



Review

Malnutrition in the elderly: A narrative review

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ABSTRACT

The focus of nutrition is often on healthy diets and exercise to minimise the risk of developing lifestyle diseases such as cancer, diabetes and cardiovascular disease. However, during the shift into older years often the nutrition priorities change towards meeting increased nutrient needs with less energy requirements, and minimising lean muscle loss. There are several causes of general malnutrition in the elderly that lead to depletion of muscle including starvation (protein-energy malnutrition), sarcopenia and cachexia. The prevalence of protein-energy malnutrition increases with age and the number of comorbidities. A range of simple and validated screening tools can be used to identify malnutrition in older adults, e.g. MST, MNA-SF and 'MUST'. Older adults should be screened for nutritional issues at diagnosis, on admission to hospitals or care homes and during follow up at outpatient or General Practitioner clinics, at regular intervals depending on clinical status. Early identification and treatment of nutrition problems can lead to improved outcomes and better quality of life.

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Contents

1. Introduction	296
2. Causes of general malnutrition – starvation (PEM), sarcopenia, and cachexia	297
3. Prevalence of PEM in the elderly	298
4. Risk factors of PEM in the elderly	298
5. Identifying PEM	298
6. Consequences of PEM	299
7. Management of PEM	299
8. Implications for practice	301
9. Conclusion	301
Contributors	301
Competing interest	301
Funding	301
Provenance and peer review	301
References	301

1. Introduction

The world's population is rapidly ageing with estimates that in the first five decades of the 21st century the proportion of the world's population over 60 years will double from 11% to 22%. The expected increase in the absolute number of older adults will triple

from 605 million to 2 billion over this period [1]. As the number of older people continues to rise, provision of improved healthcare to the elderly – both in hospital and in the community – is imperative. Often, the focus of nutrition in older adults is a healthy diet and exercise to minimise the risk of developing lifestyle diseases (such as cardiovascular disease, Type 2 diabetes mellitus). However, there is a large body of evidence to indicate that protein-energy malnutrition (PEM) is a common problem in this age group, including in the hospital, nursing home and community setting. Therefore, the purpose of this paper is to summarise the current literature regarding:

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Table 1
PEM prevalence in the acute care setting.

(Authors, Year)	Number of hospitals; Country	Total number of participants; age (years)	Number of elderly participants	Nutrition screening/assessment method; stage of nutrition assessment	Malnutrition risk or prevalence in elderly participants
Agarwal et al., 2012 [20]	56 hospitals; Australia and New Zealand	N = 3122; mean age: 65 ± 18 years	n = 1650	SGA; during hospital admission	60% of elderly participants (≥65 years) were malnourished
Imoberforf et al., 2009 [21]	Seven hospitals; Switzerland	N = 32,837; mean/median age not specified	Not specified	NRS-2002; on admission	Nutrition risk in 65–84 year old participants: 22%; Nutrition risk in participants aged >85 years: 28%
Pirlich et al., 2006 [22]	13 hospitals; Germany	N = 1886; mean age: 62 ± 17 years	n = 1109	SGA; during hospital admission	PEM prevalence in: 60–69years: 23%; 70–79 years: 35%; ≥80years: 55%
Correia and Campos, 2003 [23]	Hospitals from 13 countries in Latin America	N = 9348; mean age: 52 ± 17 years	Not specified	SGA; during hospital admission	PEM prevalence in participants aged >60 years: 53%
Waitzberg et al., 2001 [24]	25 hospitals; Brazil	N = 4000; mean age not specified	n = 1441 (age>60years)	SGA; during hospital admission	PEM prevalence in participants aged >60 years: 53%

NRS-2002, Nutrition Risk Screening 2002 [25]; PEM, protein-energy malnutrition; SGA, subjective global assessment [26].

- the prevalence,
- aetiology,
- identification, and
- effective nutritional management

of PEM in the elderly.

2. Causes of general malnutrition – starvation (PEM), sarcopenia, and cachexia

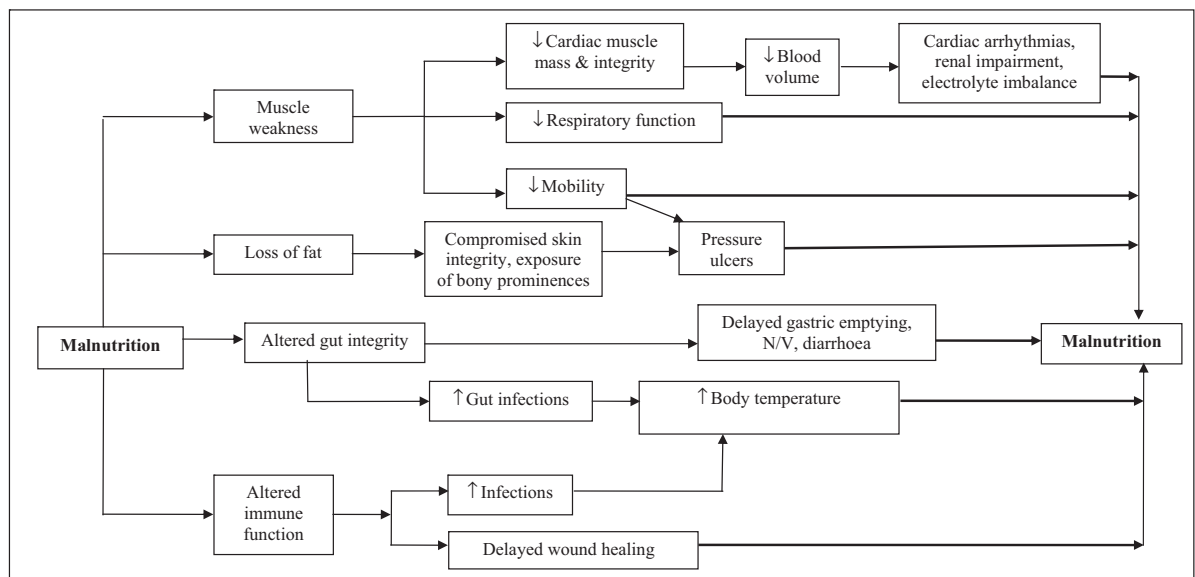
While there is no universally accepted definition of malnutrition, one of the most commonly used identifies malnutrition as “a state of nutrition in which a deficiency, or excess, of energy, protein and micronutrients causes measurable adverse effects on tissue/body form (body shape, size and composition) and function, and clinical outcome” [2]. However, in relation to under-nutrition, this definition does not take into account the aetiology of unintentional weight loss. Recent literature suggests that unintentional weight loss is comprised of three primary syndromes: starvation, sarcopenia and cachexia [3,4]. Furthermore, there is a level of complexity involved in that the unintentional weight loss may be a result of any two or three of those syndromes in combination [5]. The term malnutrition dominates the literature around unintentional weight loss and is likely to capture all unintentional weight loss as if it were one condition. Disentangling the primary aetiology is critical for implementation of appropriate nutrition support as responsiveness to dietary modifications differ. Even now there is uncertainty and confusion amongst dietitians, which is likely to be reflected amongst all clinicians [6].

Starvation is generally accepted to occur purely as a result of protein-energy deficiency and is synonymous with PEM [4,7]. The major factor that distinguishes starvation from other syndromes of unintentional weight loss is that it is reversed when adequate energy and protein intake is achieved (discussed further in Section 7) [7]. There are numerous nutrition screening tools to detect PEM (discussed further in Section 5) and these are increasingly becoming mandatory across the continuum of care but primarily in the acute care setting.

Results of recent attempts to provide, and agree upon, definitions and diagnostic criteria for sarcopenia indicate that it is a progressive loss of muscle mass that occurs with normal ageing

although this area is still under investigation [8–10]. It is known to be associated with increased frailty, loss of strength, reduced physical function and diminished capacity for exercise, as a result of decreased muscle mass and alterations to muscle structure at the microscopic level which change the function of muscle in sarcopenia [11]. It is likely that effective interventions for the treatment of sarcopenia should be multi-disciplinary. Dietary management should provide adequate energy and protein intake however this alone would be unlikely to address weight loss as sarcopenia is thought to occur regardless of energy balance [12,13]. Recent evidence indicates that the most effective intervention thus far is a combination of nutrition and resistance training [14]. There are currently no screening tools for the detection of sarcopenia, and diagnosis is usually based on clinical judgement, although criteria have been proposed by at least one recent consensus paper [8]. Health professionals working with older adults with unintentional weight loss should be mindful that nutrition alone may not improve their condition.

Cachexia is mediated by pro-inflammatory cytokines and has long been associated with a number of chronic conditions such as cancers, HIV/AIDS, heart failure and chronic obstructive pulmonary disease (COPD). In 2008 a group of prominent researchers in the field came together to develop a consensus definition for cachexia which indicates that “cachexia is a complex metabolic syndrome associated with underlying illness and characterised by loss of muscle with or without loss of fat mass [15]. Furthermore, an expert group used the Delphi technique to define diagnostic criterion for cancer cachexia as weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index, BMI; <20 kg/m²) or skeletal muscle mass (sarcopenia) [16]. An agreement was made that the cachexia syndrome can develop progressively through various stages; precachexia to cachexia to refractory cachexia. Assessment for classification and clinical management should include: anorexia or reduced food intake, catabolic drive, muscle mass and strength, functional and psychosocial impairment [16]. Although there is little research into the condition there is evidence that geriatric cachexia also manifests in the elderly [17,18]. Evans et al. [15] were also clear in identifying cachexia as a separate syndrome from starvation and sarcopenia. There has been a considerable amount of research into



(Summarised from [50, 51, 55])

(↓: Reduced/Altered; ↑: Increased; —→: decreased dietary intake; N/V= nausea/vomiting)

Fig. 1. PEM – a cause and consequence of adverse outcomes.

Source: Summarised from [50,51,55].

interventions for the treatment of cachexia although the majority has been conducted in individuals with end-stage chronic disease therefore it may be prudent to treat application of these results in older adults with caution. In addition to appropriate dietary intake, the most promising therapies appear to be appetite stimulants, combination pharmacological treatments and exercise interventions although studies in this area are prone to high levels of dropout and side effects which may not be due to the interventions under investigation [19].

3. Prevalence of PEM in the elderly

Multicentre studies that have evaluated PEM prevalence in the acute care setting report that 23–60% of elderly patients are malnourished and an estimated 22–28% are at nutritional risk (Table 1).

In comparison to other healthcare settings, there is limited literature on the prevalence of PEM in community-dwelling older adults. However, the reported prevalence indicates a range of 5–30% [27–29]. In the residential aged care setting, the reported PEM prevalence ranges from 16% to 70% depending on the assessment tool used and the level of care required [30–33]. In general it is known that the prevalence of PEM increases as the level of care increases.

4. Risk factors of PEM in the elderly

The aetiology of PEM in the elderly is multifactorial and consists of physiological, social and economic parameters, often referred to as the “nine d’s” (dementia, dysgeusia, dysphagia, diarrhoea, depression, disease, poor dentition, dysfunction, and drugs) [34]. The physiological parameters also affect food consumption in the elderly (Fig. 1); thereby further exacerbating the problem of PEM.

5. Identifying PEM

Malnutrition screening is the recommended first step in the nutrition care process as it allows the early identification of nutritional concerns [35–37]. Given the multifactorial nature of PEM in the elderly, and in the absence of a single objective measure or

“gold standard”, a number of nutrition screening tools specific to the older adult population have been developed. Each tool is unique as they include a range of different parameters [38]:

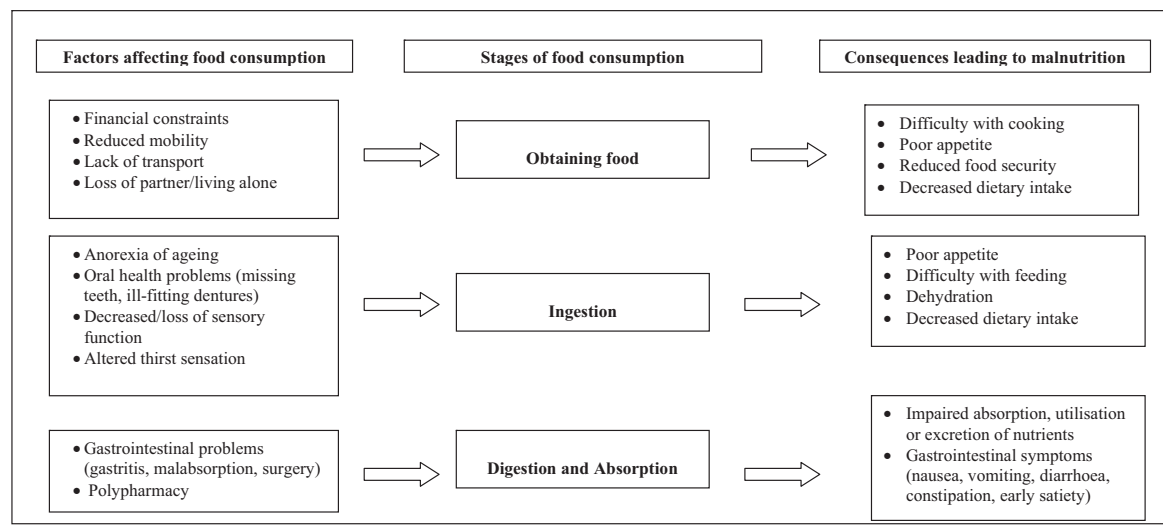
- Biochemical and clinical indices: Nutritional Risk Index (NRI) [39] and the Geriatric Nutritional Risk Index (GNRI) [40].
- Anthropometry, mobility, cognitive state, self-perceived health and nutrition: Mini Nutritional Assessment Screening Form (MNA-SF) [41], Malnutrition Universal Screening Tool (MUST) [42]; and unintentional weight loss and poor intake (MST) [57].
- Medical history, clinical and subjective evaluation: Nutrition Risk Screening 2002 (NRS-2002) [25].

Tools such as the MNA-SF, MUST, and NRS-2002 incorporate body mass index (BMI) for detecting the risk of PEM. BMI is a simple index of weight-for-height (defined as weight in kilograms divide by the square of height in metres (kg/m^2)) [43]. Individuals are classified as underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$), normal weight ($18.5\text{--}24.9 \text{ kg/m}^2$), overweight ($25\text{--}29.9 \text{ kg/m}^2$) or obese ($\geq 30 \text{ kg/m}^2$) [43]. However, nutrition screening tools such as the MNA-SF [41] support the use of higher cut-off points to identify PEM in older adults. The rationale for higher BMI cut-off points is that older adults are likely to [44]:

- have a smaller proportion of lean body mass than younger adults (as a result of ageing, PEM, or inactivity);
- shorten with age due to the compression associated with an osteoporotic spine (kyphosis).

Research also indicates that moderately higher BMI is protective against mortality [45]. A recent study investigating the relationship between BMI and selected clinical outcomes found that after adjustment for age, sex and level of care, $\text{BMI} < 22 \text{ kg/m}^2$ increased the risk of fracture by 38% and mortality by 52% in a sample of 1846 older adults in residential aged care [46].

The Subjective Global Assessment (SGA) [26] and Mini-Nutritional Assessment [47] are validated nutrition assessment methods that use a range of parameters that can be used to make a nutritional diagnosis and initiate nutritional management in



(Adapted from [79–85])

Fig. 2. Factors affecting food consumption in the elderly.

Source: Adapted from [79–85].

elderly patients. In contrast to nutrition screening tools, nutritional assessment methods are much more comprehensive and are used by trained professionals (such as dietitians, physicians, nurses or research assistants).

A recent study compared the accuracy of identifying malnutrition by seven validated nutrition screening tools against SGA and MNA in their accuracy of identifying malnutrition in an elderly cohort ($N=134$) [48]. With the exception of the rapid screen, all other tools performed with a high sensitivity and specificity when compared with the SGA [48]. The MST and NRS-2002 had the highest accuracy when compared with the SGA [48]. Although MNA-SF had a high sensitivity with MNA, it demonstrated poor specificity and positive predictive value when compared with the SGA [48]. The MNA-SF was developed to identify patients requiring comprehensive assessment using the MNA, and therefore the inherent differences between MNA and SGA could have explained this result [48].

Given that there are a range of validated nutrition screening tools for the elderly population, it is advised that tools are selected on the basis of who will perform the nutrition screening and the resources available within the healthcare setting. Some screening tools contain anthropometric measures and calculations and take more time to complete. Involuntary weight loss is easy to overlook in someone who is overweight and it is important to recognise that someone may be malnourished even though they appear healthy or overweight.

6. Consequences of PEM

PEM can affect almost every function, organ and/or system of the human body [49] and therefore has been associated with a range of outcomes with implications for health and recovery from illness/surgery [50]. Although the onset of PEM depends on the body's nutritional reserves (independent of the disease state) [50], a connection between PEM and disease exists, whereby disease may influence PEM, or PEM may have a negative effect on disease [49]. Therefore, PEM is often referred to as “a cause and consequence of adverse outcomes” (Fig. 2). Older patients are known to be especially vulnerable to PEM-related consequences [51] such as prolonged length of stay in hospital [29,52], increase risk of falls [29], admission to higher level care [52], decreased physical function [52], poorer quality of life [52], increased risk of life-threatening complications [53] and increased mortality [54].

The Australasian Nutrition Care Day Survey is the largest study in the Australian and New Zealand acute care setting to evaluate nutritional status and its association with health-related outcomes [20,56]. The study recruited 3122 acute care patients from 56 hospitals across the two countries [20]. More than 50% of the cohort in this study ($n=1650$, 56%) were aged ≥ 65 years [20]. Participants were screened for nutritional risk using the PEM screening tool (MST) [57]. Patients identified with nutritional risk were then comprehensively assessed for PEM using Subjective Global Assessment (SGA) [26]. Health-related outcomes data (namely LOS, readmissions, and in-hospital mortality) were collated 90 days after nutritional assessment [56]. Results (unpublished) from the survey indicated that elderly malnourished patients (≥ 65 years) had significantly longer LOS, readmissions, and 90-day in-hospital mortality in comparison to their well-nourished counterparts and those aged <65 years (Table 2) [58].

A retrospective study aimed to evaluate if PEM at hospital admission predicted clinical outcomes (LOS, readmissions, mortality, change in level of care at discharge) at 18-months follow-up in 2076 geriatric patients (aged ≥ 65 years) recruited from two sub-acute hospitals in Australia [59]. Nutritional status was determined using the MNA within 72-h of admission [59]. The study found that 30% of the patients were malnourished at admission and 53% were at risk of malnutrition [59]. Malnourished patients had significantly higher median LOS (34 days, range: 21–58) in comparison to patients at nutritional risk (26 days, range: 15–41 days) or well-nourished (20 days, range: 14–26 days) ($p<0.001$) [59]. Although number of readmissions was not significantly associated with PEM, malnourished patients demonstrated a significantly high rate of discharge to high level residential aged care facilities (33% versus 17% in patients with PEM risk and 5% in well-nourished patients, $p\leq 0.001$) [59]. Survival analysis (controlling for age, gender, major disease classification, morbidity, and LOS at index admission) indicated that the hazard ratio of death in the malnourished group was 3.4 times (confidence interval (CI): 1.07–10.87, $p<0.05$) the well-nourished group [59].

7. Management of PEM

In addition to the pathophysiological, social and behavioural factors that play a role in the development of PEM amongst older adults, illness and hospitalisation have also been implicated in the development (or worsening of PEM) in elderly patients. A

Table 2

Comparison of health-related outcomes in well-nourished and malnourished acute care participants (<65 years, ≥65 years) from the Australasian Nutrition Care Day Survey 2010 [58].

Outcomes	Participants aged <65 years (n = 1175)		Participants aged ≥65 years (n = 1650)		p-value
	Well-nourished (n = 847)	Malnourished (n = 328)	Well-nourished (n = 974)	Malnourished (n = 484)	
LOS (days) ^a	9(2–158)	14(2–116)	11(2–111)	15(2–119)	<0.0001
Readmissions (n (%))	220 (26%)	125 (38%)	351 (36%)	189 (39%)	<0.0001
90-day in-hospital mortality ((n (%))	16(2%)	19(6%)	51 (5%)	50 (10%)	<0.0001

^a LOS, length of stay; represented as median (range).

large number of barriers adversely affecting food intake in elderly patients have been identified in the literature. These include self-limiting factors (loss of appetite, acute illness, oral issues, low mood, dysphagia, confusion, isolation), catering limitations (inflexible mealtimes, difficulty accessing food and beverage packaging, lack of menu variety, unappealing meals), and organisational barriers (interruptions during mealtimes, inadequate feeding assistance, unpleasant smells, disruptive behaviour from staff members and other patients) [60].

Weekes et al. [61] evaluated the efficacy of different nutritional care interventions (including nutrition screening and nutritional support, excluding artificial nutritional support like parenteral nutrition) aiming to improve nutritional or clinical outcomes or costs by reviewing 297 associated publications. The review found a scarcity of unbiased, large randomised controlled trials in the published literature and highlighted that not enough research had been done to demonstrate the nutritional- and cost-effectiveness of interventions [61]. Given that oral nutritional supplements are commonly prescribed to alleviate PEM, another systematic review by Milne and colleagues assessed 55 randomised trials (n = 9187) for the clinical and nutritional outcomes for older people offered supplements in different settings [62]. Although the review found that supplements could improve the nutritional status of older people, lead to a small gain in weight and muscle mass, the authors identified that elderly people may have difficulty accepting supplements as a result of reported gastrointestinal disturbance [62]. Milne et al. also acknowledged that the results of their review were limited by inadequate studies, which used mainly poor methodologies, lacked sufficient statistical power and duration of follow-up to demonstrate any beneficial effects [62].

However, there is a growing body of evidence to demonstrate merit in offering nutritional support to patients following hospital discharge:

- A Cochrane review by Shepperd and colleagues indicates that structured discharge plans that are tailored for individual patients are associated with reductions in LOS and readmission rates in older people [63].
- In a randomised controlled trial, 259 elderly acute care patients who were at nutritional risk were randomised into two groups – the intervention group received individualised nutritional care from a dietitian and three post-discharge home visits; participants in the control group received either one dietitian visit during hospitalisation or standard care (nil dietitian review) [64]. Outcomes measured at baseline and at six months included nutritional status (MNA), mortality, health status, biochemistry, cognitive, emotional and functional parameters [64]. At six months, researchers noticed lower mortality and moderate improvement in nutritional status in the intervention group [64].
- Two recent studies, involving over 200 participants each, have demonstrated that nutrition interventions (including enriched diets and/or oral nutritional supplements, home visits and/or telephone follow-ups) in elderly patients (aged 65 years and over) yielded improvements in nutritional status, functional status and mortality rates [65].

- A recent systematic review and meta-analysis of randomised controlled trials evaluating the use of ONS in medical and surgical patients (aged over 65 years) has also established positive associations with dietary intake and weight status [66].
- In an Australian prospective cohort pilot study an interdisciplinary discharge team (consisting of a specialist discharge planning nurse and dietitian) provided 12 elderly participants (aged over 65 years) with nutrition support (education, advice, service coordination, home visits and telephone reviews) for six weeks following hospital discharge [67]. Participants found the proposed model of care acceptable and demonstrated improved nutritional status at 12 weeks post-discharge [67].
- In a Danish study 152 geriatric medical patients (aged over 65 years) who were at nutritional risk were randomised into two groups: one group was offered a 12-week individualised dietary counselling with a dietitian along with follow-up by a general practitioner; and the other group was offered a 12-week follow-up by the general practitioner only [68]. Outcome measures were functional status (hand-grip strength, chair stand, mobility, disability, tiredness in ADLs, rehabilitation capacity) and nutritional status (weight, BMI, energy and protein intake). Participants in the group receiving individualised dietary counselling had a positive effect on both outcomes measures [68]. This study is unique for demonstrating the effectiveness of dietary counselling in a general medical setting and perhaps the study design can be used to conduct larger randomised controlled trials [68].

These studies demonstrate positive outcomes associated with offering individualised nutritional support to malnourished elderly people – both during hospitalisation and post-discharge. These studies also highlight the importance of routine nutrition screening to monitor PEM (risk) in order to identify, diagnose and treat PEM in a timely manner.

The use of high energy and protein diets and oral nutritional supplements have demonstrated improved nutritional, clinical and functional outcomes and therefore should be provided to patients not meeting their dietary requirements during hospitalisation [35,63,69–77]. Pharmacologic treatment of some vitamin and/mineral deficiencies may also be indicated clinically. In particular, low levels of vitamin D, B₁₂ and/or iron can occur in those with PEM. Low serum albumin levels are not necessarily indicative of PEM as this could reflect inflammation or disease state. Albumin and transferrin levels may be normal but glucose and cholesterol may be low in undernourished adults.

Food services are also increasingly using systems-level strategies designed to maximise nutritional intake, such as feeding assistance, red trays to identify those at risk of PEM and therefore in need of assistance, and protected mealtimes [78]. Thus far however, there is little evidence that these systems-level interventions result in improvements in intake or patient outcomes with a recent Australian review in the area identifying only seven studies investigating this type of strategy [78]. Only two of the seven studies identified clinically meaningful improvements in energy intake and two studies demonstrating clinically meaningful improvements in protein intake [78]. Despite these increases in energy and protein

intake there was no report of significant difference in weight, length of stay or mortality, between those in the intervention group and those in the control group in any included study [78].

8. Implications for practice

Validated nutrition screening tools and monitoring weight (and body composition) are important to identify older adults at nutritional risk. Geriatricians should continue to identify and manage nutritional issues as part of a comprehensive geriatric assessment. General practitioners often have the primary role of monitoring the nutritional status of patients who are discharged from acute or rehabilitation settings, the residential aged care setting and in the community. Strategies to identify and manage patients at PEM risk will avoid further decline in their patients' health status. Where available a dietitian can provide a comprehensive nutrition assessment, treatment and follow-up plan for patients. Future research is required to validate proposed definitions and criteria of sarcopenia and cachexia. In the meantime, clinicians should use their professional judgement in identifying and managing these conditions. Regardless of the underlying causes of muscle depletion, nutritional therapy should still play a key role as part of the multimodal treatment that may also include exercise and pharmaceutical interventions.

9. Conclusion

Malnutrition risk increases with age and level of care. Muscle wasting related to ageing (sarcopenia) is more evident in advanced years and can be masked by fat mass. Cachexia is mediated by proinflammatory cytokines and occurs with particular conditions like cancer but may also occur with ageing. The prevalence of PEM in older adults due to reduced dietary intake remains unacceptably high. Several valid malnutrition screening tools, e.g. MST, MNA-SF and MUST are available to identify nutritional risk but further work regarding tools to distinguish between PEM, sarcopenia and cachexia are required. PEM is independently associated with poorer outcomes and decreased quality of life. For elderly with PEM or at nutritional risk there is evidence that oral nutritional supplements and dietary counselling can help increase dietary intake and improve quality of life. Further research into multimodal (e.g. nutritional, pharmaceutical, exercise) treatment of sarcopenia and cachexia are required.

Contributors

All coauthors have contributed and agree to the content of the paper.

Competing interest

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