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Original Article

Frailty in a Community Hospital in Singapore: Prevalence and Contributing Factors

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ABSTRACT

Background/Purpose: To determine the prevalence and contributing factors of frailty in the community hospital setting of Singapore by utilising the FRAIL scale as a screening tool for older adult patients admitted for rehabilitation and subacute care, as well as for patients who have been discharged and are followed up in the community hospital outpatient clinic.

Methods: This was a cross-sectional study. The FRAIL scale was utilised to screen older adult patients aged 65 and above who were admitted as inpatients from 1 July 2017 to 30 April 2018, or seen as outpatients from 1 August to 31 December 2017. A total of 647 inpatients and 616 outpatients were screened. Data was analysed for both groups to determine the prevalence and contributing factors of frailty and compared with baseline demographic data.

Results: The prevalence of frailty was 45.6% for the inpatient group and 51.3% for the outpatient group. The prevalence of pre-frailty was 40.2% for the inpatient group and 29.5% for the outpatient group. For both groups, incapacity in resistance and ambulation ranked as the main contributors for frailty and pre-frailty.

Conclusion: Frailty screening among older adults using the FRAIL scale is a practical tool that can be utilised in the community hospital setting of Singapore. The prevalence of frailty is high in the community hospital setting and is contributed significantly by incapacity in resistance and ambulation. Interventions targeting these components would thus be beneficial in potentially reversing and preventing the progression of frailty in the rehabilitative setting.

1. INTRODUCTION

Frailty is an emerging geriatric concept. It is recognized as a clinical state of older adults with increased vulnerability, resulting from age-associated declines in physiologic reserve and function across multiple organ systems, such that the ability to cope with every day or acute stressors is compromised.[1] The International Association of Gerontology and Geriatrics Frailty Consensus has defined frailty as "an

age-related state characterized by reduced strength and physiologic malfunctioning that increases an individual's susceptibility to increased dependency, vulnerability, and death."[2] Frailty is associated with adverse health outcomes such as falls, disability, hospitalisations, institutionalisation and mortality.[2]

In Singapore, among the community dwelling older adults, the prevalence of frailty was reported to be 6.2% and pre-frailty to be 37% respectively.[3] The prevalence of frailty has been reported to be higher in clinical settings: 27% in an outpatient population[4] and 50.0-87.1% among inpatients of a geriatric ward in a tertiary hospital.[5] There is currently no local data on the prevalence of frailty in the residential Intermediate and Long-Term Care (ILTC) setting, although the prevalence of frailty in nursing homes has been reported to range from 19.0-75.6% globally.[6]

To our knowledge, there is also paucity of local studies evaluating the contributing factors of frailty when the FRAIL scale[7] is used as an identification tool for frailty. Current studies have focussed on ascertaining the associated and predictive factors of frailty. While multiple frailty measurement tools are available, no specific tool has been recommended for use in the residential ILTC setting by consensus guidelines. Internationally, the two most common frailty measurement tools used are the Fried's Frailty Phenotype[8] and the Rockwood and Mintski's Frailty Index.[9] Recently, the FRAIL scale, a hybrid tool containing elements from both has been developed and has shown similar predictive accuracy.[10] The FRAIL scale has been extensively validated in numerous populations internationally, including Hong Kong,[11] which has a pre-dominantly Chinese population like Singapore. The FRAIL scale has been recommended by the International Academy on Nutrition and Aging (IANA)[12] and the Asia-Pacific clinical practice guidelines[13] for use in clinical practice. It has shown to be a quick, simple and cost-effective screening tool for frailty[14] and has been validated for frailty screening in the community.[11] Locally, in the inpatient hospital setting, the performance of the FRAIL scale was compared to other frailty measurements (Clinical Frailty Scale and Tilburg Frailty Indicator) and performed better in predicting in-hospital mortality and length of hospitalisation.[5] Of note, the FRAIL-NH scale,[15] a modification of the FRAIL scale, has been validated for use in the nursing home and long-term care facilities.[16,17]

The spectrum of institutions under the residential ILTC sector in Singapore comprise community hospitals, chronic sick hospitals, nursing homes, inpatient hospices, rehabilitation homes and sheltered homes for persons in mental health recovery.[18] There are currently 8 community hospitals operating in Singapore, with more projected to open to meet the needs of Singapore's ageing population. Community hospitals admit patients from tertiary hospitals who require an extended period of inpatient rehabilitation, medical care or social support before discharge. Upon discharge, patients who require complex medical care are offered follow-up in the community hospital outpatient clinic for care continuity and consolidation. The purpose of community hospitals are thus distinct from nursing homes and long-term care hospitals, in that the majority of patients in community hospitals are in transit and intended for discharge after appropriate rehabilitation.

Given that there are interventions available to reverse frailty, by knowing patients' frailty status and the components that they are predominantly frail in, community hospitals can better allocate resources and develop programmes to maximise rehabilitation outcomes in the fight against frailty.

We hypothesize that there is a high prevalence of pre-frailty and frailty in the inpatient and outpatient setting of the community hospital. Hence, the objectives of this study were to determine the prevalence of frailty in the community hospital setting of Singapore using the FRAIL scale, as well as to identify the components of the FRAIL scale which contributed significantly to frailty. This allows specific interventions to be designed with a view to reverse or counter the progression of frailty.

2. METHODS

2.1. Study Population

Study participants were from the inpatient and outpatient settings of a community hospital located in western Singapore. The community hospital is a 243 bedded designated subacute inpatient rehabilitation hospital, providing multidisciplinary team-based rehabilitation for patients from tertiary hospitals who require stepdown care. Inpatients who require complex medical care or care coordination are offered follow-up in the outpatient clinic on discharge. Based on the hospital's historical data of the fiscal year 2017, there were 2,091 inpatient hospital admissions, of which 84% were for rehabilitation. In the outpatient setting, there were 1,436 clinic patients, of which 77.9% had a record of previous inpatient admission to the community hospital.

2.2. Inclusion and Exclusion Criteria

The cohort of participants used in this study included inpatients and outpatients, between the ages of 65 and 100 years upon admission or clinic visit, who were of any ethnicity or gender, and who had the ability or potential to ambulate. The inpatient population used in this study comprised those with an admission date from 1 July 2017 to 30 April 2018. The outpatient population in this study comprised patients with at

least one clinic visit from 1 August to 31 December 2017. Participants diagnosed with a terminal illness and/or had a prognosis of less than 6 months or who were bedbound were excluded from the study. The final number of participants included in this study was 1,263 (647 inpatients and 616 outpatients).

2.3. Study Design

We performed a retrospective study on de-identified data from the frailty registry database of the community hospital. Data was extracted by co-investigators under the supervision of the principal investigator. Ethics approval was obtained from the local Institutional Review Board (SLH IRB Reference Number: IRB-05-2019-01-03), with study support sought from hospital management.

Based on the hospital's current admission protocol, all patients (inpatients and outpatients) were screened with the FRAIL scale if they were at least 65 years of age and had the ability or potential to ambulate. The FRAIL scale (see APPENDIX 1) is a well-validated time- and cost-effective 5-point scale measuring frailty. The 5 items include fatigue (have felt tired most or all of the time in past 4 weeks), resistance (have difficulty or unable to climb a flight of steps), ambulation (have difficulty or unable to walk a block), illness (have more than 5 illnesses; the range of which includes hypertension, diabetes, cancer (other than a minor skin cancer), chronic lung disease, heart attack, congestive heart failure, angina, asthma, arthritis, stroke, and kidney disease) and loss of weight (more than 5% unintentional weight loss over 12 months).[7] Participants were classified as "frail" if they had positive answers for 3 or more domains, "pre-frail" if they had positive answers for 1 to 2 domains, and "robust" if they had no positive answers.

Age at screening, gender and ethnicity were measured as basic demographic variables for all participants. For inpatients, admission ward class and eligible government healthcare subsidy rate (based on household means testing) were recorded as surrogates of socio-economic status (SES).

Individual-level measures of SES have been shown to be independent factors that influence major disease and health outcomes.[19] Examples of individual-level measures of SES include educational level, income status, employment status and level of financial assistance provided.[20] SES based on hospital admission ward class and means testing have been analysed in other local studies done in the community hospital setting of Singapore.[21] Wards are classed by the sophistication and availability of physical amenities, although all patients receive the same standard of medical care. In our hospital, both "A" and "B" class wards are air-conditioned. "A" class rooms are 1-bedded (private) while "B" class rooms are 5-bedded (semi-private). "C" class wards are dormitory style (6 to 8-bedded) and are not air-conditioned. The average monthly inpatient bill size for patients undergoing rehabilitation in "A" and "B" classes are $17,400 and $15,000 respectively. In contrast, the average monthly inpatient bill size for a "C" class bed ranges from $4,290 to $11,520 for Singapore citizens and $8,400 to $12,840 for permanent residents because of a heavy government subsidy. Singapore citizens or permanent residents have a choice of ward class upon admission but those who decide on "C" class ward are subject to means testing to determine the level of subsidies eligible from the government which are awarded according to patients' and their family's financial circumstances. Both "A" and "B" class patients do not receive any government subsidies. In community hospitals, government healthcare subsidies are granted to patients on a tiered basis, depending on the per capita monthly household income via means testing (see APPENDIX 2). We defined ward class as a binary variable- ward class "A" and "B" were grouped together as "Upper Ward Class", while ward class "C" was grouped separately as "Lower Ward Class". Likewise, eligibility for additional subsidies amongst citizens and permanent residents was defined as a binary variable-0% to 20% were grouped as "Low Subsidy" while >20% was grouped as "High Subsidy".

Table 1. Demographics of patients in the study, n (%).

	Inpatient (n=647)	Outpatient (n=616)	p-value
Sex			
Male	286 (44.2)	242 (39.3)	0.086
Female	361 (55.8)	374 (60.7)	0.086
Ethnicity			
Chinese	548 (84.7)	528 (85.7)	0.668
Malay	59 (9.1)	68 (11.0)	0.298
Indian	33 (5.1)	15 (2.4)	0.020
Others	7 (1.1)	5 (0.8)	0.600
Age Group (mean age=79.12 years)			
65-74 years	239 (36.9)	182 (29.5)	0.006
75-84 years	265 (41.0)	282 (45.8)	0.095
85-100 years	143 (22.1)	152 (24.7)	0.311
Frailty Status			
Robust	92 (14.2)	118 (19.2)	0.023
Pre-frail	260 (40.2)	182 (29.5)	<0.001
Frail	295 (45.6)	316 (51.3)	0.049
Frailty Components			
F (Fatigue)	232 (35.9)	190 (30.8)	0.067
R (Resistance)	497 (76.8)	387 (62.8)	<0.001
A (Ambulation)	469 (72.5)	373 (60.6)	<0.001
I (Illnesses)	170 (26.3)	349 (56.7)	<0.001
L (Loss of weight)	107 (16.5)	41 (6.7)	<0.001

2.4. Statistical Methods

De-identified data from the community hospital's frailty registry database was analysed and the prevalence of frailty for the inpatient and outpatient groups calculated. Descriptive statistics were used to summarize the data. Multi-way frequencies were computed and reported, and multinomial logistic regression analysis was used to investigate the demographic correlates of pre-frailty and frailty. Analyses were performed using R, software version 3.5.2.

3. RESULTS

The demographics of the study population, as well as the prevalence of frailty and its components, are shown in Table 1. Females comprised 55.8% of the inpatient group and 60.7% of the outpatient group. There were significantly more females than males in this study, which corresponds to the higher life expectancy of females compared to males. The ethnic composition of the study cohort was generally representative of the Singapore population.

The prevalence of frailty based on the FRAIL scale was 45.6% in the inpatient group and 51.3% in the outpatient group. The components of frailty that were the primary contributors to the identification of frailty were "R" (Resistance) and "A" (Ambulation) in both the inpatient and outpatient groups. Frail outpatients had a significantly higher prevalence of component "I" (more than 5 illnesses) compared to inpatients. No systematic differences were observed between men and women.

Among inpatients who were pre-frail, the prevalence of the "R" (Resistance) component of the scale was highest compared to the other components. For pre-frail outpatients, component "I" (more than 5 illnesses) had the highest prevalence compared to the other components. In addition, the prevalence of the "I" component among pre-frail outpatients was also significantly higher compared to pre-frail inpatients. This is graphically represented in Figures 1 and 2.

The results of one-way associations between frailty status and covariates are shown in Table 2. The mean frailty score for all covariates ranged from 1.83 to 2.76. The results of the multinomial logistic regression are shown in Table 3. The analysis showed that patients who were older and admitted as inpatients were at a higher risk of pre-frailty and frailty. In addition, non-Chinese patients were at a higher risk of frailty. No significant associations were found for sex. This was consistent with what we observed in other multi-way comparisons, and the association holds even after controlling for the other demographic factors.

Similar subgroup analysis was performed on the inpatient population using multinomial logistic

Figure 1. Prevalence of the FRAIL components among frail patients. Patients are categorised by the setting (inpatient or outpatient) and sex (M, Male or F, Female) within each FRAIL component.

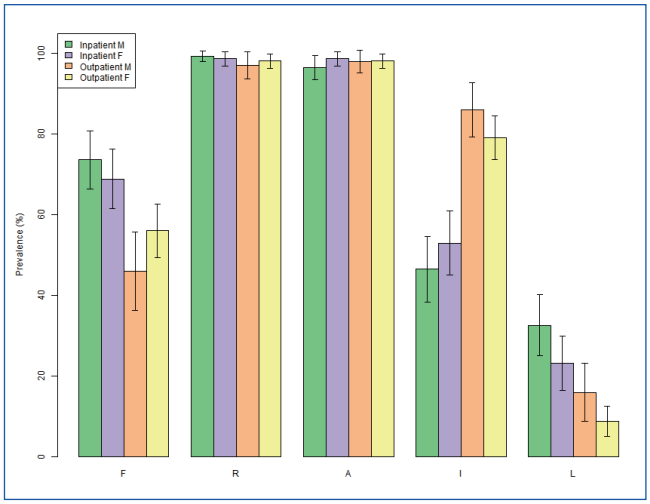

Figure 2. Prevalence of the FRAIL components among pre-frail patients. Patients are categorised by the setting (inpatient or outpatient) and sex (M, Male or F, Female) within each FRAIL component.

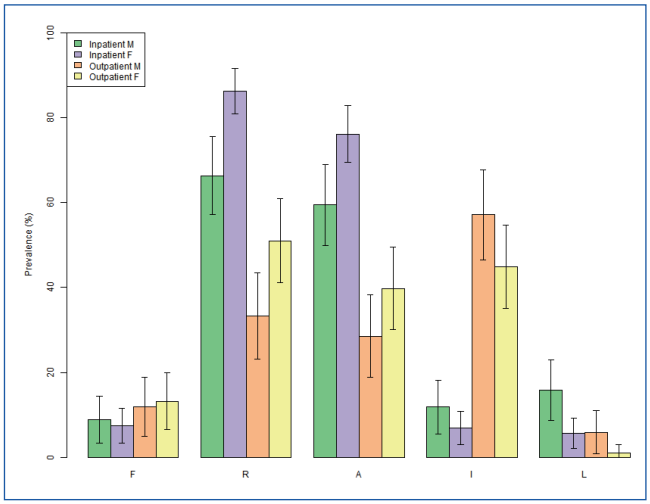

Table 2. Results of one-way associations between frailty status and covariates.

	Mean Frailty Score	Proportion of Pre-Frail or Frail	Proportion of Frail
Age Group			
65-74	1.83 (0.07)	74.11 (2.14)	35.15 (2.33)
75-84	2.24 (0.06)	84.28 (1.56)	49.36 (2.14)
85-100	2.76 (0.07)	94.92 (1.28)	65.42 (2.77)
Sex			
Male	2.12 (0.06)	81.25 (1.70)	46.21 (2.17)
Female	2.30 (0.05)	84.90 (1.32)	49.93 (1.85)
Race			
Chinese	2.16 (0.04)	82.62 (1.16)	46.38 (1.52)
Others	2.58 (0.10)	87.70 (2.41)	59.89 (3.59)
Admission Type			
Inpatient	2.27 (0.05)	85.78 (1.37)	45.60 (1.96)
Outpatient	2.18 (0.06)	80.84 (1.59)	51.30 (2.02)

(Parentheses indicate standard error).

Table 3. Results of multinomial analysis: Correlates of pre-frailty and frailty.

	Pre-Frail		Frail	
	Relative Risk Ratio (95% CI)	p-value	Relative Risk Ratio (95% CI)	p-value
Age				
	1.065 (1.039, 1.091)	<0.001	1.120 (1.093, 1.147)	<0.001
Race				
Chinese	(reference)			
Others	1.181 (0.695, 2.005)	0.538	2.267 (1.379, 3.727)	0.001
Sex				
Male	(reference)			
Female	1.149 (0.819, 1.611)	0.423	1.118 (0.802, 1.559)	0.509
Admission Type				
Inpatient	(reference)			
Outpatient	0.498 (0.355, 0.699)	<0.001	0.713 (0.512, 0.993)	0.046

Table 4. Subgroup analysis of inpatient population: Correlates of pre-frailty and frailty.

	Pre-Frail		Frail	
	Relative Risk Ratio (95% CI)	p-value	Relative Risk Ratio (95% CI)	p-value
Age				
	1.077 (1.037, 1.118)	<0.001	1.131 (1.089, 1.174)	<0.001
Race				
Chinese	(reference)			
Others	0.890 (0.425, 1.863)	0.758	2.150 (1.063, 4.348)	0.033
Sex				
Male	(reference)			
Female	1.141 (0.698, 1.865)	0.6	0.693 (0.422, 1.137)	0.147
Socio-economic factor: Ward Class				
Ward Class A & B	(reference)			
Ward Class C	1.469 (0.495, 4.358)	0.488	2.265 (0.757, 6.775)	0.144
Socio-economic factor: Eligible healthcare subsidy rate				
Low (0-20%)	(reference)			
High (>20%)	1.030 (0.435, 2.437)	0.946	0.722 (0.308, 1.693)	0.454

regression to evaluate the associations between frailty status and demographic factors, but with the additional covariates of the socio-economic factors of ward class and eligible healthcare subsidy rates. The results are shown in Table 4. The analysis remained robust, with increasing age being significantly correlated with both pre-frailty and frailty. As before, non-Chinese patients were at a higher risk of frailty, but not pre-frailty. Interestingly, the two defined socio-economic factors of ward class and eligible subsidy rate were not significant correlates of frailty status.

4. DISCUSSION

This study found that the prevalence of frailty and pre-frailty were high in the community hospital setting. About half of all inpatients and outpatients were frail. This corresponds to the prevalence of frailty in the tertiary hospital setting (50%), as reported in a previous study.[5] The true prevalence may be even higher as we excluded patients who did not have the potential to ambulate (e.g. bedbound patients). The rationale for this exclusion criteria was that such patients were likely to be at the extreme end of the frailty spectrum (i.e. severely frail), such that standard frailty interventions may result in more harm than benefit, with little hope of reversing frailty.

This study serves to highlight that the FRAIL scale is a quick, effective and practical tool that can be utilised in the community hospital setting of Singapore. Furthermore, the very elderly and the non-Chinese population are more likely to be frail and this corroborates the findings of previous local studies on frailty prevalence.[3,22] However, it has been observed in other studies that the FRAIL scale generates higher prevalence of frailty when compared to the Cardiovascular Health Study criteria (Fried's Frailty Phenotype).[14,23] This suggests that the FRAIL scale may assess different aspects of physical vulnerability as a study showed that the FRAIL scale had moderate diagnostic accuracy when compared with the Cardiovascular Health Study criteria.[14] This same study also showed a high specificity of 90% when a cut-off of 3 points was used to identify frailty using the FRAIL scale, which is advantages in identifying robust patients too.

Our study did not find significant correlation between socio-economic factors and frailty in the inpatient setting. This result corroborates another local study, which showed that the relationship of SES with frailty and pre-frailty did not persist after adjusting for confounders.[22] Of note, SES in that study was determined differently, i.e., by access to eight household amenities. Moreover, the Cardiovascular Health Study carried out in the USA also did not find any evidence of such association.[24] However, a study conducted in Hong Kong reached the opposite conclusion and found significant associations between SES and frailty.[25] This suggests that the impact of SES on frailty could be heterogeneous across cultural and societal contexts. More research is needed to uncover the drivers that link socioeconomic factors to frailty.

Interestingly, there was a slightly higher proportion of frail patients in the outpatient setting compared to the inpatient setting, although this difference was not statistically significant. This may be explained by the 22.1% of outpatients who did not have a prior record of the same community hospital admission, who may represent frail patients with complex medical issues

referred from other healthcare services or stepped down directly from the tertiary hospitals without the need for inpatient rehabilitation. As for the 78% of the outpatients seen in the clinic with previous admissions to the community hospital, higher frailty prevalence in the outpatient setting could reflect appropriate selection of more complex or ill patients for follow-up on discharge to the outpatient clinic.

Incapacity of "Resistance" and "Ambulation" were the main components of the FRAIL scale that contributed significantly to frailty in both the inpatient and outpatient groups. This was also true for the pre-frail inpatient group. This corroborates well with the rehabilitative aim of patients being admitted or referred to the community hospital. Results from a study conducted in Brazil utilising the FRAIL scale in a geriatric outpatient setting have suggested the evidence of 2 sub-dimensions to frailty based on differential patterns of association with demographic and clinical variables.[26] "Resistance" and "Ambulation" components have been classified as "physical performance frailty" while "Fatigue", "Illness" and "Loss of weight" have been classified as "health status frailty". These sub-dimensions indicate different pathways to frailty which concurs with the multidimensional model (physical, psychological, cognitive and social) to explain the process of the frailty syndrome. The 2 components of "Resistance" and "Ambulation" are also thought to represent the concept of sarcopenia, which has significant overlap with frailty. Sarcopenia is characterised by low muscle strength, low muscle quality and quantity.[27] The ageing process entails a net conversion of muscle fibres from type 2 to type 1, incurring an overall loss in strength and power.[28] Hence, it is not surprising that age was a significant correlate of frailty and pre-frailty. Physical exercise, adequate protein intake and vitamin D supplementation (if deficient) are effective interventions to tackle these 2 domains of frailty.[29] Among these interventions, physical exercise has been considered one of the most important components in the prevention and treatment of frailty, because of the improvements in functional capacity, gait ability, balance, cardiorespiratory capacity and muscle strength development, as well as the decreased risk for falls.[30-32] Specifically, resistance training has been highlighted as an essential component of physical intervention for the frail population, as it improves muscle mass, muscle strength, power output and functional capacity.[32,33] Indeed, it is the focus of combined frailty exercise programs (i.e. multi-modal training involving different components such as balance, endurance and gait training), an example of which is the "Gym Tonic" outpatient programme of the community hospital. While it would make sense to channel resources toward frailty-specific exercise programmes (targeting resistance and ambulation) for inpatients who are frail or pre-frail, the challenge is that inpatients may still have unresolved acute medical issues that would limit willingness and ability to participate. Moreover, the primary focus of inpatient rehabilitation is to optimally restore the patient's functional status and any additional physical frailty interventions may paradoxically result in the patient becoming more fatigue. At present, the practice is to offer eligible patients enrolment for such programmes at or after discharge.

Frail and pre-frail outpatients had a significantly higher prevalence of the component "I" (more than 5 illnesses) compared to inpatients. Similarly for pre-frail outpatients, the component "I" had the highest prevalence compared to the other components and was also significantly higher compared to pre-frail inpatients. This may likewise be due to a higher proportion of patients with multiple comorbidities being stepped down to the outpatient clinic from the inpatient setting, or referred from elsewhere. Such patients tend to have polypharmacy, which is associated with worsening of geriatric syndromes and adverse drug events.[34] Recognition of frailty is thus important as it offers the opportunity to identify and optimize the management of coexisting conditions that might contribute to, or be affected by, frailty. Medication reconciliation should be proactive, so as to mitigate pharmacologic stressors that might precipitate adverse outcomes. The FRAIL scale also serves as a framework to assist physicians in individualising goals of care and determining appropriate interventions based on the components contributing to frailty or pre-frailty. A frailty intervention algorithm using the FRAIL scale has been developed and proposed by Morley.[29]

5. CONCLUSION

To our knowledge, this is the first study to determine the prevalence of frailty and its contributing factors in the community hospital setting of Singapore. This paper is also the first study describing the use of the FRAIL scale in the community hospital setting. However, the temporal relationship between the changes in frailty status from the inpatient to the outpatient setting could not be established in this study. Granular details on comorbidities was not available to ascertain if a particular disease had any correlation with frailty.

Studies targeting the relationship between rehabilitation outcomes in the community hospital setting with frailty status and the impact of interventions to reverse frailty will be useful to assess the versatility of the FRAIL scale. This can be extended to other community hospitals throughout Singapore to minimise bias. Finally, further research investigating models of care and integration across the healthcare continuum may be worthwhile to tackle the problem of frailty in Singapore.

Frailty screening among older adults using the FRAIL scale is a practical tool that can be utilised in the community hospital setting of Singapore. The prevalence of frailty is high in the community hospital setting and is contributed significantly by incapacity in resistance and ambulation. Interventions targeting these components would thus be beneficial in potentially reversing and preventing the progression of frailty in the rehabilitative setting. More studies are needed to analyse the efficacy of specific interventions to reverse frailty in the inpatient and outpatient settings of a community hospital.

CONFLICT OF INTEREST

There are no conflicts of interest. This research did not receive any funding from agencies in the public, commercial, or not-for-profit sectors. However, the co-author, Joel Goh, acknowledges support from NUS Startup Grant number R-314-000-110-133.

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Appendix 1. The FRAIL Scale.[7]

Component	Question	Scoring
Fatigue	Do you feel tired all or most of the time for the past 4 weeks?	Yes = 1 No = 0
Resistance	Can you climb 1 flight of stairs (10 steps) without resting and without aids?	Yes = 0 No = 1
Ambulation	Can you walk 1 block (about 100 meters) alone and without aids?	Yes = 0 No = 1
Illness	> 5 illnesses	Yes = 1 No = 0
Loss of weight	> 5% weight loss over the past 12 months	Yes = 1 No = 0
Points and classification: 0 = robust; 1-2 = pre-frail; 3-5 = frail.		

Appendix 2. Subsidies for patients in community hospital subsidised wards.[35]

Household Per Capita Monthly Income	Subsidy Rate	
	Singapore Citizens	Permanent Residents
$700 and below	75%	50%
$701 to $1,100	60%	40%
$1,101 to $1,800	50%	30%
$1,801 to $2,600	45%	25%
$2,601 to $3,100	40%	20%
$3,101 and above	20%	10%