Original Article

Dietary pattern and ultra-processed food intake among hemodialysis patients: an analysis of food consumption and nutritional composition

Padrão alimentar e ingestão de alimentos ultraprocessados por pacientes em hemodiálise: uma análise do consumo alimentar e da composição nutricional

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ABSTRACT

Introduction: Patients with chronic kidney disease (CKD) undergoing hemodialysis (HD) have high cardiovascular mortality. The consumption of ultra-processed foods has been increasing in the general population, and evidence shows its association with worse outcomes related to chronic diseases and cardiovascular risk. This study aimed to investigate the consumption of ultra-processed foods among HD patients and to analyze the nutritional composition of the most frequently consumed products. **Methods:** This cross-sectional study included adult patients (>18 years) undergoing HD at a university hospital in southern Brazil. Clinical and nutritional data were collected, including a 24-hour dietary recall analyzed using Nutrório software. Ultra-processed food consumption was classified according to the NOVA system. The nutritional composition of the ten most frequently consumed ultra-processed products was evaluated based on the nutrition labeling of three different brands per item, including analysis of ingredient lists to identify food additives and compounds containing phosphorus and potassium. **Results:** A total of 63 patients were evaluated. Within the sample, high sodium intake and low fiber consumption were observed, although macronutrient distribution was within recommended ranges. On average, 18.5% of total energy intake was derived from ultra-processed foods, with margarine, sliced bread, processed meats and soft drinks being the most frequently consumed items. Most participants (63.5%) reported consuming three or more groups of ultra-processed foods. A total of 63 different ultra-processed foods were identified, comprising 146 ingredients listed across the analyzed products, including food additives. Label analysis revealed high sodium content and low density of fiber, protein, and micronutrients in the evaluated products. **Conclusion:** The consumption of ultra-processed foods contributes substantially to high sodium and additive intake and to low fiber consumption, negatively impacting the dietary quality of HD patients. These findings reinforce the need for nutritional interventions aimed at reducing ultra-processed food consumption and promoting fresh and minimally processed foods.

RESUMO

Introdução: Pacientes com doença renal crônica (DRC) em hemodiálise (HD) apresentam elevada mortalidade cardiovascular. O consumo de alimentos ultraprocessados vem aumentando na população em geral e as evidências mostram sua relação com piores desfechos, relacionados a doenças crônicas e risco cardiovascular. Este estudo teve como objetivo investigar o consumo de alimentos ultraprocessados por pacientes em HD e analisar a composição nutricional dos produtos mais consumidos. **Método:** Esse foi um estudo transversal realizado com pacientes adultos (>18 anos) em HD em um hospital universitário no sul do Brasil. Foram coletados dados clínico-nutricionais, incluindo recordatório alimentar de 24 horas, analisado no *software* Nutrório. O consumo de alimentos ultraprocessados foi classificado pelo escore NOVA. A composição nutricional dos dez produtos ultraprocessados mais consumidos foi avaliada com base na rotulagem de três marcas distintas por item, incluindo a análise dos ingredientes descritos nos rótulos, com identificação de aditivos alimentares e compostos contendo fósforo e potássio. **Resultados:** Foram avaliados 63 pacientes. Houve elevada ingestão de sódio e baixo consumo de fibras, embora a distribuição de macronutrientes estivesse dentro das recomendações. Em média, 18,5% do valor energético total da dieta foi proveniente de alimentos ultraprocessados, sendo margarina, pão de forma, presunto e refrigerantes alguns os mais consumidos. A maioria dos participantes (63,5%) refere consumir três ou mais grupos de alimentos ultraprocessados. Foram identificados 63 tipos de alimentos ultraprocessados consumidos, totalizando 146 ingredientes descritos nos rótulos das três marcas analisadas, incluindo aditivos alimentares. Nos produtos avaliados, observou-se elevado teor de sódio e baixa densidade de fibras, proteínas e micronutrientes. **Conclusão:** O consumo de alimentos ultraprocessados contribui de forma relevante para a ingestão elevada de sódio e aditivos alimentares, além de baixa ingestão de fibras, impactando negativamente a qualidade da dieta de pacientes em HD. Esses achados reforçam a necessidade de intervenções nutricionais voltadas à redução do consumo de ultraprocessados e à promoção de alimentos in natura também nesta população.

Keywords:
Food intake. Hemodialysis. Chronic kidney disease.

Unitermos:
Ingestão de alimentos. Hemodiálise. Doença renal crônica.

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INTRODUCTION

Chronic kidney disease (CKD) is characterized by persistent kidney damage over a period of at least three months, affecting the structure or function of the kidneys[1-3]. The global prevalence of CKD is estimated at 9.5%, with regional variations. Among patients undergoing hemodialysis (HD), mortality in the first year of treatment ranges from 1% to 10% in nearly half of the countries evaluated, with cardiovascular diseases being the leading cause of death[2,4]. In Brazil, however, data from the Brazilian Society of Nephrology indicate a higher annual mortality rate, around 16%, reinforcing the severity of the national scenario[5].

This is a population with a high burden of comorbidities, especially of cardiovascular origin[1]. Coronary artery disease, heart failure, arrhythmias, and sudden death are the main causes affecting HD patients, reflecting the important relationship between the heart and kidneys. These risks are further increased by underlying conditions such as hypertension and diabetes, as well as other factors specific to kidney disease and hemodialysis treatment[6].

Current studies demonstrate a strong relationship between CKD in HD and increased cardiovascular risk, with major cardiac events accounting for approximately 50% of deaths among these patients[2,7]. This high burden of cardiovascular disease reinforces the importance of understanding associated factors, such as dietary patterns, which may aggravate complications in this group[1,4,8].

In this context, diet plays an essential role in the morbidity and mortality of HD patients. An inadequate diet may worsen risk factors such as hypertension, dyslipidemia, and sodium and fluid overload, being directly associated with an increased risk of adverse cardiovascular events[9]. High sodium intake, in particular, is related to poor blood pressure control and volume overload, critical factors in this population. In the context of cardiovascular health, poor diet is directly associated with a higher risk of adverse events. Among the main dietary components of concern is the consumption of ultra-processed foods, which have been associated with the worsening of kidney and cardiovascular diseases[10-15].

The NOVA classification, developed by the Center for Epidemiological Research in Nutrition and Health (NUPENS) at the University of São Paulo, categorizes foods into four groups: fresh or minimally processed, culinary ingredients, processed, and ultra-processed[16]. Ultra-processed foods are industrial formulations with low nutritional value, high amounts of sugars, fats, and sodium, in addition to various chemical additives. They are products designed to be convenient, hyper-palatable, and long-lasting[3,16-19].

Excessive consumption of this category of foods has been associated with an increased risk of obesity and other conditions such as type 2 diabetes and dyslipidemia, diseases that not only worsen the course of CKD but also increase the risk of cardiovascular complications[13,14,20,21]. Furthermore, recent studies associate increased intake of ultra-processed foods with chronic noncommunicable diseases (NCDs), general cardiovascular conditions, cerebrovascular diseases, cardiometabolic disorders, and mortality[10,22,23]. In the context of CKD, there is an association with metabolic acidosis, hyperphosphatemia, dysbiosis, and hyperkalemia[12,23,24].

Thus, the aim of the present study was to investigate the consumption of ultra-processed foods and the nutritional composition of the main products consumed by patients on hemodialysis, with emphasis on their potential effects on cardiovascular risk.

METHODS

This study used a convenience sampling approach, as patients were recruited from a single hemodialysis (HD) center in a university hospital in Southern Brazil. The inclusion criteria were: patients aged over 18 years, undergoing HD for at least three months, and who agreed to participate in the study by signing the informed consent form (ICF).

Clinical and nutritional data were collected, including age, sex, ethnicity, marital status, education level, height, weight, and body mass index (BMI). Dietary intake was assessed using a self-reported 24-hour dietary recall, in which participants reported their food consumption from the day prior to the HD session. The analysis was performed using the Nutrório software by previously trained researchers. Total energy intake (TEI, kcal) and nutrient intake were obtained, including sodium (mg), protein (g and % of TEI), carbohydrates (% of TEI), lipids (% of TEI), and fiber (g).

Based on the 24-hour dietary recall, the foods consumed were identified and categorized using the NOVA Tracker according to ultra-processed food groups[25]. This Tracker included questions regarding the consumption of 23 groups of ultra-processed foods, such as cookies, sugar-sweetened beverages, and ready-to-eat meals[26].

Nutritional label analysis was conducted based on the ten most frequently consumed ultra-processed foods among patients. These foods were randomly selected from different supermarket chains in the same city where the HD center is located. Each food item was analyzed in triplicate, considering three different brands per item, totaling 30 food product samples. Nutritional information was described as declared on the labels and subsequently standardized per 100 g to present data.

For sample characterization, categorical variables were described using absolute and relative frequencies. Quantitative data were assessed for normality using the Shapiro-Wilk test and presented as mean ± standard deviation or median (interquartile range), according to data distribution. Additionally, Spearman correlation analyses were performed to evaluate the association between ultra-processed food consumption and clinical and nutritional variables. The analysis was conducted using R software (version 4.3.1) with the RStudio interface (version 2023.12.1 Build 402).

This study was approved by the Research Ethics Committee of PUCRS (CAAE 80914024.7.0000.5336), in accordance with Resolution No. 466/2012 of the National Health Council. All participants signed the ICF, ensuring data confidentiality. There are no conflicts of interest to declare[27].

RESULTS

Sixty-three patients were included in the study. Sociodemographic and clinical-nutritional data are described in Table 1.

The data regarding the contribution of food groups to TEI are presented in Table 2.

Table 1 – Sociodemographic characteristics and clinical-nutritional data of the study population.

Variables	Overall (n=63)
Male gender	41 (65.0%)
Age (years)	61±16
Adults	25 (39.7%)
Elderly	38 (60.3%)
Ethnicity	
White	37 (58.7%)
Black	15 (23.81%)
Brown	9 (14.2%)
Asian	2 (3.1%)
Marital status	
Married	31 (49.2%)
Single	24 (38.1%)
Widowed	8 (12.7%)

Continuation Table 1 – Sociodemographic characteristics and clinical-nutritional data of the study population.

Variables	Overall (n=63)
Level of education	
High school completed	31 (49.20%)
Higher education completed	20 (31.70%)
Other	12 (19.10%)
Smoking	
Non-smoker	59 (93.65%)
Alcohol	
Doesn't consume	56 (88.89%)
Associated conditions	
Hypertension	50 (79.4%)
Type 2 diabetes	17 (27.0%)
Type 1 diabetes	2 (3.2%)
Nutricional data	
Dry weight (kg)	72.1±19.0
BMI (kg/m²)	25.3±5.9
Classification older adults	
Underweight	16 (25.4%)
Normal weight	12 (19.0%)
Overweight	3 (4.8%)
Obesity	6 (9.5%)
Classification adults	
Underweight	2 (3.2%)
Normal weight	12 (19.0%)
Overweight	10 (15.8%)
Obesity I	1 (1.6%)
Obesity II	1 (1.6%)
Dietary intake	
Total energy intake (kcal)	1709.2 (1334.8 - 2496.7)
Carbohydrates (%)	57.3 (41.7 - 63.1)
Protein (%)	22.0 (9.9 - 35)
Protein (g)	78.0 ± 41.5
Protein (g/kg)	1.1 ± 0.7
Lipids (%)	18.5 (11.4 - 24.5)
Dietary fiber (g)	13.6 ± 10.5
Sodium (mg)	4356.7 (2844.1 - 9093.6)

n = sample size; BMI = body mass index. Data are presented as absolute values and frequency percentages, and as mean ± standard deviation (parametric data), or median (25th–75th percentile) (nonparametric data). Elderly aged ≥60 years.

Table 2 – Evaluation of ultra-processed food intake based on 24-hour dietary recall (n = 63).

Food groups	Median (%)	P25-P75
Culinary ingredientes	20	13.8–28
Fresh or minimally processed foods	35	0–70.6
Processed foods	20	13–26.5
Ultra-processed foods	18.5	10.2–32.5

n = sample size. Values are represented as absolute values and frequency percentages, average ± standard deviation (parametric data), or median (25–75 percentile) (non-parametric data).

Sixty-three different ultra-processed foods consumed by the patients were identified and classified according to the 23 ultra-processed food subgroups of the NOVA score (Table 3 and Figure 1). A high consumption of margarine, sliced bread, processed meats, and soft drinks was observed in the study population.

Many patients consume ultra-processed foods daily, with most of the population (40; 63.5%) reporting the consumption of three or more groups. The frequency of food groups consumed is presented in Figure 2. A variation ranging from 0 to 8 food groups consumed on the assessed day was observed, with the consumption of at least three ultra-processed food groups per day being the most prevalent pattern.

Table 3 – Assessment of ultra-processed food intake according to the 23 subgroups proposed by the NOVA score (0–23) (n = 63).

Variable	Overall (n=63)	
Ultra-processed food groups	n	%
Margarine	31	49.21%
Sliced bread, hot dog bun or hamburger bun	24	38.00%
Soft drinks (regular or diet) Processed meats (ham, salami or mortadella)	20	31.80%
Fruit juice (boxed or canned)	18	28.62%
Packaged snacks, shoestring potatoes or savory biscuits Sweet biscuits (with or without filling)	11	17.40%
Flavored yogurt (fruit or chocolate)	9	14.30%
Powdered drink mixes Chocolate milk beverages Chocolate bars or bonbons	8	12.70%
Mayonnaise, ketchup or mustard Tea-based beverages	5	7.95%
Sausages, hamburgers or nuggets Salad dressing Instant noodles or packaged soups	3	4.76%
Cereal bars Packaged cakes Ice cream or popsicles	2	3.17%
Breakfast cereals (including sweetened) Frozen lasagna or other ready-to-eat frozen meals Frozen pizza or fast-food pizza Frozen French fries or fast-food fries	1	1.59%

n = sample size. Data are presented as absolute values and percentage frequencies.

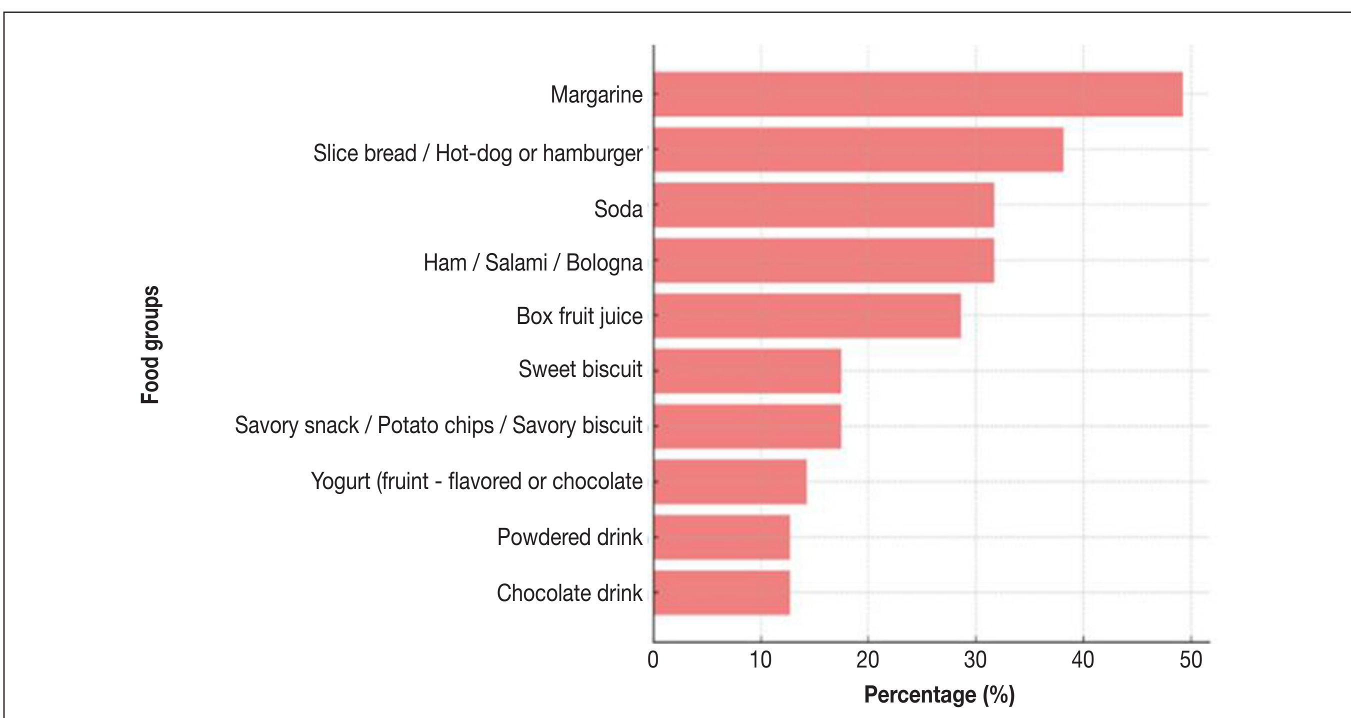


***Figure 1 -** Ten most commonly consumed ultra-processed food subgroups in the study population.*

Spearman correlation analysis was performed between ultra-processed food consumption and clinical and nutritional variables. No significant association was observed between ultra-processed food intake and sodium intake (ρ=0.113; p=0.379), fiber intake (ρ=0.023; p=0.856), or age (ρ=-0.105; p=0.411). On the other hand, a significant positive correlation was observed between ultra-processed food consumption and BMI (ρ=0.301; p=0.016), indicating that higher consumption of these foods was associated with higher BMI values in the studied population (Figure 3).

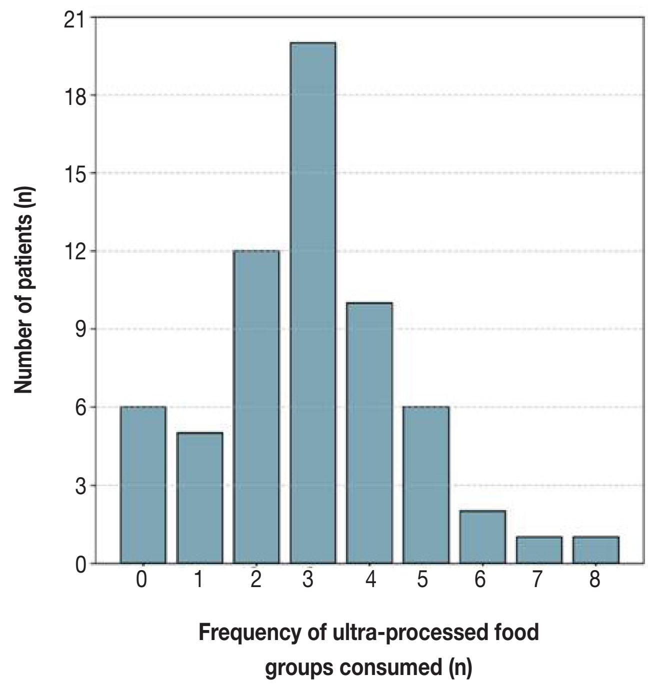
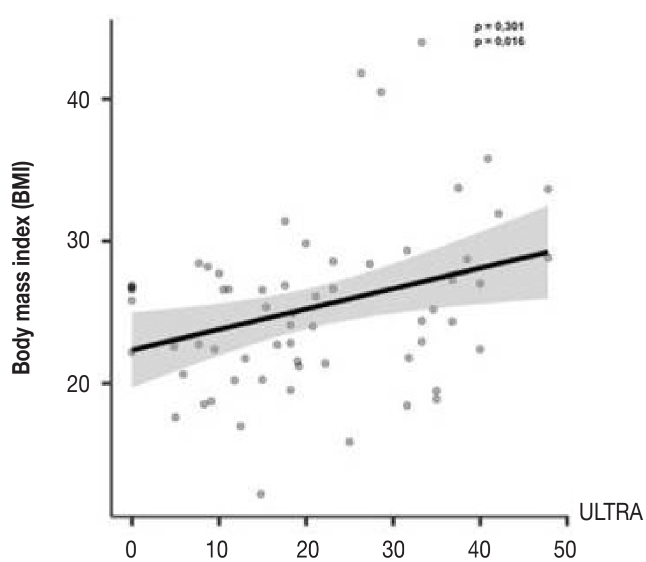


Figure 2 - *Frequency of ultra-processed food groups consumed per day, according to the NOVA score, by patients on hemodialysis.*



n = sample size. Spearman correlation: ρ=0.301; p=0.016

Figure 3 - *Correlation between ultra-processed food consumption (% TEI) and body mass index (BMI) in hemodialysis patients (n = 63).*

TEI of the evaluated products showed a median of 183 kcal/100 g (50.5–383). Total carbohydrates had a median of 3.75 g/100 g (1.15–48.8) and, while total sugars were 1.75 g/100 g (0–10) and 0.17 g/10 g (0–1). Protein content showed a median of 1.65 g/100 g (0–9.57). Total lipids presented values of 4.90 g/100 g (0–16.8). Among fat types, the most frequent component was saturated fat, with 1.15 g/100 g (0–6.75). Values for monounsaturated, polyunsaturated, trans fats, and cholesterol were zero in nearly all samples, suggesting absence or non-reporting of these nutrients on the labels.

Dietary fiber was virtually absent in the evaluated products. Similarly, phosphorus and calcium were not reported or were absent in most labels. On the other hand, sodium was prevalent in the analyzed products, with a median of 322 mg/100 g (2.8–575), showing wide variability among products. Vitamins were generally present in low concentrations. In all cases, the median was zero, indicating that most samples did not contain detectable amounts of vitamins.

This absence of some nutrients (such as fiber, calcium, and phosphorus) may be related to non-mandatory declaration, lack of analytical determination, or presence in amounts below the limits established by current legislation. Therefore, these data should be interpreted with caution, as they may impact the estimation of the intake of these nutrients.

Table 4 presents the descriptive analysis of the most frequently found ingredients in the 30 analyzed labels. A total of 146 distinct ingredients were identified, with variation in frequency across products. The presence of salt was identified in 13 labels (43.3%).

Table 4 – Most frequently found ingredients on the labels of the analyzed products (n = 30).

Ingredients	Overall (n=30)	
	n	%
Water		
Citric acid (acidulant)	14	46.7%
Salt	13	43.3%
Sugar	11	36.7%
Potassium sorbate	9	30.0%
Soy lecithin		
Vegetable oils and fats	6	20.0%
Flavorings		
Sodium benzoate		
Sodium bicarbonate		
Ammonium bicarbonate	5	16.7%
Invert sugar		
Lactic acid (acidulant)		

Continuous Table 4 – Most frequently found ingredients on the labels of the analyzed products (n = 30).

Ingredients	Overall (n=30)	
	n	%
Fully hydrogenated/interesterified oils and fats		
Wheat flour enriched with iron and folic acid		
Natural flavor	4	13.3%
Acesulfame potassium		
Pasteurized cream		
Tetrasodium pyrophosphate		
Calcium chloride		
Sodium metabisulfite	3	10.0%
Starch		

n = sample size. Data are presented as absolute values and frequency percentages, and as mean ± standard deviation (parametric data).

DISCUSSION

The analysis of the data collected in this study highlights the contribution of ultra-processed foods to the diet of the evaluated population. The intake of these foods may contribute to increased risks associated with CKD and its treatment. Previous studies in HD populations and in the general population have demonstrated an association between higher consumption of ultra-processed foods and poorer diet quality, as well as increased intake of sodium, phosphorus, and food additives[13,28-30].

Based on the 24-hour dietary recall, a relatively balanced macronutrient distribution was observed, with carbohydrate and protein intake within recommended ranges, while lipid intake was below recommended level[31]. However, no statistical comparisons with reference values were performed, and this interpretation should therefore be considered descriptive.

Regarding micronutrients, the median daily sodium intake significantly exceeded the recommended maximum of 2000 mg/day according to current guidelines[31-33]. High sodium intake, particularly in patients with CKD, is associated with increased blood pressure, cardiovascular overload, and excessive interdialytic weight gain. In this context, sodium restriction is an essential measure for maintaining clinical stability in these patients[1,32,34]. The magnitude of sodium intake observed in this study is consistent with previous findings in HD patients, in whom sodium consumption often exceeds recommendations, highlighting the difficulty of adhering to dietary restrictions in this population[13,30].

With regard to food group consumption, the finding that 18.5% of TEI was derived from ultra-processed foods indicates a relevant contribution of this group to the dietary routine of this population. Although lower than that observed in studies of the general Brazilian population where contributions may exceed 20–30% of TEI this value is still considerable given the specific dietary recommendations for HD patients[26]. This percentage reflects a dietary pattern of low quality, often associated with the development and progression of conditions such as hypertension and diabetes, which worsen the prognosis of CKD in HD[17,35].

The low proportion of fresh or minimally processed foods and fiber intake may indicate a diet with lower nutrient density, implying poorer dietary quality. Low fiber intake has been associated with impaired intestinal transit, increased absorption of uremic toxins, and reduced fecal excretion of substances such as potassium and phosphorus. These effects may contribute to an increased risk of cardiovascular complications, which are highly prevalent in the HD population[36].

Through dietary recall, the most frequently consumed ultra-processed foods were also identified. This study revealed significant consumption of margarine, cream cheese, and soft drinks. These foods are characterized by high levels of sodium, fats, and food additives, such as phosphates and emulsifiers, which may contribute to relevant metabolic disturbances in CKD. The literature indicates that phosphate additives present in industrialized products have high bioavailability (up to 90–100%), unlike plant-based phosphorus, which has lower absorption[12,37,38]. In this context, minimally processed foods such as legumes and whole grains present lower bioavailability of these compounds and are therefore more suitable alternatives for this population.

In parallel with dietary intake analysis, the evaluation of ultra-processed food labels revealed characteristics commonly associated with this group, such as high energy density and the presence of sodium and food additives. However, it is important to note that ultra-processed foods may vary in composition, including products with added fiber or micronutrient fortification, which does not necessarily reflect better nutritional quality due to the concurrent presence of additives and the degree of processing[30].

The analyzed products generally showed a composition rich in compounds such as phosphates and sodium, frequently used as additives for preservation and flavor enhancement. These components are rapidly absorbed by the body and may exacerbate electrolyte imbalances and inflammatory processes in HD patients[39-41].

Furthermore, the recurrent presence of additives such as preservatives, emulsifiers, acidulants, and artificial flavorings is a marker of the high degree of processing. Although widely used in the food industry, studies suggest that habitual consumption of these compounds is associated with adverse health effects, including increased systemic inflammation, metabolic alterations, and negative impacts on gut microbiota factors particularly relevant for the HD population[42,43].

Another important aspect concerns the absence or limitation of information on food labels. According to current regulations, not all nutrients and additives are mandatory for declaration, which may lead to underestimation of the intake of compounds such as phosphorus and phosphate additives. Additionally, even when not explicitly described, products may contain added ingredients or fortified vitamins that alter their nutritional profile. However, the presence of these compounds does not necessarily indicate better nutritional quality, as they are often associated with foods that are highly processed, energy-dense, and rich in additives[43,44].

Thus, the analysis of ultra-processed food labels corroborated the findings from the dietary intake assessment. The frequent presence of products high in sodium, low in fiber, and lacking vitamins directly reflects the observed dietary pattern, characterized by a high intake of industrialized foods and low consumption of fresh foods.

Considering that the most frequently consumed ultra-processed products presented high sodium content, low fiber content, and the presence of additives, the dietary pattern identified among patients becomes understandable. In other words, the poor diet quality observed reflects not only the type of food consumed but also its nutritional composition, reinforcing the potential risks associated with this dietary profile in individuals with CKD[30].

This study has limitations that should be considered when interpreting the results. Notably, the use of a single 24-hour dietary recall does not allow for assessment of habitual intake. Additionally, there are no established reference values for ultra-processed food consumption, as current recommendations advise avoiding or minimizing their intake. Therefore, the presence and frequency of consumption of these foods already represent a relevant finding in terms of diet quality. Nevertheless, the results contribute to a better understanding of dietary patterns in hemodialysis patients and highlight the need for nutritional strategies aimed at reducing the consumption of ultra-processed foods in this population.

CONCLUSION

The results of this study demonstrate a high consumption of ultra-processed foods in the diet of HD patients in the sample studied, contributing significantly to total daily energy intake. Dietary assessment using a 24-hour recall revealed high sodium intake and low fiber intake, as well as a lower contribution of fresh foods factors potentially associated with cardiovascular risk, although not directly evaluated in this study.

The analysis of the nutritional composition of the main ultra-processed foods consumed revealed products high in sodium and food additives. The variability and, in some cases, insufficiency of information on nutrition labels may hinder food literacy and adherence to dietary recommendations among hemodialysis patients.

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