Module 36.1

Epidemiology, Aetiology and Consequences of Malnutrition in Older Adults

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Learning Objectives

- To know the prevalence of malnutrition according to the subject’s life setting;
- To know the major reasons for malnutrition in the older adult;
- To know the main medical consequences of malnutrition.

Contents

1. Introduction
2. What is the prevalence of malnutrition in older adults living in the community, in nursing homes, and when they are hospitalised?
3. Aetiology of malnutrition in older adult
4. What are the consequences of malnutrition in older adults?
5. What about micronutrients?
6. Summary
7. References

Key Messages

- The prevalence of protein–energy malnutrition (PEM) varies according to residency and the clinical setting. Up to 5% of community-dwelling older adults, 20-40% of nursing home residents and 20-50% of hospitalised older patients are reported to be undernourished;
- The reason for malnutrition is a mix of age-related, medical and socio-psychological factors. Inflammation induces anorexia, muscle wasting and energy depletion. Poor dental status and medication, as well as cognitive impairment, depression and bereavement contribute;
- PEM is associated with increased morbidity, mortality and longer hospital stays. Malnutrition also increases the risk for hip fractures, infections and pressure ulcers;
- Older subjects are at risk of micronutrient deficiency (e.g. vitamin D and vitamin B12). Vitamin D deficiency increases the risk for osteoporosis and fractures.
1. Introduction

There is a physiological decline in food intake from the ages of 20 to 80 years (1). This has been termed the "anorexia of ageing" and may be an appropriate response to the decreases in lean body mass, energy expenditure and physical activity that occur over the lifespan (2). Ageing is a degenerative process driven by diseases, oxidative damage, anabolic resistance and increased catabolism, which places older men and women at high risk of developing pathological weight loss and eventually malnutrition.

2. What is the Prevalence of Malnutrition in Older Adults Living in the Community, in Nursing Homes, and When They are Hospitalised?

The estimation of the prevalence of malnutrition in older subjects depends on the tools used to evaluate the nutritional status, and on the setting of the studied population. Assessment tools are usually combinations of anthropometry (body mass index), reports of recent weight loss, eating difficulties, and sometimes biochemical markers. The Mini Nutritional Assessment (MNA) is an example of a composite nutritional evaluation tool that is often used in older populations (3). Studies have been performed in older subjects living at home, in nursing homes and in hospitalised older patients. From several prevalence studies it can be deduced that about 5% of community-living older adults, 20-40% of nursing home residents and 20-50% of hospitalized older adults are malnourished (4,5). The population-based Euronut-SENECA study in 2600 subjects aged 70-75 years from 12 countries in Europe showed that 10% of the subjects had a body mass index (BMI) <20 kg/m² (6). Malnutrition becomes more frequent in populations with higher morbidity and care burden. About 8% of home-living older adults who needed help from domiciliary care services displayed malnutrition (7). Unintentional weight loss is reported in about 10% of free-living older subjects (8), and in up to 25% of functionally dependent home-living older persons (9).

Nursing home residents are usually frail, and show concurrent co-morbidities and cognitive decline. The care burden in such settings varies with social and cultural context, which is reflected in large variations in prevalence figures for malnutrition. Thus, ranges from 20% to 40% are reported (4, 10, 11). The National Diet and Nutrition Survey, based on 1368 subjects aged 65 and over, showed that 21% of institutionalised persons were undernourished, based on a composite measure of low BMI and recent weight loss (12). The NutritionDay initiative was recently extended to nursing homes and the first report from >2000 residents in Austrian and German settings disclosed staff-assessed malnutrition in 10%, and BMI <20 kg/m² in 17% (13). High age, immobility, dementia and dysphagia were independent risk factors for malnutrition. When close to all of the institutionalized older adults of Helsinki were assessed by MNA only 10% came out as well-nourished (14). In a comparison of nutritional status of nursing home residents in the same Swedish community in 1996 and 2010 the prevalence of malnutrition had fallen, residents were older and heavier, but still only 7% were assessed as well-nourished (15).

In the hospital, the prevalence of malnutrition is reported to be even higher; i.e. 20-50% depending on the type of ward or assessment tools that are used (4, 16, 17). One third of patients hospitalised in a geriatric unit had a BMI <20 kg/m² (18). Among sub-acute-care older patients, 18% had a BMI <19 kg/m², and 53% of the subjects had albuminaemia <35 g/L (19). Albuminaemia as an indicator of malnutrition has been questioned as it is mainly affected by ongoing inflammatory activity, but as such it reflects catabolic activity.

Although the relative occurrence of malnutrition is lowest among the community-living older adults, this group of adults make up the largest group of malnourished individuals. For example it is estimated that in Europe 4 million community-dwelling older people are malnourished compared to about 2.5 million malnourished in hospitals and nursing homes.
3. Aetiology of Malnutrition in Older Adults

Malnutrition/protein-energy malnutrition is an umbrella concept for various conditions with somewhat different phenotypes and underlying mechanisms. For example, cachexia is the disease-related inflammatory-driven catabolism (20), whereas sarcopenia is the muscle loss and weakness partly following cachexia but also a separate age-related condition (21). Frailty which is often observed in very old adults is loss of organ reserves, weight loss and age-related weakness (22). Pure starvation due to poverty or to natural catastrophes still occurs, mainly in the less developed part of the world.

There are somatic as well as social and psychological reasons for reduced food intake and increased catabolism. Disease-related malnutrition, i.e. cachexia, is driven by the inflammatory response to the underlying disease. Ageing in itself is a low-grade inflammatory condition, sometimes called inflamm-aging (23). In combination with a chronic disease this inflammation starts a number of catabolic actions, e.g. increased expression of anorexic molecules in the brain as well as of proteolytic enzymes and pathways like the ubiquitin-proteasome system. Proteolysis combined with insulin resistance has strong muscle wasting effects. The combined inflammatory effect on the body’s lipase systems results in overall lipolysis. Added to the inflammatory activities of ageing and disease there are age-specific reductions in anabolic hormone secretion (e.g. testosterone, estrogen, GH/IGF-1, DHEA). Free radicals (reactive oxidative species (ROS) coming from energy production in the mitochondria causes oxidative damage for example to mitochondrial DNA which is supposed then to trigger exaggerated cellular apoptosis (24).

Cognitive impairment, dementia and depression are neurodegenerative and neurological mechanisms behind malnutrition. Bereavement and reduced social networks are also common causes for depression in the old.

4. What are the Consequences of Malnutrition in Older Adults?

Interestingly, health economic calculations performed by the British BAPEN indicate that the societal costs from malnutrition are double that of obesity (25), half emanating from direct hospital care and the other from increased needs for community care.

Studies have consistently reported an association between morbidity and mortality, and nutritional status in older subjects, as assessed by BMI, weight loss or food intake (26). Recent large-scale prospective observational studies point to being underweight as a stronger risk factor for death than obesity in older adults. In ~9200 70-75 year-old Americans the highest 10-year survival was observed in those with a BMI between 25 and 30 kg/m². Mortality was higher among those with BMI <20 as compared to those with BMI >35 kg/m² (27). A similar 7-year follow-up study in ~13000 subjects >65 years of age indicated that the least risk of disability was found if the BMI was ~25 kg/m² at the start, whereas survival was highest if BMI was around 30 (28). In a prospective community-based study including 247 men aged 65 and over, the annual incidence of a weight loss of 4% or more was 13%. Although the weight-losing subjects were similar to the non-weight losers for age, BMI, health status, albumin and cholesterol measurements, they had a significantly greater 2-year mortality rate (RR=2.43; 95% CI=1.34–4.41) (8). In 288 older patients receiving home help services, weight loss was a significant predictor of mortality in a multivariate analysis including age, sex, BMI, weight loss and functional status (RR=1.76; 95%CI 1.15–2.71) (29). Mortality was studied as a function of BMI in 8428 hospitalised patients. In patients aged 20-40 years mortality doubled in the most underweight (BMI <18) compared to BMI groups 20-40; however, in patients aged 70-79 years, there was a tripling in mortality for BMI <18 compared to the BMI groups 32-40 (30) (Fig. 1).
Fig. 1. Association between BMI and mortality as a function of age in 8428 hospitalised patients. Reproduced from (30).

In 109 patients admitted to a geriatric rehabilitation unit, the best predictor of mortality in the 1 year after admission and the 1 year after discharge from hospital was the percentage of usual body weight lost in the year prior to admission (31). Pre-admission weight loss was still predictive for mortality up to 4.5 years after discharge (32). In 400 consecutive geriatric patients BMI was the strongest independent predictor of 1-year mortality, a marker even stronger than diagnosis and age (33). Similarly, data from the NutritionDay programme show that among the oldest hospitalized patients a reduced food intake increased the 40-day mortality from <2% in those who ate all that was served, to 16% among those who did not eat at all. The results remained significant after adjustment for illness severity (34).

The immune system is sensitive to nutrient deprivation as it has a high cellular turnover. Thus, immune suppression with an increased risk of infections is a hallmark of malnutrition. This state is sometimes called MAIDS (Malnutrition Associated Immune Deficiency Syndrome), and is in several aspects similar to the HIV-induced immune deficiency syndrome (35). Episodes of sepsis occurred significantly more often in severely undernourished hospitalised older patients as assessed by BMI and corrected muscle area (36).

One prominent feature of malnutrition is loss of muscle mass, i.e. sarcopenia (21, 37). Weight loss in combination with muscle weakness makes up the diagnosis of frailty (38). Sarcopenia combined with osteoporosis, another condition related to malnutrition, paves the way to musculo-skeletal related incidents like gait disorders, falls and fractures. The fracture incidence is further promoted by:

- the effect of low protein and calcium intake and vitamin D depletion on bone mass;
- the decrease in fat mass that would otherwise protect the bone in the case of a fall.

In the Study of Osteoporotic Fractures, 6700 women were weighed at baseline and after a mean of 6 years. After adjustment for age, cigarette smoking, physical activity, oestrogen use, medical conditions, health status, body weight, femoral neck bone mass, and rate of change in calcaneal bone mass, the women who had lost weight had a significantly increased risk of fracture of the proximal femur, pelvis and proximal humerus (age adjusted RR per 10% decrease in weight: 1.68; 95% CI 1.17–2.41) (39). Among 255 old hip-fracture patients >50% were malnourished or at risk according to MNA, and the mortality rate was higher among the malnourished (40).
Malnutrition increases the risk of pressure sores (Fig. 3). Low protein and energy intake, BMI and hypoalbuminaemia are risk factors for the development of pressure sores in older patients (41, 42). Importantly, a meta-analysis of 4 clinical studies showed that oral nutritional supplements could significantly reduce the incidence of pressure ulcer development in at-risk patients (odds ratio 0.75, 95% CI 0.62-0.89) (43).

Depression is a common cause of malnutrition. Depression is also an underrated complication of malnutrition. An unexpected finding during the Minnesota Starvation Study when 34 young men voluntarily starved for 6 months and lost 25% of their body weight, was the observed changes in mood; i.e. depression, apathy and irritability (44). These effects disappeared after nutritional repletion. It is most likely that this observation is also valid in the older person.

All these negative consequences of malnutrition may partly account for the association between malnutrition and poor quality of life in older persons (10, 45, 46).

5. What about Micronutrients?

Older persons are at risk of micronutrient deficiency. This may be due to low food intake, chronic diseases or drugs. The Euronut-SENECA study reported in a population of 1005 subjects (aged 74–79 years) that about 1/4 of the men and half of the women had low dietary intakes or low plasma levels for at least one of the following micronutrients:
calcium, iron, retinol, ß-carotene, thiamine, pyridoxine, vitamin C, cobalamin and vitamin D (47). In institutionalised and in hospitalised older persons, the prevalence of micronutrient deficiency appears to be higher, especially for thiamine, pyridoxine, cobalamin, folate, vitamin C, vitamin E and selenium (48). Low calcium intake and low vitamin D levels increase the risk of osteoporosis. Several intervention studies have shown that the combination of calcium and vitamin D (at least 700 IU/d) supplementation reduces the incidence of hip fractures in older populations (49, 50). Almost all cells in the body express vitamin D receptors, indicating a wide spectrum of potential effects from this vitamin. A meta-analysis indicates that vitamin D supplementation reduces the incidence of falls in older adults (51). Although it is suggested that vitamin D deficiency may play crucial roles in the development of immunological, neurological and psychiatric disorders, a recent evidence-based expert consensus from The American Institute of Medicine could not find sufficient data to recommend vitamin D supplementation for purposes other than fracture prevention in the older adult (52).

As in younger adults, severe micronutrient depletion leads to specific well-known clinical symptoms and must be treated. However, in the older person, the micronutrient deficiencies described are mostly mild, the consequences of which are difficult to assess. Micronutrient intervention studies have shown conflicting results. Still, for older “small-eaters” in care homes or in hospital, the risk of malnutrition readily justifies the use of multivitamin supplementation.

6. Summary

Malnutrition is frequent (20-50%) in the hospitalized and institutionalized older persons. Most malnourished old adults live in the community, although the prevalence of malnutrition is less there (~5%). Age-related degenerative phenomena, as well as medical catabolic processes like inflammation, interact with socio-psychological factors like cognitive impairment and bereavement to make malnutrition a common condition in the older adult. Malnutrition has adverse effects on morbidity (e.g. infections, fractures), mortality, function (e.g. sarcopenia and frailty) and quality of life. Macronutrient and micronutrient deficiencies both play important roles.

7. References


