

Effect of the Dietary Protein Intake on Urea Reduction Rate in Patients on Maintenance Hemodialysis in Merjan Teaching Hospital

Khalid H. Al-Shibly, Jawad K. Al-Diwan¹

Merjan Teaching Hospital, Babil Health Directorate, Babylon, ¹Baghdad Medical College, University of Baghdad, Baghdad, Iraq

Abstract

Background: Chronic kidney disease (CKD) constitutes a major health problem worldwide. The mainstay of nutritional treatment in patients undergoing maintenance hemodialysis is the provision of an adequate amount of protein and energy. **Objective:** The present study aims to assess the correlation of protein consumption with dialysis adequacy in patients on hemodialysis. **Materials and Methods:** A cross-sectional study was conducted at the Dialysis Unit of Merjan Hospitals, Babil Governorate, Iraq on 64 hemodialysis patients from April to August 2021. The tools used for the data collection were anthropometry, medical information, and 24-h dietary recalls. A descriptive analysis was performed. **Results:** The food intake was evaluated and compared with the recommended intake. The patients' average energy intake was 18.7 ± 7.2 kcal/kg/day, which represents 53.4% of the recommended daily energy intake for dialysis patients. About 75% of the consumed energy was provided by carbohydrates, 12.2% was provided by fats, and the rest 14.6 was provided by protein. The average dietary intake of protein was 0.71 ± 0.29 g/kg/day. Only 7.8% of the patients had met the Recommended Dietary Allowance (RDA) of protein intake. In the study sample, the measures of the delivered dose of hemodialysis therapy are directly correlated to the amount of consumed protein per kilogram body weight. But this correlation is only significant for patients who consume 1.2 g/kg body weight or less. **Conclusion:** The energy and protein intake were significantly low when compared with specific recommendations for individuals in hemodialysis; a dietician has an important role in providing nutritional education to the patients to improve the nutrient intake.

Keywords: Dietary protein, hemodialysis, urea reduction

INTRODUCTION

Chronic kidney disease (CKD) is defined as evidence of structural or functional renal impairment for 3 or more months with adverse implications for health. It is generally progressive, irreversible, and affecting multiple metabolic pathways. CKD is classified into five stages based on the severity of reduced kidney function as measured by the glomerular filtration rate (GFR) and the severity of albuminuria. In young healthy adults, the normal GFR is approximately 125 mL/min/1.73 m², thus kidney disease improving global outcome (KDIGO) is defined a GFR of less than 60 mL/min/1.73 m² as indicating reduced kidney function.^[1]

"Recommended Dietary Allowance" (RDA) of protein intake for a healthy adult in a stable nonpregnant,

nonlactating, and nonrecovery condition is 0.8 g/kg/day as suggested by the USA Food and Nutrition Board of the National Academy of Sciences.^[2] It is recommended that more than 50% of the protein intake should be of a high biologic value, which supplies the essential amino acids, such as proteins in eggs, fish, poultry, meat, and dairy products.

Numerous clinical trials and observational studies^[3-5] have investigated the effectiveness of lowering dietary

Address for correspondence: Dr. Khalid H. Al-Shibly, Merjan Teaching Hospital, Babil Health Directorate, Babylon, Iraq. E-mail: khalid_shibly@yahoo.com

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protein intake (DPI) in preventing the natural progression of CKD toward end stage renal disease (ESRD) and in delaying the need for commencing dialysis treatment. These studies ultimately mentored a protein intake of as low as 0.5–0.6 g/kg/day or even very low (0.3–0.4 g/kg/day) of high biologic-value protein aiming to reduce the rate at which GFR deteriorates and to alleviate some of the complications of advanced CKD including metabolic acidosis, bone disease, and uremic symptoms and thus delay the onset of ESRD, which leads to a significant reduction in the quality of life.

Nevertheless, the evidence of a beneficial effect of dietary protein restriction in a patient with CKD remains controversial. The KDIGOs^[1] suggested restricting a daily protein to 0.8 g/kg in adults with GFR <30 mL/min/1.73 m². Still KDIGO concluded that DPI < 0.8 g/kg/day did not offer any advantage over 0.8 g/kg/day as this nutritional scarcity may depict a direct risk for protein malnutrition that can promote kidney disease progression and increase morbidity and mortality.^[6]

In reciprocity, a higher protein intake (1.2 g/kg/day) is recommended for patients on stable maintenance hemodialysis (HD)^[7] as dialysis may stimulate whole-body degradation of protein including muscle protein in addition to other pathologies including altered protein and energy homeostasis, abnormal protein catabolism, acid-base derangements, and eventually, hormonal dysfunction ensue.^[8,9]

MATERIALS AND METHODS

This was a cross-sectional study conducted on 64 HD patients at the Dialysis Center of Merjan Teaching Hospital in Babil Governorate, Iraq from April to August 2021. The survey was done using a questionnaire that included demographic information, anthropometric measurements, medical information, and 24-h dietary recall of a nondialysis day, and biochemical parameters.

The inclusion criteria of the patients include ESRD patients who are willing to participate in the study. All ESRD patients of age group between 20 and 75 years of both genders who are undergoing HD regularly for more than 3 months and visiting the HD center in Merjan Teaching Hospital according to a prearranged agenda are invited to participate in this study.

The exclusion criteria include patients of age less than 20 and more than 75 years of both sexes, patients who were not willing to participate in the study, and patients with acute inflammatory illnesses such as AIDS, hepatitis B, hepatitis C, and malignancy. Prior permission was taken from the health authorities and the administrator of the hospital after which data collection was started.

Participation in the study was voluntary; the study protocol was explained to participants and a written consent form was signed by each participant.

After obtaining written consent, a history regarding the demographic data, duration of the disease, associated clinical features, and 24-h dietary recall were obtained. The data were collected by an interview method. The interview was done before the dialysis session in a suitable room.

Anthropometric measurements such as height, weight before, and after dialysis were obtained by the researcher using the same instrument to minimize the biases and used to calculate the body mass index (BMI). The medical history about the ESRD such as the duration of the disease, etiology of the ESRD, duration of HD, and the number of dialysis sessions per week was obtained from either the hospital records, through an interview with the patient, or from the doctor responsible.

Biochemical parameter regarding blood urea before and after dialysis of the interviewing day was recorded from patients' medical reports. All investigations were collected and analyzed at the laboratory of the center as a part of the routine checking of every patient to determine the serum levels of blood urea.

The reduction in urea as a result of HD or the urea reduction ratio (URR) was expressed as a percentage. The URR parameter was calculated by the following equation: (predialysis blood urea nitrogen (BUN)–postdialysis BUN)/predialysis BUN.^[10,11] The second measure of the adequacy of HD is Kt/V (where K is the amount of urea clearance, t represents the duration of treatment, and V is the volume of urea distribution).

This parameter was calculated using the Daugirdas formula, $Kt/V = -\ln(R-0.03) + [(4-3.5R) \times (UF/W)]$, where UF is the ultrafiltration volume in liters, W is the postdialysis weight in kilograms, and R is the ratio of the postdialysis to predialysis BUN.^[12,13]

The basal metabolic rate (BMR) was calculated using Harris Benedict's equation,^[14] which provides an acceptable predictor of basal metabolism among chronic kidney patients.

For the dietary assessment, each patient was interviewed about his daily consumption of different foods using the 24-h recall method by using a standard and familiar sized utensil. The portion size determination of the consumed food, conversion of this amount into servings, and the macronutrients calculation were carried out using the Finnish national dietary survey in adults and the elderly (FinDiet 2017).^[15]

Statistical analysis

The data were double-entered and checked for consistency and analyzed using version 25 of Statistical Package for the Social Sciences (SPSS). A descriptive analysis was carried out in which the categorical variables were expressed as frequencies and percentages and the continuous variables as averages and standard deviation or means and median,

with a confidence interval of 95%. A *P* value of <0.05 was considered statistically significant.

Ethical consideration

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number 364 on April 22, 2021.

RESULTS

Sixty-four patients were enrolled in this study, 60% of whom were males. The patients' mean age was 50.5 ± 15.0 years, and the median time on HD was 24 months. The vast majority of the males in the study group have no job or retired, whereas most of the female participants are housewives [Table 1].

The average BMI of the study population was below the recommended 23 kg/m^2 that is recommended for individuals undergoing HD, and expectedly all the participants were anemic.

The duration of the ESRD was widely variable, and ultimately, the period of HD was quite mutable but the number of HD sessions was 2–3 per week. Hypertensive nephropathy was the main cause of CKD in half of the patients, whereas type 2 diabetes mellitus was the

underlying cause of ESRD in 42%. The median for predialysis and postdialysis blood urea were 25.5 and 8.5 mg/dL, respectively. Accordingly, the recommended urea reduction rate of more than 65% and Kt/V ratio greater than 1.2 were not met in half of the patients.

The patients' average energy intake was 18.7 kcal/kg/day, which represents 53.4% of the recommended daily energy intake for dialysis patients of 35 kcal/kg body weight per day. More than 60% of our patients consumed less than 20 kcal/kg/day, and only two patients (3%) consumed more than 35 kcal/kg/day [Figure 1].

The protein intake was 0.71 g/kg/day, 73.4% of the energy was provided by carbohydrates, 12.2% was provided by fats, and the rest 14.6 was provided by protein.

Only two patients have consumed calories that reached the calculated total energy expenditure. Furthermore, the dietary energy that was registered by about 20% of our patients has not reached their basal metabolic rate.

Additionally, the calories from protein were less than 15% of the total consumed energy by about half of the patients, while more than 85% of our participants consuming less than 1 g protein per kilogram body weight [Figure 2].

The protein consumed by our patients or the grams of protein ingested per kilogram body weight in this study showed no correlation with variables such as age, sex, occupation, educational level, BMI, or the duration of the disease since the first diagnosis of the ESRD, whereas a weak significant correlation has been demonstrated for the consumed protein by the participants with their activity factor.

In the study sample, the measures of the delivered dose of HD therapy (i.e., Kt/V and the urea reduction rate) are directly correlated to the amount of consumed protein per kilogram body weight, but this correlation is only significant for patients who consume 1.2 g/kg body weight or less [Table 2].

DISCUSSION

Although nutritional requirements of HD patients are high, the nutritional intake by those patients is overwhelmingly insufficient. This explains why HD patients often face the risk of malnutrition, which was concluded by several studies that point to a lack of intake of energy and proteins in HD patients.^[16,17]

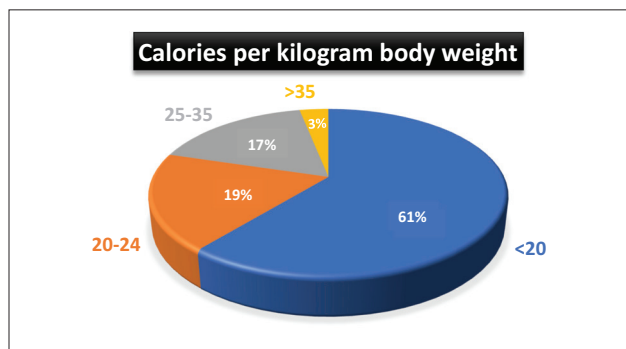
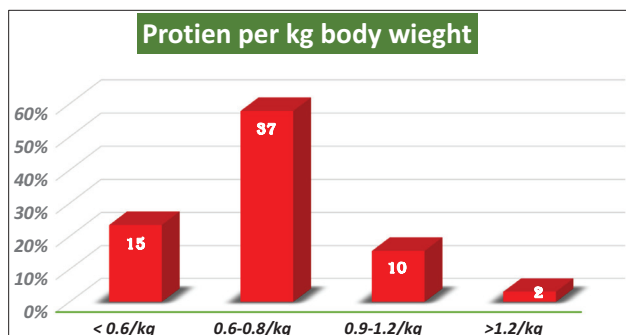
In such individuals as with all chronic disease states, decreased DPI, which may be caused by anorexia as a result of inflammation, can be associated with poor survival. Several studies showing a correlation between high protein intake and better outcomes in dialysis patients, whereas a low DPI, as well as biochemical evidence for protein malnutrition, are associated with significantly higher mortality and morbidity.^[18,19]

Table 1: Characteristics of the study sample, *n* = 64

		Frequency	%
Age (years)	<35	9	14.1
	35–60	37	57.8
	>60	18	28.1
Sex	Male	38	59.4
	Female	26	40.6
Body mass index	<18.5	3	4.7
	18.5–23	27	42.2
	23–25	15	23.4
	25–30	18	28.1
	>30	1	1.6
Occupation	No job	34	53.1
	Housewife	14	21.9
	Business	2	3.1
	Clerk	2	3.1
	Retired	12	18.8
Marital status	Single	9	14.1
	Married	55	85.9
Residence	Urban	33	51.6
	Rural	31	48.4
Educational level	Illiterate	6	9.4
	Primary	39	60.9
	Secondary	18	28.1
	Higher education	1	1.6

Table 2: Correlation of the dialysis dose with the consumed protein in the study HD patients, $n = 64$

		Protein per kilogram weight (g/kg)			P value
		<0.6	0.6–0.8	0.9–1.2	
Urea reduction rate	<65%	3	15	7	<0.05
	65%–76%	12	21	1	
	>76%	0	1	0	
Kt/V ratio	<1.2	3	16	6	<0.05
	1.2–1.5	12	20	2	
	>1.5	0	1	0	

**Figure 1:** Consumed calories by the study patients per kilogram body weight, $n = 64$ **Figure 2:** Consumed grams of protein by the study patients per kilogram body weight, $n = 64$

The current national guidelines recommend a DPI of 0.8 g/kg/day in the general population and 0.66 g/kg/day for adults who have CKD, whereas the estimated average daily requirement of protein for patients on HD is 1.2 g/kg/day to ensure neutral or positive nitrogen balance. Half of the protein should consist of “high biologic value” and the other half may be plant proteins, “low biologic value.”^[20] Yet, in patients with chronic HD, an increased DPI may lead to hyperphosphatemia or the need for phosphate binders. As a result, the aim to be achieved in the nutrition of dialysis patients is to provide the necessary intake of dietary protein but to limit the intake of phosphorus without changing nutritional habits and lifestyle.^[11]

Consistent with the findings of this study, virtually every study examining the nutritional status of HD patients indicates that such patients frequently manifest

protein-calorie malnutrition.^[9] However, the estimation of protein intake from 24-h dietary recall is limited by reliance on memory and that the responses may be less accurate or unrepresentative of typical intakes. Yet, the 24-h dietary recall method is a widely used approach to collect dietary information because it is simple, imposes a little burden on the respondents, and does not require high literacy in respondents.

The median age of dialysis patients (50 years) in the present study was substantially lower than that reported in developed countries including the United Kingdom, where the majority of patients is in their sixth to seventh decade.^[21] The lack of CKD awareness, delayed diagnosis, and the management of CKD and/or etiological chronic conditions such as diabetes and hypertension play a significant role in the rapid progression of CKD to ESRD in developing countries.^[22] Though, age or gender differences in food intake among the participated patient were not evident apart from the apparent low consumption of high-fat meat among patients above 60 years. Likewise, a patient's characteristics such as educational level, residence, marital status, or occupation have not explicit any correlation with their dietary scheme.

Concerning physical activity, our patients adopt a sedentary lifestyle and spend less time being physically active than healthy adults. Nearly 70% of the participants have little or no activity. This standard is far away from the physical activity guidelines for Americans, which recommended that HD patients should perform at least 150–300 min per week of moderate-intensity aerobic exercise, 75–150 min of vigorous-intensity aerobic exercise per week, or an equivalent combination of both.^[23] An analogous picture has been shown in a US study, in which almost 50% of coronary heart disease patients perform exercise once or less than once per week.^[24] Thus, in addition to the nutritional support, and to maximize its impact, HD patients should be encouraged to increase their physical activity levels as regular physical activity can positively affect the nutritional status and the perception of the well-being of CKD patients and may facilitate the anabolic effects of nutritional interventions.

The recommended daily energy intake for maintenance HD patients is 35 kcal/kg body weight/day for those who are

less than 60 years of age and 30–35 kcal/kg for individuals 60 years of age or older.^[18] In this cross-sectional study, calorie ingestion fell behind the recommendations, and the patients' average energy intake was 18.7 kcal/kg/day. More than 60% of our patients consumed less than 20 kcal/kg/day and only two patients (3%) consumed more than 35 kcal/kg/day. This is of concern as inadequate energy may reduce the benefit of protein by catabolizing it for energy.

This standard of low daily calories is the reason behind the fact that the patients in our study had comparatively diminished body weights, with a low-normal BMI of $23.1 \pm 3.0 \text{ kg/m}^2$.

Moreover, the protein intake was also inadequate as only 7.8% of our patients are eating more than 1.1 g of protein/kg/day. Protein sources were mainly fish and chicken (reported by more than 65% of respondents) though consumed in small quantities. On average, they were consumed once a day and derived from medium and high fat meat.

Similarly, the consumption of milk and derivatives by our participants was found to be very low. Less than 10% of the patients' registered milk consumption in the 24-h recall, all of them had only one serving daily. This is below the recommended intake of at least three servings each day.^[18] Consequently, the majority of participants did not meet their daily total protein intake recommendation of $\geq 1.1 \text{ g/kg body weight/day}$.^[18]

As regard dialysis adequacy, results of this study revealed that about 39% of the study population had $\text{Kt/V} < 1.2$ and a $\text{URR} < 65\%$, indicating that patients were receiving an inadequate dose. This result is superior to the findings of similar studies carried out in other developing countries such as Brazil, Nigeria, Nepal, Pakistan, and Iran (about 55%–65% of patients had a $\text{Kt/V} < 1.2$).^[25] but it is quite lower than studies from developed countries such as the United States as over 90% of the patients had a $\text{Kt/V} > 1.2$.^[26]

Although multiple variables may influence the delivery of an adequate dialysis dose, factors such as the duration of dialysis treatment and the type and size of the dialyzer membrane used during the treatment are the same for all the patients as they served the HD sessions in similar HD machines in a single center. Yet, personal characteristics such as age proved a significant statistical correlation as patients older than 60 years in this study manifested better dialysis adequacy but no difference in the dialysis dose between the males and the females. These findings are contradicted by Teixeira Nunes *et al.* study,^[27] which found a better HD adequacy in younger patients and a higher dialysis dose in females.

In the study sample, the measures of the delivered dose of HD therapy (Kt/V and URR) are directly correlated to the amount of consumed protein per kilogram body

weight. But this correlation is only significant for patients who consume 1.2 g/kg body weight or less. Furthermore, each of the plant or the animal protein separately failed to manifest a significant correlation with Kt/V and URR . These results are in line with recent studies like that of Sohrabi *et al.*^[28] and Afaghi *et al.*^[29] and with older studies such as Miguelsanz *et al.*^[30] and Singri *et al.*^[31] studies.

CONCLUSIONS

The analysis of dietary patterns among the patients in this study implies the necessity for several changes including increasing the consumption of protein and calories among the patients on HD. Thus, the assessment of quality and quantity of food intake are crucial steps in the management of HD patients.

To increase protein intake, the consumption of a daily portion of meat with a lower phosphorus/protein ratio and egg is recommended for a healthy diet, since these foods provide proteins with high biological values. Likewise, it is advised to improve calorie intake in the hemodialyzed patient by increasing the consumption of complex carbohydrates, with an emphasis on cereals and whole foods and a reduction in simple carbohydrates.

Nevertheless, it is of paramount importance that tailored nutrition education is provided to patients with renal failure, which recognizes their nutritional needs, personal characteristics, and disease status.

Study limitations

The limitation of the study is that it was done in a single center.

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Conflicts of interest statement

There are no conflicts of interest.

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