



# Physiological Determinants of Malnutrition in Elderly



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## Abstract

Old age is associated with many changes, viz., physical, psychological, social and economic and age of 75 years or above is considered as autonomous risk factor for poor nutritional and health status. Body composition changes with ageing, fat mass and visceral fat increases, while lean muscle mass decreases. Physical activity goes down, and so does the bone mineral density. The age-related changes affect the food intake and nutritional status of older persons. Consequently, the elderly suffers from malnutrition, which along with co morbidities become life threatening issues. Inadequate nutrient intake and associated consequences in elderly can be effectively counteracted on having thorough understanding of the causes of malnutrition. Poor nutritional status has a multifactorial aetiology. This review examines the physiological risk factors responsible for malnutrition in the older adults. These include poor appetite, cachexia, oral health, micronutrient deficiencies and acute and chronic infections.

**Keywords:** Aging; Elderly; Malnutrition; Nutritional status; Older adults

## Introduction

The elderly population worldwide is growing, from 461 million people aged 65 years and more in 2004 to an estimated 2 billion by 2050 [1]. Individuals are living longer, that does not essentially mean that they are living healthier. Higher age is associated with greater risk of disease, functional disabilities, frailty and sensory losses [2,3]. Energy needs of the individuals decreases with ageing whereas requirements of protein (i.e., for maintenance of muscle mass) and different micronutrients (eg., for bone health) remain same or increases depending on their health and nutritional status [4], demanding more nutrient dense diet (food choices) to meet their nutritional [5].

In present scenario where obesity has emerged as a global crisis, under nutrition continues to prevail among older adults worldwide. Approximately 25%-60% of older adults have BMI < 18.5 kg/m<sup>2</sup> [6]. Age of 75 years or above is considered as autonomous risk factor for poor nutritional and health status [7]. Body composition changes with ageing, fat mass and visceral fat increases [8], while lean muscle mass decreases [9]. Fat free mass (FFM) (i.e., muscle, skin, organ tissue and bone) of the body decreases with advanced age, around 40-50 years of life which cause reduction in physical activity and bone mineral density. With ageing central retention of fat mass rises whereas appendicular fat mass reduces. Around 75 years of age this fat mass deposition decreases, or it remains stable [10]. Body composition of older people changes during malnutrition. Any variation in dietary intake has adverse effect on nutritional status of elderly. Insufficient dietary intake, muscle wasting, poor

appetite and weight loss lead them towards undernutrition [11]. Undernutrition in greying population leads to loss of skeletal muscle mass and lean body mass, impaired physical performance, functional dependencies, reduced nutritional and health status, higher morbidity and mortality, inflammatory stress, impaired wound healing due to compromised immune function [12]. Undernourished people are more prone to infections. Malnutrition in greying population is caused by extremely varied factors, which are discussed under following heads:

### Poor Appetite

Poor appetite is likely the main reason of malnutrition which can be resolved by several factors [13]. With advancing age, persons experience a physiologic reduction in food and energy intake which has been termed as 'anorexia of ageing', caused by multiple factors. Physiological factors (cause decreased intake) include age related changes that affect the gastro-intestinal system, impairment of the central feeding drive, decrement of taste and smell [14-16], gastro-intestinal and adipokine hormone secretion and altered feedback of autonomic nervous system [17]. Physical factors (i.e., teeth loss, ill-fitting dentures or taste changes) may influence food choices of elderly person and limit their food intake [14]. Poverty, loneliness, cut-off from the society and insufficiency and inadequacy of social support programmes are the significant social factors. Inability to do various works (i.e., purchase and preparation of meals, feed oneself) also results in reduced food intake in older adults [14,18]. Psychological problems (depression, dementia and Alzheimer's)

significantly cause loss of appetite [19-21] that affect food intake of elderly. Anorexia in old age is often caused by several medical problems, i.e., gastrointestinal disease, malabsorption syndrome, acute and chronic diseases, and hypermetabolism [14,18]

### Cachexia

Cachexia is a complicated metabolic syndrome which is characterized by loss of muscle mass either with or without loss of fat mass. Eminent characteristic of cachexia is weight loss and inflammation [18]. Firstly interleukin-1 (IL-1) is produced in cachexia, which triggers other parts of the immune response, including the production of tumor necrosis factor (TNF $\alpha$ ) and then interleukin-6 (IL-6) [18,22]. These cytokines play an important role in immunomodulation and in the metabolic response to injury or stress. Therefore, rate of gluconeogenesis and resting energy expenditure (REE) increases, which cause negative nitrogen balance and reduced muscle mass in body [22]. Elevated concentration of TNF $\alpha$ , IL-6, IL-1 receptor antagonist and soluble TNF receptors are seen in old age which suggests the activation of whole inflammatory series. It is not clear from the researches that changes in cytokine concentration in old age are due to underlying disease. It may arise because of catecholamine hyper-secretion and sex steroid hypo-secretion [23]. Sometimes cachexia and malnutrition overlap but they are not the same. Although all patients with cachexia are undernourished but not all undernourished patients are cachectic [24] Cachexia is different from age-related problems and it does not easily respond to increased feeding [25] which is also called as inflame-ageing. "Inflamm-ageing is defined as the chronic low-grade inflammation of ageing" [26]. "It could be either the cause or the effect of the increased prevalence of a clustering of metabolic abnormalities with inflammatory pathogenesis including obesity, dyslipidemia, hypertension, insulin resistance, and type 2 diabetes mellitus" [27].

### Oral Health

Nutritional status of a person can be compromised by poor oral health [28]. Poor oral health and poor general health of elderly are directly or indirectly interrelated with each other, due to common risk factors [29]. Tooth losses, ill fitting dentures and dry mouth (xerostomia) are common in old age which lead to soreness, ulceration, chewing and swallowing problems that are the significant cause of reduced food intake. The ability to eat certain foods is related to the presence and distribution of natural teeth that affects nutrient intakes and nutritional status of elderly [30]. A study illustrated that the loss of natural teeth and wearing of dentures are associated with the increased risk of malnutrition [31]. These oral problems consequently affect nutritional status and cause involuntary weight loss among community dwelling elderly [22] and also increases the risk of general health problems [32]. Hypo functioning of salivary glands has been reported with protein energy malnutrition consequently resulting in a decreased salivary secretion rate and decreased salivary constituents particularly proteins [33].

### Micronutrient Deficiencies

Micronutrients, i.e., vitamins and minerals are necessary for healthy functioning of human body. Micronutrient deficiencies in old age cause numerous changes in body functioning, leading to malnutrition. Calcium along with vitamin D are necessary for intact bone and bone remodelling. In aged people absorption and status of these nutrients were influenced due to age related reduction in receptor expression in the duodenum [34] Furthermore, synthesis of vitamin D in the skin also decreases with age. Deficiency of these micronutrients leads to reduced bone mass in elderly (especially after menopause in women) making them prone to osteoporosis and osteoporotic fractures [35]. Calcium metabolism and bone health is controlled by vitamin D and parathyroid hormone [36]. A low serum level of vitamin D has been associated with muscle loss, fractures, falls and increased mortality [37]. Low vitamin D level has been linked with variety of chronic diseases related to ageing, i.e., diabetes [38,39] and cardiovascular diseases [40]. Anaemia is a multifactorial condition that increases the comorbidities in elderly [41].

Approximately one-third of anaemia cases in elderly are attributed to iron, B $_6$ , folate and/or vitamin B $_{12}$  deficiencies [42]. These deficiencies have been occurring due to malabsorption of food cobalamin caused by gastro-intestinal problems [43]. It causes high homocysteine concentration in the blood [44] which is considered as an important risk factor of cardiovascular diseases [45]. Vitamin B $_{12}$  deficiency and hyper homocystinuria have also been associated with depression due to genetic polymorphism [46]. Conditions, i.e., recurrent aphthous stomatitis, atrophic glossitis or a painful burning tongue are possibly caused by iron or B-vitamin deficiency [47]. Zinc is an important trace mineral crucial for synthesis of structural proteins, transcription factors and enzymatic processes [48]. Its deficiency produces a wide spectrum of clinical manifestations. Moderate zinc deficiency is associated with deficient nutrient intake, imbalanced nutrition, chronic liver disease, chronic renal disease, malabsorption syndromes, skin abnormalities, anorexia and delayed wound healing. Severe zinc deficiency may arise due to acrodermatitis enteropathy, prolonged high-calorie parenteral therapy, or penicillamine therapy and eventually ends up in bullous or pustular dermatitis, diarrhea, balding and mental abnormalities [49]. Age related changes are related to dysfunctions which influences the intracellular availability of zinc ion [50]. Zinc deficiency induces comparable impairment of cellular immune response of elderly which can result in infection and even death [51].

### Acute and Chronic infections

Various infections (eg., typhoid, tuberculosis, AIDS), gastro-intestinal problems (i.e., peptic ulcers, bowel disorders), life-style diseases (eg., obesity, hypertension, cardiac problems), endocrine disorders (i.e., diabetes, thyroid), cancer and neurological disorders (Parkinson's, and multiple sclerosis) alter metabolic demands of the body. At the same time body's ability of meeting these demands is reduced due to decreased appetite, special dietary restrictions and

physical limitation that may impede the act of feeding [52]. Obesity is combined with an increased burden of cardiovascular and other chronic diseases that impair quality of life of individuals [53]. It is also related with maximized risk of various types of cancers (i.e., renal, breast, pancreas, cervical, gallbladder, uterine, prostate, bladder and colon cancers) that occur frequently in elderly than in younger adults [54]. Due to decreased muscle mass and strength, elderly are more prone to the adverse effects of excess body weight on physical function [55]. Therefore, it is important to consider weight reduction therapy to improve physical function, quality of life along with medical complications related with obesity or overweight in older persons.

Malnutrition is very common in senior subjects. Elderly are prone to numerous infections, disorders and diseases. All factors either individually or in combination with others are responsible for various nutritional problems. This in turn can lead to rapid functional and mental deterioration and consequently deteriorate quality of life. This segment of population needs more attention and care of family, society and health administration to prevent undernutrition, so that they can maintain optimal health and can live their life being happy and healthy.

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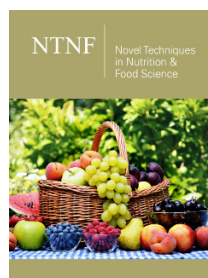
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