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Elderly patients on hemodialysis have worse dietary quality and higher consumption of ultraprocessed food than elderly without chronic kidney disease

Aline Moutinho Martins M.S. [a], Annie Seixas Bello Moreira Ph.D. [a,b], Daniela Silva Canella Ph.D. [a,b], Juliana Rodrigues Ph.D. [a], Fernanda Santin M.S. [a], Brenda Wanderley [c], Roberto Alves Lourenço M.D., Ph.D. [d], Carla Maria Avesani Ph.D. [a,b,*]

[a] Graduate program in Food, Nutrition and Health, Nutrition Institute, Rio de Janeiro State University, Rio de Janeiro, Brazil
[b] Department of Applied Nutrition, Nutrition Institute, Rio de Janeiro State University, Rio de Janeiro, Brazil
[c] Nutrition Institute, Rio de Janeiro State University, Rio de Janeiro, Brazil
[d] Internal Medicine Department, School of Health Sciences, Rio de Janeiro State University, Rio de Janeiro, Brazil

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ABSTRACT

Objectives: The multiple dietary restrictions recommended to patients on hemodialysis (HD), coupled with conditions imposed by aging, may lead to poor dietary quality in these patients. The aim of this study was to investigate the dietary quality and consumption of ultraprocessed food by elderly patients on HD and those without chronic kidney disease (CKD). Additionally, diets on the day of dialysis and on nondialysis days were evaluated.

Methods: This was a cross-sectional study conducted with 153 noninstitutionalized elderly patients on HD (Elder-HD) and 47 non-CKD elderly (Elder-Healthy) aged ≥60 y. From a 3-d food record, the dietary quality was assessed using the Brazilian Healthy Eating Index Revised (BHEI-R) and the energy contribution of food-processing groups.

Results: Compared with the Elder-Healthy group, the Elder-HD group showed a lower total BHEI-R score ($P < 0.05$). On the weekdays, the Elder-HD group showed lower scores ($P < 0.05$) of whole fruit, dark green vegetables and legumes, meat, eggs, and legumes, whereas total cereals showed a higher score ($P < 0.05$). When furthering the analysis on the Elder-HD group, although the total BHEI-R score did not differ among the days assessed, the components whole fruit, dark green vegetables, and legumes had lower scores ($P < 0.05$) on the day of dialysis, and the opposite was observed for milk and dairy products. Moreover, the Elder-HD showed a higher ($P < 0.05$) contribution of processed and ultraprocessed foods and lower ($P < 0.05$) contribution of natural or minimally processed foods.

Conclusion: The Elder-HD group showed poorer dietary quality and higher consumption of processed and ultraprocessed foods than the Elder-Healthy group. Moreover, when compared with the nondialysis day, these patients exhibited worse dietary quality, on the day of dialysis.

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Introduction

Individuals ≥65 y of age comprise the fastest growing subset of patients with end-stage renal disease (ESRD), according to the United States Renal Data System [1]. The prevalence of protein–energy wasting (PEW) in elderly patients on dialysis is higher than that of young patients [2–4], indicating that elderly patients on dialysis are more vulnerable and require special attention to prevent and improve this often observed comorbidity [5]. Up to

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* Corresponding author. Tel.: +55-21-2334-0270.
E-mail address: carla.avesani@gmail.com (C. M. Avesani).

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now, the current specialized nutrition guidelines for the care of dialyzed patients have not differentiated the energy and nutrient needs between elderly and young patients on dialysis [6,7]. Moreover, the guidelines focus on the intake of energy, protein, potassium, phosphorous, and sodium, not considering the overall dietary quality.

Thus, considering that the dietary quality influences the course of the disease, studies focused on the assessment of this field are of the utmost importance. Recent observational studies on large cohorts have shown that a healthier dietary pattern is associated with a lower likelihood of ESRD, higher survival rates in individuals with manifest chronic kidney disease (CKD) [8] and lower systemic inflammation, as well as better renal function [9]. Similarly, in individuals without CKD, there are studies linking a poorer dietary quality to worse cardiovascular outcomes [10,11]. Additionally, the multiple dietary restrictions often recommended for dialyzed patients are difficult to achieve, as they impose an important change in the habitual food intake and represent a lifestyle modification. Consequently, patients might limit intake of fruit, vegetables, grains, meat, milk, and dairy products, which will overall lead to a poor dietary quality [12]. In fact, in a study conducted with adult hemodialysis (HD) patients, comparing the reported nutrient intake from 3-d food records with the recommended guidelines, it was observed that a large proportion of patients did not meet the current renal-specific dietary recommendations. Additionally, the quality of diet was considered poor and proatherogenic, triggered by an excessive intake of saturated fat, and an insufficient intake of fiber, vitamins, and micronutrients [13]. Also of importance, the insufficient intake in terms of energy and nutrients, as well as poor dietary quality, may be made worse by dialysis treatment, due to the length of time spent at the clinic for the dialysis session. In agreement with this hypothesis, a previous study carried out by our group indicated that elderly patients on HD had lower intake of energy, protein, potassium, and phosphorous on the day of dialysis than on days without dialysis, and that elderly patients on dialysis had a lower intake of protein and phosphorous than their peers without CKD [14].

In this sense, and considering the factors just mentioned, the aim of the present study was to further investigate the food intake of elderly patients on HD, by focusing on dietary quality rather than on nutrient consumption. It was hypothesized that elderly patients on HD have a poorer overall quality of diet and that they presented with a higher consumption of processed and ultraprocessed food compared with elderly individuals without CKD. On the other hand, it was hypothesized that on the day of dialysis, a worse dietary quality and higher intake of processed and ultraprocessed food was observed when compared with the nondialysis days.

Materials and methods

Design and participants

This was an observational and cross-sectional study that included a convenience sample of 173 elderly patients on HD from six dialysis centers in Rio de Janeiro and one in São Paulo, Brazil. Additionally, 47 individuals with normal renal function (glomerular filtration rate [GFR] >60 mL·min·1.73 m^2) [15] from a cohort involved in research on frailty in the Brazilian elderly (Rede de Pesquisa Fragilidade em Idosos Brasileiros–Seção Rio de Janeiro, FIBRA-RJ Study) also were included as a control group. The elderly patients on HD were grouped as Elder-HD and individuals with normal renal function were grouped as Elder-Healthy. Data were collected between March 2011 and February 2014. The inclusion criterion for both groups included being $\geq$60 y of age. Those who were institutionalized; had amputated limbs or were dependent on wheelchairs; had acute infection, cancer, AIDS, liver disease, or Alzheimer's and Parkinson's diseases were not included in the study. For the Elder-HD group, in addition to the aforementioned eligibility criteria, patients on dialysis for $\geq$3 mo and with a dialysis regimen of three weekly sessions on alternate days (each session lasting 3.5–4 h) were included. Patients who did not complete the 3-d food record were excluded (n = 20). Therefore, the present analysis comprised 153 of 173 elderly patients on HD and 47 healthy elderly individuals. The comparison between participants included (n = 153) and those who were excluded (n = 20) showed no significant differences in the proportion of sex, age, urea Kt/V, and body mass index (BMI; data not shown). All participants gave written informed consent before their enrollment in the study, and Ethics Committee of Rio de Janeiro State University approved the study protocols.

Clinical examinations

The investigation was conducted under standardized conditions. Eligible individuals who accepted enrollment into the study received a food record with detailed instructions on how to complete it. BMI was calculated as the ratio of the body weight (kg) to the height (m^2) [16]. For HD patients, body weight was obtained immediately after their HD session. Estimated GFR was calculated from serum creatinine concentrations (mg/dL) by the CKD Epidemiology Collaboration equation [17]. Urea KtV was calculated to evaluate the efficiency of dialysis by using the equation proposed by Daugirdas [18], in which values $>$ 1.2 were considered adequate. The presence of comorbidities was registered from medical records. Body weight, height, and comorbidity assessment of Elder-Healthy group were assessed at the Interdisciplinary Nutritional Assessment Laboratory from Nutrition Institute, Rio de Janeiro State University.

Assessment of dietary intake

All participants filled out a 3-d food record, including two days from Monday to Saturday (called weekday) and one weekend day (Sunday). To assess separately the day of dialysis and the nondialysis days of the Elder-HD group, the two weekdays corresponded to one dialysis day and one nondialysis day. A dietitian instructed individuals from both groups on how to perform dietary registration. All types and amounts of food and liquid ingested were reported in household measurements, or specified as portion sizes, according to household utensils such as spoons, cups, glasses and plates that were shown to the patient. Those who could not read or who were physically limited in their ability to write had an accompanying person, and were instructed on how to fill in the food record. Food records were reviewed in detail with each participant by using household utensils and food models to improve the accuracy of recorded information.

A considerable number of individuals from the Elder-Healthy group did not complete the second weekday of food record, thus the analysis was comprised by the first day of the food record. The comparisons between Elder-HD and Elder-Healthy were performed between weekend and weekdays of each group (i.e., dialysis day of the Elder-HD group versus day 1 of the Elder-Healthy group; nondialysis day of the Elder-HD group versus day 1 of the Elder-Healthy group, and weekend day of Elder-HD group versus weekend day of the Elder-Healthy group).

The reported food quantities were converted into kcal and g or mg of nutrients based on the nutritional composition table of the food consumption in Brazil [19]. Additionally, to classify food groups, standard recipes were used to disaggregate culinary preparations into individual food items [20].

Assessment of dietary quality

Dietary quality was evaluated by the Brazilian Healthy Eating Index–Revised (BHEI-R) based on the Healthy Eating Index (HEI) devised by Kennedy et al. [21], which was adapted for local needs by Fisberg et al. [22] and revised by Previdelli et al. [23]. The BHEI-R is based on the previous Dietary Guidelines for the Brazilian Population [24] and consists of 12 components, each of which has a minimum score of zero and a maximum score of 20, depending of the component. The intermediate values were calculated proportionally, resulting in a maximum score of 100 (Table 1). Table 1 describes the BHEI-R, which includes nine components based on food groups (total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk and dairy products, meat and beans, and oils). It also includes two components based on nutrients (saturated fat and sodium); and one component derived from solid fat, alcohol, and added sugar (SoFAAS).

Assessment of energy contribution of food processing groups

Food items were grouped according to a classification based on the nature, extent, and purpose of food processing, as proposed by Monteiro et al. [25]. Thus, as described in Table 2, foods were grouped into the following three categories: natural and minimally processed foods; processed culinary ingredients; processed and ultraprocessed foods. The percentage of total energy intake for each group was calculated.

Table 1
Brazilian Healthy Eating Index–Revised: Overall and components scoring

Components	Scoring				
	0	5	8	10	20
Total fruit*	0	1 serving/4186 kJx			
Whole fruit†	0	0.5 serving/4186 kJ			
Total vegetable‡	0	1 serving/4186 kJ			
Dark green and orange vegetables and legumes‡	0	0.5 serving/4186 kJ			
Total grains§	0	2 servings/4186 kJ			
Whole grains	0	1 serving/4186 kJ			
Milk and dairy products‖	0			1.5 servings/4186 kJ	
Meat, eggs and legumes	0			1 serving/4186 kJ	
Oils¶	0			0.5 serving/4186 kJ	
Saturated fat	≥15		10	7% of TEI	
Sodium	≥2		1	≤0.7 g/4186 kJ	
SoFAAS	≥35				≤10% of TEI

SoFAAS, solid fat, alcohol, and added sugar; TEI, total energy intake
* Including fruit and fruit juices.
† Excluding fruit juices.
‡ Including legumes only after maximum score for meat, eggs, and legumes is reached.
§ Total cereals represents the groups of cereals, roots, and tubers.
‖ Including soy-based milk and dairy products.
¶ Including mono- and polyunsaturated fats, oilseeds, and fish oils.
Adapted from Previdelli et al. [23].

Statistical analysis

Values are presented as mean (±SD), median (interquartile range), or percentage, as appropriate. The Kolmogorov–Smirnov or Shapiro–Wilk tests were applied to test normality of the studied variables. The unpaired *t* test or nonparametric Mann–Whitney test were used to compare demographic, clinical characteristics, and dietary consumption between the two groups. The comparisons within the Elder-HD group among the dialysis and nondialysis days and weekend day were made by the repeated measures of analysis of variance with Bonferroni post hoc when applicable. The categorical variables were compared by χ^2 test. By considering an expected difference of 8.5% (based on findings from a previous study [14]) on the primary outcome (BHEI-R) and a significance level fixed at 0.05, the post hoc analysis to detect differences in the BHEI-R between the Elder-HD and Elder-Healthy groups was 95.15%. All the statistical analyses were conducted using Statistical Package for Social Sciences, version 20 for windows (SPSS Inc, Chicago, IL, USA). All tests were two-tailed, and $P < 0.05$ was considered statistically significant.

Results

General characteristics

Table 3 depicts the comparison of general characteristics between the Elder-HD and Elder-Healthy groups. Except for the proportion of men and BMI, the remaining characteristics were similar between groups. In both groups, mean age was around the seventh decade of life and hypertension was the main comorbidity observed. The estimated GFR showed that participants from the Elder-Healthy group had normal renal function.

Comparisons between Elder-HD versus Elder-Healthy groups

Table 4 shows the comparisons of the dietary quality and food consumption, classified according to industrial processing, between Elder-HD and Elder-Healthy groups. The total BHEI-R score was significantly lower in Elder-HD group than in the Elder-Healthy group on the weekend day, on the dialysis day, and on the nondialysis day, inferring that the Elder-HD group had an overall poorer dietary quality. When comparing the scores of each component in accordance with the day assessed, and further taking the Elder-Healthy group as reference, the Elder-HD group had more components with lower scores ($P < 0.05$) on the dialysis day than on the nondialysis day. Of note, the score of total cereals component on the Elder-HD was higher than that of the Elder-Healthy group for the day of dialysis and nondialysis day, which probably indicates a higher intake of bread, biscuits, and snacks by Elder-HD patients. Regarding food processing groups, the contribution of energy from processed and ultra-processed foods of the Elder-HD was higher than that of the Elder-Healthy for the weekend day and for the day of dialysis. For natural or minimally processed foods, the Elder-HD group had a lower intake on the weekend, dialysis, and nondialysis days compared with the Elder-Healthy group.

Comparisons within Elder-HD group

We examined the dietary quality of the Elder-HD group between the day of dialysis, nondialysis day, and the weekend day. As shown in Table 5, the total score of the BHEI-R was similar

Table 2
Food classification based on the nature, extent and purpose of industrial processing

Food classification	Examples
Natural and minimally processed foods	Fresh, chilled, frozen, vacuum-packed fruits, vegetables, fungi, roots, and tubers; grains (cereals) in general; fresh, frozen, and dried beans and other pulses (legumes), dried fruits and 100% unsweetened fruit juices; unsalted nuts and seeds; fresh, dried, chilled, frozen meats, poultry and fish; fresh and pasteurized milk, fermented milk such as plain yogurt; eggs; teas, coffee, herb infusions, tap water, bottled spring water.
Processed culinary ingredients	Vegetable oils, margarine, butter, milk cream lard; sugar, sweeteners in general; salt; starches, flours, and "raw" pastas and noodles (made from flour with the addition only of water); corn syrup.
Processed and ultraprocessed foods	Breads, biscuits (cookies), cakes and pastries; ice cream; jams (preserves); fruits canned in syrup; chocolates, confectionary (candies), cereal bars, breakfast cereals with added sugar; chips, crisps; sauces; savory and sweet snack products; cheeses; sugared fruit and milk drinks; frozen pasta and pizza dishes; preprepared meat, poultry, fish, vegetable and other "recipe" dishes; processed meat including chicken nuggets, hot dogs, sausages, burgers, fish sticks; canned or dehydrated soups, stews and pot noodle, salted, picked, smoked or cured meat and fish; vegetables bottled or canned in brine, fish canned in oil; infant formulas, follow-on milks, baby food.

Adapted from Monteiro et al. [25].

among all evaluated days, although some of the food components differed according to the days assessed. Of note, a lower score of whole fruits, dark green and orange vegetables, and legumes was observed on the day of dialysis compared with the nondialysis day, whereas the opposite was observed for milk and dairy products. Moreover, the component of saturated fat was higher on the dialysis and nondialysis days than on the weekend day. Regarding the contribution of different food groups according to the extent and purpose of food processing, on each day assessed, the energy contribution of processed and ultraprocessed foods was higher on the day of dialysis compared to the weekend day. The opposite occurred for the contribution of culinary ingredients toward total energy intake, probably indicating that on dialysis days, patients eat more sandwiches and snacks as a meal substitute. Moreover, as can be seen in Figure 1, for all assessed days, a small percentage of patients reached the recommended intake of the BHEI-R components and that a higher percentage of patients reached the recommend intake of whole fruit on nondialysis day compared with both dialysis and weekend days.

Table 3
Main demographic and clinical characteristics of Elder-HD and Elder-Healthy groups

Variable	Elder-HD group (n = 153)		Elder-healthy group (n = 47)		*P* value*
	Mean	SD or IR	Mean	SD or IR	
Age (y)	70.8†	7.2	73.2	7.9	0.06
BMI (kg/m^2)	25.5†	4.4	27.3	5.5	0.03
Urea Kt/V	1.49†	0.4	–	–	–
eGFR (mL·min·1.73 m^2)	–	–	74.7	14.5	–
Dialysis length (y)	2.8‡	(1.2–5.5)	–	–	–
Male	–	–	–	–	0.02
N	98	–	21	–	–
%	64.1	–	44.7	–	–
Main comorbidities					
Hypertension	–	–	–	–	0.03
n	116	–	28	–	–
%	75.8	–	59.6	–	–
Diabetes	–	10	–	–	0.04
n	57	–	21.3	–	–
%	37.3	–	–	–	–

BMI, body mass index; eGFR, estimated glomerular filtration rate; HD, hemodialysis
* Independent *t* test or Mann–Whitney or χ^2.
† Mean (SD).
‡ Median (IR).

Discussion

This study aimed to evaluate the dietary quality of elderly patients on HD through comparisons of BHEI-R and processed and ultraprocessed food consumption between elderly patients on HD and non-CKD elderly. Additionally, the analysis of dietary quality among dialysis, nondialysis, and the weekend days was furthered by comparing it within the Elder-HD group. As indicated in a review, studies focused on the nutritional aspects of elderly on dialysis are scarce [25]. The main finding of the present study was that the dietary quality of the Elder-HD group was worse than that of the Elder-Healthy group, as depicted by the lower BHEI-R and higher consumption of processed and ultraprocessed foods. Furthermore, by comparing the week day diet of the Elder-Healthy, a lower consumption of the components whole fruits, dark green vegetables, and legumes was seen on the day of dialysis. A higher consumption of the components cereals was observed on the day of dialysis, implying a worse overall dietary quality on this day, although the total BHEI-R did not statistically differ among the three days (Table 4). These results confirm the initial hypothesis, in which the overall dietary quality of Elder-HD is worse on the day of dialysis. Although the effect of dialysis on patient's behavior to choose more convenience food was not investigated, we speculate that the changes in the patient's daily routine, imposed by the dialysis treatment, are likely to partially explain these findings. The length of time away from home on the day of dialysis probably leads to the substitution of vegetables, legumes, meat, fruits, and other natural foods for ultraprocessed foods, such as snacks, sandwiches, fast foods, and cookies. Therefore, the present findings may stimulate the development of studies investigating the motivation behind food choices on dialysis days to foster the establishment of education programs aiming a better dietary quality to this segment of population.

Moreover, the many dietary restrictions recommended to HD patients also may relate to the present findings. In fact, dialyzed patients often are advised to limit their intake of fruit, vegetables, legumes, and animal protein, including beef and poultry, to achieve a better control of serum potassium and phosphorus. However, these multiple dietary restrictions might lead to a poorer overall dietary quality, consisting of a lower intake of fiber, vitamins, and nutrients that ultimately falls outside of what is generally recommended as a healthy diet [12]. Unfortunately, in the present study this alarming scenario was confirmed, once fewer patients reached the recommended intake for fruit, whole grains, dairy products, saturated fat, and sodium. Similarly, Kim

Table 4
Comparison of the total BHEI-R score and the energy contribution of food groups according to the day of the week

Variable	Weekend day					Week day						*P* value*,‡
	Elder-HD (n = 153)		Elder-healthy (n = 45)		*P* value*	Elder-HD dialysis day (n = 153)		Elder-HD nondialysis day (n = 153)		Elder-healthy (n = 45)		*P* value*,†	
	Mean	SD or IR	Mean	SD or IR		Mean	SD or IR	Mean	SD or IR	Mean	SD or IR		
BHEI-R													
BHEI-R total score	69.1	(62.5–76.7)	74.9	(67.6–79.8)	0.006	70.7	(65.7–76.7)	72.5	(65.6–77.7)	76.4	(69.9–79.7)	0.005	0.02
Total fruit§	3.3	(1.1–5)	4.2	(1–5)	0.51	3.7	(0.2–5)	3.7	(0.8–5)	5	(2.3–5)	0.07	0.19
Whole fruit‖	4.6	(0.0–5)	5	(0.4–5)	0.28	3.1	(0–5)	5	(0–5)	5	(2–5)	0.009	0.32
Total vegetable¶	3.7	1.7	3.9	1.7	0.42	3.9	1.7	4	1.6	4.3	1.4	0.17	0.34
Dark green and orange vegetables and legumes¶	3.5	2.1	3.7	1.9	0.53	3	2.3	3.6	2	3.9	1.8	0.004	0.12
Total cereals#	4.7	0.7	4.8	0.6	0.98	4.8	0.6	4.7	0.7	4.4	0.9	<0.001	0.002
Whole grains	0	(0–0)	0	(0–2.4)	<0.001	0	(0–0)	0	(0–0)	0	(0–0)	0.002	<0.001
Milk and dairy products**	4.9	(2.5–8.9)	6	(2.8–8.6)	0.56	5.1	(3–8.7)	4.7	(2–7.4)	5.6	(3.6–9.7)	0.36	0.058
Meat, eggs and legumes	8.8	2.5	9.3	1.9	0.26	8.6	2.5	9.0	2.2	9.7	0.9	0.01	0.25
Oils††	–	–	–	–	–	–	–	–	–	–	–	–	–
Saturated fat	8.3	(5.3–9.5)	9.2	(7.9–10)	0.03	8.6	(7–9.6)	9.2	(6.3–10)	8.2	(3.6–10)	0.22	0.048
Sodium	2.6	(0.3–5.2)	2.4	(0–4.8)	0.21	2.4	(0.2–4.7)	1.9	(0–3.8)	1.2	(0–3.7)	0.04	0.20
SoFAAS	16.4	5.4	17.5	5.1	0.31	18	3.6	17.5	4.6	18.2	4.8	0.17	0.02
Food processing (%TEI)													
Natural or minimally processed foods	43.8	16,7	52.4	15.7	0.003	41.7	15.9	44.5	18.1	50.1	13.7	0.002	0.03
Culinary ingredients	18.6	(12.1–25.2)	17.6	(12.1–22.6)	0.41	15.5	(8.8–23.8)	16.5	(9.8–23.7)	14.5	(10.8–22.4)	0.88	0.48
Processed and ultraprocessed foods	36.7	18.2	29.7	17.2	0.026	41.6	17.6	37.8	18.3	33.4	15.9	0.005	0.15

BHEI-R, Brazilian Healthy Eating Index–Revised; HD, hemodialysis; SoFAAS, solid fats, alcohol and added sugar; TEI, total energy intake
* Independent *t* test or Mann–Whitney test.
† *P* value of the comparison between the day of dialysis of the Elder-HD vs week day of the Elder-Healthy group.
‡ *P* value of the comparison between the nondialysis day of the Elder-HD versus week day of the Elder-Healthy group.
§ Including fruit and fruit juices.
‖ Excluding fruit juices.
¶ Including legumes only after maximum score for meat, eggs, and legumes is reached.
# Total cereals represents the groups of cereals, roots, and tubers.
** Including soy-based milk and dairy products.
†† Including mono- and polyunsaturated fats, oilseeds, and fish oils.

Table 5
Comparison of the total BHEI-R score and the energy contribution of food groups on the weekend day, dialysis day, and nondialysis day of Elder-HD group (N = 153)

Components	Weekend day		Dialysis day		Nondialysis day		*P* value*
	Mean	SD or IR	Mean	SD or IR	Mean	SD or IR	
BHEI-R							
BHEI-R total score	69.1	(62.5–76.7)	70.7	(65.7–76.7)	72.5	(65.6–77.7)	0.09
Total fruit†	3.3	(1.1–5)	3.7	(0.2–5)	3.7	(0.8–5)	0.66
Whole fruit‡	4.6^{ab}	(0–5)	3.1^{a}	(0–5)	5^{b}	(0–5)	0.007
Total vegetable§	3.7	0.1	3.9	0.1	4	0.1	0.26
Dark green and orange vegetables and legumes§	3.5^{ab}	0.2	3^{a}	0.2	3.6^{b}	0.2	0.03
Total grains‖	4.7	0.1	4.8	0.1	4.7	0.1	0.11
Whole grains	0	(0–0)	0	(0–0)	0	(0–0)	0.15
Milk and dairy products¶	4.9^{ab}	(2.5–8.9)	5.1^{a}	(3–8.7)	4.7^{b}	(2–7.4)	0.04
Meat, eggs, and legumes	8.8	0.2	8.6	0.2	9.0	0.2	0.26
Oils#	10	0	10	0	10	0	–
Saturated fat	8.3^{a}	(5.3–9.5)	8.6^{b}	(7–9.6)	9.2^{b}	(6.3–10)	0.01
Sodium	2.6^{a}	(0.3–5.2)	2.4^{ab}	(0.2–4.7)	1.9^{b}	(0–3.8)	0.02
SoFAAS	16.4^{a}	0.4	18^{b}	0.3	17.5^{ab}	0.4	0.002
Food Processing (%TEI)							
Natural or minimally processed foods	43.8	16.7	41.7	15.9	44.5	18.1	0.219
Culinary ingredients	18.6^{a}	(12.1–25.2)	15.5^{b}	(8.8–23.8)	16.5^{ab}	(9.8–23.7)	0.002
Processed and ultraprocessed foods	36.7^{a}	18.2	41.6^{b}	17.6	37.8^{ab}	18.3	0.01

BHEI-R, Brazilian Healthy Eating Index–Revised; SoFAAS, solid fats, alcohol, and added sugar; TEI, total energy intake
Values followed by superscript letters (^{a} and ^{b}) differ statistically from each other ($P < 0.05$)
* Analysis of variance for repeated measures with post hoc Bonferroni when applied or Friedman test with Wilcoxon, depending on the distribution.
† Including fruit and fruit juices.
‡ Excluding fruit juices.
§ Including legumes only after maximum score for meat, eggs, and legumes is reached.
‖ Total cereals represents the groups of cereals, roots and tubers.
¶ Including soy-based milk and dairy products.
# Including mono- and polyunsaturated fats, oilseeds and fish oils.

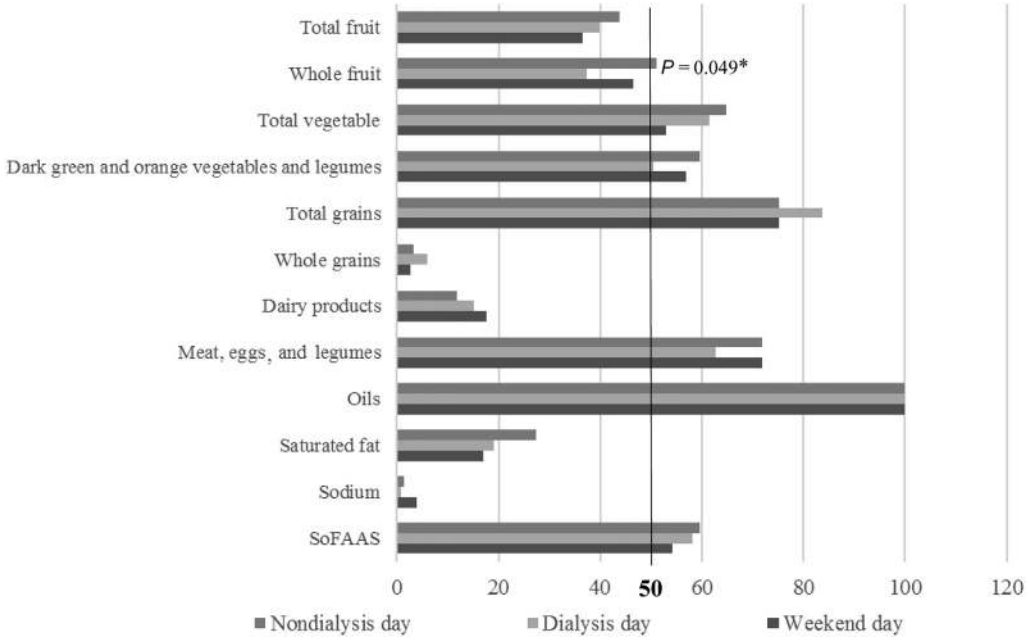

Fig. 1. Frequency (%) of elderly patients on hemodialysis who reached the maximum score for each component of the Brazilian Healthy Eating Index Revised (BHEI-R) according to the day of the week (N = 153). SoFAAS, solid fats, alcohol, and added sugar. $^{*}\chi^2$ test.

et al. [26] found that only 28% of HD patients had an adequate intake of fruit, 52% of fiber, and 40% of sodium. In accordance with these results, Vaz et al. [27] found a smaller percentage of adequacy in the consumption of fruit (5%) and saturated fat (13%), as well as 100% inadequacy in the consumption of dairy products, oils, and fats by Brazilian HD patients. Finally, Luis et al. [13], investigating the dietary quality of HD patients, reported a poor and proatherogenic dietary pattern, according to the American Heart Association guidelines, with only 32% of patients meeting the recommendation for saturated fat and 8% for fiber.

These findings can be used to rethink the benefits of these dietary restrictions regarding the overall health of dialyzed patients. As an example, a recent review showed that there is not enough evidence that the restriction of high-potassium plant foods is able to prevent hyperkalemia in HD patients [28]. The restriction of natural sources of protein, as a way to diminish phosphorous intake, also requires a special attention. Shinaberger et al. [29] reported in prevalent HD patients that compared with those whose serum phosphorus and dietary protein intake rose in 6 mo, the mortality rates increased in 11% and 6%, respectively, in the group comprised by patients whose phosphorus increased and dietary protein decreased, and in those whose phosphorus and dietary protein intake concomitantly decreased.

Aligned with the results indicating a poorer dietary quality on Elder-HD patients, the consumption of processed and ultraprocessed food by this group was higher than in Elder-Healthy patients. The percentage of energy contribution of processed and ultraprocessed food consumption found in Elder-Healthy group is similar to that reported by Louzada et al. [30], who showed that 30.5% of total energy intake by Brazilians is from processed (9%) and ultraprocessed foods (21.5%). Of note, the intake of processed and ultraprocessed foods on the day of dialysis was even higher than that reported by Louzada et al. [30], which corroborates the present findings indicating a worse dietary quality on the day of dialysis. To the best of our knowledge, this is the first study to investigate the consumption of processed and ultraprocessed foods among HD patients.

Considering the aforementioned, dietary counseling with HD patients should focus on efforts to promote a healthier diet, rather than to restrict the intake of specific nutrients. In accordance with this proposal, current Dietary Guidelines for the Brazilian Population [31], which is a tool to support food and nutrition educational activities, addresses the principles and recommendations of a healthy diet, not focusing on the recommendation of isolated nutrients. Rather it should focus on recommendations of food, meals, and eating modes, in the increase of the intake of natural or minimally processed food (and therefore avoiding the ultraprocessed), guidance on how to combine foods in the form of meals and identifying barriers to adopt healthier diets. Although this guideline was developed to promote health and to prevent diseases in the general population, these recommendations may be useful to those individuals suffering from specific diseases, such as CKD on dialysis.

This study presents certain limitations. First, the cross-sectional design hinders investigation of the association between a poor quality diet and outcomes on comorbidity and death. Second, the small sample size of control group has a weak statistical power for comparisons between the Elder-HD and Elder-Healthy groups. Despite these limitations, the strength of this study is related with the assessment of dietary quality and consumption of processed and ultraprocessed foods, rather than energy and nutrient intakes, as opposed to most of the previous studies investigating food intake in HD patients. Additionally, it focused on the assessment of food intake in elderly patients on dialysis, which comprises the fastest growing subset of patients with ESRD [1].

Conclusion

The results of this study determined that the Elder-HD group has a poorer quality diet and a higher consumption of processed and ultraprocessed foods than in the Elder-Healthy group. This situation worsened on the day of dialysis. Thus, a revision of the current renal-specific dietary guidelines, focusing on the

improvement of the dietary quality, to complement the current recommendations in terms of energy and nutrients was suggested.

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