Frequency of intake of dietary fiber food groups, its determinants, and the relationship with hyperkalemia in hemodialysis patients in a multicenter study

Fabiana Baggio Nerbass (fabiana.nerbass@gmail.com)
Fundação Pró-Rim

Natalia K Scatone
Centro de Tratamento de Doenças Renais

Juliana Malinovski
Centro de Tratamento de Doenças Renais

Andrea C Sczip
Centro de Tratamento de Doenças Renais

Jorgiane C Oliveira
Fundação Pró-Rim

Jyana G Morais
Fundação Pró-Rim

Christiane I Ramos
Universidade Federal de São Paulo

Rafaela G Santos
Centro de Tratamento de Doenças Renais

Research Article

Keywords: hemodialysis, food frequency questionnaire, dietary fiber, hyperkalemia

Posted Date: April 6th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1510340/v1

Abstract

Purpose: Patients undergoing hemodialysis (HD) treatment can have a low intake of dietary fiber-rich food groups to decrease hyperkalemia risk. This multicenter cross-sectional study aimed to investigate the frequency of intake of dietary fiber sources, its determinants, and the relationship with hyperkalemia in HD patients.

Methods: HD patients from four dialysis clinics answered a food frequency questionnaire (FFQ) involving the main dietary fiber sources with seven frequency possibilities. The answers were converted into scores. Each score point corresponded to one time per week. Demographic, nutritional, and laboratory data were obtained from the medical records. Univariate analysis was used to assess total score associations, and variables with $P<0.20$ were included in the regression analysis model.

Results: A total of 305 HD patients were included (male: 51%; age: 52.2±14.7 years; hyperkalemia: 29%). The median (interquartile) FFQ scores were as follows: fruits, 6 (2–14); vegetables, 6 (3–10); legumes, 3 (1–7); whole-grain, 0 (0–1); and seeds, 0 (0–0); total score, 19 (14–28). No difference was found between the dietary fiber food groups and total scores with hyperkalemia. Independent predictors of dietary fiber total score were older age, higher HD vintage, higher body mass index (BMI), and higher educational level.

Conclusion: The usual frequency of dietary fiber food groups intake was low, and its independent determinants were age, HD vintage, BMI, and education. The lack of association with hyperkalemia suggests that other dietary sources and clinical factors should be considered when managing hyperkalemia in this population.

Introduction

Traditionally, research on nutrition has focused on the relationship between individual nutrients and health outcomes, reporting conflicting results [1]. In recent years, there has been a gradual shift towards less reductionist approaches to examining diet-disease relationships according to, for example, the frequency of intake of food groups and the overall dietary patterns analysis [1, 2]. Despite being a recent development, this broader approach has also been applied to investigations of chronic kidney disease (CKD). In a multinational cohort study with more than 8000 adults from 11 European and South American countries undergoing hemodialysis (HD), lower consumption of fruits and vegetables was associated with higher all-cause and non-cardiovascular deaths [3].

In general, different HD populations have been found to have a consistently low intake of food groups considered healthy because of their natural content of dietary fiber, vitamins, minerals, and phytochemicals [3–5]. In addition to the influence of social, cultural, and other personal factors on dietary behavior [6], patients undergoing dialysis are frequently instructed to follow a low-potassium diet to avoid the risk of hyperkalemia. This dietary recommendation includes a controlled intake of fruits, vegetables, legumes, seeds and whole grains [7, 8]. However, observational studies in HD populations did not find significant associations between the estimated dietary potassium intake or

frequency of intake of potassium food sources and serum potassium concentration [3, 9] or hyperkalemia status [5]. Therefore, these results challenge the belief that the amount of potassium consumed strongly influences its concentration and raises awareness that restricted potassium diets can cause harm because of the impact on the overall diet quality [8].

In particular, a low intake of dietary fiber sources in HD has been associated with markers of uremic toxins, inflammation, oxidative stress, metabolic acidosis, impaired arterial stiffness, constipation, and cardiovascular mortality [10–14]. In this multicenter cross-sectional study, we aimed to investigate the frequency of intake of dietary fiber sources, its determinants, and the relationship with hyperkalemia in HD patients.

Materials And Methods

Participants and setting

This was a subset analysis of a multicenter cross-sectional study that primarily aimed to evaluate the prevalence and factors associated with constipation [14]. Participants were recruited from four dialysis units. The inclusion criteria were adult patients (>18 years old) with chronic HD for at least 90 days. We excluded patients on enteral nutritional support, presenting with mental and severe cognitive disorders, and those with visual impairment. At least 80% of eligible patients in each clinic were invited to participate (N=306), and only one patient refused to.

Study protocol

The participants were interviewed by the clinic's dietitians between December 2018 and May 2019.

A food frequency questionnaire (FFQ) was used to assess the frequency of intake of the main food sources of fibers over the last year, including fruits, vegetables, legumes, whole grains, and seeds. Examples of each group were provided. Fruits and vegetables were divided into two subgroups (rich/poor in potassium and raw/cooked, respectively). This subdivision was adopted because all patients had previously received nutritional advice to reduce the risk of hyperkalemia. Usually, we recommend three servings of a potassium-poor fruit or one serving of a potassium-rich fruit daily. The cut-off for classifying the fruit portion as being rich or poor in potassium was 195 mg (5mEq). For example, a regular-sized banana is rich in potassium, whereas a medium slice of pineapple is poor in potassium. With respect to raw vegetables, one saucer (~50 g) at lunch and another at dinner is recommended. We encourage the free consumption of cooked vegetables, provided the cooking water is discarded. As for legumes, we recommend avoiding the broth. Consumption of other fiber-rich foods (whole grains and seeds) is encouraged mainly for patients who complain of constipation during the dietitian's visits. The FFQ had seven intake options. To obtain the weekly frequency of each category, the answers were transformed into a score (Table 1), ranging from 0 (never) to 14 (twice a day). For example, a score of 1 indicated that the food group was consumed once a week. We calculated a single score for fruits and another for vegetables, adding the corresponding subgroup results.

Age, education, dialysis vintage, weight, and height to calculate body mass index (BMI), diabetes mellitus were collected from the electronic medical records. Serum potassium was obtained from blood collection in the midweek session and hyperkalemia was considered when the serum potassium level was higher than 5.5 mg/dL. For this analysis we used the result closer to FFQ application date.

The research protocol was approved by the local ethics committee (N. 3.127.551), and all participants signed an informed consent form.

Statistical analysis

Continuous variables are reported as the mean values and standard deviations when normally distributed or as the median and interquartile range when not. Comparisons between groups were performed by chi-square, Student's, or Mann-Whitney U tests, as appropriated. The correlations between continuous variables were verified by Pearson's or Spearman's tests. An exploratory analysis was performed to evaluate the determinants of fiber intake; the linear regression model included all variables associated with total score of fiber at P<0.20. Statistical analysis was performed using the Statistical Package for the Social Sciences version 21.0 for Windows (SPSS, Inc. Chicago, IL) and P value <0.05 was established as the limit of statistical significance.

Results

A total of 305 patients were included, and their main characteristics are shown in Table 2. Almost one-third of the patients had hyperkalemia (29%).

Figure 1 shows the frequency of intake of fiber source groups. The median score of fruits (6 [2–14]) and vegetables (6 [3–10]) indicates that these food groups were consumed around six times a week. A lower weekly frequency was observed for legumes (3 [1–6]), while whole grains (0 [0–1]) and seeds (0 [0–0]) were not consumed by most of the participants.

Table 3 shows the comparative analysis of all food groups and total scores according to the demographic, nutritional, and clinical characteristics. Males reported a higher frequency of fruit and legume intake than women, while older participants consumed whole grains more frequently. When compared according to the educational status, participants with higher educational levels had a higher frequency of intake of all food groups, except for legumes. Participants with diabetes mellitus had lower scores for legumes and higher scores for whole grain and total fiber. Those who were overweight based on the BMI had a lower score for legumes and higher scores for fruits, vegetables, whole grain, and total score. Participants on dialysis for less than 4 years also had a higher total fiber score than the others. No difference was found according to diuresis status neither between those with normal or high serum potassium levels.

Total fiber score was 19 (14-28), which correlated with age (r=0.15; P=0.01), HD vintage (r=-0.22; P<0.001), and BMI (r=0.15; P=0.007). Only the vegetable score was correlated with serum potassium

(r=0.17; P=0.03).

Linear regression analysis included all the compared variables with p<0.20. Independent determinants of total fiber score were age, years at school, HD vintage, and overweight status (Table 4).

Discussion

In this cross-sectional multicenter study of HD patients, we found that the participants who consumed more frequently dietary fiber sources were older, had a higher educational level, had less time on HD treatment, and were overweight. Also, the frequency of intake of these food groups was not associated with hyperkalemia.

Our participants reported a low frequency of intake of all the food groups included in the assessment. Although they had been counseled to control their intake of specific food groups to treat or decrease hyperkalemia risk, the frequency reported was lower than what is usually recommended. This dietary pattern is similar to results obtained by epidemiological studies performed in our country in the general population and in patients with CKD: low consumption of fruits, vegetables, and whole grains, leading to inadequate fiber intake [15–18].

Though different methods for evaluating and reporting food groups and dietary fiber intake have been used in the literature, it is still possible to make comparisons with our findings. A low intake of these food groups was also found in other HD populations worldwide [5]. In a multinational HD cohort study, the usual intake in servings per week of fruits was (5.5 [1.0–7.0]), vegetables (3.0 [1.0–5.5]), and legumes and nuts (1.0 [0.5–3.0]) [3]. In a study conducted in the United States, only 3% of the study population consumed at least four servings of fruits and vegetables per day [4].

Patients undergoing HD have very low dietary fiber intake compared to the daily recommendations for adults (25 g/day for women and 38 g/day for men [19]). In some American cohorts, the daily fiber intake ranged from 10 to 12 g/day, or around 50% lower than in a large American cohort [4, 20]. In Turkey, fiber intake of 12.6 ± 4.7 g/day was reported by 128 participants [10], while in Brazil, it varied from 9 to 19 g/day [12, 21, 22].

We found associations between the food groups and total scores with demographic, nutritional, and clinical variables. Of note, educational level and BMI influenced the frequency of intake of four out of the five food groups. Participants with higher educational levels consumed fruits, vegetables, whole grains, and seed sources more frequently, reflecting a higher level of information and monetary access since schooling directly influences family income [23]. Overweight participants had a higher score in fruits, vegetables, and whole grain and a lower score in legumes. We did not find other similar studies that assessed this relationship. We speculate that this pattern might be due to the higher overall quantity of food consumed among overweight participants. The lack of association between the frequency of fiber sources intake and hyperkalemia corroborates current evidence that diet is not the main cause of this common disorder in CKD [5, 9, 24]. It is well known that serum potassium is regulated not only by an

external balance (relationship among nutrient intake and its excretions) but also by many clinical factors that influence the shift between intra- and extracellular cites, such as diabetes and metabolic acidosis [5]. In a study with a Mexican HD cohort that investigated the factors associated with serum potassium, diabetes was an important hyperkalemia predictor [5]. Nevertheless, we cannot discard the potential bias of the amount of potassium ingested since the present, and most of the mentioned studies report low potassium intakes. Although we have not evaluated potassium intake, the association between dietary potassium and fiber is known [25] as those nutrients share important food sources, such as fruits, vegetables, legumes, and nuts.

Besides the amount, the bioavailability of potassium in food matrix may also influence its relationship with hyperkalemia. Potassium from plant foods seems to have less impact on potassemia than animal sources or potassium salts [24]. Carbohydrate-containing foods, such as fruits, stimulate insulinemia, which in turn induces the shift of potassium into the intracellular space [26]. At the same time, as sources of fiber, fruits and vegetables favor intestinal transit time and the consequent fecal excretion of potassium [27, 28]. In fact, a multinational cohort of 8078 HD patients found similar serum predialysis potassium levels across the tertiles of fruit and vegetable intake. More importantly, lower consumption of these food groups was associated with higher mortality [3]. Moreover, in a prospective cohort study, lower dietary potassium intake was associated with higher mortality risk, suggesting that excessive dietary potassium restriction may be deleterious in HD patients [25].

Independent determinants of total score showed that the frequency of intake of dietary fiber sources increased with age, education level, and BMI and was lower among patients on HD treatment for longer periods. In general, a higher intake of dietary fiber sources in older and higher education levels is evidenced in national surveys and HD populations [3, 29, 30]. Regarding BMI, although this parameter can reflect an overall higher quantity of food consumed, this might confer an advantage in terms of healthy nutrient intake and may benefit overweight patients. This aspect has not been discussed among the theories on the reasons behind the survival advantages consistently found in HD patients with increased BMI [31], but we believe it deserves attention.

Interestingly, HD vintage was also an independent determinant of the frequency of dietary fiber sources. It is currently unknown why patients on HD for shorter periods reported a higher intake of these food groups. Similarly, Saglimbene et al. reported that patients on HD for a shorter time had a higher fruit and vegetable intake [3]. It is possible that patients who had been on treatment for a longer time experienced more hyperkalemia episodes, influencing their food choices.

Some limitations of the study should be mentioned. Causal relationships cannot be established due to the cross-sectional nature of the study. Second, the dietary investigation was qualitative, limiting our ability to quantify the amount of fiber and potassium consumed. Finally, clinical factors associated with potassemia, which could further explain the results, were not captured. However, this exploratory analysis adds to the growing body of observational research on the relationship between diet and hyperkalemia and the importance of promoting a healthy diet among patients in HD.

In conclusion, the usual frequency of fiber source intake was low, and its independent determinants were age, HD vintage, education, and BMI. The lack of association with hyperkalemia suggests that other dietary sources and clinical factors should be considered when managing hyperkalemia in this population.

Declarations

Funding
This study was not funded.

Conflicts of interest/Competing interests

The authors have no relevant financial or non-financial interests to disclose

Availability of data and material

The research is data is available whenever required.

Authors contributions

FBN: study design, data analysis, manuscript draft

NKS, JM, ACS, JCO: study design, data collection, manuscript review

JGM: study design, manuscript review

CIR: data analysis, manuscript draft and review

RGS: study design, data collection, data analysis, manuscript review

Ethics approval

The research protocol was approved by the local ethics committee (N. 3.127.551)

Consent to participate
All participants signed an informed consent form.

Consent for publication: not applicable.

Acknowledgments: not applicable.

References

1. Hu FB (2002) Dietary pattern analysis: a new direction in nutritional epidemiology. Curr Opin Lipidol 13:3–9. https://doi.org/10.1097/00041433-200202000-00002

2. Leech RM, Worsley A, Timperio A, McNaughton SA (2015) Understanding meal patterns: Definitions, methodology and impact on nutrient intake and diet quality. Nutr Res Rev 28:1–21. https://doi.org/10.1017/S0954422414000262
3. Saglimbene VM, Wong G, Ruospo M, et al (2019) Fruit and Vegetable Intake and Mortality in Adults undergoing Maintenance Hemodialysis. Clin J Am Soc Nephrol 14:250–260. https://doi.org/10.2215/CJN.08580718
4. Tallman DA, Latifi E, Kaur D, et al (2020) Dietary patterns and health outcomes among African American maintenance hemodialysis patients. Nutrients 12:1–12. https://doi.org/10.3390/nu12030797
5. Ramos CI, González-Ortiz A, Espinosa-Cuevas A, et al (2020) Does dietary potassium intake associate with hyperkalemia in patients with chronic kidney disease? Nephrol Dial Transplant 1–9. https://doi.org/10.1093/ndt/gfaa232
6. St-Jules DE, Woolf K, Pompeii M Lou, Sevick MA (2016) Exploring Problems in Following the Hemodialysis Diet and Their Relation to Energy and Nutrient Intakes: The BalanceWise Study. J Ren Nutr 26:118–124. https://doi.org/10.1053/j.jrn.2015.10.002
7. Ikizler TA, Burrowes JD, Byham-Gray LD, et al (2020) KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. Am J Kidney Dis 76:S1–S107. https://doi.org/10.1053/j.ajkd.2020.05.006
8. Clase CM, Carrero JJ, Ellison DH, et al (2020) Potassium homeostasis and management of dyskalemia in kidney diseases: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. Kidney Int 97:42–61. https://doi.org/10.1016/j.kint.2019.09.018
9. Noori N, Kalantar-Zadeh K, Kovesdy CP, et al (2010) Dietary Potassium Intake and Mortality in Long-term Hemodialysis Patients. Am J Kidney Dis 56:338–347. https://doi.org/10.1053/j.ajkd.2010.03.022
10. Demirci BG, Tutal E, Eminsoy IO, et al (2019) Dietary Fiber Intake: Its Relation With Glycation End Products and Arterial Stiffness in End-Stage Renal Disease Patients. J Ren Nutr 29:136–142. https://doi.org/10.1053/j.jrn.2018.08.007
11. Goraya N, Simoni J, Jo C-H, Wesson DE (2013) A Comparison of Treating Metabolic Acidosis in CKD Stage 4 Hypertensive Kidney Disease with Fruits and Vegetables or Sodium Bicarbonate. Clin J Am Soc Nephrol 8:371–381. https://doi.org/10.2215/CJN.02430312
12. Esgalhado M, Kemp JA, Azevedo R, et al (2018) Could resistant starch supplementation improve inflammatory and oxidative stress biomarkers and uremic toxins levels in hemodialysis patients? A pilot randomized controlled trial. Food Funct 9:6508–6516. https://doi.org/10.1039/C8FO01876F
13. Lin Z, Qin X, Yang Y, et al (2021) Higher dietary fibre intake is associated with lower CVD mortality risk among maintenance haemodialysis patients: a multicentre prospective cohort study. Br J Nutr 1–9. https://doi.org/10.1017/S0007114521000210
14. dos Santos RG, Scatone NK, Malinovski J, et al (2021) Higher Frequency of Fruit Intake Is Associated With a Lower Risk of Constipation in Hemodialysis Patients: A Multicenter Study. J Ren Nutr 31:85–89. https://doi.org/10.1053/j.jrn.2020.07.004

15. Instituto Brasileiro de Geografia e Estatística (2010) Pesquisa de Orçamentos Familiares 2008-2009: aquisição alimentar domicilar per capita. Rio de Janeiro
16. Figueiredo ICR, Jaime PC, Monteiro CA (2008) Factors associated with fruit and vegetable intake among adults of the city of São Paulo, Southeastern Brazil. Rev Saude Publica 42:777–785. https://doi.org/10.1590/S0034-89102008000500001
17. Santin F, Canella DS, Avesani CM (2019) Food Consumption in Chronic Kidney Disease: Association With Sociodemographic and Geographical Variables and Comparison With Healthy Individuals. J Ren Nutr 29:333–342. https://doi.org/10.1053/j.jrn.2018.10.010
18. Santin F, Canella D, Borges C, et al (2019) Dietary patterns of patients with chronic kidney disease: The influence of treatment modality. Nutrients 11:1–12. https://doi.org/10.3390/nu11081920
19. Institute of Medicine (2005) Dietary reference intakes for water, potassium, sodium, chloride, and sulfate. In: Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. p 640
20. Therrien M, Byham-Gray L, Denmark R, Beto J (2014) Comparison of dietary intake among women on maintenance dialysis to a women's health initiative cohort: Results from the nkf-crn second national research question collaborative study. J Ren Nutr 24:72–80. https://doi.org/10.1053/j.jrn.2013.09.005
21. Erthal Leinig C, Pecoits-Filho R, Kunii L, et al (2019) Low-Fiber Intake Is Associated With High Production of Intraperitoneal Inflammation Biomarkers. J Ren Nutr 29:322–327. https://doi.org/10.1053/j.jrn.2018.10.013
22. Teixeira RR, Dani S, Dinor J, et al (2021) Effect of Unripe Banana Flour on Gut-Derived Uremic Toxins in Individuals Undergoing Peritoneal Dialysis: A Randomized, Double-Blind, Placebo-Controlled, Crossover Trial. Nutrients 1–15. https://doi.org/10.3390/nu13020646
23. Salvato MA, Ferreira PCG, Duarte AJM (2010) O Impacto da Escolaridade Sobre a Distribuição de Renda. Estud Econômicos (São Paulo) 40:753–791. https://doi.org/10.1590/S0101-41612010000400001
24. St-Jules DE, Goldfarb DS, Sevick MA (2016) Nutrient Non-equivalence: Does Restricting High-Potassium Plant Foods Help to Prevent Hyperkalemia in Hemodialysis Patients? J Ren Nutr 26:282–287. https://doi.org/10.1053/j.jrn.2016.02.005
25. Narasaki Y, Okuda Y, Kalantar SS, et al (2021) Dietary Potassium Intake and Mortality in a Prospective Hemodialysis Cohort. J Ren Nutr 31:411–420. https://doi.org/10.1053/j.jrn.2020.05.008
26. Palmer BF (2014) Physiology Regulation of Potassium Homeostasis. Ren Physiol 5:1050–60. https://doi.org/10.2215/CJN.08580813
27. Agarwal R, Afzalpurkar R, Fordtran JS (1994) Pathophysiology of Potassium Absorption and Secretion by. Gastroenterology 107:548–571. https://doi.org/10.1016/0016-5085(94)90184-8
28. Jenkins DJA, Kendall CWC, Popovich DG, et al (2001) Effect of a Very–High-Fiber Vegetable, Fruit, and Nut Diet on Serum Lipids and Colonic Function. Metabolism 50:494–503. https://doi.org/10.1053/meta.2001.21037

29. Gombi-Vaca MF, Horta PM, Hassan BK, et al (2017) Perception of food consumed at home and dietary intake: A nationwide study from Brazil. Appetite 116:487–492. https://doi.org/10.1016/j.appet.2017.05.036
30. IBGE. Instituto Brasileiro de Geografia e Estatística (2020) Pesquisa de orçamentos familiares 2017-2018: análise do consumo alimentar pessoal no Brasil. Rio de Janeiro
31. Kalantar-Zadeh K, Rhee CM, Chou J, et al (2017) The Obesity Paradox in Kidney Disease: How to Reconcile It With Obesity Management. Kidney Int. Reports 2:271–281

Tables

Table 1: Frequency of intake scores according to food frequency questionnaire responses.

Frequency of intake	Score
Never	0
Less than once a month	0.25
One to three times a month	0.5
Once a week	1
Two to four times a week	3
Once a day	7
Twice a day	14

Table 2. Participants main characteristics (N=305)

	Total (N = 305)
Male N (%)	156 (51)
Age (years)	52.2 ± 14.7
HD vintage (month)	46 (19–82)
Education (years at school)	8 (4 - 12)
Diabetes Mellitus N (%)	86 (28)
BMI (kg/m²)	26.6 ± 5.9
Serum potassium (mEq/L)	5.2 ± 0.7
>5,5 mEq/L N (%)	89 (29)

HD: hemodialysis; BMI: body mass index;

Table 3. Food groups and total scores according to demographical, nutritional and clinical characteristics.

	N	Fruits	Vegetables	Legumes	Whole grain	Seeds	Total
Gender							
Male	156	7 (3.6 – 14.0.0)*	5.6 (3.0 – 9.8)	2.8 (1.9 – 7.0)**	0 (0 – 1.6)	0 (0 – 0)	20.4 (14.0.2 – 29.2)
Female	149	5.6 (2.1 – 9.8)	5.6 (2.9 – 11.9)	1.6 (0.5 – 7.0)	0 (0 – 2.8)	0 (0 – 0)	18.4 (12.4 – 27.5)
Age							
< 60 years	191	5.6 (3.2 – 14.0)	5.6 (2.9 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 1.6)*	0 (0 – 0)	18.7 (13.2 – 27.1)
≥ 60 years	114	5.6 (3.1 – 14.0)	7 (2.9 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 2.8)	0 (0 – 0)	21.1 (14.0.3 – 29.9)
Years at school							
< 8 years	137	5.6 (1.6 – 9.8)*	5.6 (2.4 – 9.8)*	2.8 (0.5 – 7.0)	0 (0 – 2.8)*	0 (0 – 0)**	18.2 (14.0 – 26.8)
≥ 8 years	168	6.3 (3.6 – 14.0)	5.6 (3.2 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 1.6)	0 (0 – 0)	21.2 (14.0 – 29.8)
DM							
Yes	86	7 (3.1 – 14.0)	7 (3.1 – 10.8)	2.8 (0.5 – 3.8)*	0.5 (0 – 7.0)**	0 (0 – 0)	22.5 (15.3 – 30.6)*
No	217	5.6 (3.1 – 9.8)	5.6 (2.9 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 0.5)	0 (0 – 0)	18.2 (13.1 – 26.6)
BMI							
< 25 kg/m^2	140	5.0 (0.1 – 9.8)**	4.4 (2.3 – 8.6)**	2.8 (1.6 – 7.0)*	0 (0 – 1.6)*	0 (0 – 0)	16.7 (11.7 – 24.3)**
≥ 25 kg/m^2	165	8.6 (4.4 – 14.0.0)	7.5 (3.2 - 9.8)	2.8 (1.6 – 7.0)	0 (0 – 2.8)	0 (0 – 0)	22.4 (14.7 – 29.7)
Years in HD							
< 4 years	170	7.2 (3.2 – 14.0)	7.0 (2.9 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 2.8)	0 (0 – 0)	21.2 (14.4 – 30.8)**
≥ 4 years	135	5.6 (2.8 – 9.8)	5.6 (2.9 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 1.6)	0 (0 – 0)	17.7 (12.9 – 23.8)
Anuresis							
Yes	136	5.6 (3.2 – 9.8)	5.6 (3.2 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 1.6)	0 (0 – 0)	18.5 (12.5 – 27.0)
No	169	5.6 (2.8 – 14.0)	5.6 (2.4 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 2.8)	0 (0 – 0)	21 (14.2 – 29.9)

Hyperkalemia							
Yes	89	7.0 (2.8 – 14.0.0)	7.0 (3.2 – 9.8)	2.8 (0.5 – 7.0)	0 (0 – 3.0)	0 (0 – 0)	20.1 (13.1 – 27.6)
No	216	5.6 (3.2 – 14.0.0)	5.6 (2.9 – 9.8)	2.8 (1.6 – 7.0)	0 (0 – 1.6)	0 (0 – 0)	19.4 (14.0.0 – 28.2)

*P<0.05; **P<0.01

Table 4. Linear regression analysis of total fiber score determinants (R^2=0.10).

Variables	B	(95% CI)	P
Age (years)	0.10	0.00 - 0.20	0.04
Diabetes (yes)	0.52	-2.56 – 3.60	0.73
Education (years)	0.30	0.12 – 0.48	0.001
HD vintage (> 4 years)	-4.15	-6.75 – -1.55	0.002
BMI (> 25 kg/m^2)	2.72	0.02 – 5.4	0.04

HD: hemodialysis; BMI: body mass index

Figures

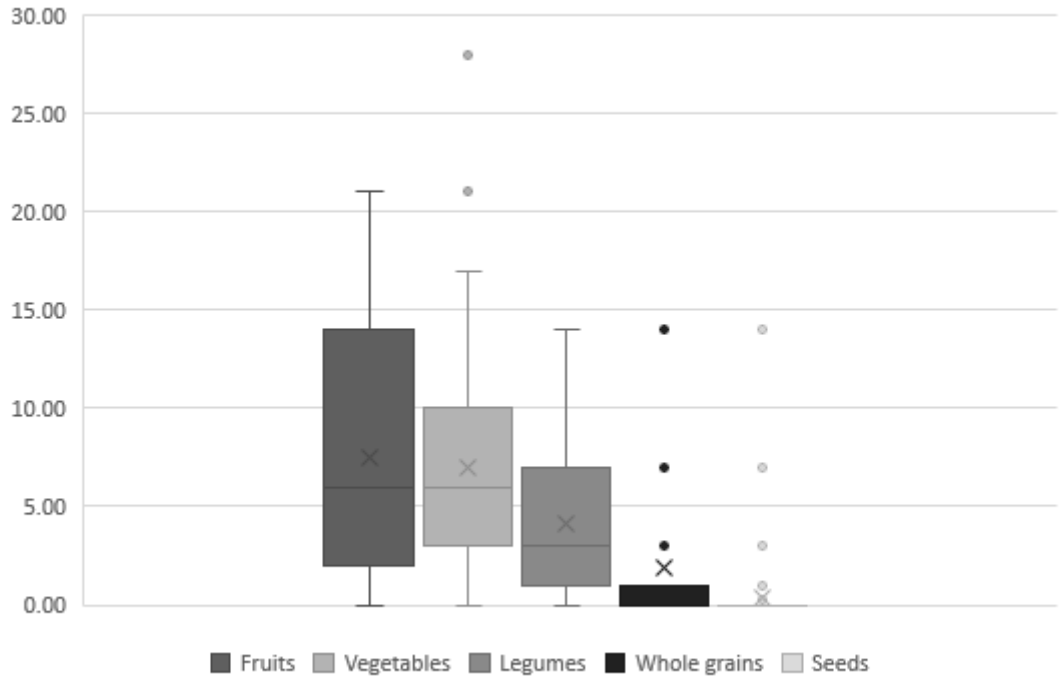

Figure 1

Distribution of food groups frequency of intake.