

1 Malnutrition associated with increased risk of frail
2 mechanical falls among older people presenting to an
3 emergency department

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7

8 **ABSTRACT**

9

10 Objectives: To identify associations between malnutrition, falls risk and hospital admission
11 amongst older people presenting to ED

12 Methods: A prospective convenience sample of patients, aged 60 years or more, presenting to
13 an Australian tertiary teaching hospital ED were included in this cross-sectional study.
14 Malnutrition Screening Tool (MST) and Subjective Global Assessment (SGA) tool were
15 administered to 126 non-consecutive participants. Participants were categorized as non-
16 fallers, frail mechanical or active mechanical fallers. Self reported falls in past six months and
17 hospital admission were documented.

18 Results: Participant age and gender (median age 74, IQR 65-82 years; male 59%, 74/126,
19 95% CI 50-67%) were representative of older people presenting to the ED. Malnutrition
20 prevalence was 15% (19/126, 95% CI 9-21%). There was an increased risk of being assessed
21 as malnourished when a frail mechanical faller relative to: a non-faller (RR: 1.5, 95% CI 1.0-
22 2.3, p=0.001); an active mechanical faller (RR: 3.1, 95% CI 1.0-10.9, Fisher's Exact test
23 p=0.02); or a non-faller and active mechanical faller combined (RR: 1.5, 95% CI 1.0-2.1,
24 p=0.001). Malnourished participants had an increased risk of self-reported falls over six
25 months (RR: 1.5, 95% CI 1.0- 2.5, p=0.03). There was over five times the risk of hospital

26 admission if malnourished than if well-nourished (RR: 5.3, 95% CI 1.4-20.0, Fisher's Exact
27 test $p=0.001$) . The MST captured 84% (16/19, 95% CI 78-92%) of participants assessed as
28 malnourished by SGA.

29 Conclusion: Older people presenting to ED's should be nutritionally screened. Malnutrition
30 prevalence of 15% was documented and was associated with an increased risk of frail
31 mechanical falls and hospital admission. The Malnutrition Screening Tool was a simple and
32 practical screen for ED.

33

34 **Keywords: falls, emergency department, malnutrition, nutrition screening, older people**

35 **INTRODUCTION**

36 Malnutrition is associated with falls risk in older populations, but has not previously been
37 documented in populations presenting to emergency departments (ED) in Australia or
38 internationally. The older population aged 65 years and over in Australia is predicted to
39 increase from 2.5 million in 2003 to 3.2 million in 2011 and then 7.2 million people by
40 2051.¹ Findings have shown that falls occur in 33% of older people living in the community
41 annually.² Once an older person falls, they are two to three times more likely to fall again
42 within the same year.² Annual health costs directly related to falls in older people are
43 projected to rise from the current \$AU500 million (2001) to \$AU1.375 billion by 2051.³
44 Unless effective prevention strategies are executed, the situation is anticipated to be critical
45 by 2010 and a 66% reduction in falls incidence is needed to be delivered to maintain parity.³

46

47 Malnutrition affects 25-60%⁴⁻⁶ of older hospitalized populations, increasing in incidence with
48 age.⁷ It is associated with increased complications, delayed wound healing, mortality and re-
49 admission rates.⁸ One in seven (170/1145) older Queenslanders receiving Home and
50 Community Care services were identified as being at risk of malnutrition using the
51 Malnutrition Screening Tool.⁹ Malnutrition is associated with falls risk in the older
52 population^{10, 11} and fallers tend to have a lower nutritional status than non-fallers.¹⁰⁻¹²

53

54 Considering the association previously observed between malnutrition and all fallers,^{10, 11}
55 determining nutritional status may be appropriate within the medical review. Kingsley¹³
56 classified falls as frail mechanical falls and active mechanical falls. While an active
57 mechanical faller may only require assessment and treatment for fall injuries, a frail

58 mechanical faller may require a more complete medical review to determine any underlying
59 issues that caused the fall.¹³ Malnutrition is commonly reported in older hospitalised
60 populations^{14, 15} and in community dwelling or institutionalised people.^{14, 15} However, no
61 studies have assessed the risk of falls in those malnourished presenting to the ED.

62

63 This study aimed to assess the association between malnutrition and the risk of falls in an
64 older population presenting to ED. This study also aimed to assess malnutrition prevalence
65 using Subjective Global Assessment as a criterion standard and to test the ability of the
66 Malnutrition Screening Tool¹⁶ to identify older people with malnutrition presenting to ED.

67 **METHODS:**

68 ***Participant Recruitment:***

69 A cross-sectional, prospective study involving a convenience sample of older fallers and non-
70 fallers was conducted for one month at the Princess Alexandra Hospital, Brisbane. Non-
71 consecutive patients ≥ 60 years who presented to the ED (with over 60 000 presentations
72 annually and over 12 000 ≥ 60 years) at a tertiary teaching hospital, between 7am and 5pm
73 Monday to Friday during April 2008 and who provided voluntary consent were recruited. No
74 sample size estimates were available as this was the first known occasion malnutrition data
75 had been collected in the ED setting. Consequently data collection was completed for one
76 month due to operational capacity as the study received no financial support. Exclusion
77 criteria included: substantial cognitive impairment (through ED staff opinion as to whether
78 informed consent possible); language barrier (excluded if no interpreter available); triage
79 category 1 or being determined unfit by medical staff. The hospital's Human Ethics Research
80 Committee approved the research protocol.

81

82 ***Pre-interview:***

83 Age, gender, triage category and the patient's original presenting problem as recorded by the
84 triage nursing staff were recorded from the Emergency Department Information System
85 (EDIS), a system that provides prospective data collection of all ED attendances available in
86 real time. Those who presented to the ED post-fall were, on occasion, prioritised over non-
87 fallers. Non-fallers were also interviewed. Participants were only assessed whilst in the ED.

88

89 ***Data collection***

90 Data were recorded on forms purpose-designed for the study in order to simplify data
91 collection and entry. Any identifying participant details were securely stored separately from
92 the data collection sheets and data was de-identified prior to analysis.

93

94 A fall was deemed to occur when environmental hazards or physical demands exceeded the
95 individual's ability to maintain independent postural stability¹⁷ such that it resulted in the
96 person coming to rest inadvertently on the floor, ground, or other lower level.¹⁸ According to
97 patient history, fallers were divided into either the frail mechanical fall group or active
98 mechanical fall group according to Kingsley.¹³ A frail mechanical fall occurred in a setting of
99 muscle deterioration, poor foot placement, and visual or proprioceptive inadequacies. Frail
100 fallers often reported attempting a routine activity that was unsuccessfully completed due
101 to weakness. An active mechanical fall often occurred during vigorous activity, with active
102 mechanical fallers normally experiencing uninhibited physical function.¹³ Those with
103 syncope or vertigo were included with active mechanical falls as per Kingsley's definitions.
104 The specific type of fall was established through review of ED medical notes, conversation
105 with the ED physician and the participants themselves.

106

107 Any self-reported falls in the previous 6 months were documented. Participants were
108 screened as either at risk or not at risk of malnutrition using the Malnutrition Screening Tool
109 (Table1).¹⁶ Subjective Global Assessment (SGA)¹⁹ was employed as the criterion standard
110 against which the clinical validity of the MST in the ED setting was assessed. SGA was
111 used to assess and confirm all participants as well-nourished (SGA A), moderately
112 malnourished or at risk of malnutrition (SGA B) or severely malnourished (SGA C).¹⁹ No
113 mildly malnourished group occurs in this categorization.

114

115 Subsequent admission to hospital or discharge from ED was recorded. Participants who were
116 admitted as an inpatient to a hospital ward, or transferred to another hospital, were considered to
117 have been ‘admitted’, while participants discharged to their usual home or residence directly from
118 ED were considered ‘discharged’.

119

120 ***Data collection and Statistical Analysis:***

121 Age was not normally distributed and was presented as medians and interquartile ranges
122 (IQR). Age, gender and triage category differences between those recruited into the study and
123 others aged ≥ 60 years of age presenting to ED in the year of the study (2008) were analysed
124 using the Mann Whitney U test. Gender, fall group, number of self-reported fallers in the
125 previous 6 months and subsequent admission or discharge was assessed against nutritional
126 status using Pearson’s Chi-square test and relative risk (RR). Fisher’s Exact Test was used in
127 cases of small cell frequency (five or less). Sensitivity, specificity, positive and negative
128 predictive values were calculated for the Malnutrition Screening Tool in relation to the SGA
129 score and 95% Confidence intervals reported. Two tailed tests were used and significance
130 was determined at $p \leq 0.05$.

131

132 One person collected all data, eliminating inter-rater variability. However, for additional
133 confidence in the malnutrition assessments completed, the data collector and exemplar (both
134 from the dietetic discipline) undertook SGAs in person with a convenience sample of
135 participants, using Cohen’s kappa statistic to assess inter-rater reproducibility Cohen’s kappa
136 statistic also assessed the intra-rater reliability of the data collector’s initial malnutrition
137 assessments against reassessments of coded and reordered participant SGA documentation
138 undertaken more than 12 months after cessation of data collection thus eliminating recall. The
139 SGA was completed in accordance with the protocol described by Detsky.¹⁹ Those rated as

140 moderately or suspected of being malnourished (SGA B) and the severely malnourished
141 (SGA C) were grouped and coded as malnourished. All data was analysed using the SPSS for
142 Windows, release 12.1 (Statistical Package for the Social Sciences Year 2003).

RESULTS:

During the one month study period 436 people aged ≥ 60 years presented to the ED. Of these, 88 were excluded, 18 declined and 204 were not seen due to time or treatment restraints. One hundred and twenty-six (126) eligible participants were recruited. Median age was 74 years (IQR 65-82) and 59% (74/126, 95% CI 50-67%) were male (Table 2). Age ($p=0.763$), gender ($p=0.274$) and triage category ($p=0.062$) were not statistically significantly different between the study participants and others aged 60 years or more who presented to the ED in 2008 ($n=12,425$).

Malnutrition prevalence was 15% (19/126, 95% CI 9-21%) (Table 2). High SGA inter-rater reproducibility was confirmed between the data collector and the dietetic exemplar (18/19, Cohen's Kappa 0.9 $p<0.001$). High intra-rater reliability of the data collector's SGA assessments was also confirmed (123/126, Cohen's Kappa 0.9 $p<0.001$).

Of the study participants recruited, 28% (35/126, 95% CI 20-36) presented to ED as a result of a fall (Table 3). A frail mechanical fall was experienced by 12% (15/126, 95% CI 6-18%) and an active mechanical fall by 16% (20/126, 95% CI 10-22%). There was an increased risk of being assessed as malnourished if a frail mechanical faller relative to a non-faller (RR: 1.5, 95% CI 1.0-2.3, $p=0.001$), active mechanical faller (RR: 3.1, 95% CI 1.0-10.9, Fisher's Exact test $p=0.02$) or non-faller and active mechanical faller combined (RR: 1.5, 95% CI 1.0-2.1, $p=0.001$).

A larger proportion of the group presenting to ED after a frail mechanical fall were malnourished (47%, 7/15, 95% CI 22-72%), compared to non-faller group (11%, 10/91, 95%

CI 5-17%) and active mechanical fallers (10%, 2/20, 95% CI 0-20%) ($p=0.001$) (Figure 1). Malnutrition prevalence was greater amongst frail mechanical fallers than active mechanical fallers but did not differ between the active mechanical fallers and non-fallers (Fishers Exact test $p=0.02$ and 1.00 respectively).

The incidence of self-reported falls during the previous six months was 31% (39/126, 95% CI 23-39%) (Table 2). Malnourished participants showed as increased risk of self-reporting a fall during the previous six months compared to the well-nourished (RR: 1.5, 95% CI 1.0-2.5, $p=0.03$) (Figure 2). The malnourished also had an increased risk of being admitted to hospital rather than being discharged from ED (RR 5.3, 95% CI 1.4-20.0, Fisher's Exact test $p=0.001$).

The Malnutrition Screening Tool identified 16 of the 19 people confirmed as malnourished by the SGA demonstrating 84% (95% CI 78-92%) sensitivity in the ED setting (Figure 3). In relation to the SGA, the Malnutrition Screening Tool demonstrated 85% (95% CI 78-92%) specificity, 50% (95% CI 33-67%) positive predictive value and 97% (95% CI 94-100%) negative predictive power (Figure 3). The current hospital practices which included malnutrition screening completed at the ward within 48 hours of admission and ED initiatives which include Community Hospital Interface Programme staff, identified 47% (9/19, 95% CI 25-69%) of the participants assessed as malnourished (SGA B or C).

DISCUSSION:

Malnutrition occurred in one in six (15%) older people presenting to ED. Malnutrition in the Australian hospital inpatient setting has been previously observed at between 31%-44%,^{6, 20} whilst a Canadian study observed 24% malnutrition within those who were admitted to a hospital ward after ED presentation.⁴ The authors are unaware of any previous study in Australia or internationally that has investigated either malnutrition prevalence amongst older people or its associations with fall presentation to ED.

The findings indicated that the specific fall type, not the fall itself, was associated with malnutrition. Participants who experienced an active mechanical fall or no fall were more likely to be well nourished compared to those experiencing a frail mechanical fall. While previous research has found a relationship between falls and malnutrition,^{10, 11} no previous study has investigated relationships between malnutrition and specific fall types.

Previous falls interventions have focused on increasing physical function, lower body strength, balance and home hazard awareness.² Falls interventions featuring nutritional supplementation have had mixed results. Fiatarone et al found that protein and energy supplementation was only effective when combined with exercise,²¹ while increased micro-nutrient (vitamin and mineral) intake alone, or combined with exercise, was not found to decrease falls in an older population.²² Nutritional studies had not previously distinguished between types of fallers which may have contributed to mixed results.^{11, 17, 18}

Malnourished participants had an increased risk of self-reporting a fall in the previous six months compared with their well-nourished counterparts. The incidence of self-reported falls over six months (31%) amongst participants were comparable to previous reports, where 33% of older community dwellers experienced one fall annually.² Considering the different time frames, our results may be conservative.

Independent of falls, ED participants assessed as malnourished had a higher risk of admission to hospital. In addition to falls risk, the identification of malnutrition alone is worthy of recognition. Using multivariate analysis and adjusting for effect of age, disease, cancer, infection, malnourished patients were demonstrated to have increased complications, length of stay, hospital costs and mortality.²³ A simple, routine and systematic approach to the identification of malnutrition across hospitals, including ED, is required.

Implementation of malnutrition screening using the MST, with subsequent dietetic assessment to confirm nutritional status, would have increased the identification of malnourished people presenting to ED from 47% (95% CI; 38.3-55.7%) to 85% (95% CI; 78.8-91.2%). Currently, dietetic staff are not routinely members of the ED team, and malnutrition screening is not undertaken in this setting. The two simple questions of the Malnutrition Screening Tool can be completed by nursing staff or by the administrative staff, patients and/or carers themselves.

Although the sample size was not large, the Malnutrition Screening Tool was assessed in the ED setting for the first time and demonstrated good sensitivity (84%) and specificity (85%) against malnutrition assessed utilizing SGA (predictive validity). While the SGA was originally developed in surgical patients²⁴ clinical and predictive validity has subsequently been confirmed amongst older adults across acute care,²⁵⁻²⁹ rehabilitation³⁰ and community settings³¹ which includes all sources of presentations to ED. There is continuing failure within health systems to recognise patients with malnutrition. A study conducted at Australian teaching hospitals revealed that the majority of malnourished inpatients (over half of whom were severely malnourished) were not recognised by staff or receiving any specialised nutrition care.⁶ A more recent Australian study identified 42% of patients as malnourished, but found only 15% of these were referred for nutrition intervention.³² Early malnutrition identification would enable early nutritional intervention, which has been shown to decrease hospital length of stay and readmission rates.⁸

Australia has an ageing population coupled with increasing life expectancy for those aged over 60 years.^{1,33} Both factors present huge resource issues for health systems overseas^{34,35} and in Australia where emergency departments already experience access block.^{36,37} The Malnutrition Screening Tool can offer a valuable addition to the ED setting enabling the rapid identification of older people at malnutrition risk with patients referred to dietitians for assessment (such as SGA) and then intervention if required. With application of the Malnutrition Screening Tool, only 32 of 126 people would have required complete assessment by the dietitian in order to identify the majority (85%, 16 /19) of malnourished older people.

Identifying people at malnutrition risk through implementing a simple validated screen is anticipated to positively impact upon the health of older people and reduce presentations to ED. Interventions to assess outcomes (including ED presentations) from timely dietetic involvement in ED of people identified at malnutrition risk are currently underway. Although falls aetiology is multi-factorial in nature, further adequately powered research is required to investigate the impact of nutritional intervention in frail patients with mechanical falls and the contribution that dietitians can make in a multidisciplinary ED setting.

STRENGTHS AND LIMITATIONS

The modest sample size is the principle study limitation. However, initial results suggest further investigation in a larger sample is warranted to confirm the Malnutrition Screening Tool's sensitivity, clinical prediction and width of confidence intervals. The occasional, prioritization of faller over non-faller during recruitment may have resulted in a slight overestimate of malnutrition prevalence. However, triage category 1 was not included in this study and those with decreased capacity were excluded also. Although not formally assessed, many older triage category 1 presentations appeared frail and were possibly more likely to be malnourished. Their exclusion could have potentially reduced the malnutrition prevalence. As fallers are more likely to have fallen in the past,² the occasional prioritizing of fallers during recruitment may have led to a slightly greater self-reporting of falls in this study. A falls calendar is a more accurate way of measuring falls over a period of time than the one-time recall method used in this study.³⁸ However, there was no contact with participants

before the initial interview and the exclusion of those with decreased mental or memory capacity would have assisted recall.

The study strength is its completion using validated measures in a real clinical setting involving collaboration from several health disciplines. The study participants were confirmed to be representative of the older person presenting to ED irrespective of the Monday to Friday convenience sample, that not all people suitable for inclusion were seen due to time or treatment restraints, and that fallers were prioritized over non-fallers during recruitment on occasion.

Error or bias is not anticipated to be high even though inter-rater reliability was not completed for falls categorization. With the exception of three syncopal falls, a fall due to epilepsy and a slip on a glass landing, active fallers had been involved in accidents subsequent to climbing household items that included ladders, chairs, walls and cars. Active fallers presented as quite a distinct group.

Even though any categorization has limitations, Kingsley's¹³ classification system attempts to recognize that fallers are not an homogenous group. It provides a preliminary acknowledgement of the heterogeneity of fallers. Although frail mechanical fallers may have been anticipated to be of poorer nutritional status, this had not been previously demonstrated. Confirming the heterogeneity in malnutrition status between groups of fallers may contribute

to an understanding of who will benefit from nutritional interventions in the prevention of falls.

CONCLUSION

Within Australia or internationally, this is the first known study to identify malnutrition prevalence amongst older people presenting to ED. Additionally, this is the first known study to explore associations between malnutrition and frail mechanical fallers, rather than any type of fall. Study results revealed that the malnourished are more likely to be admitted to hospital. This study showed the Malnutrition Screening Tool to be a simple, practical and rapid tool for malnutrition screening in the ED setting. Older people presenting to ED (especially after a frail mechanical fall) should be nutritionally screened using a validated tool such as the Malnutrition Screening Tool.

REFERENCES

- [1] Australian Bureau of Statistics. Canberra: [cited January 2009]. Available from URL <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3222.0>.
- [2] Gillespie LD, Gillespie WJ, Robertson MC, Lamb SE, Cumming RG, Rowe BH. Interventions for preventing falls in elderly people [Review]. *Cochrane Database of Systematic Reviews*. 2003.
- [3] Moller J. Projected costs of fall related injury to older persons due to demographic change in Australia. *Commonwealth Department of Health and Ageing under the National Falls Prevention for Older People Initiative*. Canberra: Commonwealth Department of Health and Ageing, 2003.
- [4] Potter MA, Luxton G. Prealbumin measurement as a screening tool for protein calorie malnutrition in emergency hospital admissions: a pilot study. *Clin. Invest. Med.* 1999; **22**: 44-52.
- [5] McWhirter JP, Pennington CR. Incidence and recognition of malnutrition in hospital. *Br. Med. J.* 1994; **308**: 945-8.
- [6] Middleton MH, Nazarenko G, Nivison-Smith I, Smerdely P. Prevalence of malnutrition and 12-month incidence of mortality in two Sydney teaching hospitals. *Intern. Med. J.* 2001; **31**: 455-61.
- [7] Bonjour JP, Schurch MA, Rizzoli R. Nutritional aspects of hip fractures. *Bone*. 1996; **18**: 139S-44S.
- [8] Jukkola K, MacLennan P. Improving the efficacy of nutritional supplementation in the hospitalised elderly. *Australas. J. Ageing*. 2005; **24**: 119-24.
- [9] Leggo M, Banks M, Isenring E, Stewart L, Tweeddale M. A quality improvement nutrition screening and intervention program available to Home and Community Care eligible clients. *Nutr. Diet.* 2008; **65**: 161-66.
- [10] Coleman Y, Welsh S, McMahon J. Nutrition and Falls. *Geriatrics*. 2000; **18**: 2.
- [11] Vellas B, Baumgartner RN, Wayne SJ, *et al.* Relationship between malnutrition and falls in the elderly. *Nutrition*. 1992; **8**: 105-08.
- [12] Bauer JD, Isenring E, Torma J, Horsley P, Martineau J. Nutritional status of patients who have fallen in an acute care setting. *J. Hum. Nutr. Diet.* 2007; **20**: 558-64
- [13] Kingsley S. A breakdown on falls in the elderly. *C. J. CME*. 2005: 59-61.
- [14] Rubenstein LZ, Powers CM, MacLean CH. Quality indicators for the management and prevention of falls and mobility problems in vulnerable elder. 2001; **135**: 686-93.
- [15] King MB, Tinetti ME. Falls in the community dwelling older persons. *J. Am. Geriatr. Soc.* 1995; **43**: 14.
- [16] Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. *Nutrition*. 1999; **15**: 458-64.
- [17] Thomas DC, Edelberg HK, Tinetti ME. Falls. In: Cassel CK, Leipzig RM, Cohen RM, Larson EB, Meier DE (eds.) *Geriatric Medicine: An Evidence Based Approach*. New York Springer-Verlag Inc, 2003; 979-94.
- [18] World Health Organisation. Geneva: [cited May 2008]. Available from URL <http://www.who.int/ageing/en/>.

- [19] Detsky AS, McLaughlin JR, Baker JP. What is Subjective Global Assessment of Nutritional Status. *JPEN. J. Parenter. Enteral. Nutr.* 1987; **11**: 8-13.
- [20] Banks M, Ash S, Bauer J, Gaskill D. Prevalence of malnutrition in adults in Queensland public hospitals and residential aged care facilities. *Nutr. Diet.* 2007; **64**: 172-78.
- [21] Fiatarone MA, Oneill EF, Ryan ND, *et al.* Exercise training and nutritional supplementation of physical frailty in very elderly people. *N Engl J Med.* 1994; **330**: 1769-75.
- [22] Chin A Paw MJM, De Jong N, Schouten EG, Hiddink GJ, Kok FJ. Physical Exercise and/or Enriched Foods for Functional Improvement in Frail, Independently Living Elderly: A Randomized Controlled Trial. *Arch. Phys. Med. Rehabil.* 2001; **82**: 811-17.
- [23] Correia MITD, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin. Nutr.* 2003; **22**: 235-39.
- [24] Detsky AS, McLaughlin JR, Baker JP, *et al.* What is Subjective Global Assessment of Nutritional Status? *JPEN. J. Parenter. Enteral. Nutr.* 1987; **11**: 8-13.
- [25] Pirlich M, Schutz T, Normana K, *et al.* The German hospital malnutrition study. *Clin. Nutr.* 2006; **25**: 563-72.
- [26] Persson MD, Brismar KE, Katzarski KS, Nordenstrom J, Cederholm TE. Nutritional status using mini nutritional assessment and subjective global assessment predict mortality in geriatric patients. *J. Am. Geriatr. Soc.* 2002; **50**: 1996-2002.
- [27] Kyle UG, Unger P, Mensi N, Genton L, Pichard C. Nutrition Status in Patients Younger and Older Than 60 y at Hospital Admission: A Controlled Population Study in 995 Subjects. *Nutrition.* 2002; **18**: 463-69.
- [28] Baker JP, Detsky AS, Whitwell J, Langer B, Jeejeebhoy KN. A comparison of the predictive value of nutritional assessment techniques. *Hum Nutr Clin Nutr.* 1982; **36**: 233-41.
- [29] Baker JP, Detsky AS, Wesson DE, *et al.* Nutritional assessment: a comparison of clinical judgement and objective measurements. *N Engl J Med.* 1982; **306**: 969-72.
- [30] Duerksen DR, Yeo TA, Siemens JL, O'Connor MP. The validity and Reproducibility of clinical assessment of nutritional status in the elderly. *Nutrition.* 2000; **16**: 740-44.
- [31] Christensson L, Unosson M, Ek A. Evaluation of nutritional assessment techniques in elderly people newly admitted to municipal care. *Eur. J. Clin. Nutr.* 2002; **56**: 810-18.
- [32] Lazarus C, Hamlyn J. Prevalence and documentation of malnutrition in hospitals: A case study in a large private hospital setting. *Nutr. Diet.* 2005; **62**: 41-47.
- [33] ABS. Mortality and Morbidity: Mortality in the 20th century. *Australian Bureau of Statistics: 4102.0 - Australian Social Trends, 2001* 2001.
- [34] Langan TS. Do elective surgical and medical admissions impact emergency department length of stay measurements? *Clin. Invest. Med.* 2007; **30**: 177-82.
- [35] Locker T, Mason S, Wardrope J, Walters S. Targets and moving goal posts: changes in waiting times in a UK emergency department. *Emerg. Med. J.* 2005; **22**: 710-14.
- [36] Richardson DB, Mountain D. Myths versus facts in emergency department overcrowding and hospital access block. *Med. J. Aust.* 2009; **190**: 369-74.

- [37] Fatovich DM, Nagree Y, Sprivulis P. Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. *Emerg. Med. J.* 2005; **22**: 351-54.
- [38] Ganz DA, Higashi T, Rubenstein LZ. Monitoring falls in cohort studies of community-dwelling older people: effect of the recall interval. *J. Am. Geriatr. Soc.* 2005; **53**: 2190-94.

Table 1. The Malnutrition Screening Tool (MST) (reproduced with permission from Ferguson et al, 1999)

Question	Circle score
Have you lost any weight recently without trying?	
No	0
Unsure	2
If Yes, how much weight (kilograms) have you lost?	
1-5	1
6-10	2
11-15	3
>15	4
Unsure	2
Have you been eating poorly because of a decreased appetite?	
No	0
Yes	1
Total	
Score of 2 or more = patient at risk of malnutrition	

Table 2. Characteristics of participants (n=126)

Characteristic	Well Nourished	Malnourished	Total Sample population (n=126)
	SGA A (n=107, 84.9%)	SGA B & SGA C (n=18, 14.3%) (n=1, 0.8%)	
Age median (inter-quartile range)	73.0 (64-81)	78.9 (71-84)	74 (65-82)
Male % (n)	58.9% (63/107)	57.9% (11/19)	58.7% (74/126)
Triage Category Median (Range)	3 (2-4)	3 (2-4)	3 (2-4)
Self-reported fall over previous 6 months % (n)	27.1% (29/107)	52.6% (10/19)	30.9% (39/126)
Admissions to hospital % (n)	49.5% (53/107)	89.5% (17/19)	55.6% (70/126)

SGA: Subjective Global Assessment

Table 3. Nutritional status according to fall group: Frail Mechanical Fallers (n=15), Active Mechanical Fallers (n=20), and non-fallers (n=91)

	Fall Group % (n)		
	Frail mechanical faller	Active mechanical faller	Non-faller
	11.9% (15/126)	15.9% (20/126)	72.2% (91/126)
Well Nourished % (n)	53.3% (8/15)	90.0% (18/20)	81.0% (81/91)
Malnourished % (n)	46.7% (7/15)	10.0% (2/20)	11.0% (10/91)

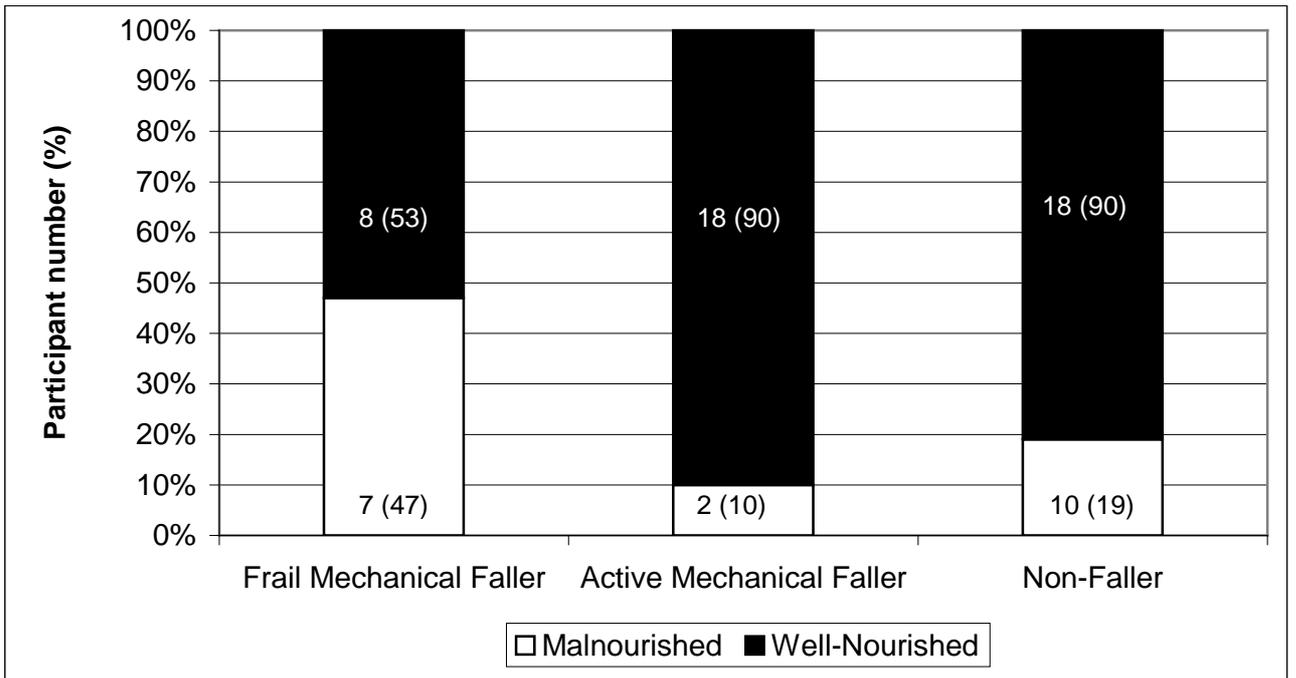


Figure 1. Number and percentage of participants assessed as malnourished within faller type

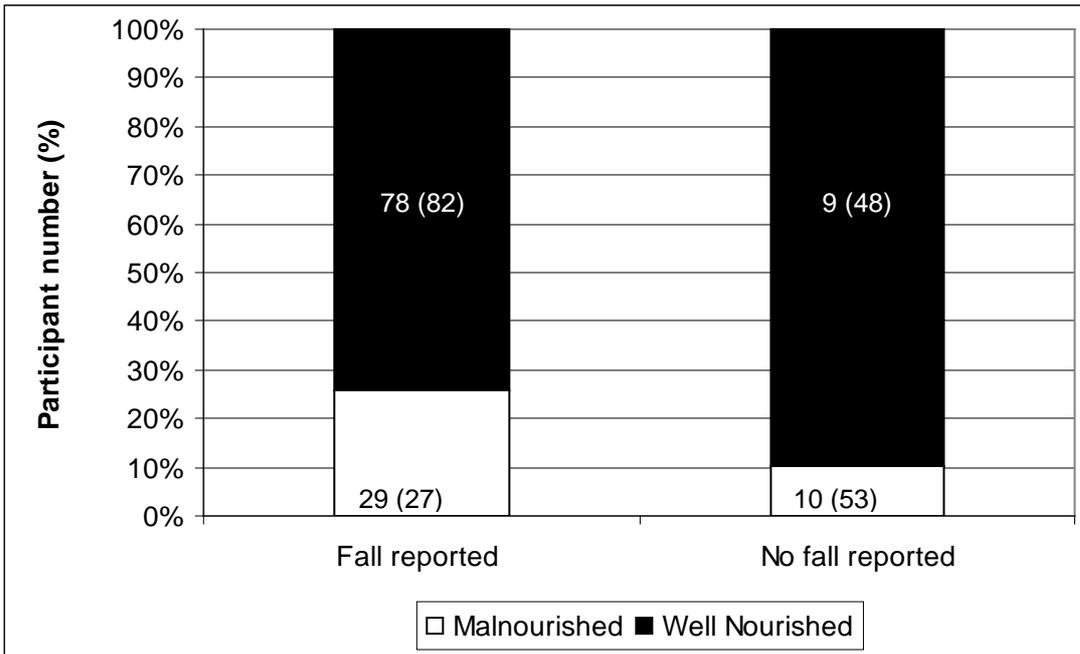


Figure 2. Number and percentage of participants assessed as malnourished within self-reported fall incidence from the previous 6 months.

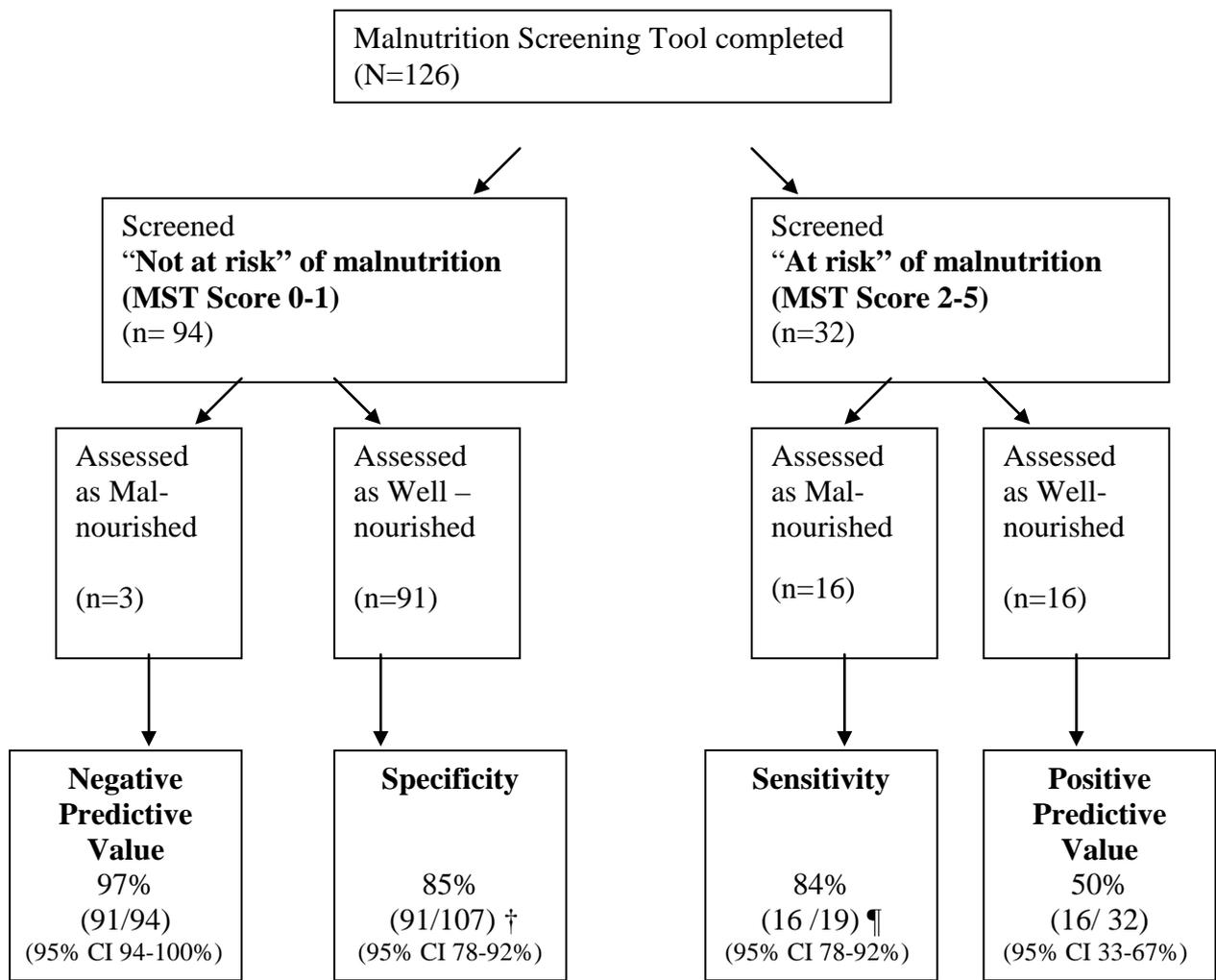


Figure 3. Flow diagram of the nutritional status and screening tool validity for 126 participants classified by the Subjective Global Assessment (SGA) and the Malnutrition Screening Tool (MST)

† 107 = 91 + 16 people assessed as well nourished

¶ 19 = 16 + 3 people assessed as malnourished