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Research Article

Characterization of Anthropometric Profile and Associations between Energy, Protein and Phosphorus of Patients with Chronic Renal Disease on Hemodialysis Therapy

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Abstract

The role of nutrition becomes essential so that there are no implications for patients with Chronic Kidney Disease (CKD). It is necessary to prevent or control possible complications so that they do not affect the nutritional status of patients. This study aimed to characterize the anthropometric profile and analyze possible associations between energy, protein and phosphorus in patients undergoing hemodialysis. An observational, cross-sectional study was carried out in a private clinic in Natal/RN. Anthropometric and 24 h recall data were collected. Energy and phosphorus intake were below the K/DOQI recommendations, and protein was above. There was a positive correlation between the variables. It was seen that the adequacy of these nutrients in the diet is of great importance, as it helps to control complications in CKD. Thus, it is necessary to have dietary advice and the adequacy of these nutrients, so that patients become aware of its importance for the effectiveness of the treatment.

Keywords: Chronic kidney disease; Hemodialysis therapy; Nutrition; Anthropometric profile

Introduction

Chronic Kidney Disease (CKD) is defined as a syndrome that is characterized by a slow, progressive and irreversible loss of kidney function. It is classified using categories of the Glomerular Filtration Rate (GFR) [1]. Decline in renal function is due to renal parenchymal injury and/or reduction in GFR to a level below 60 mL/min/1.73 m^2 for a period equal to or greater than 3 months [2,3].

The main factors for development of CDK are diabetes mellitus, arterial hypertension, aging and family history of CKD. Presently, the most frequent cause is diabetic nephropathy, followed by arterial hypertension and chronic glomerulonephritis. The mortality rate in these individuals is high, with cardiovascular disease being the main cause of death [4].

CKD occurs worldwide, given that the number of individuals affected is growing more and more in developing countries [1]. The main complications of this pathology are systemic arterial hypertension, anemia, bone diseases, impaired reproductive function and decreased quality of life [5].

Treatment of CKD consists of conservative care, which is also known as palliative or non-dialytic care, or renal replacement therapies, in the form of hemodialysis, peritoneal dialysis or kidney transplantation.

Hemodialysis is the most used method for treatment of CKD and consists in removing fluids, metabolites, as well as other substances toxic to the body, when the kidney is unable to perform this function [6,7].

In patients undergoing hemodialysis, assessment of nutritional status is crucial. Body Mass Index (BMI) is one of the most used anthropometric methods. However, in renal patients, the values indicated by the BMI may be distorted in the presence of fluid retention [8].

Nutritional monitoring is indispensable for patients on hemodialysis, as it helps to control and prevent complications of CKD.

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During hemodialysis, there are significant losses of nutrients, which may lead to Protein-Energy Malnutrition (PEM); thus, these patients need adequate calorie and protein intake because PEM is associated with higher rates of morbidity and mortality [9,10].

While protein requirement is increased to prevent malnutrition, it hinders the supply of adequate phosphorus levels, a fact that contributes to the emergence of hyperphosphatemia, which can lead to some associated pathologies such as vascular calcifications, osteoarthritis, secondary hyperparathyroidism, osteomalacia and hypercalcemia [11].

In this context, the present study can provide further insights into the possible association between energy, protein and phosphorus to assist in the treatment of CKD and prevent possible implications.

Therefore, the aim of the present study was to evaluate the characterization of the anthropometric profile and to analyze possible associations between energy, protein and phosphorus in patients with chronic kidney disease undergoing hemodialysis.

Methods

Type of research

This is an observational, cross-sectional study carried out in a private clinic located in the city of Natal, Rio Grande do Norte state, Brazil.

Universe and sample

After approval by the Research Ethics Committee, 40 patients with Chronic Kidney Disease undergoing hemodialysis were analyzed. These were the inclusion criteria: patients over 18 years of age with CKD undergoing hemodialysis, without clinical complications or treatment interruption, and able to communicate and answer the questions they were asked.

Patients were excluded if they had visual or neurological problems that made it impossible for them to answer the questionnaires, of if they were wheelchair users or patients on stretchers. The patients who agreed to participate in the research signed an Informed Consent Form (ICF) (Appendix A).

Data collection instrument and technique

Anthropometric assessment: A form (Appendix B) was used to collect data on nutritional (anthropometric and dietary) profile, in the same room where hemodialysis sessions are held. The anthropometric assessment was performed after the hemodialysis session to collect information on weight and height for calculation of the Body Mass Index (BMI).

The patients were weighed on a Toledo digital scale® with 200 kg maximum weight capacity, while wearing minimal clothing and no shoes. Height was measured using a stadiometer (attached to the scale). The patients were placed in an upright position with their arms to the side, placed slightly apart from the body, with their back against the wall and their head in the Frankfurt plane. Data on weight and height were used for calculation of BMI, which was defined according to the World Health Organization (WHO, 1995 and 1997).

Dietary assessment: Dietary profile was assessed with the 24 h dietary recall method. The interviewees were asked to verbally describe all of their food and drink intake in the previous 24 h. Food was recorded in household measures and portions and then converted into grams for nutrient analysis. Next, the data were entered into a Microsoft Excel spreadsheet designed for dietary assessment.

Data were collected regarding the intake of total calories, proteins (total protein and protein percentage in the Total Caloric Value (TCV)) and phosphorus. For conversion of calories and grams of protein into kcal/kg/day and g/kg/day, respectively, the amounts of food eaten were divided by mean body weight.

Intake of calories, proteins and phosphorus was compared to the recommendations of the Kidney Disease Outcomes Quality Initiative (K/DOQI), which establish amounts for daily intake of various nutrients by patients undergoing hemodialysis: 35 kcal/kg, 1.2 g ptn/kg and 800 mg to 1000 mg respectively.

Statistical analysis: In the statistical analysis, the data were analyzed using the software PRISMA, 2017, version 7.0 for Macbook. A descriptive analysis was made of the general characteristics of the study population (sex, age, weight, height, BMI) and dietary parameters (intake of energy, protein and phosphorus), and the data were presented as means and standard deviations (M ± SD). The r-Pearson correlation test was performed between the variables: total calories, calories per kg/day, total proteins, proteins in grams per kg/day and phosphorus. Statistical significance was defined as $p<0.05$.

Results

In the present study, 40 patients with Chronic Kidney Disease undergoing dialysis were evaluated: 16 men and 24 women, with a mean age of 49.7 ± 14.2 years.

Table 1 shows their anthropometric profile, with mean weight, height and BMI of 63.43 kg ± 12.76 kg, 1.59 m ± 0.086 m, 23.57 kg/m² ± 7.48 kg/m², respectively. Mean BMI was within the reference range (18.5 kg/m² to 24.9 kg/m²), according to the WHO, 1995 and 1997.

Food intake, which was assessed using the 24 h recall, was compared to the reference value, as recommended by K/DOQI (Table 2). Energy intake is below the recommended level and phosphorus intake is slightly below, with values of 27.98 kcal/kg/day ± 10.59 kcal/kg/day and 783.9 mg/day ± 233.2 mg/day, respectively. Protein intake was above the reference value, with mean and standard deviation of 1.3 g/kg/day ± 0.54 g/kg/day.

Table 3 shows the results of Pearson's r correlation coefficients for the 24 h recall variables relative to intake of energy, protein and phosphorus in the diet of patients on hemodialysis. There was a strong correlation between intake of energy (kcal and kcal/kg) with that of protein (g and g/kg) and phosphorus (mg) (Figure 1). However, there was a low negative correlation between energy (kcal and kcal/kg) and protein percentage in TCV.

Figure 2 shows that phosphorus showed a low correlation with protein intake (g/kg), indicating 0.419 (p-value <0.0072), hence the higher the intake of protein, the higher the values of phosphorus.

Discussion

CKD patients experience changes in nutritional status. Nutritional status and dietary pattern in hemodialysis patients are affected by

Table 1: Anthropometric parameters of patients with CKD undergoing hemodialysis in a hemodialysis clinic in Natal (RN).

Parameters	Mean ± Standard Deviation	Reference Value
Weight (kg)	63.43 ± 12.76	-
Height (m)	1.59 ± 0.086	-
BMI (Kg/m²)	23.57 ± 7.48	18.5 kg/m² to 24.9 kg/m²*

*WHO, 1995 and 1997

Table 2: Dietary intake of patients with CKD undergoing hemodialysis in a hemodialysis clinic in Natal/RN.

Variables	Mean ± Standard Deviation	Reference Value*
Energy (kcal/kg/day)	27.98 ± 10.59	35 kcal/kg/day
Protein (g/kg/day)	1.3 ± 0.54	1.2 kcal/kg/day
Phosphorus (mg/day)	783.9 ± 233.2	800 mg/day to 1000 mg/day

*K/DOQI

Table 3: Pearson's correlation coefficient (r) between variables relative to intake of energy, protein and phosphorus of the 24 h recall.

Protein	Energy (kcal)	Energy (kcal/kg)
G	0.678	0.534
g/kg	0.657	0.728
% VCT	-0.345	-0.265
Phosphorus	0.678	0.59

some factors inherent in CKD, such as insufficient food intake, increased catabolism, hormonal changes and associated diseases [12].

In the present study, hemodialysis patients were classified as eutrophic, based on their mean BMI. A similar result was found in the study of [13], in which nutritional status was compared (between men and women) with malnutrition in hemodialysis, based on some parameters. Mean BMI of the total sample was 24.1 kg/m^2 ± 3.4 kg/m^2, with no difference between males and females, who were also classified as eutrophic.

However, a study carried out by [14] compared functional capacity and quality of life of male and female chronic kidney patients on hemodialysis and pre-dialysis. An evaluation of the BMI of the group on hemodialysis showed mean of 27.16 kg/m^2 ± 4.13 kg/m^2. Therefore, the patients were classified as overweight.

BMI is a sensitive parameter, especially when referring to patients undergoing hemodialysis, as it does not detect protein depletion and increased visceral fat (which is common in renal patients). Thus, it may "disguise" patients' nutritional status, e.g., Protein-Energy Malnutrition (PEM) in the presence of fluid retention [15,16].

It is common for patients with Chronic Kidney Disease to have PEM, a fact that is extremely important because it is associated with higher rates of morbidity and mortality, and commonly associated with CKD and hemodialysis. Therefore, nutrition plays a fundamental role in maintaining the nutritional status of these patients [17].

PEM is characterized by reduced intake of energy and protein; therefore, this macronutrient becomes one of the most important for maintaining the nutritional status of these patients [18].

In the present study, protein intake was 1.3 g/kg/day, which exceeds the recommended value. Protein intake of hemodialysis patients has been described as being below current reference values, as reported in the review of [19]. In the study of [20], an assessment of patients' food intake showed that protein intake was 1.1 g/kg/day, i.e., below the recommended level.

Protein intake, in the present research, may have been higher than the recommended level because of the guidelines and the nutritional advice offered by nutritionists and other health workers at the hemodialysis clinic. In the study of [21], individualized dietary counseling was effective at improving important nutritional parameters in patients undergoing hemodialysis.

According to the Kidney Disease Outcomes Quality Initiative (K/DOQI), optimal protein intake for patients undergoing hemodialysis is 1.2 g/kg/day. The reasons for this greater amount are increased protein catabolism and loss of amino acids during hemodialysis.

In the same study mentioned above, carried out by [20], individuals' energy intake was 24.8 kcal/kg/day ± 7.5 kcal/kg/day, i.e., below the level recommended by K/DOQI (35 kcal/kg/day), as in the present study, in which energy intake was 27.98 kcal/kg/day ± 10.59 kcal/kg/day.

This result is similar to the energy intake found in the study carried out by [22], which was 28.0 kcal/kg/day ± 9.4 kcal/kg/day. In that study, higher energy intake was associated with a lower prevalence of metabolic syndrome and its components (abnormal fasting blood glucose levels, high waist circumference, high triglycerides, and low HDL cholesterol). This could be explained by energy balance, which can be disturbed in patients with inadequate energy intake, and such fact is related to a number of disorders, e.g., risks of cardiovascular disease and metabolic syndrome.

Energy intake below the recommended level is related to a higher risk of malnutrition, and it is more severe than low protein intake. Therefore, adequate energy intake is crucial for maintenance of body composition and neutral nitrogen balance [23].

The present study evaluated the correlation between energy and protein intakes by patients, and there was a strong positive correlation of 0.728, that is, it is assumed that the greater the energy intake, the

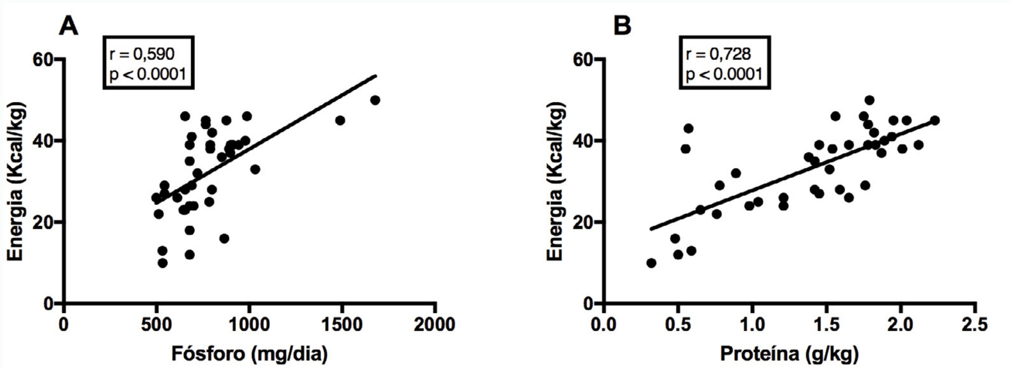

Figure 1: A) Pearson's correlation coefficient (r) between daily intake of phosphorus (mg) and energy (kcal/kg). B) Pearson's correlation coefficient (r) between daily intake of energy (kcal/kg) and protein (g/kg).

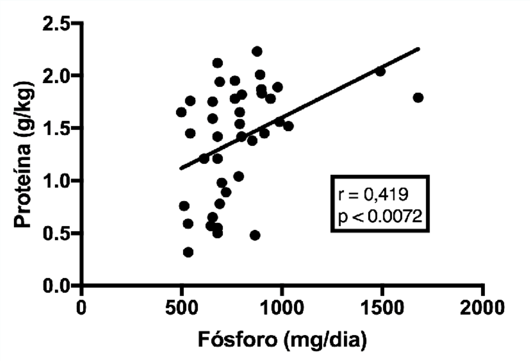

Figure 2: Pearson's correlation coefficient (r) between daily intake of protein (g/kg) and phosphorus (mg/day).

greater the protein intake; thus, it is directly proportional. The fact that protein intake is above the reference value while energy intake is below can be explained by the fact that it is common for patients undergoing hemodialysis to have their diet supplemented with higher protein intake.

In the present study, the value of phosphorus intake was 783.9 mg/day ± 233.2 mg/day, i.e., close to the recommended value. Since protein sources are sources of phosphorus, the correlation between these two variables was positive (0.419), i.e., the greater the protein intake, the greater the phosphorus intake.

In this study, it was found that phosphorus intake was slightly below the reference value with the amount of protein exceeding recommendations. Thus, the protein sources eaten may have possibly had low phosphorus content. One possible explanation is that plant protein may have been consumed, and such type of protein could have had a low concentration of phosphorus. However, food intake of these patients has not been assessed qualitatively; thus, a more specific assessment of the 24 h recall is required.

The relationship between these two nutrients needs to be assessed in order for one to choose these sources of protein. In the study of [24], phosphorus intake by elderly patients on hemodialysis was also below the recommended levels (742 mg/dL ± 239.8 mg/dL); however, protein intake was also low (0.9 g/kg/day ± 0.3 g/kg/day).

The level of phosphorus intake recommended by K/DOQI is 800 mg/day to 1000 mg/day. The restriction of this micronutrient is very important in the treatment of hemodialysis, since it is common for patients to develop hyperphosphatemia as a result of reduced renal phosphate excretion.

When untreated, hyperphosphatemia can trigger some consequences such as hyperparathyroidism, decreased bone density, cardiovascular calcification and cardiovascular diseases, the latter being one of the main causes of death in hemodialysis patients, according to [25,26].

For control of hyperphosphatemia, dialysis methods become ineffective and diet-based control is difficult to adhere to. This scenario requires the use of phosphorus-chelating agents, i.e., phosphate-binding compounds that reduce intestinal absorption of phosphorus [27].

The association of energy and phosphorus was positive (0.590); the former was below the reference value and the latter was very close to it, respectively. Probably, if energy intake had been adequate, phosphorus would have been above the reference value, which may have resulted in the emergence of hyperphosphatemia and its complications. If this had happened, it would have been necessary to use phosphorus-chelating agents to control hyperphosphatemia.

It must be taken into account that the method used for dietary assessment is also subject to errors, as it depends on interviewees' memory, their accurate recall of food intake and the correct description of such foods [28,29].

Final Remarks

The analysis of the means of all evaluated parameters showed that patients were classified as eutrophic. Regarding food consumption, it was found that the energy and phosphorus intakes were below the reference value, while protein intake was above it. The assessment of correlations showed an association between energy and protein, energy and phosphorus and protein and phosphorus.

In this context, there is a need for dietary advice and adequacy of these nutrients in the diet, so that patients become aware of the importance of nutrition for an effective treatment, in order to avoid complications of CKD.

References

1. Ottaviani AC, Betoni LC, Pavarini SCI, Say KG, Zazzetta MS, Orlandi FS. Association between anxiety and depression and quality of life of chronic renal patients on hemodialysis. Texto & Contexto-Enfermagem. 2016;25(3):1-8.
2. Capitanio BL, Abdel HMJA, Dieter DC, Marciele P. Prevalência de doença periodontal em pacientes com insuficiência renal crônica em hemodiálise. Periodontia. 2016;26(2):14-22.
3. Maciel CD, Novaes FR, Vieira FV, da Silva FI, de Oliveira Tito BAK. Adesão ao tratamento hemodialítico: percepção dos pacientes renais crônicos. Cogitare Enfer. 2015;20(3):540-7.
4. Peres LAB, Bettin TE. Dislipidemia em pacientes com doença renal crônica. Rev Soc Bras Clin Med. 2015;13(1):10-13.
5. Silva GF, de Cássia NR, dos Santos RR. Monitoramento das internações na rede pública por doença renal crônica no RS, 2008 a 2012. Gestão em saúde no Rio Grande do Sul. 2017;2:235-52.
6. Fábia B, Ferreira SM, José VM. Avaliação e educação nutricional de pacientes com insuficiência renal crônica em hemodiálise. Revista Interdisciplinar de Estudos em Saúde, Frederico Westphalen. 2017;5(2): 28-40.
7. Frazão CMFQ, de Azevedo Araújo MG, de Sá Tinôco JD, Delgado MF, Lúcio KDB, de Carvalho Lira ALB. Defining characteristics of nursing diagnoses identified in individuals on hemodialysis / Defined characteristics of the nursing diagnosis identifield on individuals in hemodialysis. Science Care and Health. 2015;14(2):1157-64.
8. Montenegro MR, Walter RM, Morimoto JM, Paternez ACAC. Correlação dos métodos de avaliação nutricional de pacientes submetidos à hemodiálise. Saúde e Pesquisa. 2015;8(2):267-75.
9. Rasche J, Bosco D, Morelo S. Doença renal crônica: estudo de caso. Revista Destaques Acadêmicos. 2015;7(3):26-30.
10. Vogt BP, Caramori JCT. Are nutritional composed scoring systems and protein-energy wasting score associated with mortality in maintenance hemodialysis patients? J Ren Nutr. 2016;26(3):183-9.
11. Araujo EKR, Ramos JLS, da Silva SET, Garcia CDL, de Oliveira MLB, de Santana WJ. Consequências da hiperfosfatemia em pacientes renais crônicos em programas de hemodiálise: uma revisão integrativa. Revista E-ciência. 2016;3(2):1-9.
12. Silva ME, Simões MO, D' almeida KSM. Qualidade da dieta e consumo de sódio por pacientes em hemodiálise de uma clínica renal da fronteira oeste do Rio Grande do Sul. Rev Bras Nutr Clin. 2016;31(1):770-74.

13. Ribeiro MMC. Analysis of different methods for the assessment of nutritional status of patients in hemodialysis. Revista Cuidarte. 2015;6(1):932-40.

14. Fassbinder TRC, Winkelmann ER, Schneider J, Wendland J, de Oliveira OB. Functional Capacity and Quality of Life in Patients with Chronic Kidney Disease In Pre-Dialytic Treatment and on Hemodialysis - A Cross sectional study. J Bra Nefrol. 2015;37(1):47-54.

15. D'amico LF, Franco S, Brecailo MK, de Freitas AR, Chiconatto P. Caracterização do Estado Nutricional de Pacientes com Insuficiência Renal Crônica em Programa de Hemodiálise na Cidade de Guarapuava Paraná. Uniciencias. 2013;17(1):17-24.

16. De Oliveira CMC, Vidal CLC, Cristino EF, Pinheiro Jr FML, Kubrusly M. Metabolic acidosis and its association with nutritional status in hemodialysis. J Bras Nefrol. 2015;37(4):458-66.

17. Sabatino A, Regolisti G, Karupaiah T, Sahathevan S, Singh BKS, Khor BH, et al. Protein-energy wasting and nutritional supplementation in patients with end-stage renal disease on hemodialysis. Clin Nutr. 2017;36(3):663-71.

18. Martins AM, Moreira ASB, Avesani CM. Ingestão alimentar de idosos em hemodiálise. Revista Hospital Universitário Pedro Ernesto. 2015;14(3):50-7.

19. Therrien M , Byham-Gray L , Beto J. A review of dietary intake studies in maintenance dialysis patients. J Ren Nutr. 2015;25(4):329-38.

20. Luis D, Zlatkis K, Comenge B, García Z, Navarro JF, Lorenzo V, et al. Dietary quality and adherence to dietary recommendations in patients undergoing hemodialysis. J Ren Nutr. 2016;26(3):190-5.

21. Garagarza CA, Valente AT, Oliveira TS, Caetano CG. Effect of personalized nutritional counseling in maintenance hemodialysis patients. Hemodial Int. 2015;19(3):412-8.

22. Van Duong T, Te-Chih W, Hsi-Hsien C, Tzen-Wen C, Tso-Hsiao C, Yung-Ho H, et al. The cut-off values of dietary energy intake for determining metabolic syndrome in hemodialysis patients: A clinical cross-sectional study. PloS One. 2018;13(3):1-13.

23. Kim H, Lim H, Choue R. A Better Diet Quality is Attributable to Adequate Energy Intake in Hemodialysis Patients. Clin Nutr Res. 2015;4(1):46-55.

24. Martins AM, Rodrigues JCD, de Oliveira Santin FG, Brito FSB, Moreira ASB, Lourenço RA. Food intake assessment of elderly patients on hemodialysis. J Renal Nutr. 2015;25(3):321-6.

25. Lee CT, Wu IW, Chiang SS, Peng YS, Shu KH, Wu MJ, et al. Effect of oral ferric citrate on serum phosphorus in hemodialysis patients: multicenter, randomized, double-blind, placebo-controlled study. J Nephrol. 2015;28(1):105-13.

26. Santos AKL, Lima TL, Costa KC, Caetano AL, Farias EHC, Silva DCP, et al. Serum Levels of Vitamin D and Parathyroid Hormone as Determinants of Sarcopenia in Patients with Chronic Renal Disease on Hemodialysis. Clin J Nutr Diet. 2020;3(1):1-7.

27. Stumm EMF, Kirchner RM, Guido LA, Benetti ERR, Belasco AGS, Sesso RCC, et al. Educational nursing intervention to reduce the hyperphosphatemia in patients on hemodialysis. Rev Bras Enferm. 2017;70(1):31-8.

28. Pierri LA, Zago JN, Mendes RCD. Eficácia dos Inquéritos Alimentares na Avaliação do Consumo Alimentar. Rev Bras Ciênc Saúde. 2015;19(2):91-100.

29. Kopple JD. National Kidney Foundation K/DOQI Clinical Practice Guidelines for Nutrition in Chronic Renal Failure. AJKD. 2001;37(1):s66-s70.