REVIEW ARTICLE

A Review of Dietary Intake Studies in Maintenance Dialysis Patients

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Protein-energy wasting affects many maintenance dialysis patients (MDPs) and decreases survival. Suboptimal dietary energy intake (DEI) and dietary protein intake (DPI), secondary to reduced dietary intake (DI), are important risk factors in the development of protein-energy wasting. Multiple investigations of DEI and DPI in MDPs have occurred but few authors have synthesized these data. A comprehensive review of DI studies in MDPs was completed with the purpose of providing timely data on DI in MDPs until updated clinical practice guidelines for nutrition in nephrology care are published. A majority of DI investigations in MDPs confirm that DEI and DPI are below current nutrition guidelines. MDPs also have significantly lower DEI and DPI when compared with healthy controls. These findings inform the direction of further guidelines for nutrition in nephrology care as well as spark future research interests.

Introduction

ACCORDING TO THE latest United States Renal Data System statistics, 430,273 patients with chronic kidney disease (CKD) stage 5 are on maintenance dialysis in the United States.[1] Despite many advances in the treatment of maintenance dialysis patients (MDPs), many still succumb to protein-energy wasting (PEW).[2–6] PEW in MDPs is a complex state which incorporates disorders in metabolism, malnutrition, inflammation, and wasting.[7]

Large epidemiologic studies have clearly demonstrated a significant relationship between PEW and mortality in CKD patients. The Netherlands Cooperative Study on the Adequacy of Dialysis-II and the Dialysis Outcomes and Practice Patterns Study revealed that patients who were considered malnourished had a higher risk of mortality than those considered to have normal nutritional status.[8,9]

Although not seen as the sole etiologic factor for PEW, decreased dietary protein intake (DPI) and dietary energy intake (DEI), often due to a loss of appetite, are common in MDPs and are associated with increased morbidity and mortality.[2,4,5] The inflammation present in PEW can lead to a loss of appetite with many MDPs having elevated levels of proinflammatory cytokines, known to play a role in appetite regulation, dietary intake (DI), and energy balance.[7,10–12] Authors have found a significant association between decreased appetite, inflammation, and higher risk of morbidity and mortality.[13,14]

Evidence-based clinical practice guidelines for nutrition in nephrology care have been developed to provide recommendations for DPI and DEI in MDPs. The National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) Clinical Practice Guidelines on Nutrition and Chronic Renal Failure recommend that hemodialysis (HD) patients consume a DPI of 1.2 g/kg/day, of which at least 50% is of high biological value, and peritoneal dialysis (PD) patients, 1.2 to 1.3 g/kg/day, of which at least 50% is of high biological value. The recommended DEI for MDPs is 35 kcal/kg/day for those who are aged less than 60 years and 30 to 35 kcal/kg/day for those 60 years or older.[15] The European Best Practice Guidelines (EBPGs) on hemodialysis guideline on nutrition recommends a DPI of at least 1.1 g/kg of ideal body weight (IBW) per day and a DEI of 30 to 40 kcal/kg of IBW per day.[16] These guidelines provide a framework with which patients can be assessed and in turn educated on the optimal DI to meet their special nutritional needs with the intent of decreasing PEW, improving quality of life, and decreasing morbidity and mortality.[15]

Tools have been used to explore DI in MDPs, and these include food frequency questionnaires (FFQs), food diaries or records, and diet recalls.[17] Many variations of FFQs have been used by researchers[18–21]; more recently, a dialysis-specific FFQ has been created.[22] Food diaries are commonly used to assess DEI and DPI in MDPs. Researchers have determined that 7 days of data are required to reliably estimate DPI and of 5 days to reliably estimate DEI.[23]

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A review of the literature on DI in MDPs is indicated and timely. KDOQI Guidelines on Nutrition in Chronic Renal Failure are more than 14 years old. Studies exploring DI in MDPs have compared DEI and DPI of MDPs to healthy controls and to clinical practice nutrition guidelines. Summarizing these findings and looking at implications on patient outcomes and clinical practice from this body of work should help target future guidelines for nutrition in nephrology care and stimulate research.

DI Studies in MDPs

To explore the DPI and DEI of MDPs, a comprehensive review was undertaken using the databases Agricola, CINAHL, Nutrition Abstracts and Reviews, PubMed, and Web of Science from 1984 to 2014 using the search terms "[diet] AND [intake] AND [dialysis]." The inclusion criteria were human adult studies of HD or PD patients in the English language with direct assessment of DEI and DPI. Studies were excluded if they were not published in English, did not study MDPs, did not use direct assessment methods such as diet records, FFQs, or food recalls to assess DI, or if DEI and DPI were not assessed. The initial search yielded 2,374 articles, of which 29 were included in this review. Table 1 lists DI studies in MDPs.[22-50]

Association Between DI and Mortality

Antunes et al.[24] studied 79 adult patients on HD and PD with a follow-up period of 38 months. All participants had to complete a 3-day food recall to capture DEI and DPI. Energy intake from PD dialysate was factored into the total energy intake for the day. By the end of the study, 29.1% (n = 23) of patients had died. DEI was significantly lower in non-survivors than survivors ($P = .008$). DPI of ≥1.2 g/kg/day was associated with increased patient survival, and DPI of less than 1.2 g/kg/day was a predictor of mortality in both HD and PD patients.[24]

Similarly, a study by Araújo et al.[25] explored the association between nutritional markers and mortality in 344 incident HD patients. All patients completed a 3-day food diary which included 1 dialysis day and 2 non-dialysis days from which DEI and DPI data were gathered. Results demonstrated that DEI and DPI were below KDOQI recommendations. Researchers then compared survivors with non-survivors in this cohort and found that non-survivors had significantly lower weight-adjusted DEI (23.5 ± 7.4 kcal/kg/day in non-survivors vs. 27.4 ± 8.9 kcal/kg/day in survivors; $P < .001$). Similar results were found for DPI (0.92 ± 0.34 g/kg/day in non-survivors vs. 1.01 ± 0.38 g/kg/day in survivors; $P = .02$). The authors concluded that nutritional status was an important predictor of death among incident HD patients.[25]

Challenges of DI Studies

Numerous factors can make studying DI in MDPs difficult. Many of the studies are small owing to the challenge of gathering direct DI data in this setting.[4] Normalized protein catabolic rate is often used to bypass the need for DI data.[17] Under-reporting of DEI, although not exclusive to MDPs, has been demonstrated through investigations looking at self-reported DEI compared with the doubly labeled water technique.[51]

Gender-specific studies make comparison with those that include both men and women problematic, and dialysis modality may also affect research results. A study exploring factors affecting DEI and DPI in older adults on HD and PD found no significant differences in DEI based on dialysis modality.[26] Similar results were obtained when the DEI and DPI of women on HD and PD were compared.[27] On the other hand, Harvinder et al.[29] found that HD patients consumed significantly more protein than PD patients (1.07 ± 0.47 g/kg/day vs. 0.82 ± 0.37 g/kg/day; $P < .001$), but no significant differences were observed in DEI between HD and PD patients. It is worth noting that the addition of PD dialysate calories can impact DEI results. Although Harvinder et al.[29] added PD dialysate calories to DEI totals, other authors do not report PD dialysate calories in their analysis of DEI.[26,27]

Adding to the confusion is the estimation of body weight in MDPs, which is key to estimating nutrient needs. It is clear that each DI study uses its own interpretation of body weight, which confounds comparison.[52] These differences in methodology make it hard to generalize findings; however, studies in both HD and PD patients show low DEI and DPI.

DI Studies in PD Patients

Akbulut et al.[30] explored DEI and DPI of 28 PD patients and reported a baseline DEI of 22.35 kcal/kg/day and DPI of 0.85 ± 0.27 g/kg/day. Wang et al.[31] found similar results in a study of 249 PD patients with a DEI of 24.7 ± 8.7 kcal/kg/day (not including PD dialysate) and DPI of 1.10 ± 0.45 g/kg/day. In 2003, Wang et al.,[32] in a cross-sectional study of 266 PD patients, found a DEI of 25.1 kcal/kg/day and DPI of 1.11 ± 0.45 g/kg/day. After adding PD dialysate, energy consumed reached 28.9 kcal/kg/day. These studies clearly demonstrate that PD patients are unable to meet current recommendations for DPI and DEI and even with the addition of PD dialysate calories; levels still fall short of recommendations, which may in turn increase their risk of PEW and ultimately mortality.

DI Studies in HD Patients

Explorations of DEI and DPI in HD patients show similar results. Burrowes et al.[33] investigated the DI of 1,901 patients from the HEMO study and obtained a DEI of 22.7 ± 8.3 kcal/kg/day and DPI of 0.93 ± 0.35 g/kg/day as did Rocco et al.[34] with a DEI of 22.9 ± 8.4 kcal/kg/day and DPI of 0.93 ± 0.36 g/kg/day. Other investigations of DI in MDPs yielded slightly higher results but featured smaller sample sizes. Kalantar-Zadeh et al.[35] examined the DI of 30 HD patients with outcomes of 26.4 ± 15.3 kcal/kg/day for DEI and a DPI of 0.88 ± 0.57 g/kg/day. Lorenzo