

Nutritional status and falls: a mini review

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Falls are a major issue for people aged 65 years and over, with one in three older people living in the community experiencing a fall each year (1). In Australia, 75% of all injury-related hospitalisations in older people are as a result of a fall, incurring both economic and social costs (2). In NSW residents aged 65 years and over, the age standardized rate for fall-related injury hospitalisation was 2,940 per 100,000 population in 2013 (3) and falls were associated with 1153 deaths, a rate of 17.8 per 100,000 population (4).

Falls risk factors

Commonly reported fall risk factors in older people include impairments in balance, muscle strength, gait, vision, cognition, depressive symptoms, fear of falling, postural hypotension, arthritis, the use of psychoactive medications and multiple (4 or more) medications (4). Other contributing factors include slippery surfaces, loose rugs, poor lighting, and clutter or other trip hazards (4, 5). Identifying modifiable fall risk factors is important and assessment tools have been developed to identify these. A measure of poor nutrition is not included in most fall risk assessments and screens, despite the importance of good nutrition for health and physical function. This mini-review will evaluate the evidence for an association between nutritional status and falls.

Malnutrition screening

Several tools have been used to screen and assess for malnutrition (6, 7). Validated tools include the Malnutrition Screening Tool (MST), the Mini-Nutritional Assessment (MNA) and the MNA Short Form (MNA-SF), the Malnutrition Universal Screening Tool (MUST) and the Subjective Global Assessment (SGA). Malnutrition screens typically record patient BMI, and contain questions about unintentional weight loss in the last 6 months and dietary intake (i.e. no or little appetite)(7). These tools usually provide a numerical score that enable categorization of malnutrition risk. Most tools define a moderate risk of malnutrition as a BMI <20.0 kg/m² and unintentional weight loss of 5-10% in the last 6 months (6, 8, 9). A severe risk of malnutrition has also been defined as a BMI <18.5 kg/m², and unintentional weight loss of more than 5% in the previous month or 10% within the last 6 months (6).

It has been reported that more than 50% of people at risk of malnutrition are not identified and/or referred for treatment (9). A recent study found that malnutrition screening of community dwelling

people aged 65 plus years by community / aged care dietitians was highly variable in Australia (10). This highlights the need for better screening of older people for malnutrition risk.

Malnutrition in Older People

Malnutrition is common in older people. A study using pooled MNA data from 4,507 people (mean age of 82.3 and 75.2% female) from 12 countries found the prevalence of malnutrition was 50.5% in the rehabilitation setting, 38.7% in the hospital setting, 13.8% in nursing homes and 5.8% in the community (11). Malnutrition is also frequently unrecognized in each of the above settings (6). Malnutrition can impair recovery from illness and injury and exacerbate functional decline (8, 12). Further, weight lost through malnutrition can lead to reduced muscle mass with subsequent weakness and impaired mobility (12). A recent study found that malnutrition was associated with walking instability (i.e. decreased lateral trunk control while walking) in community-dwelling older people (13).

Malnutrition and falls

The findings of studies that have examined whether there is an association between nutritional status and falls are summarised in Tables 1 and 2 (14-24). Table 1 presents the studies that have been conducted in general populations of older people and Table 2 presents the findings of studies conducted in older people who have received health care services, i.e. older people who have presented to an emergency department, received care in hospital or a geriatric assessment unit or who reside in residential aged care. The studies vary with respect to type of falls data collected (retrospective and prospective) and nutritional assessments used.

In Table 1, four of the five studies conducted in general populations of older people, were part of longitudinal cohort studies with the prevalence of malnutrition ranging from 3-12% [15-18]. Three of these studies found malnutrition was associated with falls [16-18]. The one prospective study identified relatively few people who met the condition of malnutrition (3.9%), and no significant association with falls was found [15].

Two studies of older people who were receiving community care services reported high prevalence rates of malnutrition, and that malnutrition significantly increased fall risk [22, 23]. One study in people reporting to ED also found malnutrition was associated with number of reported falls in the past month [20] and one study conducted in residential aged care found that fall rates were significantly higher in malnourished residents. In contrast, the two studies conducted in hospital settings did not find significant associations between malnutrition and falls [19, 21]. It may be that

the null findings were due to the participants being relatively young (mean age 71.2 and 71.5), although the reported prevalence of malnutrition was high (39-48%)[19,21].

Two studies have also included a measure of dietary protein intake as an index of nutrition; one conducted as part of a large longitudinal study reported a higher protein intake was associated with a reduced risk of falling (OR 0.80, 95% CI: 0.60 – 1.07) [14] whereas the other study conducted in an acute care setting did not [19].

Addressing malnutrition as a fall prevention strategy

The most recent Cochrane systematic review and meta-analysis on fall prevention in older people included three trials that addressed malnutrition as a single fall prevention intervention (25). The summary finding was that oral nutritional supplementation did not significantly reduce the risk of falling (RR 0.95, 95%CI 0.83 – 1.08; 1902 participants). Strategies for improving nutrition have also been included in multi-component fall prevention trials. However, it was difficult to ascertain the role that improved nutrition played in the outcome of these trials as many also included exercise interventions, which are known to improve falls risk [25]. Clearly, addressing malnutrition is good practice and ensuring older people at increased risk of falls have nourishing diets should form part of routine care.

Conclusion

The partially inconsistent findings of the studies presented in Tables 1 and 2 are likely due to design heterogeneity and confounding factors such as frailty and cognitive or psychosocial factors, which also contribute to fall risk. Taken together, however, the study findings indicate malnutrition is associated with an increased risk of falls particularly in the older population (over 75 years). Further studies are required to more precisely examine dietary intake of nutrients and which nutritional deficiencies may contribute to fall risk. Malnutrition is a significant issue for many frail older people and needs to be identified and addressed, not only because it may increase the risk of falls but also because of its effects on physical function and associations with illness and death.

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Table 1 Studies in the General Population

Authors and year	Study design	Participant characteristics	Nutrition assessment	Falls measurement	Main findings
Zoltick et al 2011 [14]	Framingham Longitudinal Cohort Study	807 community/nursing home participants, mean age 75 (SD ±4.8) years, 63% female	Willett FFQ for dietary intake includes total energy consumption as well as protein intake	Falls in previous 12 months	Higher dietary protein intake was associated with a reduced risk of falling (OR = 0.80, 95%CI=0.60–1.07). However, higher dietary protein intake was not associated with falls reported retrospectively in a subsequent 12 month period (RR = 0.93, 95% CI: 0.73 – 1.19)
Isenring et al 2012 [15]	Prospective community study	254 community dwelling participants mean age 74.3 SD±6.0 years, 52.4 % male	Mini nutritional assessment (MNA) short form	Prospective falls over 12 months	3.9% of subjects were at risk of malnutrition and there was no association between prospective falls over 12 months and malnutrition risk, weight loss in past 24 months or BMI
Chien & Guo 2014 [16]	Longitudinal cohort study	4440 community dwelling, mean age 69.5 (SD = 9.1) years, 46.8% female (48.4% of those included in analysis)	Mini nutritional assessment (MNA) Taiwan Version 2	Falls in previous 12 months	10.5% at risk of malnutrition or malnourished. Adjusted odds ratio for falls was 1.73 (95%CI=1.23 - 2.42)for 'not well nourished' (MNA-T2 score of ≤ 23)
Tsai & Lai 2014 [17]	Longitudinal cohort study	3,118 community dwelling, 61.6% > 65 years, 52.9% male	Mini nutritional assessment (MNA): full and short forms	Falls in previous 12 months	6.5% at risk of malnutrition. Risk of falling OR 1.87 (95% CI: 1.33-2.63) for full MNA and OR 1.39 (95%CI: 1.07 – 1.80) for MNA-SF
Torres et al 2015 [18]	Longitudinal cohort study	6040 Community dwelling, mean age 73.5 (SD = 5.2) years, 59% female, follow up 2, 4, 7, 10 & 12 years after inclusion	Mini nutritional assessment (MNA)	Retrospective falls and fractures reported at baseline and at 2, 4, 10 and 12 years after inclusion	12% at risk of malnutrition or malnourished. Poor nutritional status (MNA ≤ 23.5) was associated with a higher risk of falling - Hazard ratio (HR)= 1.66 (95% CI 1.35-2.04) for men and 1.20 (95% CI: 1,07-1.34) for women. Poor nutritional status (MNA ≤ 23.5) was associated with a higher risk of fracture HR = 1.28 (95% CI =1.09- 1.49) in men and women combined.

RR = Rate Ratio, OR = Odds Ratio, F = F ratio, SD = Standard deviation, CI = Confidence interval

Table 2 Studies in Health Care Services

Authors and year	Study design	Participant characteristics	Nutrition assessment	Falls measurement	Main findings
Bauer et al 2007 [19]	Prospective Convenience Sample	49 acute care patients who experienced a fall in hospital, mean age 71.2 (SD 14.1), 57% male	Subjective Global assessment (SGA) and Malnutrition Screening tool (MST) as well as total energy consumption and protein intake	Falls History and record of fall in hospital (WHO definition)	48% assessed as malnourished, no difference in median number of falls between well-nourished and malnourished patients. No difference in fall risk on admission or falls severity between well-nourished and malnourished patients
Vivanti et al 2009 [20]	Cross sectional Convenience Sample	126 patients presenting to ED over 1 month period, median age 74 years (interquartile range 65-82), 59% male,	Malnutrition Screening tool (MST)	Falls in previous 6 months	14.3 % assessed as malnourished. Malnourished participants had increased risk of falls compared with well nourished (RR 1.5, 95%CI=1.0 – 2.5, P=0.03)
Vivanti, Ward & Haines 2011 [21]	Longitudinal cohort study	194 patients presenting to Geriatric Assessment and Rehabilitation Unit (GARU) over 6 month period, 39% male, mean age 71.5 (SD 14.3) for well-nourished and 80.9 (SD 9.5) for moderately or severely malnourished	Subjective Global Assessment (SGA)	Falls in previous 6 months and falls during stay at GARU	39% assessed as malnourished, no association between malnutrition and reported falls in previous six months or inpatient falls during stay in GARU
Johnson 2003 ([22]	Cross Sectional	98 older adults (83% female) receiving home care services, Average age 82 years (SD 6.62), 76% of fallers and 84.6% of non-fallers were women	Nutrition Risk Tool	Falls in previous 4 months	Nutritional risk was significantly associated with falls (F=12.16, $p<0.001$)
Meijers et al 2012 [23]	Cross sectional multicentre study of home care clients using data from 2007 and 2009	2972 home care clients from 22 organisations, mean age 81.5 (SD 7.0), 67.9% female	BMI ≤ 20 , unintentional weight loss ≥ 6 kg in last 6 months or ≥ 3 kg in last month, reduced nutritional intake for > 10 days	Falls recorded prospective over 30 days prior to malnutrition assessment	Prevalence of malnutrition was 16.2%. Malnutrition was associated with an increased risk of falls in multivariate analysis (OR 1.98 (95% CI=1.34-2.92)
Neyens et al 2013 [24]	Cross sectional multicentre point prevalence and incidence	6701 residential long term care residents, mean age 83.7 (SD 7.07) years and 73.8% female for non-fallers and 84 (SD 6.97) years and 68.5% female for fallers	Malnutrition defined as BMI ≤ 20 , unintentional weight loss ≥ 6 kg in last 6 months or ≥ 3 kg in last month, reduced nutritional intake for > 10 days	Prospective falls over 1 month	Malnourished 22.8%, Odds of being a faller significantly higher in malnourished group OR 1.72 (95% CI=1.41 – 2.09)

RR = Rate Ratio, OR = Odds Ratio, F = F ratio, SD = Standard deviation, CI = Confidence interval