The Association Between Clinical Frailty and Walking Speed in Older Hospitalised Medical Patients: A Retrospective Observational Study

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ABSTRACT

Introduction

This study aims to further evaluate the use of the clinical frailty scale (CFS) by assessing its correlation with usual walking speed (UWS) in older medical inpatients.

Methods

Retrospective observational study in an English tertiary university hospital. We analysed all admission episodes of people admitted to the Department of Medicine for the Elderly wards during a 3-month period. We excluded those who died or had a CFS score of 9, indicating terminal illness. The CFS was recorded on admission and 6 meter UWS was measured on the day of hospital discharge. Other variables collected were: age, sex, the four item version of the Abbreviated Metal Test (AMT4), and the Emergency Department Modified Early Warning Score.

Results

There were 1022 patients admitted over the study period, of which 741 met inclusion criteria and had both CFS and walking speed data available. 570 were able to mobilise at least 6 meters. The median UWS was 0.33 (0.21 – 0.50) m/s. Logistic ordinal regression showed that lower CFS, being male and higher score in the AMT4 were associated with higher odds of being in a higher walking speed category (odds ratio for CFS after covariable adjustment: 0.57 (95% CI, 0.50 to 0.65).

Conclusions

We observed a strong association between higher admission CFS and lower discharge UWS. This association was not explained by variation in age, sex, presence of cognitive impairment or illness acuity and provides further evidence that the CFS maybe a valid measure of frailty in acute clinical settings.

Key words:

England, Frail Elderly, Geriatric Assessment, Observational Study, Walking speed

1. Introduction

Frailty is a state of increased vulnerability to poor resolution of homeostasis after a stressor, such as an illness or fall necessitating an admission to hospital [1]. In our hospital, a local Commissioning for Quality and Innovation (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 older admitted through the emergency pathway be screened for frailty using the Clinical Frailty Scale (CFS) within 72 hours of admission. The admitting team (usually the junior doctor) score the patient making a judgment about the degree of a person's baseline frailty (i.e. prior to the onset of the acute illness triggering the admission) based on information from a formal clinical assessment [2]. The scoring of the CFS is based on a global assessment of patients' comorbidity symptoms, cognition and their level of physical activity and dependency on activities of daily living (http://geriatricresearch.medicine.dal.ca/clinical_frailty_scale.htm). 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).

Walking speed has been described as the 'sixth vital sign' in older adults [3]. It is a well validated, sensitive and robust tool [4]. Usual walking speed (UWS) has been shown to correlate with daily ambulatory activity [5], future health status [6], functional decline [7], and the physical frailty phenotype [8]. The relationship between UWS and the CFS has been less studied.

AMT4: 4 item version of the Abbreviated Mental Test
CQUIN: Commissioning for Quality and Innovation
CFS: Clinical Frailty Scale
DME: Department of Medicine for the Elderly
ED-MEWS: Emergency Department Modified Early Warning Score
IQR: Inter-quartile range
SD: Standard deviation
UWS: Usual walking speed

In hospitalised older adults, frailty as measured by the CFS has been shown to predict mortality, length of stay and functional trajectories [9-12]. We aimed to further evaluate the clinical use of the CFS by assessing its correlation with UWS at discharge.

2. Method

2.1 Setting and participants

This was a retrospective observational study in a large tertiary university NHS hospital in the United Kingdom. We analysed all admission episodes of people admitted to the Department of Medicine for the Elderly (DME) wards between 2nd May and 26th Aug 2016. Patients who died during hospital admission and patients with a frailty score of 9 were excluded as it is felt that 'terminal illness' can be independent from frailty and could therefore bias the results.

2.2 Measures

Routinely collected clinical data was obtained from the hospital electronic medical records. All measures used in this service evaluation audit were routinely collected as part of normal clinical care.

As mentioned above, the CFS is routinely scored on admission to hospital in patients aged 75 or more years. UWS over 6 meters is routinely measured by DME physiotherapist on day of discharge from hospital. The patient is asked to walk down a corridor at their own pace, starting approximately 1-2 meters before the 6 meters course, marked out along the corridor and stopping approximately 1-2 meters after the end of the course, to avoid acceleration or deceleration interfering with the UWS measurement [13]. Patients walk with their usual walking aid.

Other variables routinely collected were: age, sex, the Emergency Department Modified Early Warning Score (ED-MEWS, highest recorded in the ED), and the four-item

version of the Abbreviated Mental Test (AMT4).[14] ED-MEWS scores are routinely collected by nursing staff in ED, and are considered as a measure of acute illness severity [15]. The version of the ED-MEWS that we use scores from 0-15 and components include: heart rate; respiratory rate, systolic blood pressure; degree of alertness and body temperature [9]. The usual trigger for escalation (i.e. immediate referral to doctor for clinical review) is 4 or more points. The 4 item version of the Abbreviated Mental Test (AMT4) [14] is routinely collected in our center as part of a Dementia/Delirium CQUIN, which aims at detecting cognitive impairment on admission to hospital. The AMT4 consists of four questions regarding the patient's age, date of birth, the place that the person is currently located, and the current year.

2.3 Statistical Analyses

Anonymised data was analysed with IBM SPSS Statistics (version 22) software. Descriptive statistics were given as count (with percentage) or mean (with standard deviation (SD)). For continuous variables with a non-normal distribution, median values with inter-quartile ranges (IQR) were used. UWS was divided into 5 ordinal groups; the first group consisted of those unable to mobilise 6 meters, the 4 other groups were defined by the inter-quartile range of the walking speed data, with group 2 being the slowest and group 5 the fastest. The groups are referred to as 'walking quintiles' in the text.

The relationship between CFS and UWS was assessed by logistic ordinal regression, using the walking quintiles as the dependent variable. Other covariables in the model were: age, sex, ED-MEWS and AMT4.

The level of statistical significance was set at $P < 0.05$, and $P < 0.1$ was considered as statistical trend.

2.4 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.

2.5 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.

3. Results

There were 1022 patients admitted over the study period. 78 patients died during admission, 62 patients had missing CFS data, and 4 had a CFS score of 9 leaving a total of 878 patients for analysis. Patient characteristics are given in Table 1. Due to the small populations in CFS groups 1, 2, and 8, patients with a score of 1 or 2 were grouped together (i.e. 'very fit' and 'well') and those with a score of 7 or 8 were grouped together (i.e. 'severely frail' and 'very severely frail').

Walking speed assessments were carried out on 741 patients (84.4%) on the day of discharge; of the 137 missing, 6 were not assessed as were receiving end of life care, 4 declined, and the remaining 127 patients were discharged before the physiotherapist could carry out the assessment. Of the 741 with day of discharge walking assessment, 570 (77%) were able to mobilise at least 6m. The median UWS was 0.33 (0.21 – 0.50) m/s. The number of patients able to mobilise 6m and median (IQR) walking speed for each CFS category are reported in Table 1 and illustrated in Figure 1.

Walking quintiles were categorised as follows: group 1: unable to walk (n = 171), group 2: 0.00-0.21m/s (n = 142), group 3 0.22 - 0.33m/s (n = 141), group 4: 0.34 - 0.50m/s (n

= 140), group 5: ≥ 0.51m/s (n = 147). The logistic ordinal regression (Table 2) showed that lower CFS score, being male and higher AMT4 were associated with higher odds of being in a higher walking speed category (odds ratio for CFS: 0.57 (95% CI, 0.50 to 0.65), p < 0.001; odds ratio for AMT4: 1.20 (95% CI, 1.07 to 1.34), p = 0.002; odds ratio for male versus female: 1.49 (95% CI, 1.08 to 2.04), p = 0.014). Neither age or ED-MEWS were independently correlated with walking speed.

4. Discussion

The present study investigated the relationship between the pre-admission level of frailty, as assessed by the CFS (which is based on clinical judgement), and objectively measured UWS, assessed on the day of discharge from hospital. We observed a strong association between higher admission CFS and lower discharge UWS. This association was not explained by variation in age, sex, presence of cognitive impairment or illness acuity and provides further evidence that the CFS maybe a valid measure of frailty in clinical settings.

The average walking speed was slower to that previously reported in studies of elderly inpatients who reported average speeds of 0.52-0.58m/s [16-18], and significantly slower than community averages of 85-92 year olds 0.83m/s for men and 0.78m/s for women [19]. The walking speed data highlights the high burden of frailty in this hospital population.

Despite a normal age distribution, 77.3% of patients in this study are categorised as 'frail'. A systematic review found the weighted mean prevalence of frailty in community cohort studies was 10.7% [20]. Given the significant heterogeneity of walking speeds within different age groups [19], it is understandable owing to the highly selective frail population seen in this study that age is not independently associated with UWS. Perhaps surprisingly the ED-MEWS score was not a significant predictor of walking speed. In previous research the severity of illness has influenced functional recovery during hospitilisation [21]. As with

previous studies, sex influenced walking speed [16,19] and cognitive impairment was associated with poor walking speed [22].

The main limitations of this study was the single center perspective and missing CFS and walking assessment data, which may have introduced a selection bias or an underpower. Furthermore, we lack data regarding the reliability of the data collected within our service. An external study however, has demonstrated substantial inter-reliability of the CFS[23].

Measuring walking speed on admission has many more practical considerations compared to the CFS. The CFS assesses a person's pre-admission baseline, walking speed measures the person's current functional ability, and is therefore more likely to be influenced by illness severity and type. Furthermore, only just over half of patients admitted to DME wards are able to mobilise 6m on admission, which is not always an indicator of low physical ability. For example, patients with suspected acute coronary syndrome may be instructed not to mobilise rather than be unable to mobilise. For these reasons, the CFS becomes a very valuable tool which can be unanimously applied on admission with information already collected as part of the comprehensive geriatric assessment. We did not compare admission UWS with CFS for the same reasons, i.e. the effect of the acute illness. Most people by discharge from hospital however reach their pre-admission functional baseline by discharge from hospital[24]. Post discharge from hospital though, there is quite a mixed report of functional trajectories within the literature.[25-29] All these studies measure function as the number of ADLs that patients require assistance with, such as the Katz ADL score, and compare to UWS are likely to be far less sensitive to change. In a population from an acute geriatric ward, Bodilsen et al. 2013[30] reported that the timed up and go test improved from 17.3 seconds on admission to 13.3 at discharge from hospital (p = 0.003) but with no improvement at the 30 day follow up (12.4 p = 0.064). We have therefore used UWS at discharge as a proxy for UWS at 'functional baseline', to which the CFS also refers, but

recognise that not having UWS at a suitable time post hospitalisation is a limitation of the study. A study looking at clinically stable frail individuals might be a more valid approach to assessing the relationship between UWS and CFS.

The results of this study add weight to the use of the CFS in a clinical setting. Despite being a tool based on clinical judgement that takes little time to complete, the CFS appears robust, and successfully identifies vulnerable patients. Knowing a person's vulnerability to poor hospital outcomes should allow for early targeting of specialist interventions, including the need for a specialist geriatric ward and early physiotherapy assessment and intervention.

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Disclosure statement

The authors declare no conflict of interest.

References

[1]   Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. Lancet 2013; 381(9868):752-62.

[2]   British Geriatrics Society. Fit for Frailty: Consensus Best Practice Guidance for the Care of Older People Living with Frailty in Community and Outpatient Settings: A Report by the British Geriatrics Society in Association with the Royal College of General Practitioners and Age-UK, 2014.

[3]   Fritz S, Lusardi M. White paper: "walking speed: the sixth vital sign". J Geriatr Phys Ther 2009; 32(2):46-9.

[4]   Middleton A, Fritz SL, Lusardi M. Walking speed: the functional vital sign. J Aging Phys Act 2015; 23(2):314-22.

[5]   Middleton A, Fulk GD, Herter TM, Beets MW, Donley J, Fritz SL. Self-Selected and Maximal Walking Speeds Provide Greater Insight Into Fall Status Than Walking Speed Reserve Among Community-Dwelling Older Adults. Am J Phys Med Rehabil 2016; 95(7):475-82.

[6]   Purser JL, Weinberger M, Cohen HJ, Pieper CF, Morey MC, Li T, et al. Walking speed predicts health status and hospital costs for frail elderly male veterans. J Rehabil Res Dev 2005; 42(4):535-46.

[7]   Brach JS, VanSwearingen JM, Newman AB, Kriska AM. Identifying early decline of physical function in community-dwelling older women: performance-based and self-report measures. Phys Ther 2002; 82(4):320-8.

[8]   Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 2001; 56.

[9]   Romero-Ortuno R, Wallis S, Biram R, Keevil V. Clinical frailty adds to acute illness severity in predicting mortality in hospitalized older adults: An observational study. Eur J Intern Med 2016.

[10]   Wallis SJ, Wall J, Biram RW, Romero-Ortuno R. Association of the clinical frailty scale with hospital outcomes. QJM 2015; 108(12):943-9.

[11]   Bagshaw SM, Stelfox HT, Johnson JA, McDermid RC, Rolfson DB, Tsuyuki RT, et al. Long-term association between frailty and health-related quality of life among survivors of critical illness: a prospective multicenter cohort study. Crit Care Med 2015; 43(5):973-82.

[12]   Hartley P, Adamson J, Cunningham C, Embleton G, Romero-Ortuno R. Clinical frailty and functional trajectories in hospitalized older adults: A retrospective observational study. Geriatr Gerontol Int 2016.

[13]   Tiedemann A, Sherrington C, Lord SR. Physiological and psychological predictors of walking speed in older community-dwelling people. Gerontology 2005; 51(6):390-5.

[14]   Swain DG, Nightingale PG. Evaluation of a shortened version of the Abbreviated Mental Test in a series of elderly patients. Clin Rehabil 1997; 11(3):243-8.

[15]   Subbe CP, Kruger M, Rutherford P, Gemmel L. Validation of a modified Early Warning Score in medical admissions. QJM 2001; 94(10):521-6.

[16]   Peel NM, Kuys SS, Klein K. Gait speed as a measure in geriatric assessment in clinical settings: a systematic review. J Gerontol A Biol Sci Med Sci 2013; 68(1):39-46.

[17]   De Buyser SL, Petrovic M, Taes YE, Vetrano DL, Corsonello A, Volpato S, et al. Functional changes during hospital stay in older patients admitted to an acute care ward: a multicenter observational study. PLoS One 2014; 9(5):e96398.

[18]   Ostir GV, Berges I, Kuo YF, Goodwin JS, Ottenbacher KJ, Guralnik JM. Assessing gait speed in acutely ill older patients admitted to an acute care for elders hospital unit. Arch Intern Med 2012; 172(4):353-8.

[19]   Keevil VL, Hayat S, Dalzell N, Moore S, Bhaniani A, Luben R, et al. The physical capability of community-based men and women from a British cohort: the European Prospective Investigation into Cancer (EPIC)-Norfolk study. BMC Geriatr 2013; 13:93.

[20]   Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc 2012; 60(8):1487-92.

[21]   Fimognari FL, Pierantozzi A, De Alfieri W, Salani B, Zuccaro SM, Arone A, et al. The Severity of Acute Illness and Functional Trajectories in Hospitalized Older Medical Patients. J Gerontol A Biol Sci Med Sci 2016.

[22]   Fitzpatrick AL, Buchanan CK, Nahin RL, Dekosky ST, Atkinson HH, Carlson MC, et al. Associations of gait speed and other measures of physical function with cognition in a healthy cohort of elderly persons. J Gerontol A Biol Sci Med Sci 2007; 62(11):1244-51.

[23]   Islam A. Gait Variability Is an Independent Marker of Frailty. Electronic Thesis and Dissertation Repository: The University of Western Ontario; 2012.

[24]   Hartley P, Gibbins N, Saunders A, Alexander K, Conroy E, Dixon B, et al. The association between cognitive impairment and functional outcome in hospitalised older patients: a systematic review and meta-analysis. Age & Ageing 2017; In Press.

[25]   Cornette P, Swine C, Malhomme B, Gillet J-B, Meert P, D'Hoore W. Early evaluation of the risk of functional decline following hospitalization of older patients: development of a predictive tool. European journal of public health 2006; 16(2):203-8.

[26]   Sager MA, Franke T, Inouye SK, Landefeld CS, Morgan TM, Rudberg MA, et al. Functional outcomes of acute medical illness and hospitalization in older persons. Arch Intern Med 1996; 156(6):645-52.

[27]   Noriega FJ, Vidán MT, Sánchez E, Díaz A, Serra-Rexach JA, Fernández-Avilés F, et al. Incidence and impact of delirium on clinical and functional outcomes in older patients hospitalized for acute cardiac diseases. American Heart Journal 2015; 170(5):938-44.

[28]   Barnes DE, Mehta KM, Boscardin WJ, Fortinsky RH, Palmer RM, Kirby KA, et al. Prediction of recovery, dependence or death in elders who become disabled during hospitalization. J Gen Intern Med 2013; 28(2):261-8.

[29]   Hansen K, Mahoney J, Palta M. Risk factors for lack of recovery of ADL independence after hospital discharge. J Am Geriatr Soc 1999; 47(3):360-5.

[30]   Bodilsen AC, Pedersen MM, Petersen J, Beyer N, Andersen O, Smith LL, et al. Acute hospitalization of the older patient: changes in muscle strength and functional performance during hospitalization and 30 days after discharge. Am J Phys Med Rehabil 2013; 92(9):789-96.

Figure 1   Percent of patients able to mobilise 6m on discharge and median and IQR

walking speeds by CFS
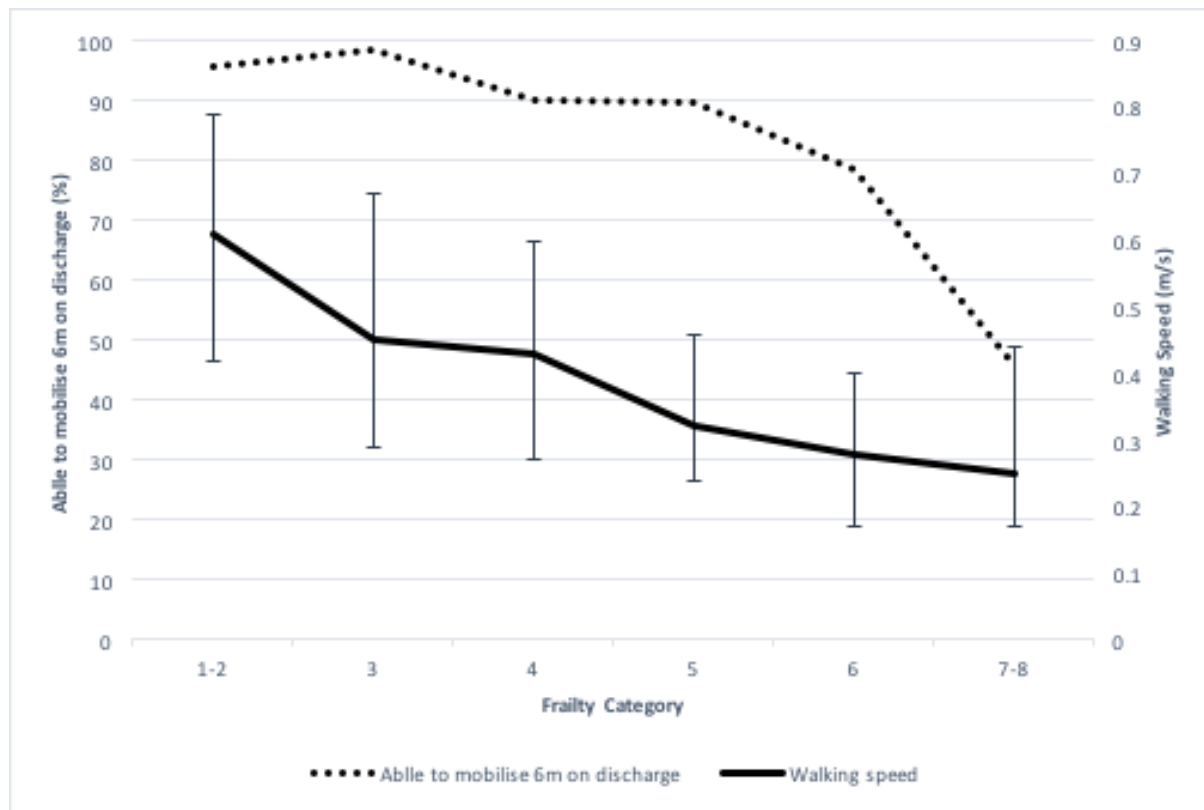
Table 1   Patient characteristics

Frailty Score	1-2	3	4	5	6	7 - 8
Count (%)	23 (2.6)	74 (8.4)	103 (11.7)	163 (18.6)	330 (37.6)	185 (21.1)
Age	81.7 (5.69)	83.7 (5.82)	84.5 (6.06)	86.7 (5.60)	87.3 (5.99)	86.15 (6.10)
Female	11 (47.8)	41 (55.4)	45 (43.7)	101 (62)	195 (59.1)	120 (64.9)
ED-MEWS	3.0 (1.0 – 4.0)	2.0 (1.0 – 3.0)	3.0 (2.0 – 4.0)	2.0 (1.0 – 3.0)	3.5 (2.0 – 3.0)	2.0 (2.0 – 4.0)
AMT4	4.0 (4.0 – 4.0)	4.0 (4.0 – 4.0)	4.0 (4.0 – 4.0)	4.0 (3.0 – 4.0)	4.0 (2.0 – 4.0)	2.0 (0.0 – 4.0)
Length of Stay (days)	2.2 (1.9 – 8.0)	3.7 (2.0 – 7.0)	6.6 (3.2 – 12.8)	8.8 (4.6 – 14.9)	8.8 (4.4 – 19.1)	8.7 (4.6 – 21.9)
Able to walk 6m on discharge	21 (95.5)	62 (98.4)	83 (90.2)	123 (89.8)	214 (78.4)	67 (45.9)
6MWT walking speed	0.61 (0.42 – 0.79)	0.45 (0.29 – 0.67)	0.43 (0.27 – 0.60)	0.32 (0.24 – 0.46)	0.28 (0.17 -0.40)	0.25 (0.17 – 0.44)
Walking Quintile	5.0 (4.0 – 5.0)	4.0 (3.0 – 5.0)	4.0 (3.0 – 5.0)	3.0 (2.0 – 4.0)	2.5 (2.0 – 4.0)	1.0 (1.0 – 3.0)

Table 2   Logistic ordinal regression analysis. Dependent variable: Walking Quintiles

Parameter	Odds ratio	Lower 95% CI	Upper 95% CI	P
CFS	0.57	0.50	0.65	<0.001
Sex = Male	1.49	1.08	2.04	0.014
Age	0.98	0.96	1.01	0.225
ED-MEWS	1.04	0.93	1.16	0.493
AMT4	1.20	1.07	1.34	0.002