ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

DOI: 10.5336/jtracom.2019-72202

What is the Level of Awareness About the Foods Containing Inorganic Phosphorus in Patients with Chronic Renal Failure?

Kronik Böbrek Yetmezlikli Hastalar İnorganik Fosfor İçeren Gıdaların Ne Kadar Farkında?

Nihan TEKKARIŞMAZ[a],
Dilek TORUN[a],
Rüya ÖZELSANCAK[a]

[a]Department of Nephrology,
Başkent University
Adana Dr. Turgut Noyan Application and Research Center,
Adana, TURKEY

Received: 07 Nov 2019
Accepted: 13 Dec 2019
Available online: 26 Dec 2019

Correspondence:
Nihan TEKKARISMAZ
Başkent University
Adana Dr. Turgut Noyan Application and Research Center,
Department of Nephrology, Adana,
TURKEY/TÜRKİYE
tekkarismaznihan@gmail.com

This study was been presented at 54th ERA EDTA Congress (Poster presentation, Madrid/Spain, 03/06/2017 - 06/06/2017) and 33th National Congress of Nephrology, Hypertension, Dialysis and Transplantation (Poster presentation, Antalya/Turkey, 19/10/2016 - 23/10/2016).

Copyright © 2019 by Türkiye Klinikleri

ABSTRACT Objective: Hyperphosphatemia is an important factor causing morbidity and mortality in patients with chronic renal failure (CRF). Most processed foods and carbonated beverages contain inorganic phosphorus compounds. The aim of our study to investigate the level of awareness about foods and beverages containing inorganic phosphorus in patients with chronic renal failure in our region. **Material and Methods:** A total of 319 patients with chronic renal failure were included in the study. A seven-question survey was prepared to test the patients' awareness of food and beverages containing inorganic phosphorus. The patients were surveyed twice in the course of one year, before and after receiving education on nutrition. **Results:** After the training, there was no statistically significant difference in the first and second survey scores of the patients (10.00 vs. 10.19; p= 0.14). While there was an increase in the first four questions, which measured awareness, there was no difference in the other three questions, which tested habits. After the training, the patients' phosphorus level increased rather than falling (4.6±1.43 vs. 4.86±1.52 mg/dl; p= 0.01). **Conclusion:** Although the patients knew of the harmful effects of high phosphorus, they were not sufficiently aware of it in fast foods and carbonated beverages. Furthermore, there seemed to be a lack of the discipline when it came to taking preventative dietary measures to combat excessive phosphorus intake.

Keywords: Chronic renal failure; phosphorus; nutrition; fast foods; carbonated beverages

ÖZET Amaç: Hiperfosfatemi, kronik böbrek yetmezliği olan hastalarda morbidite ve mortaliteye neden olan önemli bir faktördür. İşlenmiş gıdaların ve gazlı içeceklerin çoğu inorganik fosfor bileşikleri içerir. Çalışmamızın amacı, bölgemizdeki kronik böbrek yetmezlikli hastaların, inorganik fosfor içeren yiyecekler ve içecekler hakkındaki farkındalığını araştırmaktır. **Gereç ve Yöntemler:** Çalışmaya kronik böbrek yetmezliği olan toplam 319 hasta dahil edildi. Hastaların inorganik fosfor içeren yiyecek ve içecek farkındalığını test etmek için yedi sorudan oluşan bir anket hazırlandı. Hastalara, beslenme konusunda eğitim almadan önce ve sonra olmak üzere, bir yıl içinde iki kez anket uygulandı. **Bulgular:** Eğitim sonrası, hastaların birinci ve ikinci anket puanları arasında istatistiksel olarak anlamlı bir fark yoktu (10.00'e karşı 10.19; p= 0.14). Farkındalığı ölçen ilk dört soruda bir artış varken, alışkanlıkları test eden diğer üç soruda bir fark yoktu. Eğitimden sonra hastaların fosfor seviyesi düşmek yerine arttı (4.6±1.43 vs. 4.86±1.52 mg/dl; p= 0.01). **Sonuç:** Hastalar yüksek fosforun zararlı etkilerini bilmelerine rağmen, hazır gıdalar ve gazlı içeceklerde bulunan fosforun yeterince farkında değillerdi. Ayrıca, aşırı fosfor alımı ile mücadele etmek için koruyucu diyet önlemleri almaya gelindiğinde, hastalarda disiplin eksikliği olduğu görülmüştür.

Anahtar Kelimeler: Kronik böbrek yetmezliği; fosfor; beslenme; hazır gıdalar; gazlı içecekler

Hyperphosphatemia is an important factor associated with morbidity and mortality in patients with chronic renal failure (CRF).[1-4] A normal amount of phosphorus taken in the diet is 1.000 mg per day, and a significant part of this comprises hidden inorganic phosphorus. In the prevention and treatment of hyperphosphatemia, adequate dialysis, restriction

of dietary phosphorus intake, and treatment using phosphorus-lowering drugs are the essential measures.[1-3]

In a patient undergoing regular hemodialysis (HD) treatment three times weekly, the amount of phosphorus removed by dialysis is approximately 3.000 mg/week.[5] However, HD alone is not enough to yield a negative phosphorus balance. Therefore, in addition to dialysis treatment, patients should be well informed about the importance of limiting their daily phosphorus intake through the diet.

Most processed foods and carbonated beverages contain inorganic phosphorus compounds. It is generally not well known that inorganic phosphorus is added to processed food, such as cured meat, cheese, various condiments, carbonated beverages, and baked goods.[1] The added inorganic phosphorus is often omitted on the product nutrition facts/labels.[1,3] As a result of improper dietary preferences, the daily phosphorus intake of CRF patients can be increased.[1] Thus, we should educate our patients on reading nutrition labels.[6]

Among the general population, the consumption of fast food and processed food has dramatically increased over the past 25 years.[7] Fast foods are rich in detrimental nutrients (sugar, sodium, saturated fats, and trans-fatty acids) but lacking in healthy nutrients (vitamins, minerals, and fiber).[7] Fast food consumption in CRF patients causes three major problems: Obesity, cardiovascular disease, and malnutrition.[7] It is useful to educate patients to avoid consuming "hidden" phosphates through additives found in preserved foods or soft drinks.[8]

We did not know about the level of awareness among dialysis patients in our country, so we carried out a study on a prospective cohort with the aim of investigating the level of awareness about the foods and beverages containing inorganic phosphorus among the patients with CRF and considering the effects of patient education on awareness and serum phosphorus levels.

MATERIAL AND METHODS

This study was approved by Başkent University Institutional Review Board and Ethics Committee (Project no: KA17/61) and supported by Başkent University Research Fund. Informed consents were obtained from all participants. All procedures that involved human participants were in accordance with the ethical standards of the institutional research committee and with the 2008 Helsinki Declaration and its later amendments or comparable ethical standards. Our prospective cohort study was conducted between January 2016 and January 2017.

The inclusion criteria were as follows: male and female volunteering patients with CRF who were over the age of 18, had the mental capacity to assess and respond to our questionnaires and no intellectual disability, and had been on dialysis treatment (HD or peritoneal dialysis (PD)) for at least 3 months. Patients not freely providing consent and pregnant women were excluded.

A total of 319 CRF patients (female/male, 135/184), with a mean age of 55.2±14.8 years were included in the study; 274 of them were undergoing HD and 45 were undergoing PD. All the HD patients were on high-flux HD (blood flow=350 ml/min, three times per week, 4-hour sessions). Phosphorus binders and vitamin D medications were prescribed to all eligible patients according to the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines.[9]

A seven-question survey was prepared to test the patients' awareness of fast food and carbonated beverages containing inorganic phosphorus (Table 1). The survey was adapted from the study by Shutto et al. The patients were surveyed before and after education on nutrition, twice in the course of one year.[3] Survey 1 was conducted in January 2016, while survey 2 was conducted in January 2017.

During the calendar year, between the surveys, patients were provided educational presentations and seminars on dietary phosphorus. Dietitians and dialysis physicians engaged in monthly bedside educational presentations. Nephrologists provided two educational seminars, one in January 2016, at the beginning of the study, after survey 1, and another in June 2016, halfway

TABLE 1: Survey questions.

1. Are you aware that there is high sugar content in carbonated beverages*? Y† / N‡
2. Are you aware that carbonated beverages contain high phosphorus? Y† / N‡
3. Are you aware that there is high phosphorus content in fast foods**? Y† / N‡
4. Are you aware that high phosphorus intake is harmful to the body? Y† / N‡
5. How many bottles or cans of carbonated beverages do you consume in a week?
a. I don't drink
b. 1-5
c. 6-10
d. >10
6. How often do you eat fast foods?
a. I don't eat
b. Once a month
c. Once a week
d. Almost every day
7. What do you think you should do now that you know high phosphorus consumption is harmful?
a. I want to learn more about phosphorus
b. I want to reduce food and drinks with phosphorus in my diet
c. I'm not interested in phosphorus-related issues

Y†: Yes, N‡: No, *Carbonated beverages are limited to cola or soda, **Fast food is limited to hamburgers, pizza or fried chicken.

through our study. The topic of the educational presentations and seminars covered foods and beverages that are rich in phosphorus and the clinical problems that these foods and beverages can cause in CRF patients. The participants were trained with visual slides and brochures.

A point system was used for the survey answers. The most health-conscious responses to the survey questions gained the highest points, while the least health conscious ones gained the lowest points. Each patient's score from the survey was referred to as the "survey score" and recorded. The first four questions test the patients' knowledge level and awareness. The other three questions tested the patients' behavior and habits. Therefore, the answers to the survey questions were interpreted under two headings. The patients' dialysis duration, education status, marital status, and working status were recorded. In addition, routinely observed glucose, calcium, phosphorus, albumin, alkaline phosphatase, parathyroid hormone serum values, Kt/V (for measuring dialysis adequacy), and survey scores of the patients in the first and the final survey months were recorded. The patients were divided into two subgroups, HD and PD, and examined.

STATISTICAL ANALYSIS

Statistical analysis was performed by using *SPSS software* (Version 17.0, SPSS Inc., Chicago, IL, USA). Comparisons between groups (PD vs HD) were applied using Student T test for normally distributed data and Mann Whitney U test were used for the data not normally distributed. The categorical variables between the groups was analyzed by using the Chi square test or Fisher exact test. Pre-post categorical variables were analyzed with Mc Nemar test and continuous variables were analyzing Wilcoxon test. Values of $p<0.05$ were considered statistically significant.

RESULTS

Of the 319 patients who participated in our surveys, 72 were eliminated during the study, and only 247 completed it. The reasons for elimination were as follows: death, kidney transplantation, hospitalization, change in dialysis center, and withdrawal due to personal choice. The demographics

TABLE 2: Comparison of baseline characteristics of HD and PD patients.

	HD	PD	Total	p
Number of Patients	212 (85.9%)	35 (14.1%)	247 (100%)	-
Age (years)	55.6 ±14.8	52.4±14.5	55.2±14.8	0.18
Dialysis duration (months)	79±67	54.5±64	75.6±67	0.14
Female gender	89 (42%)	16 (45.7%)	105 (42.5%)	0.68
Employed	61 (28.8%)	9 (25.7%)	70 (28.3%)	0.07
Unemployed	109 (51.4%)	14 (40%)	123 (49.8%)	
Retired	42 (19.8%)	12 (34.3%)	54 (21.9%)	
Married	171 (80.7%)	29 (82.9%)	200 (81%)	0.76
Single	41 (19.3%)	6 (17.1%)	47 (19%)	
No formal education	54 (25.5%)	1 (2.9%)	55 (22.3%)	0.00
Middle school graduate	113 (53.3%)	14 (40%)	127 (51.4%)	
High school graduate	31 (14.6%)	10 (28.6%)	41 (16.6%)	
University graduate	14 (6.6%)	10 (28.6%)	24 (9.7%)	

p <0.05 statistically significant value, HD: Hemodialysis, PD: Peritoneal dialysis.

TABLE 3: Comparison of laboratory findings of HD and PD patients.

	Survey	HD	PD	Total	p
Glucose (mg/dL)	1	109.5 (45-552)	98 (79-214)	107 (45-552)	0.45
	2	111 (64-588)	94 (74-264)	104 (64-588)	0.54
Calcium (mg/dL)	1	8.66±0.88	8.62±0.90	8.66±0.88	0.07
	2	8.88 ± 0.71	8.90 ± 10.2	8.89 ± 0.69	0.39
Phosphorus (mg/dL)	1	4.61±1.49	4.59±1.03	4.61±1.43	0.71
	2	4.85 ± 1.54	4.91 ± 1.44	4.86 ± 1.52	0.97
Albumin (g/dL)	1	3.70±0.35	3.46±0.42	3.67±0.37	0.00
	2	3.83 ± 0.33	3.72 ± 0.32	3.82 ± 0.33	0.03
ALP (IU/L)	1	100 (34-703)	116 (53-245)	102 (34-703)	0.81
	2	105 (18-1022)	110 (38-312)	105 (18-1022)	0.19
iPTH (pg/mL)	1	325 (5.5-2856)	334 (6-1576)	326 (5.5-2856)	0.53
	2	408 (0-1900)	368 (4-1487)	404 (0-1900)	0.22
Kt/V*	1	1.46 ± 0.30	2.28±0.63	1.58±0.46	0.00
	2	1.51 ± 0.27	2.21 ± 0.60	1.61 ± 0.41	0.00

p <0.05 statistically significant value, HD: Hemodialysis, PD: Peritoneal dialysis, ALP: Alkaline phosphatase, iPTH: Intact parathyroid hormone, *For measuring dialysis adequacy.

and laboratory data of the patients are shown in Table 2 and Table 3.

After the training, there was no statistically significant difference in the first and second survey scores of all the participants (10.00 vs. 10.19; p = 0.14) (Table 4). While there was an increase in the scores for the first four questions which measured the respondents' awareness, there was no difference in the other three questions which tested habits.

We observed a statistically significant increase in the number of patients providing correct answers to the first three questions of the survey. The awareness of high phosphorus intake being harmful to the body increased after our educational programs, although the increase was not statistically significant (Figure 1). No statistically significant differences in the amounts of daily carbonated beverage intake or processed food intake frequency were observed in patients after the education (Figures 2 and 3). Despite the education, a significant decrease was ob-

TABLE 4: Change in laboratory values of patients between Survey 1 and Survey 2.

		Survey 1	Survey 2	p
Survey score	HD patients	9.9	10.1	0.18
	PD patients	10.4	10.5	0.57
	All patients	10.00	10.19	0.14
Glucose (mg/dL)	HD patients	109.5 (45-552)	111 (64-588)	0.76
	PD patients	98 (79-214)	94 (74-264)	0.82
	All patients	107 (45-552)	104 (64-588)	0.80
Calcium (mg/dL)	HD patients	8.66±0.88	8.88 ± 0.71	0.00
	PD patients	8.62±0.90	8.90 ± 10.2	0.04
	All patients	8.66±0.88	8.89±0.69	0.00
Phosphorus (mg/dL)	HD patients	4.61±1.49	4.85 ± 1.54	0.02
	PD patients	4.59±1.03	4.91 ± 1.44	0.20
	All patients	4.61±1.43	4.86±1.52	0.01
Albumin (g/dL)	HD patients	3.70 ± 0.35	3.46 ± 0.42	0.10
	PD patients	3.46 ± 0.42	3.72 ± 0.32	0.00
	All patients	3.67 ± 0.37	4.41± 6.78	0.08
ALP (IU/L)	HD patients	100 (34-703)	105 (18-1022)	0.40
	PD patients	116 (53-245)	110 (38-312)	0.61
	All patients	102 (34-703)	105 (18-1022)	0.47
iPTH (pg/mL)	HD patients	325 (5.5-2856)	408 (0-1900)	0.00
	PD patients	334 (6-1576)	368 (4-1487)	0.56
	All patients	326 (5.5-2856)	404 (0-1900)	0.00
Kt/V*	HD patients	1.46 ± 0.30	1.51 ± 0.27	0.00
	PD patients	2.28±0.63	2.21 ± 0.60	0.55
	All patients	1.58±0.46	1.61 ± 0.41	0.15

p <0.05 statistically significant value, HD: Hemodialysis, PD: Peritoneal dialysis, ALP: Alkaline phosphatase, iPTH: Intact parathyroid hormone, *For measuring dialysis adequacy.

served in the number of patients responding, "I don't eat fast food." (Figure 3). In addition, after the education, statistically significant increases were observed in the numbers of patients who responded, "I want to reduce the intake of foods and beverages containing phosphorus." (Figure 4).

A statistically significant increase was found in serum calcium (8.66 ± 0.88 vs. 8.89 ± 0.69; p =

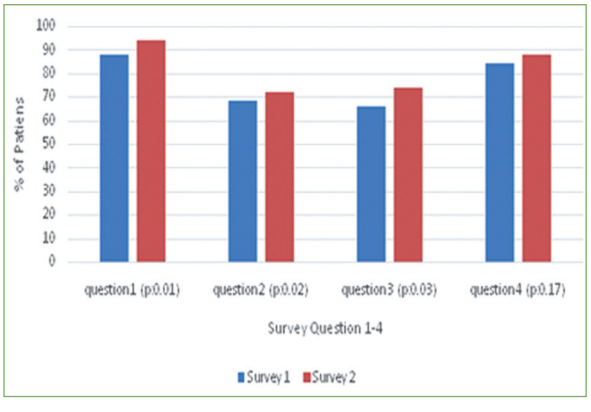

FIGURE 1: Difference in correct responses between Survey 1 and Survey 2.

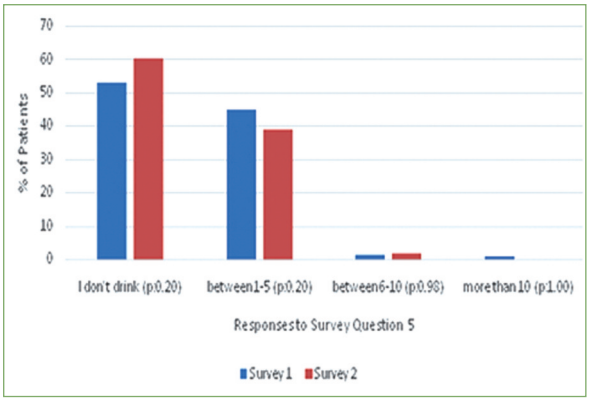

FIGURE 2: Difference in responses to question 5 between Survey 1 and Survey 2.

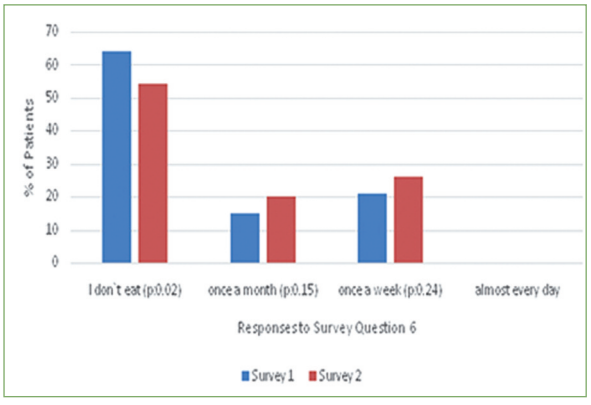

FIGURE 3: Difference in responses to question 6 between Survey 1 and Survey 2.

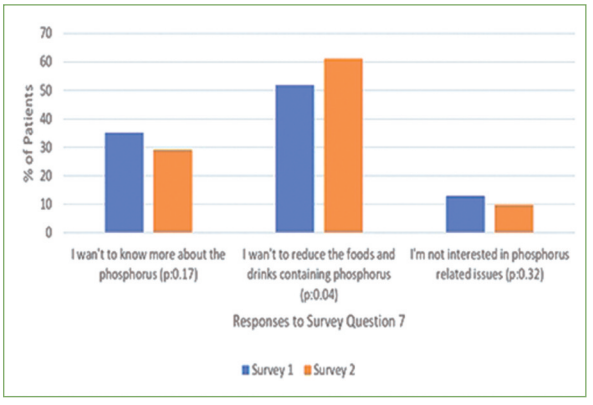

FIGURE 4: Difference in responses to question 7 between Survey 1 and Survey 2.

0.00), phosphorus (4.6 ± 1.43 vs. 4.86 ± 1.52 mg/dl; $p = 0.01$), and parathyroid hormone [326 (5.5-2856) vs. 404 (0-1900); $p = 0.00$] levels between the first and the second surveys. There was no statistically significant difference in the serum glucose, albumin, alkaline phosphatase, Kt/V, or survey score results of the patients between the first and the second surveys (Table 4).

SUBGROUP ANALYSIS

Education level and Kt/V were higher in PD group than HD group (Table 2). Compared with HD group, serum albumin level of PD group was lower (Table 3). When the other findings were examined, the two groups were statistically similar.

There was no statistically significant difference between the HD (9.9 vs. 10.1; $p = 0.18$) and PD (10.4 vs. 10.5; $p = 0.57$) groups in terms of the post-training survey score (Table 4).

Difference in responses to questions between survey 1 and survey 2 and subgroup of patients were shown in Table 5. There was a significant improvement in the answers of the HD group to the first, third and sixth survey questions. In the PD group; there was no difference in the answers given to the survey questions. There was a difference in HD and PD groups in terms of responses to survey questions 5, 6 and 7 (Table 5).

DISCUSSION

Dietary counselling is extremely important for improving phosphate control in hemodialysis patients. Especially, the phosphorus in processed foods is a matter that has not received sufficient attention. According to our first (baseline) survey, although most of our patients were aware of high sugar content in carbonated beverages, they were not sufficiently aware of the high phosphorus content in carbonated beverages and fast food. In addition, though our patients were aware of the detrimental effects of phosphorus, almost half still consumed fast food and carbonated beverages.

In the study by Butt et al., it was observed that the serum phosphorus levels increased and weight gain between two dialysis sessions was more frequent in CRF patients that consumed fast food.[7] There were 194 hemodialysis patients evaluated, and 42% of these patients were observed to consume fast food at least once every 4 days.[7] In our study, there was a lower proportion of patients who consumed fast food at least once per week, at 21%.

In another study that emphasized the importance of patient education, which included 279 CRF patients with hyperphosphatemia, the patient group that received education on inorganic phosphorus–added foods for a duration of 3 months displayed a decrease in serum phosphorus levels compared with the control group.[10] In the present study, our patients' survey score did not change after the training. However, we did not observe the anticipated decrease in serum phosphorus levels after the patient education.

Different studies have shown that education does not change dialysis patients' behavior or de-

TABLE 5: Comparison of HD and PD patients' answers to questions.

		Survey 1	Survey 2	p
Question 1#	HD patients (%)	86.8	94.8	0.005
	PD patients (%)	94.3	91.4	1.00
	p	0.27	0.42	-
Question 2#	HD patients (%)	68.4	74.5	0.136
	PD patients (%)	68.6	88.6	0.065
	p	1.00	0.08	-
Question 3#	HDa patients (%)	64.2	73.1	0.0371
	PD b patients (%)	77.1	80	1.00
	p	0.17	0.53	-
Question 4#	HD patients (%)	82.1	87.7	0.119
	PD patients (%)	94.3	91.4	1.00
	p	0.08	0.77	-
Question 5*	HD patients (%)	50	56.6	0.144
	PD patients (%)	74.3	77.1	0.759
	p	0.03	0.04	-
Question 6**	HD patients (%)	67	55.2	0.016
	PD patients (%)	48.6	48.6	1.00
	p	0.00	0.04	-
Question 7***	HD patients (%)	30.7	25.5	0.279
	PD patients (%)	62.9	51.4	0.468
	p	0.00	0.00	-

p <0.05 statistically significant value, HD: Hemodialysis, PD: Peritoneal dialysis, #Yes *I don't drink, ** I don't eat, *** I want to learn more about phosphorus.

crease serum phosphorus levels. Lim et al. studied the effects of education on a low-phosphate diet and phosphate binder intake for controlling serum phosphate among maintenance hemodialysis patients. They found no difference in calcium-phosphate products after the education.[11] This may be attributed to patients' lack of discipline over their diet or fatigue with long-term treatment programs.

As expected, as a result of the educational programs, we have observed an increased awareness of fast foods and carbonated beverages containing high levels of sugar and inorganic phosphorus compounds. However, although the awareness increased, there was no decrease in the frequency of consumption of carbonated beverages and fast foods. While the number of patients who decided to reduce the phosphorus intake in their diets increased, a real reduction was not observed in the laboratory values, which could indicate that patient awareness does not directly correlate to the changes in patient dietary habits. Perhaps the patient caregivers should be trained to help the patients to decrease their phosphorus intake.

In a similar study on HD patients, the consumption frequency of carbonated beverages and fast food was about the same with our study. However, our patients had more awareness of phosphorus content in fast food and carbonated beverages.[3] The difference in our study was that we also surveyed PD patients. In our research, the PD patients had the same level of awareness as the HD patients did. Although education level and dialysis adequacy of PD patients were better than HD patients, we could not find any difference between the two surveys.

The problem of patient adherence to the dietetic-nutritional scheme is a key element for the success and safety of dietetic-nutritional therapy, and it can be favored by an interdisciplinary and multi professional approach involving information, education, dietary prescription and follow up.[8] The also most important difference that distinguishes our study from other research is its being a prospec-

tive cohort study. Another difference between our study and the two mentioned above is that our research included educational programs over a period of time and the effects of those educational programs on the patients.

CONCLUSION

In conclusion, although patients seem to be aware of the harmful effects of high phosphorus consumption, they are not sufficiently aware of high phosphorus in fast foods and carbonated beverages. Furthermore, they seem to lack the skills to practice appropriate dietary measures to combat excessive phosphorus intake. Therefore, educational programs on how to reduce phosphorus intake need to be designed specifically for CRF patients and possibly their first-degree caregivers. In this way, they can internalize the information and change their dietary habits.

Acknowledgments

The author thanks for the supports of all the staff members working at dialysis clinic and the statistical evaluation of Çagla Saritürk.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Dilek Torun;* ***Design:*** *Nihan Tekkarışmaz;* ***Control/Supervision:*** *Rüya Özelsancak;* ***Data Collection and/or Processing:*** *Nihan Tekkarışmaz;* ***Analysis and/or Interpretation:*** *Nihan Tekkarışmaz;* ***Literature Review:*** *Nihan Tekkarışmaz;* ***Writing the Article:*** *Nihan Tekkarışmaz;* ***Critical Review:*** *Rüya Özelsancak;* ***References and Fundings:*** *Dilek Torun;* ***Materials:*** *Nihan Tekkarışmaz.*

REFERENCES

1. Uribarri J, Calvo MS. Hidden sources of phosphorus in the typical American diet: does it matter in nephrology? Semin Dial. 2003;16(3):186-8. [Crossref] [PubMed]
2. Shutto Y, Shimada M, Kitajima M, Yamabe H, Razzaque MS. Lack of awareness among future medical professionals about the risk of consuming hidden phosphate-containing processed food and drinks. PLoS One. 2011;6(12):e29105. [Crossref] [PubMed] [PMC]
3. Shutto Y, Shimada M, Kitajima M, Yamabe H, Saitoh Y, Saitoh H, et al. Inadequate awareness among chronic kidney disease patients regarding food and drinks containing artificially added phosphate. PLoS One. 2013;8(11): e78660. [Crossref] [PubMed] [PMC]
4. Ritz E, Hahn K, Ketteler M, Kuhlmann MK, Mann J. Phosphate additives in food--a health risk. Dtsch Arztebl Int. 2012;109(4):49-55. [Crossref] [PubMed] [PMC]
5. Copland M, Komenda P, Weinhandl ED, McCullough PA, Morfin JA. Intensive hemodialysis, mineral and bone disorder, and phosphate binder use. Am J Kidney Dis. 2016;68(5S1):S24-32. [Crossref] [PubMed]
6. Karalis M, Murphy-Gutekunst L. Patient education. Enhanced foods: hidden phosphorus and sodium in foods commonly eaten. J Ren Nutr. 2006;16(1):79-81. [Crossref] [PubMed]
7. Butt S, Leon JB, David CL, Chang H, Sidhu S, Sehgal AR. The prevalence and nutritional implications of fast food consumption among patients receiving hemodialysis. J Ren Nutr. 2007;17(4):264-8. [Crossref] [PubMed] [PMC]
8. Cupisti A, Brunori G, Di Iorio BR, D'Alessandro C, Pasticci F, Cosola C, et al. Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018;31(4):457-73. [Crossref] [PubMed] [PMC]
9. Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Work Group. KDIGO clinical practice guideline for the diagnosis, evaluation, prevention, and treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). Kidney Int Suppl. 2009;(113):S1-130. PMID: 19644521. [PubMed]
10. Sullivan C, Sayre SS, Leon JB, Machekano R, Love TE, Porter D, et al. Effect of food additives on hyperphosphatemia among patients with end-stage renal disease: a randomized controlled trial. JAMA. 2009;301(6):629-35. [Crossref] [PubMed]
11. Lim E, Hyun S, Lee JM, Kim S, Lee MJ, Lee SM, et al. Effects of education on low-phosphate diet and phosphate binder intake to control serum phosphate among maintenance hemodialysis patients: a randomized controlled trial. Kidney Res Clin Pract. 2018;37(1):69-76. [Crossref] [PubMed] [PMC]