 (5.2)	86 (5.5)	87 (6.2)	$r_s = 0.216$†	$p < 0.001$
Female: n (%)	73 (60.3%)	157 (66.8%)	95 (69.3%)	$\chi^2 = 2.263$ ‡	$p = 0.133$
ED-MEWS >3: n (%)	31 (27.2%)	69 (30.3%)	60 (44.8%)	$\chi^2 = 8.979$ ‡	$p = 0.003$
Baseline mRS: mean (SD)	1.7 (1.0)	2.9 (0.9)	3.5 (0.8)	$r_s = 0.574$†	$p < 0.001$
Admission mRS: mean (SD)	3.1 (1.6)	4.0 (0.9)	4.3 (0.7)	$r_s = 0.297$†	$p < 0.001$
Discharge mRS: mean (SD)	2.1 (1.1)	3.2 (0.8)	3.8 (0.8)	$r_s = 0.551$†	$p < 0.001$
Discharge mRS ≤ baseline mRS: n (%)	89 (73.6%)	178 (76.1%)	110 (80.3%)	$\chi^2 = 1.653$ ‡	$p = 0.199$
LOS, days: mean (SD)	9.1 (9.0)	15.5 (16.3)	17.5 (17.3)	$r_s = 0.250$†	$p < 0.001$
LOS, days until CFD: mean SD	8.1 (7.3)	10.5 (11.3)	12.0 (11.8)	$r_s = 0.130$†	$p = 0.004$
Admitted from own home: n (%)	112 (92.6%)	187 (79.6%)	84 (61.3%)	$\chi^2 = 36.550$ ‡	$p < 0.001$

Discharged to own home: n (%)	103 (85.1%)	143 (60.9%)	54 (39.4%)	$\chi^2 = 56.131$ ‡	$p < 0.001$
No formal care package on admission: n (%)	105 (86.8%)	112 (47.7%)	34 (24.8%)	$\chi^2 = 97.149$ ‡	$p < 0.001$
No formal care package on discharge: n (%)	81 (66.9%)	47 (20.0%)	9 (6.6%)	$\chi^2 = 112.878$ ‡	$p < 0.001$
Readmission within 30 days: n (%)	14 (11.6%)	52 (22.1%)	14 (10.2%)	$\chi^2 = 0.192$ ‡	$p = 0.661$

†Spearman correlation coefficient ‡Pearson Chi squared test for linear trend

Table 3. Estimated marginal means of the mRS for the CFS categories at baseline, admission and discharge.

CFS Categories	Time	mRS estimated marginal mean (% change from previous)	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
No Frailty	Baseline	1.8	0.1	1.7	2.0
	Admission	3.3 (+83%)	0.1	3.1	3.5
	Discharge	2.2 (-33%)	0.1	2.0	2.3
Moderate Frailty	Baseline	2.9	0.1	2.8	3.0
	Admission	4.0 (+38%)	0.1	3.8	4.1
	Discharge	3.2 (-20%)	0.1	3.1	3.3
Severe Frailty	Baseline	3.5	0.1	3.3	3.6
	Admission	4.3 (+23%)	0.1	4.1	4.4
	Discharge	3.7 (-14%)	0.1	3.6	3.9