Dietary Intake and Its Related Factors in Peritoneal Dialysis Patients in Tehran, Iran

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Introduction. Poor nutritional status is prevalent in peritoneal dialysis (PD) patients and is related to morbidity and mortality. Therefore, the aim of the present study was to assess the dietary intake and its related factors in PD patients in Tehran, Iran.
Methods. All eligible PD patients in Tehran peritoneal dialysis centers were included in this cross-sectional study. Dietary intake of PD patients was determined using a 3-day dietary recall. Also, a 4 mL blood sample was obtained from each patient to measure serum biochemical parameters.
Results. Intake of energy, protein, and fiber were lower than recommended values in 81%, 92%, and 100% of PD patients; respectively. The prevalence of inadequate energy intake in PD patients with dialysis vintage ≤ 5 years was significantly higher as compared to those with dialysis vintage > 5 years ($P < .05$). A significant association was observed between inadequate energy intake and inadequate vitamin B3 intake ($P < .05$). There was a marginally (not) significant association between inadequate energy intake and inadequate vitamin B1 intake ($P > .05$). Intake of the vitamins B1, B2, B3, B6, folic acid, B12, E, C, and of the minerals, calcium, and zinc from both the diet and supplements were lower than recommended values in 15%, 38%, 23%, 39%, 52%, 32%, 47%, 29%, 54%, and 50.5% of PD patients, respectively.
Conclusion. Insufficient intake of energy and various nutrients are common in PD patients in Tehran, Iran; which may contribute to morbidity and mortality in these patients.

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INTRODUCTION

Poor nutritional status is common among peritoneal dialysis (PD) patients[1-4] and is related to morbidity and mortality.[1,2,5] Poor nutritional status in PD patients is a result of low appetite, high catabolism due to increased production of inflammatory cytokines, nutrient removal by dialysis, and dietary restrictions.[5,6-8] Some investigations indicated that the frequency of energy and/ or protein deficiency is about 49% to 89% in PD patients.[3,4] In addition, inadequate dietary intake of various micronutrients is prevalent in PD patients.[1,2]

Dietary assessments in PD patients have been performed in various countries;[1-4,9] however, despite most Iranian PD patients are in Tehran (the capital of Iran),[10] to our knowledge; no investigation has yet been performed on dietary intake of PD patients and its related factors in Iran. Therefore, the aim of this study was to determine the dietary intake of PD patients and its related factors including inflammation, total dialysis adequacy, dialysis vintage, age, gender, and appetite-affecting nutrients such as B-group vitamins, and zinc, in Tehran, Iran.

MATERIALS AND METHODS

Participants and Ethical Aspects

All eligible PD patients (n = 79) in all peritoneal dialysis centers in Tehran were included in this cross-sectional study. Inclusion criteria were age ≥ 18 years and being on continuous ambulatory peritoneal dialysis for at least 6 months, while exclusion criteria were the presence of edema, and peritonitis diagnosed by the physician. After the treatment of edema and peritonitis, these PD patients were enrolled in our study. The Ethics Committee of the National Nutrition and Food Technology Research Institute of Iran approved the study protocol. The study was in adherence with the Declaration of Helsinki. Written informed consent was obtained from all patients.

Measurements

The dietary intake of patients was determined based on a 3-day diet diary-assisted recall (also referred to as a 3-days diet record), by a trained dietitian.[11] In this dietary assessment method, the patients were asked to record the amount and type of their eaten foods, based on the instructions given to them, for 3 consecutive days. At the end of each day, patients were asked by phone carefully about their consumed foods. The analysis of patients' diets was performed by Nutritionist IV software (N Squared Computing, San Bruno, CA, USA) adjusted for some Iranian foods to assess daily intake of energy, and nutrients. Patients' dietary intake was compared with dietary guidelines for PD patients.[12-16] Height was measured to the nearest 0.5cm, and dry weight to the nearest 0.1kg. Weight was measured in a state without dialysate in the peritoneal cavity. Dry weight was used for calculating energy or protein intake per kg of body weight in PD patients with body mass index (BMI) £ 25 kg/m^2, whereas adjusted dry weight was applied for patients with BMI > 25 kg/m^2.[16] All patients were questioned about the use and the dosage of supplements including vitamin B1, B2, B3, B6, folic acid, B12, C, E, calcium, zinc, L-carnitine, and 1, 25 dihydroxycholecalciferol (calcitriol).

In addition, a 4 mL blood sample was taken from each patient, after a 12- to 14- hours fasting, to determine serum biochemical parameters. Serum urea, creatinine, calcium, and phosphorus were measured by commercial kits (Pars-Azmoon, Tehran, Iran) with the aid of a Selectra 2 Autoanalyzer (Vital Scientific, Spankeren, The Netherlands). Serum potassium was determined by flame photometry. Coefficients of variation (CV) for serum creatinine, urea, calcium, phosphorus, and potassium were less than 3%. Serum high sensitive C-reactive protein (hs-CRP) concentration was assessed by enzyme-linked immunosorbent assay kits (Zellbio GmbH, Ulm, Germany), with a CV of 4%. Serum concentration of hs-CRP > 3 mg/L was considered as the presence of microinflammation.[17,18]

Dialysis adequacy (as total Kt/V per week) was measured for each patient by a Kt/V calculator, using information recorded in patient files, including blood urea concentration, 24-hour urine volume, urine urea concentration, 24-hour dialysate drain volume, dialysate urea concentration, weight, height, and age.[19] In this study, from 79 PD patients, information regarding Kt/V index was available only for 65 patients. The peritoneal equilibration test (PET) for glucose was performed for each patient based on a 2L, 4.25% dextrose dwell with dialysate samples at 0 and 4 hours during the dwell period. The ratio of dialysate glucose concentration at time 4 to dialysate glucose level at time zero (D4/D0) was determined and then the percentage of glucose absorbed from the dialysate was calculated based on the 1- D4/D0 formula.[14,20] Total amount of glucose, absorbed daily from PD solutions was equal to the total infused anhydrous glucose multiplied by the percentage of absorbed glucose.[14] The total amount of glucose absorbed daily from PD solutions was used to calculate total intake of energy and carbohydrate from diet and dialysis solution in PD patients.

Statistical Analysis

Data are shown as the mean ± standard deviation (SD). Statistical analysis was done by Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, USA) for Windows version 21.0. A chi-square test was used to assess relationship between categorical variables. A *P* value £ .05 was considered statistically significant.

RESULTS

Table 1 shows characteristics of PD patients. Table 2 shows the dietary intake of patients as compared with dietary guidelines for PD patients. Intakes of energy, protein, and fiber were lower as

Table 1. Characteristics of the PD Patients

Characteristics	All patients (n = 79)
Age, y	
18 - 40	17 (21.5%)
41 - 64	41 (52%)
≥ 65	21 (26.5%)
Sex	
Men	35 (44%)
Women	44 (56%)
Dialysis vintage, y	
≤ 5	67 (85%)
> 5	12 (15%)
Total Dialysis Adequacy (Kt/V)	
< 1.7	25 (38.5%)
≥ 1.7	40 (61.5%)
Intake of Supplement	
Vitamin B1	52 (66%)
Vitamin B2	44 (56%)
Vitamin B3	44 (56%)
Vitamin B6	48 (61%)
Folic acid	38 (48%)
Vitamin B12	44 (56%)
Vitamin C	40 (50.5%)
Vitamin E	39 (49.5%)
Calcium	46 (58%)
Zinc	36 (45.5%)
L-Carnitine	10 (13%)
1, 25 Dihydroxycholecalciferol (Calcitriol)	37 (47%)
Serum Creatinine (mg/dL)†	5.5 ± 2.2
Serum Urea (mg/dL)†	95 ± 25.5

†Serum creatinine and urea are presented as mean ± standard deviation.

Table 2. Dietary Intakes of Patients in Comparison with Recommendations of Dietary Guidelines for PD Patients

Variable	Dietary Recommendations for Peritoneal Dialysis	Daily Dietary Intake†
Energy Intake from Diet, kcal/d	–	1317 ± 404
Total Energy from Diet and Dialysis Solution, kcal/d	–	1665 ± 422
Total Energy from Diet and Dialysis Solution, kcal/ kg bw /d		
< 60 years	35	29 ± 7
≥ 60 years	30 - 35	
Protein, g/kg bw /d	≥ 1.2	0.8 ± 0.3
Protein, g/d	–	52 ± 19.5
Energy from Protein, %	15	12 ± 3
HBV Protein to Total Protein Ratio, %	≥ 50	55 ± 15
HBV Protein, g/d	–	27.5 ± 13
Carbohydrate Intake from Diet, g/d	–	181 ± 67
Total Carbohydrate from Diet and Dialysis Solution, g/d	–	268 ± 73
Energy from Carbohydrate, %	55	64 ± 7
Fat, g/d	–	45.5 ± 17.5
Energy from Fat, %	30	24 ± 6
Cholesterol, mg/d	< 300	154 ± 94
Fiber, g/d	20 - 25	10 ± 3.5
Vitamin B1, mg/d	1.1 - 1.5	1.2 ± 0.4
Vitamin B2, mg/d	1.2 - 1.7	0.9 ± 0.3
Vitamin B3, mg/d	14 - 16	14 ± 5
Vitamin B6, mg/d	10	0.8 ± 0.4
Folic acid, µg/d	1000	137 ± 54
Vitamin B12, µg/d	2.4	2.2 ± 2.7
Vitamin E, mg/d	15	6.4 ± 6
Vitamin C, mg/d	75 - 90	71 ± 48
Zinc, mg/d	15	5 ± 2
Calcium, mg/d	1000 - 2000	386 ± 164
Potassium, mg/d	3000 - 4000	1412 ± 552
Phosphorus , mg/kg bw /d	≤ 17	8.6 ± 3
Phosphorus, mg/d	800 - 1000	522 ± 176

†Values are presented as mean ± SD.

compared with recommended values in 81%, 92%, and 100% of PD patients, respectively (Table 3).

The prevalence of inadequate energy intake in PD patients with dialysis vintage ≤ 5 years was significantly higher as compared to those with dialysis vintage > 5 years ($P < .05$, Table 4). There was a marginally (not) significant association between inadequate energy intake and inadequate vitamin B1 intake ($P > .05$, Table 4). A significant association was observed between inadequate energy intake and inadequate vitamin B3 intake ($P < .05$, Table 4). There were no significant association between energy intake with intake of vitamin B2, B6, B12, folic acid, and zinc (Table 4). No significant associations found between intake of energy and protein with sex, age, inflammation, and total dialysis adequacy (Tables 4 and 5). There were no significant association between protein intake with dialysis vintage and intake of B-group vitamins and zinc (Table 5).

Intake of the vitamin B1, B2, B3, B6, folic acid, B12, E, C, and of the minerals, calcium and zinc from both the diet and supplements was lower as compared with recommended values in 15%, 38%, 23%, 39%, 52%, 32%, 47%, 29%, 54%, and 50.5% of PD patients; respectively (Table 3).

Dietary intake of cholesterol, potassium, phosphorus, and calcium was higher as compared with recommended intake in 14%, 0%, 0%, and 7.5% of PD patients; respectively.

In 1.5% of PD patients, serum potassium concentration was above the acceptable level (> 5.5

Table 3. Frequencies of Patients with Intakes Below Those of Dietary Recommendations for PD Patients

Variable	Number of Patients with Dietary Intake Below Recommendations (%)	Number of Patients with Intakes from Both the Diet and Supplement Below Recommendations (%)
Energy, kcal/kg bw /d	74 (94%)	64 (81%)†
Protein, g/kg bw /d	73 (92%)	–
HBV Protein to Total Protein Ratio, %	30 (38%)	–
Fiber, g/d	79 (100%)	–
Vitamin B1, mg/d	29 (37%)	12 (15%)
Vitamin B2, mg/d	67 (85%)	30 (38%)
Vitamin B3, mg/d	44 (56%)	18 (23%)
Vitamin B6, mg/d	79 (100%)	31 (39%)
Folic Acid, µg/d	79 (100%)	41 (52%)
Vitamin B12, µg/d	51 (65%)	25 (32%)
Vitamin E, mg/d	71 (90%)	37 (47%)
Vitamin C, mg/d	47 (59.5%)	23 (29%)
Zinc, mg/d	79 (100%)	43 (54%)
Calcium, mg/d	79 (100%)	40 (50.5%)

†For Energy: Number of Patients with Total Energy Intake from Diet and Dialysis Solution Below Recommendations (%)

Table 4. Association of Energy Intake with Different Factors in PD Patients

Variable	Energy Intake		
	Deficient	Acceptable	*P*
Sex			
Men	29 (83%)	6 (17%)	NS[a]
Women	35 (79.5%)	9 (20.5%)	
Age, y			
18 - 40	15 (88%)	2 (12%)	
41 - 64	32 (78%)	9 (22%)	NS
≥ 65	17 (81%)	4 (19%)	
Dialysis Vintage, y			
≤ 5	57 (85%)	10 (15%)	< .05
> 5	7 (58%)	5 (42%)	
Micro-inflammation			
Yes (hs-CRP > 3 mg/L)	39 (78%)	11 (22%)	NS
No (hs-CRP ≤ 3 mg/L)	23 (88.5%)	3 (11.5%)	
Dialysis Adequacy, Kt/V			
< 1.7	20 (80%)	5 (20%)	NS
≥ 1.7	33 (82.5%)	7 (17.5%)	
Vitamin B1 Intake			
Deficient	12 (100%)	0 (0%)	NS
Acceptable	52 (78%)	15 (22%)	
Vitamin B2 Intake			
Deficient	26 (87%)	4 (13%)	NS
Acceptable	38 (78%)	11 (22%)	
Vitamin B3 Intake			
Deficient	18 (100%)	0 (0%)	< .05
Acceptable	46 (75%)	15 (25%)	
Vitamin B6 Intake			
Deficient	25 (81%)	6 (19%)	NS
Acceptable	39 (81%)	9(19%)	
Folic acid Intake			
Deficient	33 (80.5%)	8 (19.5%)	NS
Acceptable	31 (82%)	7 (18%)	
Vitamin B12 Intake			
Deficient	22 (88%)	3 (12%)	NS
Acceptable	42 (78%)	12 (22%)	
Zinc Intake			
Deficient	34 (79%)	9 (21%)	NS
Acceptable	30 (83%)	6 (17%)	

[a]NS: Non-significant
hs-CRP: High Sensitive C-reactive Protein

mEq/L) (Table 6). Serum phosphorus concentration was higher than normal range (> 5.5 mg/dL) in 13% of PD patients. In 72.5% of PD patients, serum calcium concentration was above the acceptable level (> 10 mg/dL), and was lower than normal range (< 8.4 mg/dL) in 10.5%. Serum calcium - phosphorus product was above the acceptable level (> 55 mg^2/dL^2) in 17% of PD patients (Table 6).

DISCUSSION

The present study indicated that intake of energy and protein was lower as compared with those recommended in 81% and 92% of PD patients, respectively. Mean (± SD) energy and protein intake in PD patients was 29 ± 7 kcal/kg $_{bw}$/d and 0.8 ± 0.3 g/kg $_{bw}$/d, respectively, amounts which were lower than those recommended.[12,14,15] These results were in agreement with previous investigations. Sutton et al., in a study from the United Kingdom, indicated that intake of energy and protein was less than those recommended in 89% and 79% of PD patients, respectively.[3] Adbu et al. in an investigation in South Africa, showed that 49% of PD patients had energy and protein intake lower than those recommended.[4] Imani et al. showed in a clinical trial in Iran, that mean dietary energy and protein intake in PD patients was respectively 17 ± 7 kcal/kg $_{bw}$/d and 0.7 ± 0.2 g/kg $_{bw}$ /d.[21] In a study from Mexico, Martin- Del-Campo et al. reported mean energy and protein intake in PD patients without malnutrition to be 22.2 ± 6.5 kcal/kg $_{bw}$ /d and 0.88 ± 0.23 g/kg $_{bw}$ /d, respectively.[1] Bovio et al. indicated in a study in Italy, that mean dietary energy and protein intake in PD patients was respectively 24.2 ± 7.9 kcal/kg $_{bw}$ /d and 0.95 ± 0.39 g/kg $_{bw}$ /d.[9] Wang

Table 5. Association of Protein Intake with Different Factors in PD Patients

Variable	Protein Intake		
	Deficient	Acceptable	*P*
Sex			
Men	33 (94%)	2 (6%)	NS
Women	40 (91%)	4 (9%)	
Age, y			
18 - 40	16 (94%)	1 (6%)	NS
41 - 64	38 (93%)	3 (7%)	
≥ 65	19 (90.5%)	2 (9.5%)	
Dialysis Vintage, y			
≤ 5	61 (91%)	6 (9%)	NS
> 5	12 (100%)	0 (0%)	
Micro-inflammation			
Yes (hs-CRP > 3 mg/L)	47 (94%)	3 (6%)	NS
No (hs-CRP ≤ 3 mg/L)	24 (92%)	2 (8%)	
Dialysis Adequacy, Kt/V			
< 1.7	24 (96%)	1 (4%)	NS
≥ 1.7	36 (90%)	4 (10%)	
Vitamin B1 Intake			
Deficient	12 (100%)	0 (0%)	NS[a]
Acceptable	61 (91%)	6 (9%)	
Vitamin B2 Intake			
Deficient	27 (90%)	3 (10%)	NS
Acceptable	46 (94%)	3 (6%)	
Vitamin B3 Intake			
Deficient	18 (100%)	0 (0%)	NS
Acceptable	55 (90%)	6 (10%)	
Vitamin B6 Intake			
Deficient	27 (87%)	4 (13%)	NS
Acceptable	46 (96%)	2 (4%)	
Folic acid Intake			
Deficient	39 (95%)	2 (5%)	NS
Acceptable	34 (89.5%)	4 (10.5%)	
Vitamin B12 Intake			
Deficient	23 (92%)	2 (8%)	NS
Acceptable	50 (93%)	4 (7%)	
Zinc Intake			
Deficient	38 (88%)	5 (12%)	NS
Acceptable	35 (97%)	1 (3%)	

[a]NS: Non-significant
hs-CRP: High Sensitive C-reactive Protein

Table 6. Frequencies of PD Patients According to Serum Biochemical Parameters

Serum Parameters	Number of Patients (%)
Potassium, mEq/L	
≤ 5.5	75 (98.5%)
> 5.5	1 (1.5%)
Phosphorus, mg/dL	
≤ 5.5	66 (87%)
> 5.5	10 (13%)
Calcium, mg/dL	
< 8.4	8 (10.5%)
8.4 - 10	13 (17%)
> 10	55 (72.5%)
Calcium × Phosphorus, mg^2/dL^2	
≤ 55	63 (83%)
> 55	13 (17%)

et al. in a study from Hong Kong, showed that mean energy and protein intake of PD patients to be 28.4 ± 8.7 kcal/kg $_{bw}$ /d and 1.1 ± 0.45 g/kg $_{bw}$ /d, respectively.[2]

Insufficient intake of energy and protein results in malnutrition, low quality of life and high morbidity and mortality in PD patients.[1-5] Anorexia is one of the main causes for insufficient energy and protein intake in PD patients. Anorexia may be caused by the absorption of glucose from PD solution, inflammation, uremic toxins, changes in secretion of appetite-affecting hormones and neurotransmitters, and by underlying illness such as infection.[5-7,22] Other cause of insufficient intake of energy and protein in PD patients is the reduction of food consumption to prevent hyperphosphatemia.[22] Strategies for ingesting a sufficient diet by PD patients include nutrition counseling,[22] use of glucose polymer-based PD solutions (such as Icodextrin) for reducing glucose absorption from peritoneal cavity,[5] reduction of inflammation by L-carnitine therapy,[23] and related medical care for treating underlying illness.[22]

In our study, there were no significant association between energy and protein intake with age, sex, total dialysis adequacy, inflammation, and zinc intake. In addition, no significant associations were observed between protein intake with dialysis vintage and intake of B-group vitamins. However, the prevalence of insufficient energy intake in PD patients with dialysis vintage ≤ 5 years was significantly higher than those with dialysis vintage > 5 years. This could be due to limited experience and knowledge of nutrition in the patients with dialysis vintage £ 5 years.[11] These patients may reduce total food consumption instead of removing specific foods to prevent hyperphosphatemia.[11] There was a marginally significant association between inadequate energy intake and inadequate vitamin B1 intake. Also, a significant association was observed between inadequate energy intake and inadequate vitamin B3 intake. Evidence shows that inadequate intake of B-group vitamins especially vitamins B1 and B3 leads to anorexia.[24] Thus, for PD patients with

insufficient intake of B-group vitamins a vitamin B complex supplement should be prescribed.

Dietary fiber intake was lower than the recommended value in 100% of PD patients and mean (± SD) fiber intake in these patients was 10 ± 3.5 g/d, an amount that was less than recommended fiber intake (20 to 25 g/d).[14] The finding was in agreement with previous investigations in PD patients.[1,9] Intake of vitamins E and C was lower than the recommended values in 47% and 29% of PD patients, respectively. Mean (± SD) intake of vitamins E and C in PD patients was 6.4 ± 6 mg/d and 71 ± 48 mg/d, respectively; amounts less than recommended intake.[13,15] The findings are in agreement with those of Imani et al. who showed that vitamins E and C intake was less than recommended intake in PD patients.[21] In addition, in the Martin-Del-Campo et al. study, vitamin C intake was lower than the recommended intake in > 50% of PD patients.[1] The insufficient intake of fiber, vitamins E and C in PD patients may be due to low nutrition knowledge, a lack of nutrition counseling, and severe limitation of vegetable and fruit consumption to prevent hyperkalemia.[25] However, none of PD patients had dietary potassium intake higher than the recommended intake and serum potassium was above the acceptable limit (> 5.5 mEq/L) in only one of the patients.

Oxidative stress is a prevalent complication in PD patients,[26] and insufficient intake of vitamins E and C can increase oxidative stress and its complications such as peritoneal membrane fibrosis and cardiovascular diseases.[26,27] Therefore, an antioxidant supplement should be prescribed for PD patients with inadequate dietary intake of vitamins C and E . Since large doses of vitamin C may increase oxalate production, a vitamin C supplement should be prescribed at the level of recommended dietary allowance (RDA).[13] In contrast, vitamin E is not related to high oxalate production and its supplementation for PD patients is safe.[28]

Intake of vitamins B1, B2, and B3 from both diet and supplements was lower as compared with the recommended values in 15%, 38%, and 23% of PD patients; respectively. This may be due to insufficient food intake.[13,14] Inadequate intake of these water-soluble vitamins and their losses during peritoneal dialysis may cause vitamin deficiencies in PD patients.[13,14]

Vitamin B6 and folic acid intake from both diet and supplements was lower as compared with the recommended intake in 39% and 52% of these patients, respectively. In agreement with these findings, previous studies showed that mean intake of vitamin B6 and folic acid was less than recommended intake for PD patients.[1,2,21] In PD patients, recommended intake for vitamin B6 and folic acid is 10 mg and at least 1 mg, respectively; [13,14] while in healthy adults, RDAs for vitamin B6 and folic acid are 1.3 to 1.7 mg/d and 400 µg/d, respectively.[13] Therefore, diets alone can not meet the needs of PD patients, and vitamin B6 and folic acid supplementation is required for these patients.[13,14]

Intake of vitamin B12 from both diet and supplement was lower as compared with the recommended value in 32% of PD patients. This could be due to insufficient intake of animal protein sources.[24] In agreement with our study, Martin-Del-Campo et al. indicated that 25% of PD patients had vitamin B12 intake lower than recommended value.[1]

Dietary zinc intake was lower as compared with the recommended intake in 100% of PD patients and mean (± SD) zinc intake was 5 ± 2 mg/d. On the other hand, 54% of PD patients did not receive zinc supplement. The result is in agreement with those of previous studies.[1,2] Insufficient zinc intake in PD patients may be related to insufficient consumption of meats and dairy products to prevent hyperphosphatemia.[24]

In our study, calcium intake from both diet and supplements was lower than recommended intake of 1000-2000 mg/d[12,14,15] in 50.5% of PD patients. Insufficient calcium intake in PD patients is associated with inadequate consumption of dairy products, rich in phosphorus,[24] to prevent hyperphosphatemia. On the other hand, in dialysis patients, vitamin D cannot be converted to calcitriol and the use of calcitriol is necessary for PD patients;[16,29] however, 53% of PD patients did not use calcitriol supplement. In PD patients receiving calcium and calcitriol supplements, if the serum calcium-phosphorus product is above 55 mg^2/dL^2, the supplements should be stopped to prevent the calcification of soft tissue, especially the coronary arteries.[29] In our study, serum calcium-phosphorus product was higher than > 55 mg^2/dL^2 in 17% of PD patients. Therefore, sufficient counseling is necessary for PD patients to use

calcium and calcitriol supplements appropriately.

Although serum phosphorus was above the acceptable limit (> 5.5 mg/dL) in 13% of PD patients, none of these patients had dietary phosphorus intake higher than the recommended intake. This may be due to insufficient intake of protein foods such as meats, dairy products, legumes, and nuts. The finding is in agreement with those of previous studies that showed mean dietary phosphorus intake was in the acceptable limit in PD patients.[2,9,21]

In the present study, 87% of PD patients did not receive L-carnitine supplement, which can result in carnitine deficiency, due to intradialytic loss of carnitine, impaired biosynthesis of carnitine in the kidney, and low dietary intake of carnitine.[23] Carnitine deficiency can lead to myopathy, cardiomyopathy, inflammation, loss of body protein, cachexia, altered plasma lipid profile, anemia, and resistance to erythropoietin.[23] Therefore, intravenous L-carnitine should be administered to dialysis patients.[23]

One of the limitations of this study was the lack of data collection on socioeconomic status of PD patients. In our study, all eligible PD patients in Tehran were enrolled, thus, there was no selection bias, and the generalizability of this study was appropriate for PD patients in Tehran. In addition, since recent dietary intake of PD patients was assessed in our study, there was few recall bias.

CONCLUSION

Insufficient intake of energy and various nutrients is common in PD patients in Tehran, Iran, which may contribute to high morbidity and mortality in this population.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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