Nutritional strategies to reduce falls risk in older people


Date of submission: 10 November 2017; date of acceptance: 13 February 2018. doi: 10.7748/nop.2018.e1016

Abstract

A literature review found an association between increased falls risk and malnutrition, sarcopenia, vitamin D deficiency and dehydration. Strategies to identify, prevent and treat these conditions can help to reduce falls risk in at-risk groups such as frail, older people. Nurses can reduce falls risk in older people by raising awareness of risk factors and embedding nutritional strategies in local falls reduction strategies.

Keywords

falls, frailty, gerontology, malnutrition, nutrition, older people

A LOCAL audit found that more than half the patients referred to Airedale NHS Foundation Trust’s specialist dietitian for frail older people had been admitted to hospital after a fall. In light of these findings, a literature review was conducted to determine if there was an association between falls risk and:

» Malnutrition and sarcopenia.

» Vitamin D deficiency.

» Dehydration.

The following databases were searched: PubMed, MEDLINE, CAB Abstracts and Embase. Key search terms included: ‘fall’ and (‘nutrition’ or ‘hydration’ or ‘malnutrition’ or ‘sarcopenia’ or ‘energy’ or ‘protein’ or ‘deficiency’ or ‘vitamin D’). Studies published in English from 2005 were included. Initially 98 publications were identified, mainly published between 2011 and 2015. These included: meta-analyses, systematic reviews, randomised controlled trials (RCTs), cohort studies, position papers, consensus statements, expert group recommendations, clinical guidelines and review articles. Those of higher quality and greater relevance were then considered for this review, with 56 publications included in the final review.

Association between malnutrition, sarcopenia and falls risk

Definitions

The definition of malnutrition used in this review focused on undernutrition, that is, weight loss and/or low body mass index. Sarcopenia has been defined as: ‘A syndrome characterized by progressive and generalised loss of skeletal muscle mass and strength... it is strictly correlated with physical disability, poor quality of life and death’ (Santilli et al 2014).

Evidence supporting the association between malnutrition, sarcopenia and falls risk

Malnutrition can result in a negative nitrogen balance, which can reduce muscle mass, strength and function (Deutz et al 2014) and increase falls risk (Stratton et al 2003). This review identified 12 further publications from various healthcare settings supporting the association between malnutrition and increased falls risk. Some of these studies are outlined in Table 1. More recent research has focused on sarcopenia and the identification of new recommended protein requirements for older adults (Bauer et al 2013, Deutz et al 2014). These authors identified:

» Protein requirements are higher for adults aged 65 years and over compared with younger adults because of increased anabolic resistance and elevated metabolism in inflammatory conditions, for example, heart failure and chronic obstructive pulmonary disease.

» Healthy adults aged 65 years and older need 1-1.2g protein per kg body weight daily, compared with 0.75g for younger adults. Malnourished older adults with acute and/or chronic disease have even higher protein needs, typically 1.2-1.5g protein per kg body weight daily.

» Age-related declines in muscle mass, strength and function can be reversed with adequate
protein intake. Frail older adults can gain muscle strength and function into their nineties and beyond.

» The beneficial effects of protein ingestion are enhanced by resistance and endurance exercise. After exercise 20g of protein is recommended. Examples of good sources of protein are shown in Table 2.

**Evidence against the association between malnutrition, sarcopenia and falls risk**

One study found no association between nutritional risk and falls. However, within the 254 participants, the proportion of malnourished individuals was low (Isenring et al 2013). A meta-analysis found inconclusive evidence that being underweight or overweight predicted fall incidence (Moore and Boltong 2011). This supports the view that weight loss associated with sarcopenia may be a greater risk factor for falls than low body weight alone. No publications contradicted the evidence around sarcopenia and falls risk.

Conclusions and implications for practice

In view of the higher falls risk experienced by malnourished and sarcopenic adults, the higher protein needs of the over 65s and the potential for increased protein/energy intake to improve muscle mass, strength and function, there is scope to improve patient outcomes by including assessment and treatment of malnutrition and sarcopenia in falls reduction strategies.

**Association between vitamin D deficiency and falls risk**

Vitamin D plays an important role in bone health through regulation of calcium and phosphorus metabolism (Scientific Advisory Committee on Nutrition (SACN) 2016). Research has explored the theory that vitamin D helps to reduce falls risk through its direct effects on muscle cells, resulting in rapid entry of calcium into the cell, improved muscle contraction and differentiation, and proliferation of type 2 muscle fibres (Halfon et al 2015). Unfortunately, dietary vitamin D is not sufficient to meet our needs. Until recently, it was assumed that, for most people, the amount of vitamin D produced by sunlight exposure in summer would be sufficient to achieve adequate vitamin D concentrations during winter. However, this has since been disproved (SACN 2016). People with minimal sunshine exposure are at increased risk of vitamin D deficiency; this includes frail and institutionalised people, and adults aged 65 years and over (SACN 2016).

**Inconclusive evidence**

The National Institute for Health and Care Excellence (NICE) (2013) identified that vitamin D deficiency impairs muscle strength and, possibly, neuromuscular function and that correcting this deficiency may reduce falls risk. However, there was insufficient evidence at that time to make any firm recommendation. Other authors have similar views (Scragg 2012, Stubbs et al 2015). Halfon et al (2015) highlighted the controversies in the interpretation of meta-analyses, which may explain some of the conflicting findings.

**Evidence supporting the association between vitamin D deficiency and falls risk**

An association between low vitamin D status and falls risk was identified in 18 publications: 14 found that vitamin D supplementation reduces falls risk, including a Cochrane review.

<p>| TABLE 1. Examples of studies that have identified that treating malnutrition and sarcopenia can contribute to reducing falls risk |</p>
<table>
<thead>
<tr>
<th>Authors</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vivanti et al (2011)</td>
<td>Study of 194 inpatients found that malnourished patients scored lower on functional tests, for example Timed Up and Go, and had reduced mobility</td>
</tr>
<tr>
<td>Neyens et al (2013)</td>
<td>Dutch study of 6,701 care home residents (mean age 84) found malnourished residents fell more often (odds ratio 1.78) and that nutritional intervention lowered falls risk</td>
</tr>
<tr>
<td>Meijers et al (2012)</td>
<td>Analysis of adults aged over 65 receiving homecare (n=2,971) found malnutrition to be a potential reversible risk factor related to falls</td>
</tr>
<tr>
<td>Neelemaat et al (2012)</td>
<td>Randomised controlled trial of 210 malnourished older adults newly admitted to hospital found that additional energy and protein intake decreased the number who fell</td>
</tr>
<tr>
<td>Landi et al (2012)</td>
<td>iSIRENTE study of 260 adults aged over 80 identified that sarcopenic participants were three times more likely to fall during a two-year follow-up period</td>
</tr>
</tbody>
</table>
of 60 trials involving 60,345 participants in care facilities and hospitals (Cameron et al 2012). In addition, more recent guidance from NICE (2015) concluded that vitamin D supplementation can reduce risk of falls in adults aged over 60. Likewise, SACN (2016) confirmed a beneficial effect of vitamin D supplementation in reducing falls risk in community-dwelling adults aged over 50.

Some studies identified that vitamin D supplementation only reduces falls risk in adults who are deficient or at risk of deficiency. Other studies concluded that vitamin D only decreases falls risk in combination with calcium (Bolland et al 2014, Guo et al 2014). Some authors have concluded that vitamin D with calcium can reduce fracture risk (Di Monaco et al 2011, NICE 2015).

Evidence against vitamin D supplementation to reduce falls risk
Five publications identified in this review, involving 5,445 participants, concluded that vitamin D supplementation does not reduce falls risk. Two of these were RCTs of three-monthly (Glendenning et al 2012) and annual high-dose supplementation (Sanders et al 2010). Interestingly, the annual high dose was found to increase falls and fracture risk.

Vitamin D and calcium toxicity
Excessive vitamin D may lead to hypercalcaemia and hypercalciuria and may enhance renal stone formation in susceptible individuals (Food Standards Agency (FSA) 2003). However, vitamin D toxicity is usually associated with serum 25 hydroxyvitamin D (25(OH)D) concentrations over 300nmol/L and usually more than twice this. In most adults a dose of 7,500 micrograms (300,000 international units (IU); 1 microgram = 40IU) would be needed to achieve a concentration of >300nmol/L (SACN 2016).

Calcium levels are normally well regulated by the healthy human body. When regulation becomes impaired, acute hypercalcaemia can impair renal function. Chronic hypercalcaemia can lead to renal calcification and deposition of calcium in soft tissue. Hypercalcaemia tends to occur because of hyperparathyroidism and malignancy, for example, breast cancer, lung cancer and multiple myeloma (FSA 2003). There is also a risk of increased myocardial infarction when taking calcium supplementation without vitamin D (NICE 2015).

Target serum vitamin D concentrations
Guidance varies on the actual level at which deficiency or insufficiency of vitamin D occurs. The authors’ trust has adopted the targets recommended by the National Osteoporosis Society (2013) for serum 25(OH)D:
- <30nmol/L = deficient.
- <50nmol/L = insufficient in some people.
- >50nmol/L = sufficient in most people.

In contrast, SACN (2016) recommends a lower minimum concentration of 25nmol/L.

Prevalence of vitamin D deficiency
In England average plasma vitamin D concentrations for institutionalised adults are 33.7nmol/L in men and 32.5nmol/L in women (Finch et al 1998). In one study, 38% of men and 37% of women had a plasma 25(OH)D

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**TABLE 2. Protein content of common foods and drinks**

<table>
<thead>
<tr>
<th>Serving</th>
<th>Protein content*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small chicken breast</td>
<td>75g 20g</td>
</tr>
<tr>
<td>Roast lamb, pork or beef</td>
<td>Two slices (75g) 20g</td>
</tr>
<tr>
<td>Lamb or pork chop</td>
<td>Two small or one large (70g) 20g</td>
</tr>
<tr>
<td>Gammon</td>
<td>Half rasher (85g) 20g</td>
</tr>
<tr>
<td>Battered fish</td>
<td>Half fillet 20g</td>
</tr>
<tr>
<td>Baked cod fillet</td>
<td>100g 20g</td>
</tr>
<tr>
<td>Tinned tuna/salmon</td>
<td>Half tin 20g</td>
</tr>
<tr>
<td>Tinned sardines</td>
<td>Whole tin (100g) 20g</td>
</tr>
<tr>
<td>Eggs</td>
<td>One egg 6g</td>
</tr>
<tr>
<td>Baked beans</td>
<td>Half tin (200g) 9.5g</td>
</tr>
<tr>
<td>Milk – skimmed, semi-skimmed, full fat, soya</td>
<td>200mL glass 6-7g</td>
</tr>
<tr>
<td>Skimmed milk powder**</td>
<td>Two teaspoons 3.6g</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>150mL pot 4g</td>
</tr>
<tr>
<td>Greek yoghurt</td>
<td>150mL 13.5g</td>
</tr>
<tr>
<td>Cheddar cheese</td>
<td>Matchbox (25g) 6g</td>
</tr>
<tr>
<td>Roasted peanuts</td>
<td>Handful (30g) 7g</td>
</tr>
<tr>
<td>Rice pudding</td>
<td>140g pot 5g</td>
</tr>
<tr>
<td>Chocolate mousse</td>
<td>100g pot 4g</td>
</tr>
<tr>
<td>Peanut butter</td>
<td>Two teaspoons (12g) 3g</td>
</tr>
<tr>
<td>Ground almonds</td>
<td>One tablespoon (15g) 3g</td>
</tr>
</tbody>
</table>

* NB protein content varies by product type and size so always check the label.
** Top tip: a cup of tea/coffee with 30mL full-fat milk plus two teaspoons of skimmed milk powder contains 4.6g protein. Six cups a day = more than 27g protein.
concentration of <25nmol/L (Finch et al 1998). The Health Survey for England (Craig and Hirani 2010) reported higher concentrations in white adults (45.8nmol/L) compared with Asian (20.5nmol/L) and black (27.7nmol/L) adults. A review conducted at Airedale General Hospital between May and November 2015 (Figure 1) identified widespread vitamin D deficiency among inpatients. The mean vitamin D level was 17nmol/L (range 1-45) and the mean age was 70 years (range 18-93).

Vitamin D supplementation
Anecdotal reports indicate that vitamin D management is inconsistent throughout NHS trusts in the UK. This may be partly attributed to the existence of more than one guideline. The chief medical officers for England, Wales, Northern Ireland and Scotland (2012) recommended vitamin D supplementation of 10 micrograms daily for adults aged over 65 and those not exposed to the sun, including housebound people. In relation to preventing fractures NICE (2015) recommends:

- 10 micrograms daily with calcium if dietary calcium intake is inadequate, for adults aged over 65 and anyone not exposed to much sun.
- 20 micrograms daily with at least 1g calcium daily for older housebound/care home residents.

More recently, SACN (2016) recommended that all the UK population over the age of one should take a supplement of 10 micrograms daily.

The authors’ trust policy recommends high-dose vitamin D treatment for patients with:

- Serum 25(OH)D <30nmol/L.
- Serum 25(OH)D 30-50nmol/L with fragility fracture, documented osteoporosis or high fracture risk; treatment with anti-resorptive medication for bone disease; symptoms suggestive of vitamin D deficiency; increased risk of developing vitamin D deficiency in the future because of reduced exposure to sunlight, religious/cultural dress code, dark skin; raised parathyroid hormone; treatment with antiepileptic drugs or oral glucocorticoids; and malabsorption conditions.

The recommended high-dose treatment is 40,000 units colecalciferol once a week for seven weeks. For longer term vitamin D supplementation, the authors’ trust recommends 400-800 units daily (10-20 micrograms) purchased over the counter (OTC). For adults aged over 65 and those with low sun exposure the authors’ trust recommends:

- Patients with an adequate calcium intake: 400 units of vitamin D daily.
- Patients with an inadequate calcium intake:
  - 400 units of vitamin D with at least 1,000mg calcium daily; or
  - 800 units of vitamin D with at least 1,000mg calcium daily for those who are housebound or living in a nursing home.

There are economic considerations about who should finance vitamin D supplementation. The authors’ trust recommends that vitamin D should be purchased OTC where feasible.

Conclusions and implications for practice
High-quality evidence has identified that vitamin D deficiency increases falls risk through its interactions with muscle fibres. Vitamin D supplementation can reduce falls risk and is appropriate in at-risk groups and those who are deficient or insufficient. Regular low doses of vitamin D are safer and more effective than irregular high doses. Calcium should be considered alongside vitamin D.

NICE (2015) recommends supplementation of 20 micrograms daily for older housebound patients with:
- Fall, fractured neck of femur
- Fall, fractured leg and alcohol
- Gastro-oesophageal cancer
- Fall and alcohol
- Colon cancer
- Dysphagia
- Ileus
- Myocardial infarction
- Motor neuropathy
- Myeloma
- Parkinson’s
- Pneumonia
- Stroke
- Total hip replacement

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Figure 1. Vitamin D levels of at-risk inpatients identified by dietitians at Airedale General Hospital, May to November 2015

<table>
<thead>
<tr>
<th>Condition</th>
<th>Serum 25(OH)D (nmol/L)</th>
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<tbody>
<tr>
<td>Alcohol liver disease</td>
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<tr>
<td>Anterior resection</td>
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<tr>
<td>Cardiac failure</td>
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<tr>
<td>Cerebral palsy</td>
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<tr>
<td>Chronic pancreatitis</td>
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<tr>
<td>Colon cancer</td>
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<tr>
<td>Dysphagia</td>
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<tr>
<td>Fall</td>
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<tr>
<td>Fall and alcohol</td>
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<tr>
<td>Fall, fractured leg and alcohol</td>
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<tr>
<td>Fall, fractured neck of femur</td>
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<td>Fall, fractured neck of femur</td>
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<tr>
<td>Gastro-oesophageal cancer</td>
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<td>Ileus</td>
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<tr>
<td>Laparotomy</td>
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<td>Meningitis</td>
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<tr>
<td>Myocardial infarction</td>
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<td>Motor neuropathy</td>
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<td>Pneumonia</td>
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<td>Pneumonia</td>
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<td>Small bowel obstruction</td>
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<td>Short bowel resection</td>
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<td>Stroke</td>
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<td>Stroke</td>
<td></td>
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<tr>
<td>Total hip replacement</td>
<td></td>
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</table>

Implications for practice
- Consider the importance of adequate protein, vitamin D and fluid in older adults at risk of falls in your clinical setting.
- Share the evidence presented in this article with your local falls group.
- Consider whether your processes for recognising and preventing dehydration are adequate.
- Liaise with your local dietitians and nutrition nurses – can they offer education about malnutrition and sarcopenia?
- Explore the options for combining exercise and protein – discuss these with your local therapists and dietitians.
Evidence & Practice / Falls Prevention

Association between dehydration and falls risk

The association between dehydration and increased falls risk is well established (Thomas et al 2008, Begum and Johnson 2010). Begum and Johnson (2010) provide an overview of the physiology and causes of dehydration among older adults:

- Reduced glomerular filtration rate and renin secretion.
- Increased plasma vasopressin.
- Decreased response to antidiuretic hormone.
- Diuretics.
- Co-morbidities.
- Dysphagia.
- Cognitive impairment.
- Decreased sense of thirst during the ageing process.

Disorientation and confusion are well-known risk factors for falls. No evidence has been found to contradict the association between dehydration and increased falls risk.

The 2014 Parliamentary Hydration Forum Report (Wilson 2014) summarised recent projects in care homes aiming to increase fluid intake. For example, the Anglian Water project identified that increasing the availability and visibility of water, in addition to regular reminders, increased fluid intake. This intervention resulted in a 50% decrease in falls.

Conclusions and implications for practice

Dehydration increases falls risk. Adequate hydration should be emphasised in falls prevention strategies.

Conclusion

The aim of this literature review was to determine if there was an association between falls risk and: malnutrition and sarcopenia; vitamin D deficiency; and dehydration. The findings have highlighted the association between overall nutritional status and falls risk, and the importance of including nutrition and hydration in falls reduction strategies in acute and community settings.

Identifying and treating malnutrition and sarcopenia, preventing and treating vitamin D deficiency in at-risk groups, and reducing the risk of dehydration are strongly recommended.

References


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