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NDT Perspectives

As we grow old: nutritional considerations for older patients on dialysis

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ABSTRACT

The number of older people on dialysis is increasing, along with a need to develop specialized health care to manage their needs. Aging-related changes occur in physiological, psychosocial and medical aspects, all of which present nutritional risk factors ranging from a decline in metabolic rate to assistance with feeding-related activities. In dialysis, these are compounded by the metabolic derangements of chronic kidney disease (CKD) and of dialysis treatment *per se*, leading to possible aggravation of protein–energy wasting syndrome. This review discusses the nutritional derangements of the older patient on dialysis, debates the need for specific renal nutrition guidelines and summarizes potential interventions to meet their nutritional needs. Interdisciplinary collaborations between renal and geriatric clinicians should be encouraged to ensure better quality of life and outcomes for this growing segment of the dialysis population.

Keywords: elderly, geriatric, malnutrition, protein–energy wasting

INTRODUCTION

The population of older people initiating and living with dialysis is increasing each year [1, 2]. According to the 2013 ERA-EDTA registry report [3], 55% of patients starting dialysis in Europe were ≥65 years of age (Figure 1). There is a need to develop specialized health care for this growing segment of the dialysis population. Nutritional needs change throughout the life course. Energy intake decreases with aging, due to the biological, psychological and social consequences of growing older. There is a wealth of information in the field of geriatrics about nutritional needs, risks and interventions in older people, however, how this evidence relates to the older person on dialysis remains less explored. The aetiological determinants of protein–energy wasting (PEW) syndrome in chronic kidney disease (CKD) [4, 5] are all present in the older patient, with additional nutritional risks and plausibly different nutritional requirements [6]. The European Renal Nutrition (ERN) working group of the ERA-EDTA aims to increase awareness of the prevalence and importance of nutritional alterations in CKD patients. In this article we summarize our understanding of

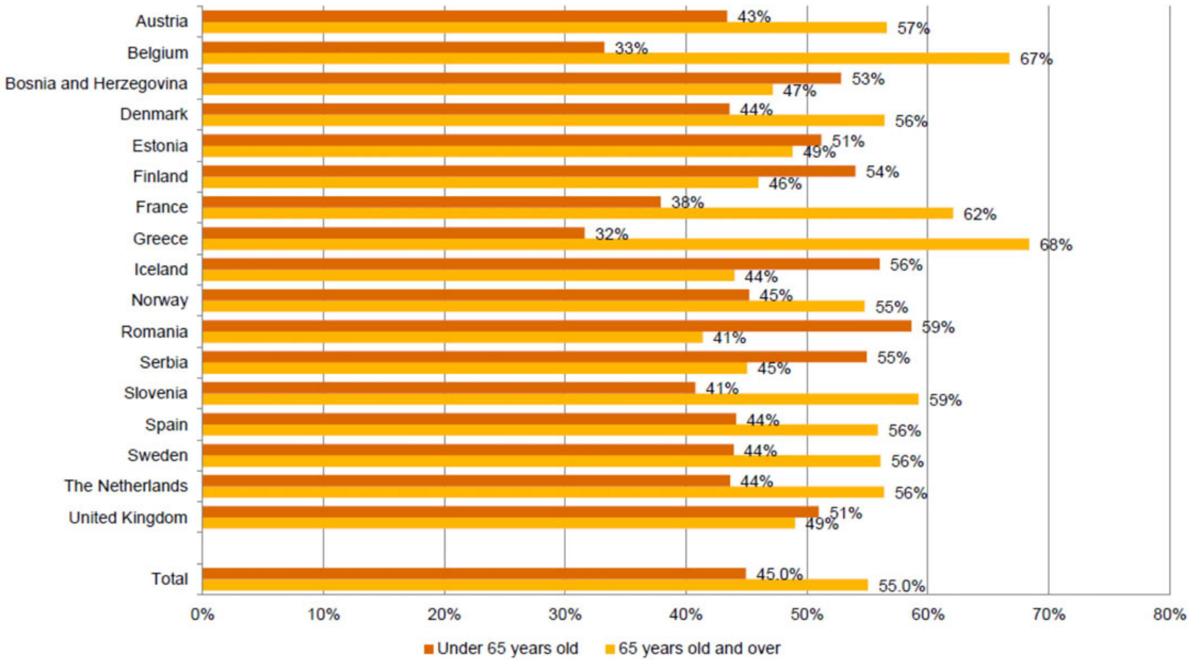

FIGURE 1: Incident percentages of people starting dialysis at Day 1 by age for European countries, adapted from the European Renal Association–European Dialysis and Transplantation Association Registry Annual Report 2013.

the impact of aging on PEW risk in patients on dialysis and elaborate on current research and care gaps.

IS PEW MORE COMMON AMONG OLDER DIALYSIS PATIENTS?

Establishing the prevalence of PEW syndrome among patients on dialysis is hampered by the lack of consensus on how to define and assess this multifactorial syndrome, exemplified by a highly variable prevalence ranging from 26 to 77% in the elderly dialysis population depending on the methods used to define it [7]. Establishing the validity of specific nutritional markers or cut-offs to diagnose malnutrition in the older dialysis patient is an interesting area of discussion, but outside the scope of this review [8, 9]. It is challenging to distinguish between the impact of aging and the impact of disease on nutrition; for instance, hypoalbuminaemia has been reported to be more prevalent in older people on dialysis [10–12]. This may be due to older people maintaining a lower rate of albumin synthesis regardless of whether they have a higher or lower protein intake. However, it could also be due to higher underlying inflammation among the comorbid older population.

It is assumed that there is a higher degree of PEW in older versus younger dialysis patients, but few studies have examined this issue. Qureshi *et al.* [13] reported that 68 (>65 years) compared with 46% (≤65 years) of patients were malnourished, as assessed by subjective global assessment (SGA). In an Italian study from the mid-1990s, 51% of older maintenance dialysis patients on dialysis demonstrated malnutrition compared with 27–31% in younger participants (Figure 2) [14]. As many as 50% of older dialysis patients from France had at

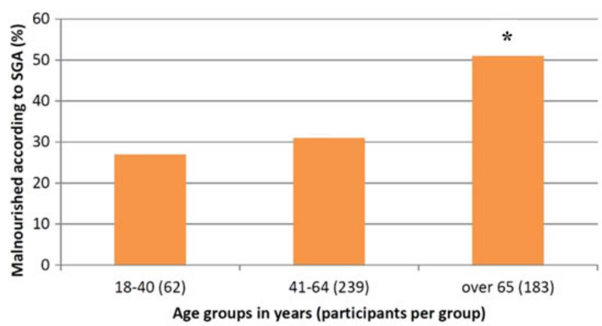

FIGURE 2: From Cianciaruso *et al.* [14]. Difference in prevalence of malnutrition (defined by Subjective Global Assessment) per age strata in patients on dialysis. *$P < 0.05$ compared with the other two age groups.

least one abnormal nutritional parameter [15], and in a more recent French study, those patients ≥75 years of age were found to have a lower body weight, body mass index (BMI), normalized protein nitrogen appearance, serum albumin, phosphorus and parathyroid hormone and higher C-reactive protein (CRP) [12]. Similar findings were echoed in DOPPS [11]. Collectively, these studies may suggest a stronger risk of PEW among older patients on dialysis. The rates of malnutrition in older dialysis patients were as high as those seen in residents of nursing homes with a mean age >80 years [16]. Nutritional status is important in determining patient outcomes, particularly in older people. This is emphasized by a recent study from Australia [17] on 1781 incident dialysis patients >75 years of age. The authors observed that a BMI <18.5 kg/m^2 had a greater association with mortality than 5-year age increments. Recently a 4-year prospective French–Swiss study added to these findings and reported that BMI change (increase and

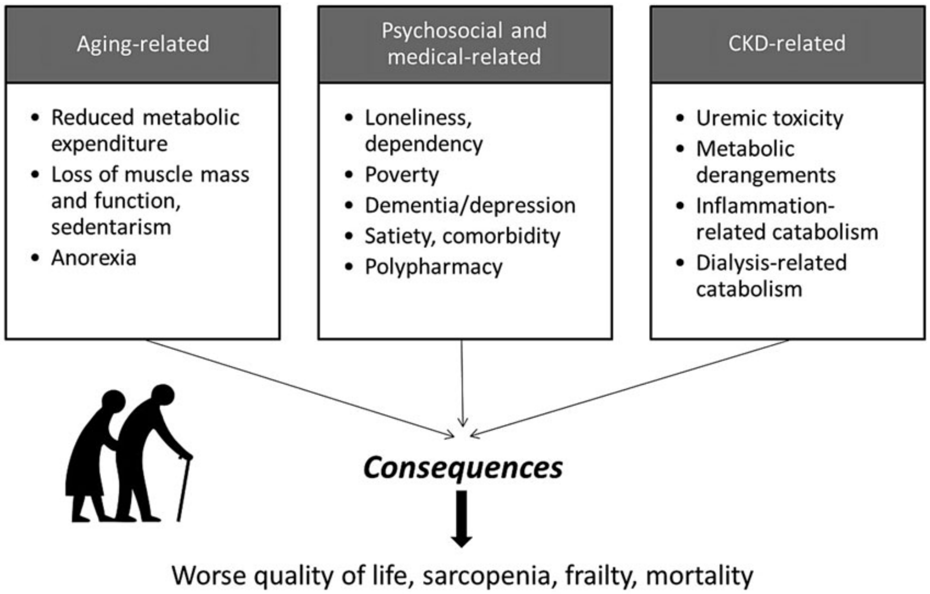

FIGURE 3: Nutritional alterations in the older patient on dialysis.

decrease) per year in 502 prevalent patients on haemodialysis (HD) (≥75 years) was associated with an increased risk of death when compared with those with a stable BMI [18].

FACTORS CONTRIBUTING TO PEW IN THE OLDER DIALYSIS PATIENT

Some factors that affect the risk of PEW in the older patient on dialysis are summarized in Figure 3.

Age-associated changes in metabolism and body composition

As we grow old, changes in body composition and metabolism occur in parallel with modifications in physical activity, impacting societal roles. Resting metabolic rate (RMR), which accounts for 60–70% of daily energy expenditure, declines from birth to old age due to a progressive loss of lean body mass (LBM), with older people (free from illness) having a reduction in cellular metabolic activity. Muscle size and function are affected by different factors [19, 20] and decline with aging at different rates (Figure 4) [19, 21–26]. In healthy older men, LBM decreased by 15% in 12 years, whereas muscle strength reduced by 20–30% [27]. This translates into a yearly loss of 0.64–1% of lean mass versus a 2.5–4% loss of muscle strength [19, 23]. The mechanisms behind this disassociation may relate to changes in muscle composition, alterations in contractile quality, neural activation, systemic inflammation and intramuscular fat infiltration [20, 24, 28, 29]. In parallel with this process, total body fat increases, mostly in the abdominal area [30]. Muscle mass appears to decline more rapidly in adults with advanced renal disease [31, 32], with a similar disassociation between muscle strength and mass observed. A recent US study noted that physical function was lower in people on haemodialysis (HD) compared to older non-HD participants, even though their muscle mass was greater [33]. Old age, comorbidities,

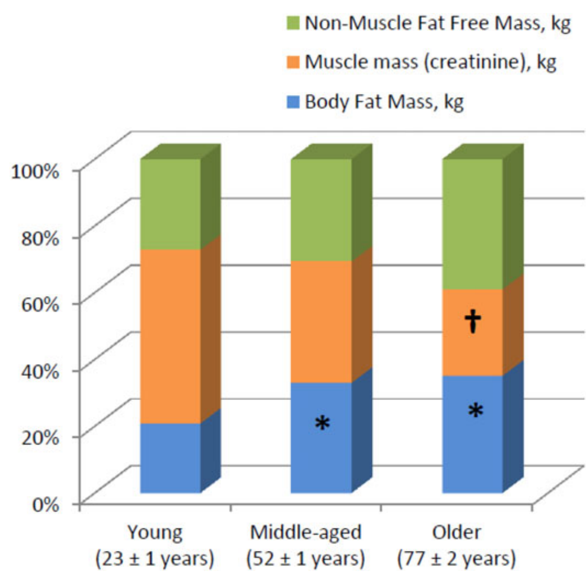

FIGURE 4: Percentage of muscle, fat and non-muscle fat free mass in three different age groups (eight subjects per group). *$P < 0.01$ significantly different from young group. †$P < 0.01$ significantly different from middle-aged group. Based on results from Balagopal *et al.* [21].

physical inactivity and inflammation are all related to low muscle strength among patients on HD, and possibly low muscle mass [34].

A decrease in physical activity and functional decline is also seen in aging [35–37], with a more pronounced effect in those who have a long-standing illness [36]. The decline in physical activity parallels the decrease in muscle mass and RMR [37]. Most patients on dialysis are sedentary, and this increases with aging (Figure 5) [38], regardless of dialysis modality [39]. Low physical activity level is associated with increased mortality in patients on dialysis [40].

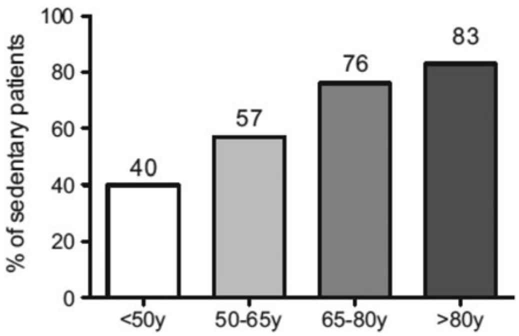

FIGURE 5: Sedentary behaviour (less than 5000 steps per day) as a function of age amongst 1163 prevalent patients on HD from France [38].

Also, as we grow old, nutritional intake declines [41], a phenomenon termed the 'anorexia of aging'. This is attributed to reduced physical activity and loss of smell [42] and taste [43] as well as the natural age-related renal function decline [44]. This decline in energy intake may be due to conditions promoting satiety in older people: delayed gastric emptying due to chronic conditions (e.g. diabetes), medications (e.g. opiates and nitrates) or longer colon transit time promoting constipation [45]. Compared with younger adults, older adults usually eat less protein [46, 47]. In Europe, up to 10% of community-dwelling older adults and 35% of those in institutional care fail to meet the estimated average requirement (EAR) for daily protein (0.7 g/kg body weight/day), the minimum intake level to maintain muscle integrity [48].

Psychosocial and medical-related nutritional risk factors

Older people have a greater vulnerability to non-physiological or clinical factors that can precipitate malnutrition. Cognitive dysfunction increases with age, ranging from 11 to 30.3% [49]. In the setting of CKD, 37% of older people on HD were found to have severe cognitive dysfunction [50]. The association of cognitive dysfunction with low BMI and fat mass index was observed in a study of >4000 hospitalized geriatric patients [51]. Depression is also a nutritional risk factor, and its prevalence increases with the degree of dependency, ranging from 1–3% in community-dwelling older people to 12–16% in those in nursing homes [52], and is often driven by deterioration in health, poor social support and food insufficiency [53, 54]. In a sample of Japanese community-dwelling older people, depression and difficulty with meal preparation were found to be independently associated with the risk of malnutrition [54]. Poor social support can directly impact the ability to obtain and prepare food: >60% of people ≥70 years of age living on their own were either at risk of or had established undernutrition, and 44% of the sample were unable to carry a 5-kg shopping bag [55]. Undernutrition also has a broader impact by negatively influencing quality of life in older people (both mentally and physically) [56]. In older people on dialysis, nutritional intake is related to psychosocial influences such as social networks, socio-economic variables and depression [57].

Table 1. Potential psychosocial and medical causes of malnutrition in older people

Social
Poverty
Inability to perform activities of daily living
Loneliness
Psychological
Dementia/cognitive dysfunction
Depression
Bereavement
Medical
Drugs
Oral health and swallowing problems
Increased metabolism due to conditions such as cancer, chronic obstructive pulmonary disease, Parkinson's

Special mention should be given to the often underestimated impact of drugs on nutritional status in older people, especially given the current tendencies towards polypharmacy [58]. Drug treatment may contribute to poor nutritional status, for example, by causing loss of appetite, nausea, diarrhoea, weight changes, taste alterations, decrease in saliva secretion, modifications in lipid profile, alterations in electrolyte balance and changes in glucose metabolism [59]. Conversely, nutritional status may have an impact on the pharmacology of many drugs [60]. Food can affect drug absorption and metabolism, which can lead to both decreased or exacerbated drug effects. Malnutrition leads to a decreased amount of serum protein (e.g. albumin), leading to a higher unbound drug fraction. Because only unbound drug fractions have pharmacological activity, this can result in increased effects of drugs. A summary of factors potentially influencing nutritional intake in older people is listed in Table 1.

The aggravation of malnutrition by superimposed CKD in older people

In illness, RMR can increase with age with the development of comorbidities and functional impairments [61]. This was illustrated in a study where people on dialysis showed a higher RMR than age-, sex- and BMI-matched controls [62]. Inflammation [63] and diabetes [64] increase RMR in patients with CKD (not on dialysis), whereas in those on HD, severe hyperparathyroidism increases RMR [65]. In patients on peritoneal dialysis (PD), loss of residual renal function, decreased albumin, cardiovascular disease and CRP [66] were all associated with an increase in RMR [67]. Recently, Shah *et al.* [68] evaluated dietary energy requirements in 13 stable patients (<60 years old) on HD over a mean of 90 days and concluded that dietary energy requirements are similar to those of sedentary individuals without CKD. No studies have addressed, to our knowledge, whether RMR differs in older patients on dialysis.

Patients on dialysis often suffer from a lack of appetite plus olfactory and taste problems that contribute to lower dietary intake [5]. Multiple factors associated with CKD, such as retention of uraemic toxins, associated comorbidities (e.g. diabetes, osteoporosis, cardiovascular disease), complications (e.g. metabolic acidosis, excess glucocorticoid production, hypogonadism, inflammation and/or impaired insulin/insulin-like growth factor-1 signalling) and therapies (e.g. dialysis) have been shown to stimulate the loss of skeletal muscle mass [5, 8, 69]. Further, the requirements of HD therapy favour lower physical activity. It is important to note that the existing evidence, as stated above, is generally derived from younger patients on HD, and there is scarce or no information on whether these complications may exert similar, reduced or enhanced muscle catabolic effects or nutritional deficiencies in the older dialysis patient. We acknowledge that it is difficult to disentangle the separate contribution of age and CKD from the PEW burden of older patients on dialysis. An example of the problem comes from a recent National Health and Nutrition Examination Survey report [70] that found an almost linear crude association between the prevalence of low muscle mass and renal function in the community. This association, however, completely flattened when standardizing by age. It is possible that differences in the prevalence of muscle atrophy in this study might just reflect differences in the age distribution of patients with and without CKD [71].

NUTRITIONAL REQUIREMENTS FOR OLDER PEOPLE ON DIALYSIS: A NEED FOR SPECIFIC GUIDELINES?

Energy requirements

Energy requirements are believed to be lower in the older person (by ∼20%), in part due to the loss of LBM and lower physical activity [72]. Most renal nutrition guidelines do not differentiate the energy needs of older people. However, Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines state that patients who are <60 years of age should meet 35 kcal/kg/day, whereas for patients ≥60 years of age the recommended intake is reduced to 30 kcal/kg/day [73]. An interesting and laborious recent study provides evidence for these requirements in younger people [68]: 13 sedentary, clinically stable patients on HD received a constant energy intake while residing in a metabolic research ward for a mean of 92 days. The average dietary energy requirement of these patients was 31 ± 3 kcal/kg/day, with a high variability of 26–36 kcal/kg/day, calling for caution and careful monitoring of the nutritional status of individual patients on HD. It is tempting (yet unproven) to speculate that older patients on HD would demonstrate a lower dietary energy requirement.

Protein requirements

In a whole-body protein turnover study of healthy, older people, metabolic demands were reduced [74]. These reduced metabolic demands were related to lower rates of protein flux, synthesis and breakdown per kilogram of bodyweight, but not per kilogram of fat-free mass, and therefore were explained by changes in body composition associated with aging [75]. The amount of protein required to maximally stimulate muscle protein synthesis is higher in healthy older men compared with healthy younger men [76]. Because an imbalance between protein supply and protein need can result in a loss of skeletal muscle mass, older adults may need more dietary protein than younger adults [77, 78]. Recently, the European Society of Enteral and Parenteral Nutrition (ESPEN) endorsed an expert panel recommendation regarding protein intake for optimal muscle function with aging [79]: for healthy older adults, at least 1.0–1.2 g protein/kg body weight/day was recommended. For older adults who have acute or chronic illnesses, a higher protein intake threshold was suggested (1.2–1.5 g protein/kg body weight/day) to counteract disease-induced hypermetabolism.

Renal nutritional guidelines for dialysis do not differentiate with regard to age but do recommend a higher protein intake for all adults, ranging from 1.1 to 1.4 g/kg/day [73, 80–83] due to reported losses of amino acids into the dialysate [84] and the impact of metabolic acidosis and inflammation, all of which increase muscle protein breakdown in patients on dialysis [5].

Macro- and micronutrient requirements

With lower energy and protein intakes, the risk of specific nutrient deficiencies may appear. Calcium and vitamin D are the two most common nutritional deficiencies among older people, with subsequent bone resorption leading to a greater risk of falls and fractures [85–87]. Martins *et al.* [88] compared dietary intake among older patients on HD and age-matched people with normal renal function; except for protein and phosphorus, energy, macro- and micronutrient intakes of older patients on HD are similar to those of older people without CKD [88]. No differentiation is made in this regard in current renal nutrition guidelines.

In recent years there has been an emerging trend towards the study of dietary patterns rather than single nutrient or food group restrictions among people with CKD. In observational studies of individuals with CKD, adherence to a Mediterranean dietary pattern [89] or a prudent anti-inflammatory diet [90] has been consistently linked to better outcomes. At present, there is a scarcity of information with regard to dietary quality and outcomes in patients on HD.

Frequency and type of nutritional assessment

Despite the compounded nutritional risk factors (age and CKD), the frequency of nutritional assessment in dialysis is the same for adults of all ages in most guidelines or consensus documents [73, 80, 83, 91], with an exception [82] where monitoring of nutritional status is increased from every 6 to every 3 months in those ≥50 years of age. Current nutritional assessment is vastly compromised in older people on dialysis in relation to food-related social support and cognitive and functional performance measures [4, 83] that are included in geriatric screening tools [92, 93].

GERIATRIC DISORDERS: SARCOPOENIA AND FRAILTY IN CKD

Sarcopoenia and frailty are overlapping geriatric syndromes that arise from various interrelated causes and contributors linked to both aging and disease. Sarcopoenia is defined as a 'syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength' [94]. Frailty represents a syndrome resulting from cumulative deterioration in multiple physiological systems, leading to impaired homeostatic reserve and decreased capacity to withstand stress [95–97]. While the term sarcopoenia is confined to muscle-related disorders with aging, frailty encompasses other problems, such as exhaustion, low physical activity and weight loss [95]. Nutrition, from the perspective of unintentional weight loss, is a feature of frailty and can be involved in sarcopoenia by contributing to loss of muscle mass and/or strength. Both conditions benefit from the assessment of performance, as functional deficits may precede noticeable losses in muscle mass. Of available muscle function tests, grip strength and gait speed tests may be the easiest to implement clinically [98].

The prevalence of sarcopoenia in different populations, or within the same population [99–102], varies due to different cut-offs within the same measures proposed by different geriatric guidelines. The study by Lamarca *et al.* [103] from Brazil illustrates this issue, with sarcopoenia prevalence varying from 4 to 63% in older people on HD, depending on the definition adopted. In nephrology, studies often fail to distinguish between the older subsample and adults of all ages. A Swedish study reported a sarcopoenia prevalence of 20% among incident dialysis patients with a mean age of 53 ± 13 years [34]. In a slightly older HD sample from Korea (mean age 66 ± 10 years), the prevalence increased to 33.7% [104]. As a comparison, the prevalence of sarcopoenia in community-dwelling older people (mean age 73–77 years) ranges from 5 to 10.2% [105, 106]. Regarding frailty, two independent studies applying the Fried frailty phenotype to dialysis cohorts reported prevalences of 30 and 41.8% [107, 108]. Other studies utilizing different definitions and cut-offs have reported higher prevalence rates, ranging from 53 to 78% [109–111]. Collectively, there is evidence to support the hypothesis that sarcopoenia and frailty are common among (older) dialysis patients and that both entities are associated with poor patient outcomes [34, 112, 113]. Currently, there are no practical recommendations as to how to intervene in these problems in the CKD literature.

NUTRITION INTERVENTIONS FOR OLDER PEOPLE: WHAT CAN BE LEARNED FROM GERIATRICS?

Interventions tackling age-related causes

In the non-CKD elderly population, evidence has been mixed regarding the impact of nutritional interventions on improving muscle mass and performance due to the heterogeneous nature of the population studied, duration and type of intervention used and whether placebo controlled [114]. A Cochrane systematic review of participants ≥65 years of age receiving oral energy and protein supplementation found that there was an improvement in weight gain and arm muscle circumference, with a lower mortality, in those who were defined as undernourished [115]. A recent multicentre, randomized study on sarcopoenic older adults found that a multinutrient supplement improved appendicular muscle mass and chair-stand time compared with an isocaloric protein-free product [116]. The essential amino acid leucine is thought to directly stimulate muscle protein synthesis, but evidence has been mixed [117–119]. A high-protein β-hydroxy β-methylbutyrate–containing supplement in hospitalized malnourished older people significantly reduced 90-day post-discharge mortality [120]. Pulse feeding with protein may be useful in promoting muscle protein anabolism, with a net anabolic effect with 80% of the daily protein intake delivered in one meal (pulse) as opposed to spread over four meals [121, 122]. Considering the high prevalence of sarcopoenia in older patients on dialysis, exploration of these therapeutic interventions is warranted. To our knowledge, no specific protein or essential amino acid supplementation studies have been explored in patients on dialysis to promote muscle protein anabolism and physical function.

Interventions tackling psychosocial and medical causes

Socialization at meal times can help improve nutritional intake in older people (non-CKD), as was demonstrated in those needing home help who increased their intake during meals by 114 kcal when eating in the presence of others [123]. Eating while on HD has been shown to reduce protein degradation [124]; this could be a useful intervention in older people at risk of social isolation. Quality of life and nutritional status were improved in nursing home residents in a study comparing the impact of taking meals family style as opposed to individual pre-plated meals over 6 months [125]. Social support in nutrition-related interventions has yet to be explored in older people on dialysis.

Interventions tackling CKD causes

Most of the interventional nutritional studies performed in patients on dialysis have enrolled many older people, although they did not study this category of patients separately. Because loss of muscle mass, strength and performance are features of dialysis patients, the approach may benefit from focusing on identification of at-risk patients, regardless of age. For instance, Fouque *et al.* [126] showed that the addition to the diet of two servings per day of a renal-specific nutritional supplement facilitated meeting energy and protein requirements in patients on HD (mean age 71 years) with insufficient protein intake but no PEW at baseline. Studies involving intradialytic parenteral nutrition (IDPN) have recruited participants ≥65 years of age and showed benefits of IDPN compared with standard nutritional counselling in the short term [127] but no superiority in terms of mortality reduction when compared with oral nutrition support [128].

Conversely, it can be argued that certain interventions may not be equally suitable for the older patient. While the use of anabolic steroids such as testosterone in CKD patients has, so far, shown beneficial effects in increasing muscle mass, quality and function in younger patients on dialysis [129–131], its use in geriatric populations outside nephrology has not consistently been shown to improve walking distance, with the risks still being uncertain [132]. Exercise either in isolation or in combination with nutrition is feasible and can have a positive impact on nutritional status [133], physical function and quality of life [134], but the exercise demands must be lowered for an older patient and may be more difficult to implement. Finally, strategies including more dialysis time and frequency, or convective therapy, could possibly improve nutritional status and overall health [135–138].

Summary

Older people on dialysis are fighting features of PEW due to the physiology of aging, as well as life circumstances, all compounded by the acceleration of muscle protein wasting induced by their disease and dialytic therapy. Although multiple causative factors of PEW, sarcopoenia and frailty can be targeted, there are still a number of unanswered questions in relation to energy and protein requirements as well as nutritional assessment in older dialysis patients. As this segment of the dialysis population is growing continuously, we recommend the need to put future research focus on these aspects. Information regarding nutritional interventions in older people on dialysis is limited, however, research in the non-CKD elderly population is gathering momentum. Much can be learned from the field of geriatrics, and interdisciplinary approaches between renal and geriatric clinicians should be encouraged to ensure better quality of life and outcomes for the older dialysis patient.

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CONFLICT OF INTEREST STATEMENT

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