



## Associations and predictions of readmission or death in acutely admitted older medical patients using self-reported frailty and functional measures. A Danish cohort study



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### ABSTRACT

**Objective:** To assess whether frailty in acutely admitted older medical patients, assessed by a self-report questionnaire and evaluation of functional level at discharge, was associated with readmission or death within 6 months after discharge. A second objective was to assess the predictive performance of models including frailty, functional level, and known risk factors.

**Methods:** A cohort study including acutely admitted older patients 65+ from seven medical and two acute medical units. The Tilburg Frailty Indicator (TFI), Timed-Up-and-Go (TUG), and grip strength (GS) exposure variables were measured. Associations were assessed using Cox regression with first unplanned readmission or death (all-causes) as the outcome. Prediction models including the three exposure variables and known risk factors were modelled using logistic regression and C-statistics.

**Results:** Of 1328 included patients, 50% were readmitted or died within 6 months. When adjusted for gender and age, there was an 88% higher risk of readmission or death if the TFI scores were 8–13 points compared to 0–1 points (HR 1.88, CI 1.38;2.58). Likewise, higher TUG and lower GS scores were associated with higher risk of readmission or death. The area under the curve for the prediction models ranged from 0.64 (0.60;0.68) to 0.72 (0.68;0.76).

**Conclusion:** In acutely admitted older medical patients, higher frailty assessed by TFI, TUG, and GS was associated with a higher risk of readmission or death within 6 months after discharge. The performance of the prediction models was mediocre, and the models cannot stand alone as risk stratification tools in clinical practice.

### 1. Introduction

Frailty is associated with higher risk of hospitalisation, re-hospitalisation, and death and, therefore, also with high healthcare-related costs (Clegg, Young, Iliffe, Rikkert, & Rockwood, 2013; Covinsky et al., 2003; Gill, Gahbauer, Han, & Allore, 2010; Gobbens & van Assen, 2012; Pilotto et al., 2012; Wong & Miller, 2008). The number of frail older

people is increasing worldwide and underscores the necessity of prioritising and ensuring effective trajectories in and between health-care sectors (OECD, 2013). Frailty is considered a manageable condition if identified, and it seems possible to prevent or delay adverse consequences of frailty (De Lepeleire, Iliffe, Mann, & Degryse, 2009; Morley et al., 2013).

Acutely admitted older medical patients are characterised by high

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age, serious illness, comorbidity, low functional status, poor nutritional status, and low quality of life (Buurman et al., 2012; Covinsky et al., 2003; Helvik, Engedal, & Selbaek, 2010; Oliveira, Fogaca, & Leandro-Merhi, 2009). Also, a large percentage of admitted older patients with acute illness are discharged with new hospitalisation-associated disabilities, increasing the risk of readmission (Covinsky, Pierluissi, & Johnston, 2011). A review by Garcia-Perez et al. (2011) concluded that morbidity, functional disability, number of prescribed drugs, length of stay, and prior admissions were risk factors predicting hospital readmission in the elderly, whereas age and gender were not associated with readmission (Garcia-Perez et al., 2011). However, the outcome was not accurately measured as only readmissions to the same hospital were registered (Garcia-Perez et al., 2011). A review by Kansagara et al. (2011) concluded that most readmission prediction models performed poorly and recommended that future studies should include psychosocial factors and functional tests and argued for studies to provide data to act on before the discharge. It is important to obtain data allowing for targeted interventions during and after hospitalisation (Kansagara et al., 2011). A self-report multidimensional assessment tool, including psychosocial factors, may be a feasible alternative for identifying acutely admitted older medical patients regardless of their specific diagnosis. This non-specialist approach will provide data that can be used immediately by health professionals in and between sectors. As many patients have more than one readmission, it is clinically relevant that the provided data are easily understandable for health professionals in both the primary and the secondary health sector. Shared non-specialist screening tools, which are easy to administer and robust in both community-dwelling and hospital settings, would be practical and informative for the involvement, care, and treatment of medical patients. Furthermore, the screening could provide a first indication of which targeted interventions to initiate for the patients at the hospital as well as in the transition phase or post-discharge seeking to reduce readmissions. A screening questionnaire showing better clinometric properties than other multidimensional self-reporting frailty questionnaires is the Tilburg Frailty Indicator (TFI) (Gobbens, van Assen, Luijckx, Wijnen-Sponselee, & Schols, 2010; Metzger et al., 2010; Pialoux, Goyard, & Lesourd, 2012). Recently, a systematic review assessed 38 multicomponent frailty tools and concluded, that the TFI was the most robust and extensively examined tool (Sutton et al., 2016). The TFI has been tested only in community-dwelling older people and has not previously been used when studying the association between frailty and readmission or death in a population of acutely admitted older patients. However, previous research, which did not include the TFI, indicated that frailty scores alone might not contain the discriminatory power to risk stratify in relation to readmissions and mortality (Pijpers, Ferreira, Stehouwer, & Nieuwenhuijzen Kruseman, 2012; Wou et al., 2013). As functional status assessed using TUG and GS is associated with disability and mortality, (Bohannon, 2008; Buysse et al., 2013; Donoghue, Savva, Cronin, Kenny, & Horgan, 2014; Kansagara et al., 2011), objective assessment of functional status may potentially strengthen or support the association. Combining the three frailty measures, the TFI, TUG, and GS with the known risk factors of morbidity, length of stay, and previous admissions may provide a prediction model with sufficient predictive power to be useful in clinical practice.

The aim of this study was to assess whether frailty in acutely admitted older medical patients, assessed by a self-report multidimensional questionnaire, TUG, and GS at discharge was associated with unplanned readmission or death within 6 months after discharge from hospital. The second aim was to investigate whether a constructed model including the TFI, TUG, and GS measurements together with information regarding morbidity, length of stay, and previous admissions predicts readmission or death within 6 months after discharge.

## 2. Methods

### 2.1. Study design

The study was a prospective cohort study including acutely admitted older patients who were consecutively included and tested at discharge from a hospital with follow-up in central registers for 6 months (182 days). The manuscript is presented in accordance with the STROBE guidelines (Von Elm et al., 2007). A conference abstract presenting preliminary results on a part of the data has been published. The adjusted (sex, age, and comorbidity) association of the total sample between TFI, TUG, and grip strength and readmission or death was presented in short form (Andreasen et al., 2017). The present paper presents a full description of background, methodology, and results including crude, adjusted, and stratified data on the associations. Furthermore, included are prediction models and predictive performance of the models at 30, 90 and 180 days.

### 2.2. Setting

The setting was the Danish healthcare system where national health insurance covers all citizens. Recruitment took place at two acute receiving medical units and seven medical wards at Aalborg University Hospital during a 12-month period from May 2014 to May 2015. The acute receiving units received all acutely admitted medical patients. The patients stayed up to 24 h in one of the two units and were either transferred to a medical ward or discharged within this timeframe. The medical subspecialties at the seven wards were endocrinology, gastroenterology, haematology, infectious disease, nephrology, pulmonology, and geriatrics. Due to different bed capacity at the different wards, a statistician prepared a random testing sequence. The random testing sequence was based on the number of discharges in the previous year. Wards with higher discharge rates were, therefore, approached more frequently. A random testing sequence was prepared for each of the two testers, so that every morning they started at a different ward defined by the random testing sequence. From Monday thru Friday from 8 a.m. to 3 p.m. the two testers included and tested eligible patients using the random testing sequence as the two testers could not approach all admitted patients in the enrolment period. The two testers were experienced physiotherapists who had been working at the medical wards for 2 and 7 years. They were, therefore, experienced regarding testing and treating older medical patients. They were educated in protocol use, and pilot testing was performed in the weeks before the start of the study. No inter-rater reliability test was performed. Evaluation meetings were held regularly, and the project leader followed the testers at certain time points to assure compliance with the standardised protocol. It was verified for a two-month period that patients discharged during the early or late hours of the day and at weekends did not differ from the included patients regarding age and gender.

### 2.3. Study participants

Eligible for inclusion were patients aged 65 years and older, acutely admitted to and scheduled for discharge from the two acute medical units or from one of the seven medical wards, and able to provide an informed consent. Exclusion criteria were terminal illness (defined by staff and medical records), inability to cooperate due to serious conditions or severe cognitive impairment assessed by the Short Portal Mental Status Questionnaire (Erkinjuntti, Sulkava, Wikstrom, & Autio, 1987), and inability to speak Danish. Patients still hospitalised more than 2 days after inclusion and testing were excluded.

### 2.4. Exposure variables

The Tilburg Frailty Indicator consists of a part A including the life-course determinants of frailty such as gender, age, and socioeconomic

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