Iron, calcium and phosphorus mineral profile in chronic renal patients on hemodialysis

Perfil de los minerales hierro, calcio y fósforo en pacientes renales crónicos en hemodiálisis

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ABSTRACT

The main goal of this study was to verify the association between serum and dietary concentrations of calcium, phosphorus and iron, and to determine whether patients with kidney disease undergoing hemodialysis had inadequacy in dietary intake. We conducted a descriptive cross-sectional study that evaluated 40 patients undergoing hemodialysis. Food consumption was determined by the 24-hour recall. The optical technology method was used to obtain hemoglobin and hematocrit concentrations. Serum levels of iron, calcium and phosphorus were determined by dry chemistry. We observed insufficient consumption of energy, macronutrients and minerals. Energy intake of patients with longer hemodialysis was higher. The sample presented hypocalcemia, hyperphosphatemia (except in the group ≥8 years of hemodialysis), higher iron concentrations and lower hemoglobin and hematocrit values. The serum levels of minerals were not affected by dietary intake. There was a significant correlation between dietary phosphorus and calcium in patients undergoing hemodialysis for more than 8 years, those over 60 years old and, between calcium and phosphorus normal levels in patients over 60 years old. Hemoglobin, hematocrit and mineral serum levels were similar regardless of age and hemodialysis time. It was concluded that inadequacies of minerals reflected deregulation among metabolism and the pathophysiological changes inherent to Chronic Kidney Disease.

Keywords: Calcium; Chronic kidney disease; Hemodialysis; Iron; Phosphorus.
IRON, CALCIUM AND PHOSPHORUS MINERAL PROFILE IN CHRONIC RENAL PATIENTS ON HEMODIALYSIS

INTRODUCTION

Chronic renal failure (CRF) is an irreversible and progressive disease with functional impairment of the kidneys, in which the remnant nephrons do not filter blood efficiently due to renal overload and may progress to end-stage chronic kidney disease (CKD) or kidney failure. When the glomerular filtration rate is less than 15 mL/min/1.73 m², the patient will need renal replacement therapy, which consists of hemodialysis (HD), peritoneal dialysis and renal transplantation. In 2017, the most common causes of terminal CKD were systemic arterial hypertension and diabetes.

In a systematic review carried out by Marinho et al., it was stated that the prevalence of CKD in Brazil is still undefined; by population criteria, 3 to 6 million Brazilians would have CKD. In Brazil, in 2017, the total number of patients undergoing dialysis treatment was 126,583; the prevalence rate of patients on chronic dialysis was 610 patients per million population (pmp); 40,307 patients started treatment, revealing an incidence of 194 pmp.

In CKD, there are important changes in mineral metabolism, for example: irregular serum concentrations of calcium, phosphorus, parathyroid hormone (PTH), vitamin D metabolites, alkaline phosphatase, fibroblast growth factor 23 (FGF-23) and others, which can result in the development of mineral and bone disorder of chronic kidney disease (CKD-MBD). Treatment and preventive follow-up for patients with a confirmed condition of CKD-MBD is essential in order to avoid the worsening of complications, such as fracture, bone loss, inflammation and death.

In addition, patients with advanced CKD express negative iron balance, due to decreased food intake, poor absorption, and increased iron losses, so that iron supplementation is important for patients undergoing HD treatment. Thus, anemia is recurrent in CKD, and its control imposes itself as a treatment strategy for such patients, given the relationship between anemia and increased morbidity and mortality.

Correction of biochemical abnormalities in these patients must be accompanied by nutritional guidelines, as they are of fundamental importance in improving quality of life. In this sense, to prevent the development of BMD-CKD, in addition to drug treatment, specialized nutritional counseling should also be applied. For healthy communities (without a focus on comorbidities) the recommendations are different regarding the highlighted minerals. The Recommended Dietary Intake (RDA) for calcium is 1,000 and 1,200 mg for both sexes, between 19 and 50 years and 51 and 70 years or more, respectively. For phosphorus, it is 700 mg for people between 19 and 70 years of age or older, of both sexes. For iron, however, the RDA is 8 mg for men, 8 mg for women aged 51 to 70 years or older, and 18 mg for women aged 19 to 50 years.

Studies on the dietary intake of phosphorus, iron and calcium in patients with CKD undergoing HD are scarce or old. The 24-hour dietary recall (R24h) is an open-ended survey capable of collecting detailed information in a short period of time. Its application is valid to estimate average consumption, since multiple R24h have strengths in etiological studies of chronic diseases and are widely used in clinical practice.

Considering the relevance and severity of CKD, this study aimed to investigate the existence of an association between serum and dietary concentrations of calcium, phosphorus, and iron and to determine the whether these minerals are adequately consumed in the diets of patients with CKD on HD. We aimed to verify the connection between minerals in order to propose recommendations to prevent or avoid bone and hematological disorders among these patients.
MATERIALS AND METHODS
The study was designed as descriptive, quantitative, cross-sectional, developed in a renal therapy clinic. The sample consisted of patients with CKD on HD. To define the sample size, the procedure adopted was to estimate the population mean with unknown population variance, using the Student T table with a 95% confidence level and a significance rate of 5% with a finite population, reaching the sample size total of 40 individuals.

Inclusion criteria were: clinically stable patients undergoing dialysis treatment for at least 3 months, over 18 years old, without distinction by race and sex. The established exclusion criteria: chronic smokers, chronic alcohol users, individuals with severe liver dysfunction and positive test for Human Immunodeficiency Virus (HIV+).

Data regarding time on HD and age were obtained from medical records. Body weight (dry weight) of everyone was obtained after HD session with the aid of a digital scale (Welmy, model W 200/50 A), with a maximum capacity of 200 kg, with divisions of 50 g.

The adequacy of HD through fractional clearance of urea (Kt/V) was within normal limits. Venous accesses were predominantly through arteriovenous fistula, but also through permcat and double lumen catheters through jugular venous access.

The optical technology method (CELL-DYN Ruby - Abbott) was used to measure hemoglobin and hematocrit. Serum iron, calcium and phosphorus concentrations were determined by dry chemistry (Vitros 4600).

Food consumption was assessed using the 24hR, performed on two non-consecutive days during the week (days prior to HD) to verify variation in food consumed, according to the methodology of Fisberg et al. and Verly-JR et al. The second 24hR was needed to correct the data, by the intrapersonal variability of food consumption, using statistical methods. Energy consumption, macronutrients, and minerals (iron, calcium and phosphorus) were calculated using the NutWin Software, version 1.6, and later adjusted for individual and interpersonal variability, according to Jaime et al. and Willett et al.

To estimate the adequacy of food consumption in the groups, the following reference values were adopted: energy (30 to 35 kcal/kg for ≥60 years or 35 kcal/kg for <60 years), protein (1.2 g/kg), carbohydrates (50 to 60% of VET), and lipids (30 to 35% of VET). To estimate the prevalence of inadequacy of mineral dietary intake, the following reference values were adopted: iron (8 mg for men and 15 mg for women), phosphorus (<17 mg/kg/day) and calcium (<1000 mg/day).

The following reference values were used for laboratory data: hemoglobin (12.0 to 16.0 g/dL for women and 13.0 to 16.0 g/dL for men), hematocrit (36% to 46% for women and 41% to 53% for men), serum iron (>10 to 18 mg/dL), serum calcium (8.8 to 10.4 mg/dL) and serum phosphorus (2.5 to 4.8 mg/dL). Anemia was considered when hemoglobin concentration was below 11 g/dL. Acquisition of serum iron content for 3 patients was not feasible, therefore, 37 participants have information on this variable. Regarding the duration of HD treatment, those involved were divided into two groups: HD≥8 years (longer HD) and <8 years, in order to facilitate the distinction between the groups involved.

Descriptive analysis of quantitative variables was presented as mean and standard deviation of the mean. Data analysis was performed using the Statistical Package for Social Sciences (SPSS), version 25.0 for Windows. For parametric samples, Student T test was used, and the Mann-Whitney test for non-parametric variables; for analysis of categorical variables, the chi-square test was used. For the correlation analyses, Spearman’s and Pearson’s correlations were used. The significance level adopted was 95% (p<0.05).

The project was registered in “Plataforma Brasil” and submitted and approved by the Research Ethics Committee of the Federal University of Piauí (CEP/UFPI, opinion number 2.527.329 and CAAE number 82702617.8.0000.5214). To carry out data collection, this study was presented to each patient and to the clinic. When participants agreed to participate in the research, they signed the informed consent form.

RESULTS
Forty patients (25 adults and 15 elderly) with a mean age of 52 (52.3 ± 14.2) years old were evaluated, 77.5% (n= 31) of whom were male and 22.5% (n= 9) female. The mean age was 53.0 ± 13.5 years for men and 49.9±16.9 years for women. The average post-HD weight was 59.7±10.3 kg. The energy consumption in patients with longer duration of dialysis therapy was statistically higher (p= 0.033). The sample had a dietary intake of energy, macronutrients, calcium, iron and phosphorus below recommended levels (Table 1).

Mean serum values of hemoglobin, hematocrit, calcium, iron and phosphorus did not show statistical difference with respect to age and time on HD. In general, the sample showed hypocalcemia, hyperphosphatemia (except ≥8 years HD group), high serum iron concentration and reduced hemoglobin and hematocrit levels (Table 2).

Correlation analyses show that serum levels of iron, calcium and phosphorus were not influenced by their respective dietary intakes. There was a significant correlation between dietary phosphorus and calcium in patients with less than 8 years of HD and in the group aged 60 years or more; between serum calcium and phosphorus in patients under 60 years of age; and between hematocrit and serum iron and hematocrit and dietary iron, in the group with ≥8 years of HD (Tables 3 and 4). There was no significant difference regarding the presence of anemia, hyperphosphatemia and hypocalcemia in relation to age and duration of HD (Figure 1).
Table 1. Food consumption related to energy, macronutrients and minerals, according to age group and time on hemodialysis.

<table>
<thead>
<tr>
<th></th>
<th>Group n= 40</th>
<th>Age</th>
<th>Time on hemodialysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 60 years</td>
<td>≥60 years</td>
<td>p*</td>
</tr>
<tr>
<td>Energy</td>
<td>1149 ± 277</td>
<td>1153 ± 246</td>
<td>1142 ± 332</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>152 ± 16.6</td>
<td>154 ± 18.2</td>
<td>149 ± 13.7</td>
</tr>
<tr>
<td>Protein</td>
<td>56.7 ± 6.97</td>
<td>56.6 ± 6.1</td>
<td>56.9 ± 8.3</td>
</tr>
<tr>
<td>Lipid</td>
<td>33.6 ± 5.45</td>
<td>33.4 ± 4.9</td>
<td>34 ± 6.3</td>
</tr>
<tr>
<td>Calcium</td>
<td>302 ± 33.1</td>
<td>300 ± 33.6</td>
<td>306 ± 33.1</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>656 ± 73.9</td>
<td>652 ± 70.6</td>
<td>663 ± 81.2</td>
</tr>
<tr>
<td>Iron</td>
<td>7.21 ± 0.957</td>
<td>7.27 ± 1.00</td>
<td>7.10 ± 0.710</td>
</tr>
</tbody>
</table>

Data expressed as mean ± standard deviation. Student T test, significant difference (p<0.05)*. Energy (kcal), carbohydrate (g), protein (g), lipid (g), calcium (mg/day), phosphorus (mg/day) and iron (mg/day).

Table 2. Serum iron, calcium, phosphorus, hemoglobin and hematocrit profile.

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Time on hemodialysis</th>
<th>N= 40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;60 years</td>
<td>≥60 years</td>
<td>p*</td>
</tr>
<tr>
<td>Ca</td>
<td>8.15 ± 2.24</td>
<td>8.16 ± 2.94</td>
<td>0.335</td>
</tr>
<tr>
<td>Fe</td>
<td>53.9 ± 57.5</td>
<td>79.2 ± 64.0</td>
<td>0.205</td>
</tr>
<tr>
<td>P</td>
<td>5.08 ± 1.90</td>
<td>6.26 ± 8.24</td>
<td>0.442</td>
</tr>
<tr>
<td>Hb</td>
<td>10.8 ± 1.85</td>
<td>11.6 ± 1.90</td>
<td>0.197</td>
</tr>
<tr>
<td>Ht</td>
<td>33.1 ± 5.77</td>
<td>34.3 ± 9.14</td>
<td>0.632</td>
</tr>
</tbody>
</table>

Data expressed as mean ± standard deviation. Student T test and Mann-Whitney test, significant difference (p<0.05). Ca: serum calcium (mg/dL); Fe: serum iron (mg/dL); P: serum phosphorus (mg/dL); Hb: hemoglobin (g/dL); Ht: hematocrit (%). Serum iron with a sample of 37 patients.
Table 3. Correlation analysis between dietary iron and serum iron, hemoglobin and hematocrit concentrations.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>&lt;8 years of HD</th>
<th>≥8 years of HD</th>
<th>&lt;60 years</th>
<th>≥60 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p</td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Serum iron</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemoglobin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.05</td>
<td>0.821</td>
<td>0.15</td>
<td>0.532</td>
</tr>
<tr>
<td>Hematocrit&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.29</td>
<td>0.238</td>
<td>0.65</td>
<td>0.003*</td>
</tr>
<tr>
<td>Dietary iron&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.42</td>
<td>0.063</td>
<td>0.09</td>
<td>0.697</td>
</tr>
<tr>
<td>Dietary iron</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemoglobin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-0.001</td>
<td>0.995</td>
<td>0.02</td>
<td>0.937</td>
</tr>
<tr>
<td>Hematocrit&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>-0.32</td>
<td>0.175</td>
<td>0.52</td>
<td>0.019*</td>
</tr>
</tbody>
</table>

<sup>a</sup>Spearman Correlation. <sup>b</sup>Pearson correlation. Significant correlation (p<0.05). HD= hemodialysis. Serum iron (mg/dL). Dietary iron (mg/day). Hemoglobin (g/dL). Hematocrit (%).

Table 4. Correlation analysis between dietary calcium/dietary phosphorus and serum calcium and phosphorus concentrations.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>&lt;8 years of HD</th>
<th>≥8 years of HD</th>
<th>&lt;60 years</th>
<th>≥60 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p</td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Serum calcium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum phosphorus&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.42</td>
<td>0.066</td>
<td>0.36</td>
<td>0.118</td>
</tr>
<tr>
<td>Dietary phosphorus&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.09</td>
<td>0.696</td>
<td>-0.03</td>
<td>0.892</td>
</tr>
<tr>
<td>Dietary Calcium&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.38</td>
<td>0.099</td>
<td>0.07</td>
<td>0.764</td>
</tr>
<tr>
<td>Serum phosphorus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dietary Calcium&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.09</td>
<td>0.707</td>
<td>-0.01</td>
<td>0.957</td>
</tr>
<tr>
<td>Dietary phosphorus&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.05</td>
<td>0.838</td>
<td>0.15</td>
<td>0.535</td>
</tr>
<tr>
<td>Dietary calcium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dietary phosphorus&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.45</td>
<td>0.047*</td>
<td>0.35</td>
<td>0.129</td>
</tr>
</tbody>
</table>

<sup>a</sup>Spearman Correlation. <sup>b</sup>Pearson correlation. *Significant correlation (p<0.05). HD= hemodialysis. Serum calcium (mg/dL), serum phosphorus (mg/dL). Dietary calcium (mg/day), dietary phosphorus (mg/day).
Figure 1: (Pl), 2021. Comparison test, significant difference ($p<0.05$). HD: Hemodialysis. Total sample of $n=40$. 

Iron, calcium and phosphorus mineral profile in chronic renal patients on hemodialysis.
DISCUSSION

The food intake of patients with CKD may be reduced, probably due to dietary restrictions, anorexia, uremic symptoms and endocrine-metabolic alterations inherent to the pathology. Inflammation is characteristic of CKD, as is increased protein catabolism and increased excretion of bicarbonate (which contributes to metabolic acidosis); cytokines collaborate to reduce appetite and, consequently, to lower energy consumption.

In our study, we observed an average total energy value of 1149 ± 277 kcal/day (19.3 kcal/kg/day), which is below the recommended value of 2090 kcal (35 kcal/kg); and 32.5% (n= 13) of the participants had consumption of less than 1.000 kilocalories. Other studies have also shown lower caloric intakes than recommended, as in As’Habi et al. and Kim et al., who found a daily dietary intake of 1376 kcal/day and 21.9 kcal/kg/day, respectively. In contrast, the study by Vaz et al. showed an energy intake of 31.2 kcal/kg/day, expressing adequacy regarding this parameter.

After studying the survival of patients on HD, Araújo et al. showed that low energy intake at the beginning of chronic dialysis can contribute to mortality; showing that survivors ingested 27.4 kcal/kg/day, while non-survivors ingested 23.5 kcal/kg/day, reinforcing the importance of specialized nutritional monitoring for this population.

Despite the energy intake being lower than the recommendation in 100% of the participants, regardless of time on HD and age range, there was a statistically higher energy intake in patients with longer time on HD, which can be explained by the body’s adaptation to pathophysiological changes and symptoms resulting from the disease. Alvarenga et al. evaluated patients by time on HD and concluded that time on HD affects individual dietary profile.

Considering the average weight of the population in this study, the average protein intake was 0.95 g/kg/day, that is, lower than the recommended nutritional coverage to curb a negative nitrogen balance and compensate for losses due to the hemodialysis process; showing lower protein intake in 93.3% and 95% of elderly patients and those with less time of treatment, respectively, and in 97.5% of the total sample. Our finding differs from Vaz et al. who identified a protein intake of 1.18 g/kg/day, and is similar to that presented by As’habi et al. and Kim et al., who reported a daily protein intake of 0.9 g/kg/day. Insufficient protein consumption is related to worsening of the condition and loss of muscle mass. Araújo et al. found that surviving patients had a protein intake of 1.01 g/kg/day, while non-survivors consumed 0.92 g/kg/day.

The entire sample had low dietary intake of calcium and phosphorus; and 80%, 85% and 90% of adult participants, with more time and less time on HD, respectively, had insufficient iron consumption. These results may reflect a poor diet in food sources of these minerals. Which may result from self-imposed and sometimes unnecessary dietary restrictions, which express the lack of guidance food and nutrition by a competent professional, in addition to the symptoms that accompany the disease.

This study corroborates As’habi et al., who observed dietary intake of energy, protein and calcium lower than recommended. Similarly, a study by Bossola et al. showed that most individuals had a daily intake of iron, phosphorus and calcium below proposed values. Machado et al. also found an average intake of energy, protein and phosphorus below the established values. Kim et al. obtained energy, protein, calcium and phosphorus intake below recommended values, while, on the other hand, in Rodrigues et al. most participants had adequate consumption of phosphorus, iron, protein, carbohydrate and lipid.

In the total sample of this study, the mean values of serum calcium and phosphorus were 8.15 mg/dL and 5.53 mg/dL, respectively, with calcium below recommended levels and phosphorus above. Hyperphosphatemia was present in 45% and 40% of participants with less and longer HD duration, respectively. It is known that the retention of phosphorus in the blood of these patients, as evidenced in results, is due to the inability of the kidneys and HD to excrete it. Dietary reeducation is recommended in order to balance the consumption of foods rich in phosphorus, such as meat, milk and derivatives.

Phosphorus exerts a competitive mechanism with calcium (which has not yet been completely clarified), making it difficult to absorb this mineral and contributing to hypocalcemia, a condition that was found in 60% of participants with <8 years of HD and in 52% of participants aged <60 years (Figure 1). Furthermore, the reduced capacity of the kidneys to convert inactive vitamin D into 1.25-dihydroxyvitamin D (calcitriol) contributes to inadequate calcium absorption and a reduction in the plasma concentration of this mineral.

It is noteworthy that kidney disease imposes important metabolic and hormonal strain that can contribute to anemia and hypocalcemia manifested in 40% and 45% of the total sample, respectively. In CKD, anemia is also a condition frequently found, as causes include a deficit in erythropoietin, hemolysis of red blood cells, iron deficiency, vitamin B12 and folate, chronic blood loss, hypothyroidism, infections or inflammation chronic diseases, hyperparathyroidism, myeloma and erythrocyte aplasia.

In the total sample, serum iron, hemoglobin and hematocrit had values of 63.4 mg/dL, 11.1 g/dL and 33.6%, respectively, showing high levels of serum iron; and mean hemoglobin and hematocrit values below recommended levels. Corroborating this study, Signori et al. had an overall mean hemoglobin and hematocrit of 10.5 g/dL and 32.1%, respectively. In this study, 48% of patients aged <60 years had hemoglobin values compatible with anemia. However, in the studies by Afshar et al. and Draczevski et al., 85% of patients were found to have anemia; and in Bueno et al., 97.8% of the patients were anemic.

The dietary needs of participants should be enriched with food sources of citric acid, vitamin C, vitamin A and
carotenoids to optimize the absorption of non-heme iron, as well as to control the intake of foods rich in phosphates, phytates, tannins and polyphenols that prevent iron absorption and are related to iron deficiency anemia\textsuperscript{26,27}. It is also suggested to enrich the diet with dietary heme iron, which comes from the breakdown of hemoglobin and myoglobin present in foods of animal origin\textsuperscript{38}. It is important to emphasize that iron supplementation to treat anemia in patients undergoing HD should be carried out with caution, as excess body iron stores can contribute to oxidative stress in these patients, for the balance between its absorption and excretion and other factors and nutrients involved in iron metabolism\textsuperscript{19}.

The positive and significant correlations between hematocrit and serum and dietary iron levels in the group with ≥8 years of HD suggest that higher iron levels can induce an increase in hematocrit. It is known that iron is supplied to the body by the usual diet, which has 13 to 18 mg of iron, but only 1 to 2 mg is absorbed in inorganic or heme form; an adult person has 4 to 5 g of iron, around 2.5 g in the form of hemoglobin. Fe\textsuperscript{3+} is reused, mainly by the bone marrow, and participates in the hemoglobinization of new erythrocytes\textsuperscript{28}. According to Afshar et al.\textsuperscript{15}, the lower GFR, the lower production of erythropoietin, the loss of hematopoietic compounds and inflammation, associated with the disease and/or HD, can damage hemoglobin and hematocrit levels in this population.

There was a significant correlation between dietary phosphorus and calcium in patients with less than 8 years of HD and in the group aged 60 years or more, attributing to the nutritional composition of foods rich in calcium, which commonly have considerable phosphorus content, such as dairy products\textsuperscript{29,26}. There was also a positive and significant correlation between serum calcium and phosphorus in patients under 60 years of age, this correlation may be attributed to pathophysiological changes characteristic of the disease, which lead to increased PTH secretion, aiming to increase intestinal absorption of calcium and phosphorus and promote calcium reabsorption and reduce phosphorus reabsorption\textsuperscript{40}.

There was no correlation between the dietary minerals iron, calcium and phosphorus and their respective serum concentrations, showing that food did not influence their serum concentrations, attributing to the likely biases of memory and representativeness of dietary data, to the factors that influenced in the bioavailability of these minerals and the existence of antinutritional elements in participants’ diet.

It is noteworthy that this research has some limitations. As this is a cross-sectional study, it is not possible to establish a cause and effect relationship, the small sample may not be representative and parathyroid hormone measurement was not performed.

**CONCLUSION**

Insufficient dietary intake of calcium, iron, phosphorus, macronutrients and energy by patients evaluated in this study, alerts for the lack of nutritional coverage, which can contribute to the compromise of the clinical conditions and the development of complications such as: anemia, hypocalcemia and hyperphosphatemia. The significant prevalence of anemia and hypocalcemia observed calls attention for the need to adopt dietary plans with foods that are sources of protein, iron and calcium; in addition to the need to continuously monitor serum phosphorus levels and institute the use of phosphorus chelators, to attenuate the retention of this mineral.

Implementing individualized nutritional evaluation and follow-up to improve food quality and diagram intake of minerals is an important strategy in patients with CKD undergoing HD. New studies with larger samples are needed to clarify the impact of food insecurity on the prevalence of complications related to disturbances in mineral metabolism and reassuring preventive plans aimed at reducing such disturbances are important for improving the quality of life of those individuals.

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