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Original Article

A prospective cohort study of older surgical inpatients examining the prevalence and implications of frailty

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ABSTRACT

Background: Older inpatients who are frail have complex medical issues and are likely to benefit from geriatric medicine services, but currently there are limited studies of frailty in the surgical inpatient population. The aims of this prospective cohort study were to identify the prevalence of frailty in a cohort of older surgical inpatients, and the association of frailty with adverse outcomes and provision of geriatric medicine assessment.

Methods: Surgical inpatients aged ≥ 65 years admitted to a Sydney tertiary referral hospital were assessed for frailty using the Reported Edmonton Frail Scale. Outcomes in hospital and geriatrician involvement in inpatient care were identified by medical record review, and outcomes three months post-recruitment were assessed via telephone interview.

Results: Of 100 participants, 33 were classified as frail. Frailty was associated with a higher risk of falls ($P=0.01$), disability in activities of daily living ($P<0.001$), polypharmacy ($P<0.001$) and new discharge to a nursing home ($P=0.04$). Prevalence of specialist geriatric assessment was not significantly greater in frail (36%) compared to non-frail (22%) participants.

Conclusions: A significant proportion of frail surgical inpatients are vulnerable to adverse outcomes, but do not receive geriatric medicine services in the hospital setting. Preoperative frailty assessments have the potential to inform the management of these patients.

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INTRODUCTION

By 2050, the proportion of the global population aged over 60 years is projected to reach 20%.¹ In Australia, people aged 65 years and older currently account for 48% of patient days and 40% of separations.² Fundamental to the challenges of addressing the health care needs of this age group is the management of frailty. Frailty refers to a state of vulnerability to minor homeostatic stressors, including surgery, due to an age-related decline in physiological reserve.³ Frail people are at greater risk of adverse outcomes such as falls, increasing disability, hospitalisation, transfer to higher level of care, and mortality.^{4,5} There is therefore an increasing role for geriatricians in the direct admission or consultation of complex older surgical patients. The integration of geriatric medicine services into multidisciplinary management has been shown to improve outcomes such as quality of life, and reduce functional decline, postoperative complications and mortality in older patients of various medical and

surgical specialties,^{6,7,8} with particular success demonstrated in continually expanding orthogeriatric services for hip fracture patients.^{9,10,11}

Studies of frailty prevalence are therefore of considerable value as they inform the management of frailty at both the individual and population level by identifying cohorts who could significantly benefit from geriatric medicine services. However, there are limited previous studies of frailty prevalence in surgical inpatients internationally,^{12,13,14} and none to our knowledge in Australia. In addition, no association to date has been made between the prevalence of frailty in surgical inpatients and the provision of geriatric medicine assessment.

In this study, we aimed to identify the prevalence of frailty in a population of older surgical inpatients, and its association with adverse outcomes in hospital and three months thereafter. The frequency of the provision of specialist geriatric medicine services, by surgical service, was also studied.

METHODS

Participants

Participants were recruited from a convenience sample of patients aged 65 years or over who were admitted under the orthopaedic, cardiothoracic, vascular or colorectal surgical services in Royal North Shore Hospital (RNSH), a tertiary referral centre in Sydney, Australia. Patients were included if they or their person responsible were able to provide informed consent. There were no exclusion criteria. Recruitment occurred between March and July 2014, and informed written consent was obtained from the participant or their person responsible prior to enrolment. The study was approved by the Northern Sydney Local Health District Human Research Ethics Committee (LNR/13/HAWKE/429).

Data Collection

Upon enrolment, participants were interviewed by a medical student investigator (SC) and assessed for frailty using the Reported Edmonton Frail Scale (REFS), a self-reported survey that is designed for use by non-geriatrician investigators in the acute care setting.¹⁵ The REFS evaluates reported frailty status just prior to hospital admission, and encompasses multiple frailty domains including cognition, general health status, functional independence, social support, medication use, nutrition, mood, continence and self-reported performance.¹⁵ Polypharmacy, defined as the use of five or more medications, was recorded as a domain of the REFS survey. Activities of daily living (ADL) disability was assessed in the initial interview using a score validated for telephone administration,¹⁶ which asks about lack of independence in bathing, dressing, in-home mobility and ability to get in and out of a chair. Comorbidity was evaluated with the Charlson Comorbidity Index.¹⁷ Assessments conducted during the initial interview evaluated participants' baseline function prior to their acute illness.

Participants' medical records, including progress notes and discharge letters, were reviewed after discharge to determine reason for admission, length of hospital stay and the occurrence of adverse events in hospital such as falls, pressure sores, delirium, adverse drug reactions, postoperative complications and death. Postoperative complications included haemorrhage, wound dehiscence, wound infection, and other complications thought to arise as a result of postoperative deconditioning or immobility, such as atelectasis and deep vein thrombosis. Adverse events in the 'other' group included those not previously categorised into postoperative complications, such as pneumonia, urinary tract infection, sepsis of unknown source, thromboembolism and myocardial infarction.

Geriatric medicine involvement was also determined by medical record review. Orthopaedic patients with minimal trauma fractures are automatically referred to orthogeriatric services at RNSH. Other patients who received geriatric consultation were referred by their treating team.

Three months subsequent to the initial interview, participants were contacted by telephone to determine outcomes including falls, hospital readmission, transfer to a higher level of care, reported confusion and death. ADL disability was reassessed using the same score as the initial interview. If participants could not be contacted for follow-up, the telephone interview was conducted where possible with their person responsible or general practitioner.

Statistical Analyses

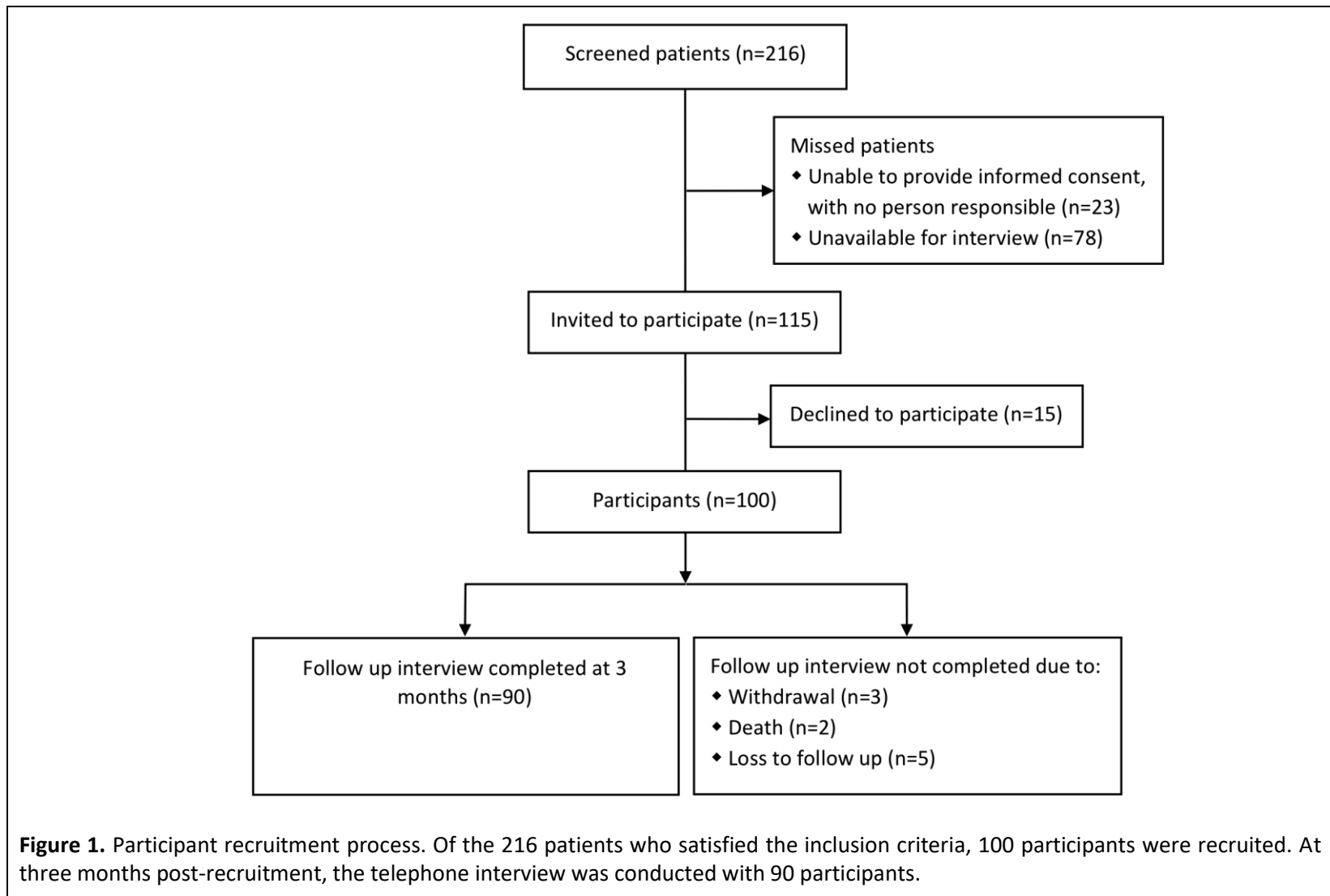
The REFS assesses frailty as a score out of 18, which categorises participants into 'not frail', 'apparently vulnerable', 'mild frailty', 'moderate frailty' and 'severe frailty'. For analyses, the study population was further classified as frail (REFS 8–18) or non-frail (REFS 0–7), as established previously.^{15,18,19}

Demographic characteristics, baseline variables, outcomes at three months post-recruitment, and provision of geriatric assessment of the frail and non-frail groups were compared using the Student's *t*-test for continuous variables, and the Chi-squared test or Fisher's exact test (for $n < 5$) for categorical variables as appropriate. Comorbidity, ADL disability and length of hospital stay were compared between the two groups using the Mann-Whitney U test. Analysis of variance was used to compare frailty scores between surgical services. The small sample size precluded use of multivariate analysis. Analyses were performed using the Statistical Package for Social Sciences (SPSS) version 15.0.1 (SPSS Inc., Chicago, IL, USA).

RESULTS

Of the 216 patients who were screened for eligibility, 23 were unable to provide informed consent and had no person responsible present, 78 were unavailable for interview after three attempts at recruitment, and therefore 115 were invited to participate (Figure 1). Of the 115 patients, 100 agreed to participate, 90 of whom were successfully contacted three months post-recruitment. One patient was consented and assessed via a person responsible, due to difficulty speaking English. Screened patients who were unavailable for interview after three attempts at recruitment did not differ significantly from the study participants in terms of age or sex. However patients who declined to participate, or who were unable to provide informed consent with no person responsible present, were more likely to be older (mean age 81.7 ± 9.5 years old) than the study participants (mean age 78.0 ± 7.0 years old, $P < 0.01$).

The prevalence of frailty in the studied surgical patient population was 33%. Participant characteristics by frailty are shown in Table 1. There was no significant difference in age, sex or comorbidity in frail compared to non-frail participants on univariate analysis. At baseline, frailty was significantly associated with living in a nursing home ($P = 0.03$), polypharmacy ($P < 0.001$), and higher ADL disability scores ($P < 0.001$). There was no relationship between frailty score and admission to any particular surgical service ($P = 0.05$).



Participants were admitted for a wide range of surgical procedures. The most common reasons for admission were neck of femur and other fractures and hip or knee replacements in orthopaedic patients, coronary bypass graft and pacemaker insertion in cardiothoracic patients, peripheral vascular disease and abdominal aortic aneurysm in vascular patients, and colectomy in colorectal patients.

On analysis of adverse events, frail participants were more likely to experience falls in hospital compared to non-frail participants ($P=0.01$), but there was no relationship between frailty and postoperative complications or length of hospital stay, even when a sensitivity analysis was performed with exclusion of emergency or multisystem trauma patients. Length of stay was not associated with initial residence in an aged care facility. Three months post-recruitment, frail participants were more likely to have experienced falls post-discharge ($P=0.04$) and were more likely to have been newly transferred to a high level residential aged care facility, such as a nursing home, from a lower level of care ($P=0.04$), compared to non-frail participants. Frailty was not significantly associated with hospital readmission, reported confusion or death at the time of the telephone interview. In addition, frail participants continued to have greater ADL disability ($P<0.001$) than their non-frail counterparts at three months post-recruitment, and had more changes in ADL disability ($P=0.01$), trending towards a worsening ADL score.

Frail participants were not significantly more likely than non-frail participants to receive geriatric medicine assessment ($P=0.14$), with 36% of frail participants reviewed by a specialist geriatrician. Characteristics of participants

who received geriatric assessment are shown in Table 2. Orthopaedic patients were more likely than patients admitted under other surgical services to receive geriatric medicine assessment ($P<0.001$). Of the 15 non-orthopaedic frail participants, only one, a colorectal patient, was reviewed by a geriatrician. However, if patients with minimal trauma fractures, for whom there is an automatic geriatric referral service at RNSH, were excluded from the analysis, there was no significant difference between orthopaedic and other surgical services ($P=0.11$), and frail patients were still not more likely to receive geriatric medicine assessment than non-frail patients ($P=0.23$). Non-automatic geriatrician referrals were either requests for orthogeriatric input for patients who were admitted to orthopaedics with injuries other than minimal trauma fractures, or for investigation and management of delirium. When vascular and colorectal patients were excluded from statistical analyses due to small sample size, frail orthopaedic patients were more likely than frail cardiothoracic patients to receive geriatric medicine services ($P=0.01$), as no cardiothoracic study participants were reviewed by a geriatrician in hospital. Furthermore, 63% of all the geriatrician assessments that were received by study participants occurred postoperatively. This study was not powered to perform multivariate analyses in order to investigate any effect of geriatric medicine input on patient outcomes.

DISCUSSION

To our knowledge, this is the first study in Australia to examine the prevalence of frailty in older surgical inpatients.

Table 1. Participant characteristics stratified by frailty as defined by the Reported Edmonton Frail Scale (REFS)

Characteristic	All	Frail	Non-frail	P-value (frail vs. non-frail)
Number of participants	100	33	67	
Age (years)	78.0 ± 7.0	79.8 ± 6.6	77.1 ± 7.1	0.07
Female	58	23 (70)	35 (52)	0.10
REFS score	6.4 ± 3.2	10 ± 1.8	4.6 ± 2.1	
Residential status				
Alone	30	6 (18)	24 (36)	0.07
With partner	36	10 (30)	26 (39)	0.41
With family	14	6 (18)	8 (12)	0.54
Retirement village	15	7 (21)	8 (12)	0.24
Residential aged care facility				
Low level (hostel)	2	1 (3)	1 (1)	1.00
High level (nursing home)	3	3 (9)	0 (0)	0.03*
Surgical service				
Orthopaedic	50	18 (55)	32 (48)	
Cardiothoracic	34	7 (21)	27 (40)	
Vascular	5	3 (9)	2 (3)	
Colorectal	11	5 (15)	6 (9)	
Triage				
Emergency surgery	52	16 (48)	36 (54)	0.62
Elective surgery	48	17 (52)	31 (46)	
Comorbidity	4.1 ± 3.1	4.8 ± 3.3	3.8 ± 2.9	0.13
Polypharmacy	64	30 (91)	34 (51)	<0.001*
Geriatric assessment	27	12 (36)	15 (22)	0.14
Adverse events in hospital	56	23 (70)	33 (49)	0.05
Falls	7	6 (18)	1 (1)	0.01*
Delirium	10	5 (15)	5 (7)	0.29
Pressure sores	12	3 (9)	9 (13)	0.75
Adverse drug reactions	11	3 (9)	8 (12)	1.00
Postoperative complications	33	11 (33)	22 (33)	0.96
Death	1	0 (0)	1 (1)	1.00
Other	22	11 (33)	11 (16)	0.06
Days in hospital	19.7 ± 16.8	18.0 ± 10.2	20.0 ± 19.3	0.41
Follow-up interview	90	29 (88)	61 (91)	1.00
Follow-up interview completed by				
Participant	68	16 (48)	52 (78)	<0.01*
Person responsible	17	10 (30)	7 (10)	
General practitioner	5	3 (9)	2 (3)	
Adverse outcomes three months post-recruitment				
Falls	11	7 (21)	4 (6)	0.04*
New admission to high level residential aged care facility	5	4 (12)	1 (1)	0.04*
Hospital readmission	38	15 (45)	23 (34)	0.26
Reported confusion	8	5 (15)	3 (4)	0.05
Death	1	1 (3)	0 (0)	0.34
Activities of daily living (ADL) disability score				
Initial	0.19 ± 0.63	0.55 ± 1.00	0.01 ± 0.12	<0.001*
Three months post-recruitment	0.64 ± 1.25	1.41 ± 1.59	0.28 ± 0.84	<0.001*
Change in ADL score	0.39 ± 1.06	0.70 ± 1.40	0.24 ± 0.82	0.01*

Non-frail was defined as REFS 0–7, and frail defined as REFS 8–18. Variables are reported as number (% within category) or mean ± standard deviation.

*indicates significant difference between frail and non-frail (P < 0.05).

Table 2. Characteristics of participants who received geriatric assessment

Characteristic	All	Frail	Non-frail
Geriatric assessment	27	12	15
Preoperative	10	5 (42)	5 (33)
Postoperative	17	7 (58)	10 (66)
Surgical service			
Orthopaedic	24	11	13
Cardiothoracic	0	0	0
Vascular	0	0	0
Colorectal	3	1	2

Variables are reported as number (% within category)

Few studies have assessed frailty prevalence in older inpatients across multiple surgical services, with previous estimates of 10% (n=594),¹² 28% (n=325),¹³ and 50% (n=28).¹⁴ At 33%, the prevalence of frailty in the studied surgical patient population is comparable to these estimates. The identified prevalence of frailty in most studies of surgical inpatients is lower than that of most medical inpatient studies, estimates of which range from 41–80%.^{14,20,21} Similarly, the frailty prevalence of 33% identified in this study is just over half the previous 64% estimate of a similar demographic of mixed medical and surgical inpatients, in which the REFS was also used.¹⁵ This could reflect the necessary level of robustness required to be considered a candidate for surgery. However, the comparability of prevalence studies is limited by the lack of a consensus definition of frailty, which results in the use of differing scoring systems in different studies.

At baseline, frailty was associated with nursing home residence, ADL disability and polypharmacy, which is consistent with previous studies of community-dwelling populations.^{22,23,24} There was no significant relationship between frailty and age (mean age: frail 78.9 ± 6.6 years old, non-frail 77.1 ± 7.1 years old, non-significant) or sex (female: frail 70%, non-frail 52%, non-significant) in this study, although previous studies have identified greater frailty rates with increasing age and female sex.^{22,25} Frailty has also been previously associated with comorbidity in surgical and medical inpatients,^{20,26} but despite trending in the same direction this was not significant in the current study (Charlson Comorbidity Index: frail 4.8 ± 3.3, non-frail 3.8 ± 2.9, non-significant), possibly due to the wide variation in comorbidity scores, relatively small sample size, and choice of frailty score.

Frailty was also associated with adverse outcomes in hospital and three months post-recruitment, such as falls, transfer to higher level of care, greater ADL disability and greater change in ADL disability over time, which is consistent with studies in both surgical and medical inpatients.^{12,27} However, no significant relationship was identified between frailty and postoperative complications or length of hospital stay. Furthermore, length of hospital stay was not significantly associated with initial place of residence, which may have reflected expedited discharge back to a residential aged care facility. Despite this, previous studies have demonstrated a consistent association between preoperative frailty and postoperative complications such as infection, prolonged ventilation, prolonged hospital stay, reoperation and mortality in both elective and emergency surgical patients,^{5,12,26,28,29} which highlights the clinical utility of preoperative frailty

assessments as a superior predictor to chronologic age of surgical outcome.¹²

In our study, frail participants were not more likely than non-frail participants to receive specialist geriatric medicine assessment, and only 36% of frail patients were reviewed by a geriatrician. A significant proportion of frail surgical inpatients are therefore vulnerable to adverse outcomes, but do not receive targeted geriatric medicine services, which have the potential to provide clinically meaningful benefit.⁶ In addition to reducing mortality and postoperative complications,^{8,10} geriatric medicine intervention may improve communication with patients and their families, and facilitate coordination of the multidisciplinary team,³⁰ outcomes that are infrequently measured but which may be of significant benefit to the older surgical inpatient, as demonstrated in orthogeriatric models of care.

Orthopaedic patients were significantly more likely than other surgical patients to be assessed by a geriatrician, which reflects the increasing and successful adoption of orthogeriatric models of care in perioperative management.¹¹ Our results suggest that there is a role for further integration of geriatric medicine services in the management of frail non-orthopaedic surgical inpatients. Furthermore, while 63% of geriatric medicine assessments in this study occurred postoperatively, recent studies have indicated that the benefit of such services is maximised if it occurs preoperatively, as it predicts surgical risk and outcomes.^{8,26,28} There may therefore be a greater role for preoperative frailty assessments in the surgical risk management of older inpatients.

Our study has several strengths. To our knowledge, this is the first study to investigate the relationship between the prevalence of frailty in surgical inpatients and the provision of geriatric medicine services, which has implications for site-specific allocation of such services. All data were collected by one investigator, removing any inter-rater confounding in frailty or other assessments. In addition, loss to follow-up in this study was low, at 10%. Furthermore, the reported format of the REFS lends itself to use in acute care settings, and allows for completion by a person responsible if required, unlike performance-based scales.¹⁵ Although the REFS may be subject to reporting or recall bias, it has been validated against the Geriatricians' Clinical Impression of Frailty,¹⁵ and encompasses physical, cognitive and psychosocial frailty domains. The REFS may therefore be an efficient preoperative risk assessment tool in older surgical inpatients. However, the lack of a consensus definition of frailty continues to affect its diagnosis and estimates of prevalence, and also limits the generalisability and comparison of studies examining the efficacy of potential interventions.

The limitations of this study include the small sample size, which reduced statistical power in analysis of the association of frailty with some baseline characteristics and adverse events such as postoperative complications, as well as the effect of geriatric assessment on outcomes, and precluded multivariate analysis. In addition, the reported prevalence of frailty may have been a conservative estimate, as patients who either declined to participate or who were unable to provide informed consent were older than the study participants, who may not have been representative of all surgical inpatients. The accuracy of the prevalence estimate would also have been

improved with a consecutive sample population, but this is not feasible in a prospective study. The multiple comparisons performed in this study increase the potential for type I errors, and the association of frailty with polypharmacy was biased by the inclusion of polypharmacy as a REFS domain. Recording of the occurrence of adverse events in hospital may have been limited by inadequate medical record documentation. Moreover, as a single site study, our results have limited generalisability to other hospitals and should be confirmed by future investigations.

CONCLUSION

A significant proportion of surgical inpatients are frail, but are not more likely to receive geriatrician assessment than their non-frail counterparts. Frail patients are more vulnerable to adverse outcomes such as falls, ADL disability, polypharmacy, and transfer to higher level of care. There may therefore be a greater role for preoperative frailty assessments in older surgical inpatients who are likely to benefit from targeted specialist geriatric medicine services.

Further prevalence studies at other sites could inform the allocation of geriatric medicine services to optimize the management of frail patients by anticipating and addressing potential adverse outcomes. Future research could also consider the impact of geriatric assessment on older surgical inpatients, across various surgical services, on outcomes over a longer period of time.

CONFLICTS OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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