FOOD AND NUTRITION IN COLLECTIVE HEALTH
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Assessment of food consumption in patients with chronic kidney disease after nutritional counseling

Avaliação do consumo alimentar em pacientes com doença renal crônica após aconselhamento nutricional

Abstract

Introduction: Nutritional counseling is a key component in treating chronic kidney disease (CKD). Adequate caloric intake helps in reducing sodium, protein, fluid, and electrolytes in the diet and prevents further complications of the disease. Thus, this study aimed to evaluate the effect of nutritional counseling on patients with non-dialysis CKD. ***Methods***: A quasi-experimental, controlled study with individuals in stages 3 and 4 of the disease, divided into two groups: control and counseling composed of individuals without nutritional counseling followed for 90 days. Anthropometry and clinical and nutritional assessment data were collected through the application of a 24-hour recall (R24h). Food consumption assessment was obtained using the Nutrition Data System for Research (NDSR) program. Data analysis was performed using a repeated measures model evaluating the interaction between groups versus moments. The 95% significant level was fixed for all tests. ***Results***: 51 patients were included, 24 controls, and 27 counselings. Initial analysis showed that the groups were homogeneous. The assessment of food consumption after the counseling, with guidelines for healthy eating, resulted in a favorable response to protein control, and mineral restrictions: phosphorus, sodium, and potassium. Lower intake of calcium and vitamin D was not observed, factor that could worsen changes in bone and mineral metabolism, and there were no adverse effects on anthropometry. ***Conclusion***: Nutritional counseling is effective, and provides adequate food consumption to the recommendations proposed in CKD.

Keywords: Diet, Food and Nutrition. Diet Therapy. Chronic Kidney Failure

Resumo

Introdução: O aconselhamento nutricional é um componente-chave no tratamento da doença renal crônica (DRC). A ingestão alimentar adequada às recomendações auxilia no controle de sódio, proteínas, líquidos e eletrólitos na dieta e previne complicações adicionais da doença. Dessa forma, o objetivo deste estudo foi avaliar o efeito da orientação nutricional nos pacientes em tratamento conservador da DRC. ***Métodos***: Estudo quase-experimental controlado e em dois momentos, incluindo indivíduos nos estadios 3 e 4 da doença, divididos em dois grupos: controle e aconselhamento, sendo este composto por indivíduos que receberam a orientação nutricional e foram acompanhados por 90 dias. Os dados de antropometria e avaliação clínica e nutricional foram coletados por meio da aplicação do recordatório de 24 horas (R24h). A avaliação do consumo alimentar foi obtida por meio do programa *Nutrition Data*

System for Research (NDSR). A análise de dados foi realizada por meio do modelo de medidas repetidas ao avaliar a interação entre grupos *versus* momentos. O nível de significância de 95% foi fixado para todos os testes. ***Resultados***: 51 pacientes foram incluídos, sendo 24 controles e 27 aconselhamentos. A análise inicial mostrou que os grupos eram homogêneos. A avaliação do consumo alimentar após aconselhamento resultou em resposta favorável ao controle proteico e restrição de minerais: fósforo, sódio e potássio. Não houve menor ingestão de cálcio e vitamina D, fatores que poderiam agravar alterações no metabolismo ósseo e mineral, e não houve efeitos adversos na antropometria. ***Conclusão***: O aconselhamento nutricional é eficaz e proporciona consumo alimentar adequado às recomendações propostas na DRC.

Palavras-chave: Dieta, Alimentação e Nutrição. Dietoterapia. Insuficiência Renal Crônica.

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INTRODUCTION

Chronic kidney disease (CKD) is defined as evidence of structural or functional renal damage that persists for more than 90 days.[1-3] CKD is classified into five stages according to estimated glomerular filtration rate (eGFR) and albuminuria. When eGFR is less than 15 mL/min / 1.73 m^2 is classified as stage 5 or terminal CKD, at risk of the brief need for renal replacement therapy (RRT).

The main risk factors for the development of the disease include hypertension, type 2 diabetes mellitus, obesity, dyslipidemia, increasing age, black race, and heredity.[4] However, several studies have demonstrated the existence of another association contributing to the disease, development, progression, and increased mortality from CKD, through the analysis of proteinuria, the detection of which is considered indicative of a pathological kidney injury,[5,6] resulting in glomerular damage and progression of CKD.[7,8]

To avoid these glomerular damages, clinical maneuvers for the management of CKD have been instituted as strategies to prevent the evolution of the disease. The strategies include the control of blood pressure, management of proteinuria through the use of blockers of the renin-angiotensin system, correction of hyperglycemia, and dyslipidemia, prevention of nephrotoxic drugs, and lifestyle changes such as nutritional counseling.[6,9,10-12]

Nutritional counseling can be a crucial component of CKD treatment.[10,13-16] Adequate caloric intake and reductions of sodium, protein, fluid, and electrolytes such as potassium and phosphate (when indicated) can improve the patient's quality of life, maintain nutritional status, prevent or mitigate signs, symptoms, and complications related to the condition, such as uremic symptoms, electrolyte disturbances, acid-base imbalances, water retention, and mineral and bone disorders, allowing to increase longevity and delaying disease progression.[4,8,14] In this sense, initial practice guidelines for prevention, diagnosis, treatment, and evaluation of CKD focused on the restriction of dietary protein and sodium.[10]

Therefore, considering the importance of nutritional guidelines in the treatment of patients, this study aimed to evaluate the effect of nutritional counseling on patients with non-dialysis CKD.

MATERIALS AND METHODS

Design

A quasi-experimental study, controlled with intervention, whose data collection was carried out at the Chronic Kidney Disease Outpatient Clinic of Botucatu Medical School, with patients followed up with nephrologists.

The Research Ethics Committee of the Botucatu Medical School, under the number 2,806,865, approved all procedures performed.

Patients

Patients in stages 3 and 4 of CKD were included, and who divided into two groups, the control, represented by individuals who had never received nutritional advice, and the counseling, represented by the individuals who followed up with the dietitian, with nutritional counseling directed to patients with CKD, based on the most recent guidelines.[2]

Both groups followed up in two moments: baseline (moment 1) and nutritional counseling after 90 days (moment 2).

The sample size was calculated considering that the prevalence of adherence to nutritional counseling is unknown in patients with CKD (50%), with a margin of error of 10% and a reliability of 95%, resulting in a total of 96 observations.

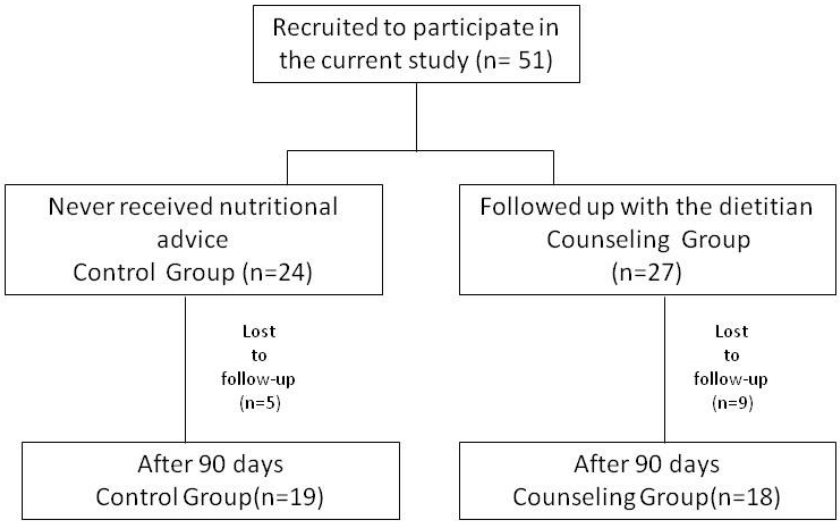
Therefore, 24 patients per group were selected (48 total patients) to be observed in two moments completing 96 observations.

The nutritional counseling is individualized depending on each patient's nutritional status and electrolyte abnormalities present. Recommendations provided in the dietetic clinic generally covered a low-moderate protein, low sodium, lower potassium, and phosphate diet (as indicated).

At the end of the research, the individuals who had never received nutritional counseling also received individualized nutritional guidance.

Exclusion criteria were less than 18 years of age, had active glomerulopathy, had previously had nutritional counseling with a focus on nephrology, and had proteinuria less than half a gram.

Figure 1. Flow diagram of patients with chronic kidney disease included/excluded in the study. 2019.



Clinical, biochemical, and demographic data

Baseline data, collected from electronic records, included sex, age, eGFR from creatinine clearance, proteinuria, microalbuminuria, marital status, and education from the electronic health records in data collection.

Anthropometry

Weight measured using a Welmy w200 digital electronic scale with 0.1 kg accuracy with the individual barefoot and with minimal clothing and height with a patient standing, barefoot with the heels aligned, arms extended next to the body,

using the vertical stadiometer attached to the scale itself. Then, BMI (Body Mass Index) was calculated from the variables weight (in kilograms) divided by height (in meters) squared (Weight / Height^2).

Blood pressure

Blood pressure (BP) was measured using an Omron sphygmomanometer accuracy one time with the patient in a sitting position, with both feet flat on the floor and with a straight back, resting on the back of the chair, respecting a 5-minute rest period. The medical team that was not aware of the nutritional counseling to the patient had undergone (blind observer) carried out these measurements.

Food consumption

A 24-hour recall was applied to patients to obtain nutritional information, which consists of obtaining information on food consumption in the last 24 hours,[17] which occurred at two times and on days of the week.

Kitchen utensils and a rubber food model were used as visual stimuli so that the interviewee could provide accurate information about their eating habits. Then, with the aid of the Nutrition Data System for Research (NDSR) food analysis program (2010 version, University of Minnesota) The data were transformed into food consumption, obtaining the protein intake (g/kg e%), vitamins D (µg), E (mg), K (µg), C (mg), folic acid (µg), B12 (µg) and minerals such as calcium (mg), phosphorus (mg), iron (mg), sodium (mg), potassium (mg).

Statistical analysis

The data obtained were typed into an Excel spreadsheet and submitted for statistical analysis.

Initially, a descriptive analysis of the patients' socio-demographic characteristics was performed, calculating the mean and standard deviation for the quantitative variables, and frequencies and percentages for the qualitative variables, stratified by groups.

A repeated measure design was used to evaluate the interaction of groups and moments by means, of ANOVA followed by the Tukey multiple comparison test in case of symmetry of the data. In the case of asymmetry, the same design was used fitting a generalized linear model with gamma distribution followed by Wald multiple comparison test.

The 95% significant level is fixed for all tests. All analyzes were performed using the SAS for Windows program, v.9.4.

RESULTS

According to the sample size, 51 patients with CKD non-dialysis were included in the present study, of which 24 were in the control and 27 were in the counseling group.

The baseline sociodemographic and clinical characteristics of all the participants are summarized in Table 1, showing the homogeneity between groups. Table 2 shows the mean comparison for age and anthropometric variables as well as eGFR, proteinuria, and albuminuria evaluating the interaction groups versus moments. No significance was found.

Table 1. Association between demographic and clinical data between groups. Botucatu, SP, 2019.

Variables	Total (n=51)	Control (n=24)	Counseling (n=27)	p-value
Sex				
F (%)	27 (53)	14 (27)	13 (25)	0.4670
M (%)	24 (47)	10 (19)	14 (27)	
Education				
Illiterate (%)	1 (2)	0 (0)	1 (2)	0.1128
Incomplete Elementary School (%)	32 (62)	17 (33)	15 (30)	
Complete Elementary School (%)	8 (16)	4 (8)	4 (8)	
Second Degree Completed (%)	8 (16)	1 (2)	7 (13)	
Graduated (%)	2 (4)	2 (4)	0 (0)	
Marital Status				
Not married (%)	4 (8)	0 (0)	4 (8)	0.1650
Married (%)	36 (70)	19 (37)	17 (33)	
Divorced (%)	7 (14)	4 (8)	3 (6)	
Widowed (%)	4 (8)	1 (2)	3 (6)	
Hypertension				
Yes (%)	50 (98)	23 (45)	27 (54)	0.2841
No (%)	1 (2)	1 (2)	0 (0)	
Type 2 Diabetes Mellitus				
Yes (%)	35 (69)	18 (35)	17 (33)	0.3551
No (%)	16 (31)	6 (12)	10 (20)	

F: Female; M: Male; Chi-square test, p <5%.

Table 2. Comparison of means evaluating the interaction between group versus moments for age, eGFR, proteinuria, microalbuminuria, anthropometric data, and systemic blood pressure in the control and counseling groups at the beginning and after the nutritional counseling. Botucatu, SP, 2019.

	Moment	1	2	
Variables	Group	Mean ± SD	Mean ± SD	p-value
Age (years)1	Control	63.08±7.63		0.7955
	Counseling	63.73±14.82		
eGFR (mL/min /1.73m^2)2	Control	27.63±9.92	25.01±11.54	0.8669
	Counseling	33.57±16.47	31.79±16.74	
Proteinuria (g/24H)2	Control	2.89±3.56	2.92±3.73	0.8271
	Counseling	2.72±3.83	3.07±4.78	

Table 2. Comparison of means evaluating the interaction between group versus moments for age, eGFR, proteinuria, microalbuminuria, anthropometric data, and systemic blood pressure in the control and counseling groups at the beginning and after the nutritional counseling. Botucatu, SP, 2019.

Variables	Moment / Group	1 Mean ± SD	2 Mean ± SD	p-value
Microalbuminuria (g/24H)2	Control	805.15±881.27	1169.56±1283.33	0.1429
	Counseling	801.17±704.15	642.87±771.21	
Weight (kg)1	Control	75.10±15.27	71.22±12.22	0.6880
	Counseling	76.86±15.00	76.53±13.60	
Height (m)1	Control	1.59±0.09		0.5663
	Counseling	1.63±0.09		
BMI (kg/m^2)1	Control	29.70±5.62	28.48±5.31	0.9208
	Counseling	29.05±5.00	28.79±5.17	
SBP (mmHg)1	Control	140.08±20.26^{aA}	130.53±10.71^{aA}	0.3336
	Counseling	140.02±10.48^{aA}	120.81±10.38^{bA}	
DBP (mmHg)1	Control	80.42±10.77^{aA}	90.20±20.30^{aA}	0.4334
	Counseling	80.21±10.03^{aA}	70.69±9.50^{bA}	

eGFR: estimated glomerular filtration rate; SD: Standard Deviation; BMI: Body Mass Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; 1-ANOVA for repeated measure design followed by Tukey test; 2-adjust in generalized linear model with gamma distribution followed by Wald test. Averages followed by the same lower case letters (fixing groups) do not differ significantly at the 5% level. Means followed by the same capital letters (fixing moments) do not differ significantly at the 5% level. Means without the presence of any letters do not differ significantly at the 5% level.

Mean eGFR at baseline for control ad counseling patients was respectively 27.63±9.92 and 33.57±16.47 mL/ min/ 1.72m^2 without differences in the second moment.

Table 3 shows the macronutrients (proteins, carbohydrates, fat) and micronutrients (vitamins and minerals) mean intake for groups and moments. It found a reduction between groups after nutritional counseling in total protein, animal and vegetable protein, sodium, phosphorus, potassium, and vitamin B12 mean intake.

Table 3. Comparison of means evaluating the group versus moment interaction for food consumption data for protein, vitamins and minerals of patients with CKD. Botucatu, SP, 2019.

Variables	Moment Group	1 Mean ± SD	2 Mean ± SD	p-value
Total Protein (g)	Control	69.56±28.04^{aA}	76.44±29.81^{aA}	0.0190
	Counseling	66.83±39.74^{aA}	48.40±12.74^{bB}	
Total Protein (g/kg)	Control	0.93±0.36^{aA}	1.05±0.46^{aA}	0.1017
	Counseling	0.92±0.67^{aA}	0.68±0.26^{aB}	
Animal Protein (g)	Control	38.31±22.75^{aA}	45.03±23.13^{aA}	0.0489
	Counseling	43.09±40.43^{aA}	29.66±13.69^{bA}	
Vegetable Protein (g)	Control	31.25±11.58^{aA}	31.40±14.80^{aA}	0.2090
	Counseling	23.74±12.55^{aB}	18.74±6.24^{aB}	
Total Carbohydrate (g)	Control	58.28±27.13^{aA}	56.78±25.54^{aA}	0.0767
	Counseling	54.56±30.13^{aA}	37.51±16.81^{bB}	
Total Fat (g)	Control	224.53±83.95^{aA}	215.05±84.37^{aA}	0.1770
	Counseling	187.33±59.91^{aA}	143.67±35.16^{bB}	
D Vitamin (µg)	Control	2.53±2.00	3.28±2.50	0.2206
	Counseling	3.03±1.86	2.84±2.56	
E Vitamin (mg)	Control	6.33±2.26^{aA}	6.00±2.88^{aA}	0.2686
	Counseling	4.66±3.17^{aA}	3.15±1.38^{bB}	
K Vitamin (µg)	Control	48.08±23.51	40.27±21.70	0.3782
	Counseling	61.51±78.87	35.28±17.95	
C Vitamin (mg)	Control	40.15±42.14	54.09±157.43	0.5076
	Counseling	44.91±35.16	37.36±53.05	
Folic Acid (µg)	Control	408.82±251.63^{aA}	403.88±275.22^{aA}	0.3962
	Counseling	293.43±135.48^{aA}	250.90±91.97^{aB}	
B12 Vitamin (µg)	Control	2.61±2.58^{aA}	4.09±3.63^{bA}	0.0373
	Counseling	2.72±2.37^{aA}	2.14±1.51^{aB}	
Calcium (mg)	Control	437.48±208.77	463.28±237.93	0.1744
	Counseling	493.42±278.10	405.26±178.53	
Phosphorous (mg)	Control	845.77±355.02^{aA}	910.60±355.06^{aA}	0.0147
	Counseling	814.06±347.07^{aA}	645.36±156.12^{bB}	
Iron (mg)	Control	15.67±8.95^{aA}	16.09±10.17^{aA}	0.0899
	Counseling	11.47±4.89^{aA}	8.89±3.16^{aB}	
Sodium (mg)	Control	2685.15±1495.25^{aA}	2719.94±1566.27^{aA}	0.1676
	Counseling	2192.07±1180.33^{aA}	1678.90±532.13^{aB}	
Potassium (mg)	Control	2082.89±695.82^{aA}	2060.57±817.32^{aA}	0.0923
	Counseling	1935.19±689.29^{aA}	1490.09±410.84^{bB}	

CKD: Chronic kidney disease; SD: Standard Deviation; BMI: Body Mass Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure. ANOVA, in repeated measure design followed by Tukey test Averages followed by the same lower case letters (setting groups) do not differ significantly at the 5% level. Means followed by the same capital letters (setting moments) do not differ significantly at the 5% level. Means without the presenmce of any letters do not differ significantly at the 5% level.

DISCUSSION

A large number of studies have documented the ill effects of food monotony in CKD patients, this study was relevant for demonstrating that nutritional counseling based on dietary guidelines recommendations is essential, as performed in our study, ensuring an adequate diet in macronutrients and micronutrients.

In the present study, the mean age of the participants comprised elderly individuals, most of them, with hypertension and type 2 diabetes mellitus, as already observed in the previous studies.[14,16-19]

It was observed that the mean BMI of participants in both groups at different times was classified in the reference range of overweight, [20,21] with no decrease in the variable after nutritional counseling, emphasizing that even with nutritional guidelines, there were no excesses of restrictions, it would impact on patients' weight loss. The literature shows that the prevalence of overweight and obesity has been increasing in CKD patients not receiving dialysis.[22] While in the general, population overweight and obesity translate into a higher risk of morbidity and mortality, in the population with kidney disease. It indicates a protective factor in the survival of patients on pre-dialysis and dialysis, due to the catabolic events that commonly affect these patients, which can result in higher rates of hospitalization and mortality, especially in the elderly individuals.[22-25] This phenomenon is called reverse epidemiology because the condition of excess weight is favorable since the adipose tissue sequesters uremic toxins, and thus, a lower risk of sarcopenia and systemic inflammation.[26,27] However, BMI measurement is not always an accurate estimate of adiposity because not capture body fat distribution between subcutaneous and central fat deposits; the latter is the more metabolically active adipose tissue and is more associated with inflammation, oxidative stress, and insulin resistance.[28,29]

Higher blood pressure levels are associated with CKD progression and cardiovascular mortality,[30] for this reason, a sodium-restricted diet is recommended as observed in the present study after the second moment of the nutritional counseling. It is known that its higher levels are associated with the progression of CKD and cardiovascular mortality.[30] Sodium is a mineral present in high amounts in added salt and industrialized foods in general,[31] and the literature still shows that an increase in fruit consumption and vegetables can also be associated with their decrease or control at appropriate levels.[2] Despite this, there were no changes in the blood pressure of patients after nutritional counseling, possibly due to the time/group interaction.

Adherence to DASH dietary patterns may have protective effects against the development and progression of CKD,[14] although there has been no reduction in renal function in patients, probably due to the short observation time.

Nutritional counseling in this population must take into account adequate protein recommendations to minimize changes in nutritional status,[8] a reduction in protein intake was observed in the present study after the nutritional counseling. In addition, the average daily protein intake followed the recommendations proposed in the literature from 0.55 to 0.8 g of protein/kg of weight / day.[2,8,32-34] It is known that the adequacy of protein consumption is a fundamental protective factor since its high intake is related to the increase in the glomerular filtration rate and this hyperfiltration damages the remaining glomeruli. Its protective effect is based on the reduction of intraglomerular pressure leading to less proteinuria, although no significant differences have yet been observed between patients. In addition, adherence to this approach can lead to a reduction in toxins from protein metabolism and better control of metabolic acidosis.[8,19] A meta-analysis[35] shows the beneficial effect of protein-restricted diets in reducing the number of patients who progress to the final stage of CKD.

The reduction in the consumption of processed and red meat might have an important effect in protecting renal function in individuals with CKD,[14] as observed in the present study a reduction in the consumption of animal protein and vitamin B12.

The literature shows that healthy eating patterns are associated with lower mortality in CKD, thus emphasizing the importance of dietary adjustments.[10,36-39.]

Less consumption of phosphorus intake was observed in the counseling group, after nutritional guidelines based on minimizing the consumption of processed foods, since they are rich in phosphorus additives, which contain the mineral in its inorganic form with almost 100% intestinal absorption.[34] The lower consumption of these is considered a beneficial factor since their retention is considered a risk factor for vascular calcification and contributes to the development of secondary hyperparathyroidism.[40]

Regarding calcium and vitamin D intakes, no differences were observed between groups and moments, an imbalance that could contribute to the worsening of changes in mineral and bone metabolism to which these individuals are more susceptible, contributing to the increase in the risk of cardiovascular disease and mortality.[2,8,41]

There was also a decrease in potassium intake after nutritional counseling. The restriction of this mineral occurred only in hyperkalemia, with serum values above 5.5 mEq/L[8], since fruits and vegetables are alkaline and have dietary fibers, which can have a beneficial effect on metabolic acidosis[42] regulating the internal balance of potassium, and in constipation, increasing fecal potassium excretion, both contributing to its control.[43]

The literature shows that eating patterns rich in fruits and vegetables can reduce the risk of progression to CKD, decrease albuminuria, and blood pressure, lead to improved survival in patients with stage 3 or 4 kidney disease,[36,38,39,44] and are associated with lower mortality from all causes.[43] In this way, the importance of not prioritizing dietary advice only in restricting nutrients or foods is emphasized, but rather providing healthy food choices, to improve the overall quality of the patients' diet.[16,45]

Of the study's noteworthy strengths, is that the nutritional counseling prioritized individualized dietary guidelines, used strategies to facilitate adherence, and provided adequate food choices to patients to prevent further complications of the disease.

Study limitations included the small sample size, short study time, single-point assessment after nutritional counseling, loss of patients in the second stage of the study, and the absence of data on patient medications that could affect CKD progression.

CONCLUSION

Nutritional counseling is effective, providing adequate food consumption to the recommendations proposed in CKD, and enabling better protein control, and minerals: phosphorus, sodium, and potassium, in addition to not altering the intake of calcium and vitamin D, nor inducing short-term unfavorable effects on anthropometry.

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