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Dietary Advice in Hemodialysis Patients: Impact of a Telehealth Approach During the COVID-19 Pandemic



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Objective: The purpose of this study was to assess the effect of a telehealth-delivered nutritional intervention via telephone in maintenance hemodialysis (HD) patients during the coronavirus outbreak.

Methods: This was a multicenter, observational, prospective, and longitudinal study of 156 patients undergoing maintenance HD from 15 dialysis units conducted during the COVID-19 pandemic. We assigned patients to receive dietary counseling through a phone call, according to their biochemical and nutritional parameters. Dry weight, intradialytic weight gain percentage (%IDWG), body mass index, potassium, phosphorus, calcium, calcium/phosphorus product, normalized protein catabolic rate, albumin, and hemoglobin were recorded at baseline and 1 month after nutrition counseling.

Results: The prevalence of hyperkalemia and hyperphosphatemia decreased significantly after dietary advice. A statistically significant reduction in serum potassium and phosphorus levels was observed in patients receiving counseling for hyperkalemia and hyperphosphatemia. In addition, there was a statistically significant decrease in the prevalence of hypophosphatemia. We also observed a significant decrease in %IDWG, although no statistically significant differences were detected in patients with high %IDWG. The data demonstrated statistically significant differences in potassium and phosphorus values when the person receiving the phone contact was the patient or the caregiver. The main statistically significant differences in hypophosphatemia %IDWG were only observed when contact was made directly with the patient. No differences were observed when the contact was made through nursing homes.

Conclusion: Our results suggest that telehealth-delivered dietary interventions can improve the clinical and nutritional parameters of HD patients. Consequently, this strategy may be effective for promoting continuous nutritional monitoring in these patients, in particular when conducting a face-to-face option is not crucial.

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Introduction

CHRONIC KIDNEY DISEASE (CKD) affects over 10% of the population worldwide.¹ During disease progression, nutrient requirements change significantly, and these alterations place patients at a higher risk for nutritional and metabolic abnormalities.² In patients with end-stage kidney disease (ESKD) who are on maintenance hemodialysis (HD), the intake of phosphorus, potassium, protein, and fluids must be controlled.

Owing to the difficulties in clearing excess phosphorus and potassium in ESKD, hyperphosphatemia may occur. This condition may lead to mineral bone disorder resulting in a high cardiovascular mortality risk.²⁻⁴ On the other hand, hypophosphatemia is associated with worse nutritional and body composition parameters and has been linked to muscle weakness, ventilatory failure, myocardial dysfunction, and other complications.^{5,6} High or low potassium levels have been associated with muscular weakness, hypertension, ventricular arrhythmias, and death.^{2,7} Thus, dietary control of potassium and phosphorus consumption is of great clinical concern, and a pragmatic, proper, intensive, and person-centered intervention to support dietary behavior change is required. Additionally, repeated reinforcement is crucial for managing the renal diet. Dietary advice for HD patients is recommended by the European Best Practice Guidelines on Nutrition, and the Kidney Disease Outcomes Quality Initiative. These advices provide a nutritional care plan and individualized dietary counseling, promoting an optimal selection of food options.^{8,9}

The barriers to regular and individualized dietary support for patients on HD include geographic location, time, and financial issues.¹⁰ These constraints already limit

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Statement of Ethics: This study was approved by the local responsible of the ethical board and an informed written consent was previously signed by the patients.

Transparency declarations: All the authors work at Nephrocare dialysis units in Portugal. The authors certify that the results presented in this paper have not been published previously in whole or part, except in abstract form.

Financial Disclosure: There is no conflict of interest or financial interest to be reported by any of the authors.

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1051-2276/\$36.00

<https://doi.org/10.1053/j.jrn.2021.04.002>

access to adequate nutritional monitoring, but the situation worsens dramatically if we consider the recent coronavirus disease (COVID-19) pandemic. To overcome this problem, novel strategies and approaches are necessary.

Telehealth technologies that are widely being implemented can provide education and self-management support to help make and sustain lifestyle changes, particularly in patients with chronic diseases.^{11,12} The World Health Organization refers to telehealth as “The delivery of health care services where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities.”¹² A telehealth intervention involves the provision of health education or counseling to individuals or groups remotely via the telephone, computer or Internet, video, e-mail, and/or mobile applications, including text and photo messaging.¹¹

Furthermore, these strategies are flexible in time and location, facilitating the intensive interventions required in some cases where traditional care models are not feasible.¹¹ The increased frequency and quality of contact between the patient and healthcare professional in these situations may improve acceptability and adherence to interventions reflecting the needs of people with CKD.¹³

This study aimed to analyze the effect of telehealth-delivered nutritional interventions on clinical and nutritional parameters in maintenance HD patients during confinement caused by the coronavirus outbreak.

Methods

Study Design

This was a multicenter, observational, prospective, and longitudinal study of a cohort of maintenance HD patients, conducted during the COVID-19 pandemic from April to May of 2020.

Subjects

The study included 156 patients from 15 dialysis units. The following inclusion criteria were applied: age ≥ 18 years, three times weekly in-center HD, and a minimum of 675 min of HD treatment in the week before the biochemical assessment. Incident patients who had their first nutrition counseling during the study period were not included.

Due to the COVID-19 pandemic, patients enrolled in the study were assigned to receive dietary counseling through phone calls. This nutritional counseling was administered once by the dietitian at each dialysis unit. Patients were selected depending on their biochemical and nutritional parameters including: phosphorus >5.5 mg/dL or <3.5 mg/dL, potassium >5.5 mEq/dL or <3.5

mEq/dL, intradialytic weight gain (IDWG) $> 4.5\%$, and unintentional weight loss or intervention for weight loss. The phone calls were made directly with the patient, patient caregiver (family member, home nurse, or others), or both, according to clinical and social conditions. Dietary advice focused on altered parameters that were reviewed with each patient and a dietary assessment through a 24 hours recall was also performed and discussed with the patient in order to recommend changes in eating habits. Written summarized nutritional recommendations including methods to reduce intake of phosphorus, potassium, and liquids, or alternatively, to increase phosphorus intake were discussed with patients or their caregivers whenever necessary.

Data Analysis

Dry weight, IDWG %, body mass index, potassium, phosphorus, calcium, calcium/phosphorus ratio, nPCR, albumin, and hemoglobin levels were recorded at baseline and 1 month after nutrition counseling. Patients were divided into groups for data analysis, depending on the purpose of the phone call. We analyzed differences in clinical and nutritional values based on the reasons prompting the phone call, and monitored changes in the prevalence of altered clinical and nutritional parameters.

Statistical Methods

Continuous variables were described as mean \pm standard deviation or as median and interquartile range, whereas categorical variables were expressed as frequencies and percentages. Data distribution was tested using the Kruskal-Wallis test. Within-group comparisons of mean continuous variables were analyzed using the paired sample t-test, and the Wilcoxon signed-rank test was used to analyze within-group comparisons of median continuous variables. Differences between dichotomous variables were assessed using the McNemar test. Statistical significance was set at

Table 1. Characteristics of HD Patients Enrolled in the Study (N = 156)

Age (years) ^a	67.2 \pm 14.1
Gender: male ^b	60.3%
Hemodialysis vintage (months) ^c	51.5 (20.0-87.2)
Duration of calls (minutes) ^a	16.7 \pm 10.0
Motive ^b	
Hyperkalemia	50.0%
Hyperphosphatemia	36.5%
Hypokalemia	0.6%
Hypophosphatemia	28.8%
Interdialytic weight gain $>4.5\%$	25.6%
Intervention for weight loss	0.6%
Unintentional weight loss	1.9%
Others	2.6%

^aResults are expressed as mean \pm standard deviation.

^bResults are expressed as frequencies (%).

^cResults are expressed as median (interquartile range).

Table 2. Changes in Clinical Parameters Before and After the Nutritional Intervention

Parameters	Before the Intervention	After the Intervention	P
Dry weight (kg) ^a	68.7 ± 15.4	68.7 ± 15.4	0.644
Body mass index (kg/m ²) ^b	24.9 (21.7-29.1)	24.9 (21.6-28.9)	0.233
Calcium (mg/dL) ^b	9.0 (8.6-9.5)	8.8 (8.4-9.2)	<0.001
Ca/P Product (mg/dL) ^a	43.4 ± 17.8	39.0 ± 14.5	<0.001
Albumin (g/dL) ^b	3.9 (3.7-4.0)	4.0 (3.8-4.2)	0.317
Hemoglobin (mg/dL) ^b	11.4 (10.7-12.2)	11.1 (1.4-12.0)	0.004
nPCR (g/kg/day) ^b	1.2 (1.0-1.4)	1.2 (1.0-1.4)	0.707

Ca/P Product, calcium/phosphorus product; nPCR, normal protein catabolic rate.

^aResults are expressed as mean ± standard deviation.

^bResults are expressed as median (interquartile range).

$p < .05$. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software (version 22.0; SPSS Inc., Chicago, IL, USA).

Results

Overall, 156 patients fulfilled the inclusion criteria and were included in the study. Demographic data, HD vintage, phone call length, and purpose of the interventions are shown in Table 1. The primary reasons for nutritional counseling were hyperkalemia, hyperphosphatemia, hypophosphatemia, and high %IDWG.

The comparison between clinical parameters that were not the focus of personalized dietary counseling, such as dry weight, body mass index, Ca, Ca/P product, albumin, hemoglobin, and nPCR, are summarized in Table 2. We did not observe any statistically significant differences in dialysis adequacy (Kt/V) before and after dietary counseling ($p = .595$). Moreover, no statistically significant differences were observed for potassium binder resin prescriptions (7.7% vs. 8.3%; $p = 1.000$) and phosphorus binders (44.9% vs. 46.8%; $p = .508$) before and after the intervention.

Table 3 illustrates differences in evaluated clinical parameters according to dietary counseling aims, as well as the frequency of distribution of the categorized parameters. At the

end of the study, most of the analyzed parameters were improved. The only exception was the IDWG category, since we observed no statistically significant difference between the number of patients who presented a desirable IDWG ($\leq 4.5\%$) before and after the nutritional intervention.

Differences in clinical parameters according to the purpose of the appointment and the contact person were also analyzed and are presented in Table 4. Our results showed that patients with hyperkalemia and hyperphosphatemia showed statistically significant differences in potassium and phosphorus levels when the patient or caregiver was the contact. Statistically significant differences were observed in patients with hypophosphatemia only when nutrition counseling was performed directly with the patient. No differences were observed when phone contact was with the nursing homes.

Discussion

Previous studies have shown that nutritional interventions are effective in improving parameters associated with nutritional status, and also with adverse outcomes in patients with ESKD.¹⁴⁻¹⁷ Based on our results, nutrition counseling provided in a phone call appeared to be effective in improving clinical and nutritional parameters.

Table 3. Changes in Clinical and Nutritional Parameters According to the Reason of the Nutritional Intervention (N = 156)

Parameters	Before the Intervention	After the Intervention	P
Potassium >5.5mEq/L (N = 78)			
Median (IQR)	6.2 (6.0-6.5)	5.7 (5.3-6.1)	<0.001
N (%)	78 (50.0%)	54 (34.6%)	<0.001
Phosphorus >5.5 mg/dL (N = 57)			
Median (IQR)	6.5 (6.1-7.2)	5.5 (4.7-6.1)	<0.001
N (%)	57 (36.5%)	30 (19.2%)	<0.001
Phosphorus <3.5 mg/dL (N = 45)			
Median (IQR)	2.8 (2.0-3.1)	2.90 (2.2-3.6)	0.016
N (%)	45 (28.8%)	29 (18.6%)	<0.001
IDWG >4.5% (N = 23)			
Median (IQR)	4.8 (4.2-6.8)	4.4 (3.8-6.2)	0.013
N (%)	23 (14.7%)	19 (12.2%)	0.219

IQR, interquartile range; IDWG, interdialytic weight gain.

Table 4. Changes in Clinical and Nutritional Parameters According to the Reason of the Nutritional Intervention and the Contact Person

Person of Contact	Before the Intervention	After the Intervention	P
Motive: Potassium >5.5mEq/L			
Patient (N = 48)			
Median (IQR)	6.2 (6.1-6.4)	5.7 (5.4-6.0)	<0.001
N (%)	48 (30.8%)	35 (22.4%)	<0.001
Caregiver (N = 22)			
Mean \pm standard deviation	6.3 \pm 0.3	5.7 \pm 0.7	0.001
N (%)	22 (14.1%)	14 (9.0%)	0.008
Patient and caregiver (N = 5)			
Mean \pm standard deviation	6.6 \pm 0.4	5.7 \pm 0.9	0.038
N (%)	5 (3.2%)	3 (1.9%)	0.500
Nursing home (N = 3)			
Mean \pm standard deviation	5.9 \pm 0.2	5.6 \pm 0.7	0.368
N (%)	3 (1.9%)	2 (1.3%)	1.000
Motive: Phosphorus >5.5 mg/dL			
Patient (N = 43)			
Median (IQR)	6.5 (6.1-7.2)	5.6 (4.9-6.1)	<0.001
N (%)	43 (27.6%)	24 (15.4%)	<0.001
Caregiver (N = 10)			
Mean \pm standard deviation	6.7 \pm 0.8	5.1 \pm 1.5	0.012
N (%)	10 (6.4%)	4 (2.6%)	0.031
Motive: Phosphorus <3.5 mg/dL			
Patient (N = 16)			
Mean \pm standard deviation	2.4 \pm 0.7	3.0 \pm 0.9	0.021
N (%)	16 (10.26%)	10 (6.41%)	0.031
Caregiver (N = 22)			
Median (IQR)	2.8 (1.9-3.2)	2.7 (2.1-3.6)	0.197
N (%)	22 (14.1%)	14 (9-0%)	0.008
Nursing home (N = 7)			
Median (IQR)	3.0 (2.7-3.3)	2.3 (2.1-4.6)	0.735
N (%)	7 (4.5%)	5 (3.2%)	0.500
Motive: IDWG >4.5%			
Patient (N = 21)			
Median (IQR)	4.6 (4.1-7.1)	4.1 (3.5-6.6)	0.033
N (%)	11 (7.0%)	9 (5.8%)	0.500
Caregiver (N = 17)			
Mean \pm standard deviation	5.5 \pm 1.6	5.2 \pm 1.8	0.303
N (%)	11 (7.0%)	10 (6.4%)	1.000

IQR, interquartile range; IDWG, interdialytic weight gain.

This outcome is even more significant during the coronavirus pandemic, where telehealth allows access to healthcare systems while patients maintain social distancing to reduce exposure and spread of COVID-19. Moreover, telehealth also promotes the safety of essential clinical staff and may reduce unnecessary hospital visits, thereby providing some relief to the currently overstretched health resources.¹⁸

Hyperkalemia is an electrolyte abnormality frequently occurring in patients with ESKD. Serum potassium may be influenced by factors such as dialysis dose, HD schedule, degree of residual renal function, and dietary potassium intake.⁷ Moreover, Noori et al. found an association between increased dietary potassium intake and increased mortality in patients on HD treatment, despite adjustment for serum potassium concentrations.⁷ Thus, dietary coun-

seling plays an important role in potassium intake and enables control of its serum levels in order to prevent the health consequences of hyperkalemia.¹⁹ In our study, patients who received counseling for hyperkalemia showed a significant decrease of 0.5 mEq/dL in serum potassium, consistent with an overall reduction in the prevalence of hyperkalemia. These results are similar to those found by Gargarza et al. in their analysis on the effects of a standard personalized intervention.¹⁴ A statistically significant decrease in serum potassium was observed when the phone call was directly with the patient, caregiver, or both. However, when phone contact was through the nursing home, no statistically significant differences were observed.

After nutritional intervention, we found a significant decrease of 0.97 mg/dL in serum phosphorus levels in hyperphosphatemic patients, and in the number of patients

with phosphorus levels >5.5 mg/dL. Hyperphosphatemia is associated with the development of secondary hyperparathyroidism, renal osteodystrophy, and soft tissue calcification, increasing the risk of cardiovascular death in HD patients.²⁰ Therefore, dietary phosphorus restriction to control serum phosphate is recommended in HD patients. We observed a decrease in the prevalence of hyperphosphatemia in both patient and caregiver groups. Moreover, it is important to note that there were no statistically significant changes in potassium or phosphorus binders prescribed before and after the intervention.

Low levels of serum phosphorus also appear to be associated with higher all-cause mortality risk.^{5,21} According to Tentori et al., this association is observed when phosphorus levels are ≤ 2.0 mg/dL.²¹ Lertdumrongluk et al. also observed an association between hypophosphatemia and increased mortality, but only in elderly maintenance HD patients.²⁰ An association between hypophosphatemia and worse nutritional and body composition parameters, as well as a higher mortality risk in the context of additional indices of malnutrition, has also been described.⁵ Previous studies demonstrated that hypophosphatemia can improve with nutritional counseling focused on recommending foods high in protein and dairy products, as they contain high amounts of phosphorus.^{14,22} Our results also suggest a positive impact of dietary advice in hypophosphatemia, resulting in a decrease in its prevalence of 10.2% after nutritional counseling, and a significant increase in serum phosphorus values. When the phone call was directly with the patient, an increase of 0.61 mg/dL was observed, and the prevalence of hypophosphatemia decreased significantly by the end of the study. Furthermore, when the contact was with the caregiver, a significant reduction was observed. However, no statistically significant results were found when the contact was with nursing homes.

Fluid intake control is a dietary restriction that is most difficult to achieve by maintenance HD patients. In these patients, fluid overload and higher IDWG are associated with higher morbidity, poorer survival, and increased cardiovascular mortality.²³⁻²⁵ Our results show a statistically significant decrease of 0.4% in IDWG after dietary intervention. The prevalence of patients with a high IDWG also decreased, although the difference was not statistically significant. These results emphasize the importance of nutritional counseling in IDWG, despite telehealth-delivered dietary interventions. A possible contributing factor to the improvement in laboratory measures and in fluid control in non-nursing home patients might be that patients were motivated by fear to maintain diet adherence during the pandemic.

It is important to highlight that better outcomes were observed when phone contact was made directly with the patient or with a close caregiver. When contact was through the nursing homes, no significant results were confirmed, regardless of the reason for the nutritional inter-

vention. A possible explanation could be that although the nutritional intervention and recommendations are similar, the application of these measures in a nursing home context could be more complex due to logistics, high number of residents, or other limitations often seen in those environments. This is consistent with other studies that have demonstrated that malnutrition is generally widespread in institutionalized elderly, and that many nursing home residents do not meet recommendations for energy or protein intake.²⁶⁻²⁸ Furthermore, we speculate that the person with whom the contact is performed (e.g., dietitian, nurse, technical director, or auxiliary/kitchen staff) may also play an important role. Therefore, future studies are important to evaluate the impact of dietary interventions conducted directly in nursing homes, and to assess the barriers that affect compliance with the recommendations. This issue becomes even more relevant if we consider that the contact with these patient's caregivers was previously routine and were not exclusively made by phone calls during the COVID-19 pandemic.

Very few studies have been published on telehealth-delivered dietary interventions specifically in CKD; however, trials conducted in patients with other chronic diseases have shown that this approach is effective when compared with face-to-face modalities. Dietary management through telehealth supports behavioral changes that reduce chronic disease risk by improving diet quality, fruit and vegetable consumption, and reducing dietary sodium intake.¹¹ The results obtained in the present study support these findings, as significant changes were observed in relevant clinical parameters after telehealth nutritional intervention. Telephone interventions provide flexibility in time and location combined with the opportunity to offer more frequent dietary coaching (which may not be feasible with traditional care models) and these factors likely underlie their observed success.^{11,13,29} Most patient appointments in regular HD programs are scheduled between dialysis shifts when patients are urged to leave the office. Pressure to leave the consultation office and potential concern about arranging transport services for returning home may cause patient distraction. In contrast, telehealth interventions may overcome these barriers, since patients are typically resting at home and have adequate time for consultations.

As mentioned previously, the provision of health care on a continuous basis for chronic patients is important for disease control, clinical outcomes, and patient's quality of life. Accordingly, it is important to guarantee the required health care for those patients even during the COVID-19 pandemic. If we consider the role of dietary intervention as an integral part of treatment of CKD in HD patients, then it is crucial to understand the impact of telephone contacts on the performance of nutritional and dietary interventions for controlling clinical and nutritional parameters. The current study results reinforce the

importance of these innovative strategies with use of the currently available technological resources, especially since the study was carried out during an unusual period of patient isolation and home confinement.

This study has some limitations. On the one hand, we demonstrated a reduced number of patients in some groups when the reason for the intervention was combined with information on the type of contact person (i.e., patient, caregiver, or both). On the other hand, multifaceted dietary changes usually result from multiple recommendations and pharmacology therapies, and although we collected information on phosphorus and potassium binder use, possible dose changes during the study period were not analyzed. Consequently, conclusions regarding the effects of isolated dietary interventions on clinical outcomes may have been hindered. Additionally, patient residual kidney function was not investigated or included in the analysis. Finally, no information related to the contact person was registered when phone calls were conducted with nursing homes.

Practical Application

In summary, the results of this study demonstrated a positive impact of dietary intervention on clinical and nutritional parameters in HD patients using a phone approach instead of the traditional face-to-face method. The effectiveness of the telehealth-delivered dietary intervention appeared to improve when contact was made directly with the patient or caregiver, rather than with nursing homes.

Future studies on the impact of telehealth-delivered dietary interventions in patients on maintenance HD should be encouraged. Further studies should incorporate longer follow-up periods and assess the effectiveness of various methods (e.g., telephone-based, video conferences, email, text messages, or apps) to determine the optimal nutritional management strategies.

Credit Authorship Contribution Statement

Ana Valente: Conceptualization, Methodology, Formal analysis, Writing - original draft. **Joana Jesus:** Methodology, Software, Formal analysis, Writing - original draft. **Joana Breda:** Methodology, Writing - review & editing. **Ana Dinis:** Methodology, Writing - review & editing. **André Correia:** Methodology, Writing - review & editing. **Joana Godinho:** Methodology, Writing - review & editing. **Telma Oliveira:** Methodology, Writing - review & editing. **Cristina Garagarza:** Conceptualization, Methodology, Supervision, Project administration.

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