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Assessment of diet in chronic kidney disease female predialysis patients

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Abstract

Introduction and objective. Nutrition is important in the therapy of predialysis patients. The aim of the presented single-centre descriptive study was to assess the diet in chronic kidney disease female predialysis patients with no previous dietary intervention, in comparison with recommendations, as well as the analysis of the energy, protein and phosphate intake in correlation with chosen laboratory measurements.
Materials and methods. The research was carried out in 31 female predialysis patients with CKD of different etiology, aged 29–79 years (GFR: 19.4±9.7ml/min/1.73m^2). Main outcome measures were self-reported data from three-day dietary recall. Nutrients content and energy value of diet were compared with guidelines for chronic kidney disease patients or, in case of nutrients when they are not settled, with the recommendations for healthy women.
Results. All patients had a lower energy intake than the recommended level. At the same time, 35.8% of patients were characterised by improper protein intake – too low or too high. The majority of patients had low intake of most of vitamins and minerals. The total, animal and plant protein were positively correlated with the energy value of diet and with amount of most of the nutrients. Values of GFR were positively correlated with animal protein intake, while phosphate and creatinine in blood were negatively correlated with total and animal protein intake.
Conclusions. The study highlights that diet of CKD predialysis patients with no previous dietary intervention is not properly balanced.

Keywords
chronic kidney disease, diet, predialysis patients, nutritional recommendation, protein intake

INTRODUCTION

The main goals in the therapy of chronic kidney disease (CKD) in predialysis patients are reduction of unfavourable symptoms of uraemia, delaying the nephro-replacement therapy and quality of life improvement, which may be achieved by an appropriate diet, applied with other elements of therapy [1]. The diet therapy should be associated with suitable protein and energy intake. Insufficient information about proper nutrition standards in restrictive low protein diet (LPD) may result in its negative influence on patients' health and body composition [2]. Patients' compliance is another problem, as few of them achieve the target protein level [3]. Nutrition is important in the therapy of predialysis patients, but in the literature the amount of research on that subject is limited. Steiber [4] assessed patients with CRF and concluded that less than a quarter of the patients met 75% or more of their energy and protein needs, but haemodialysis, peritoneal dialysis and predialysis patients were included in the study. Duenhas *et al.* [5] confirmed that energy and protein intake in a group of predialysis individuals was too low.

WHO experts recommend for healthy adults, 0.83g of protein/kg of body weight as the safe level and 0.66g as the estimated average requirement [6]. The typical Polish diet contains 1.5–2.0 times more protein than recommended [7].

Limitation of protein intake is the fundamental element of diet for predialysis patients which, according to most of the recommendations, should contain 0.6 or 0.8g of protein/kg of body weight [8, 9]. This limitation had been proven to delay the progression of CKD and to reduce renal causes mortality . Such a diet may delay development of end-stage renal disease and lengthen the predialysis phase [3]. Simultaneously, there is no evidence of its adverse effect on patients' survival time before [10] and after [11] initiating the dialysis. It should be emphasized that the change in protein intake is mainly connected with its limitation in comparison with the typical western diet, not with the recommendations for healthy ones.

Some doubts connected with LPD result from the possibility of protein-energy malnutrition, caused by following an improper diet for a long time [12]. Prevention of malnutrition must be supported by a suitable energy intake, which in CKD is almost equally essential as the limitation of protein intake [13]. Predialysis patients who apply the LPD require an energy intake of 146kJ (35kcal)/kg of body weight [8], to prevent nitrogenous balance disturbance and to maintain the stable body weight, because the deficit of calories intensifies protein catabolism and may contribute to malnutrition. In practice, patients on LPD often reduce the amount of consumed food, which leads to difficulties with achieving the correct level of energy. In such a situation, it is very difficult to prevent protein catabolism.

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OBJECTIVES

The aim of the presented research was to assess the diet in CKD female predialysis patients with no previous dietary intervention, in comparison with recommendations, as well as analysis of the energy, protein and phosphate intake in correlation with chosen laboratory measurements.

MATERIALS AND METHOD

The study was conducted at the Department of Dietetics in the University of Life Sciences in Warsaw. It was carried out in female predialysis patients with CKD of different etiology. They were monitored at the Nephrological Outpatient Clinic in the Public Central Teaching Hospital in Warsaw. 31 patients aged 29–79 years (GFR: 19.4±9.7ml/min/1.73m^2) were qualified for the study. All of them provided written consent to participate in the study. All experimental protocols were approved by the Bioethical Commission of the Medical University in Warsaw (KB/81/2009).

Inclusion criteria: free-living patients with 3rd – 5th stage of CKD (GFR<60ml/min/1.73m^2), recommended by a nephrologist to limit protein intake for a minimum 1 year before the study, without dietary intervention conducted, and CKD diagnosed minimum 1 year before the study. Exclusion criteria: patients over 80 years of age, hospitalized within 6 months before the study or qualified to dialysis therapy.

Body weight and height were measured and used to calculate BMI [kg/m^2]. GFR, creatinine, urea and phosphate blood level were chosen as typical indicators of CKD progression [14] and were obtained from patients' medical documentation. GFR was calculated using the MDRD equation [15].

Assessment of diet was based on self-reported data from patients' 3-day dietary record (2 week days, 1 weekend day). To provide reliable estimates of food intake, participants were instructed about the principles of completing a 3-day dietary record, as well as about the necessity for accurate and scrupulous recording of all food products and beverages consumed. The 3-day dietary record was conducted on the basis of widely accepted and applied rules [16].

The results were analyzed using the Polish dietician software 'Dietetyk 2' and the Polish base of the nutritional value of the products [17, 18]. The obtained average nutritional value of analysed diets (mean of 3 analysed days) was the basis for the further analysis.

Nutrients contents and energy value of diets were compared with guidelines for CKD patients [8, 9, 19, 20, 21] or, in the case of nutrients, when they were not settled, with the recommendations for healthy women [6, 7] (Tab. 1). To assess phosphorus, magnesium, iron, zinc, copper, vitamin A, B_1, B_2, niacin, vitamin B_6, folate, vitamin B_{12} and C daily intake, the Recommended Daily Allowance (RDA) level was chosen. In the case of sodium, potassium, calcium, vitamin D and E, the Adequate Intake Level was accepted, because RDA level was not established.

Data are presented as mean±standard deviation with minimum, maximum and median value. The ideal body weight was calculated according to the recommended estimation [21]. Distribution of the analysed factors was verified using the Shapiro-Wilk test. To characterise relationships among the analyzed factors, Pearson's correlation (in the case of normal distribution) and Spearman's correlation (in the case of distribution different from normal) was used. To define the significance of correlations, the level of significance α=0.05 was accepted. Statistical analysis was conducted using the Statistica software version 8.0 by StatSoft Inc.

Table 1. Recommended nutrients content and energy value of diet for analysed group of CKD predialysis female patients

	Recommended supply
Energy [kJ (kcal)/ kg of ideal body mass] [1, 2]	146 (35) – age under 60; 126-146 (30-35) – age over 60
Total protein [g/ kg of ideal body mass] [1/ 3, 4]	0,6/ 0,8
Animal protein [% of protein] [1]	≥50
Fat [% of energy] [1]	25-35
SFA [% of energy] [1]	<7
MUFA [% of energy] [1]	≤20
PUFA [% of energy] [1]	≤10
Cholesterol [mg] [1]	< 200
Carbohydrate [% of energy] [1]	<60
Sucrose [% of energy] [5]	<10
Fibre [g] [1]	20-30
Sodium [mg] [1]	2400
Potassium [mg] [5]	4700
Calcium [mg] [1]	≤2000 – from diet and medications
Phosphorus [mg] [3]	≤ 1000
Magnesium [mg] [5]	310 – age 19-30; 320 – age over 30
Iron [mg] [5]	18 – age 19-50; 10 – age over 50
Zinc [mg] [5]	8
Copper [mg] [5]	0,9
Vitamin A [µg] [5]	700
Vitamin D [µg] [5]	5 (age 19-50); 10 (age 51-65); 15 (age over 65)
Vitamin E [mg] [5]	8
Vitamin B_1 [mg] [5]	1,1
Vitamin B_2 [mg] [5]	1,1
Niacin [mg] [5]	14
Vitamin B_6 [mg] [5]	1,3 (age 19-50); 1,5 (age over 50)
Folate [µg] [5]	400
Vitamin B_{12} [µg] [5]	2,4
Vitamin C [mg] [5]	75

[1] NKF K/ DOQI guidelines for CKD predialysis patients (NKF K/DOQI, 2000; NKF K/DOQI, 2003)
[2] EDTNA/ ERCA guidelines for CKD predialysis patients (EDTNA/ ERCA, 2002)
[3] Polish guidelines for CKD predialysis patients (Czekalski et al., 2004; Nowicki et al., 2004)
[4] WHO norm for healthy women (WHO, 2007)
[5] Polish norm for healthy women (Jarosz & Bułhak-Jachymczyk, 2008)

RESULTS

Characteristics of patients – age, body weight, height, BMI, GFR, creatinine, urea and phosphate blood level – are presented in Table 2. No association between age, BMI and GFR was determined.

Energy and nutrients intake is presented in Table 3. The average energy value of diet was 91±23kJ (21.8±5.6kcal)/kg of ideal body weight, but this factor was highly diverse – 56kJ (13.5kcal)/kg – 138kJ (33.1kcal)/kg. The average level of total protein in diet was 0.85±0.25g/kg of ideal body weight (animal protein – 0.54±0.22g/kg, plant protein – 0.31±0.13g/kg). The protein consumption was also highly diverse –

Table 2. Patients' characteristics

	Mean ± SD
Age [years]	61.81 ± 10.87
Weight [kg]	67.0 ± 10.8
Height [cm]	160.7 ± 5.1
BMI [kg/m²]	26.0 ± 4.4
GFR [ml/min/1.73m²]	18.0 (6–56) [1]
Creatinine [mg/dl]	2.90 ± 1.12
Urea [mg/dl]	110 ± 38
Phosphate [mM/l]	1.37 ± 0.23

[1] in case of nonparametric distribution – median, minimum and maximum values are presented

Table 3. Nutrients content and energy value of diet in analysed group of CKD predialysis female patients

	Mean ± SD
Energy [kJ (kcal)]	5584 ± 1553 (1334 ± 371)
Total protein [g]	52.4 ± 17.0
Animal protein [g]	33.4 ±14.6
Plant protein [g]	19.0 ± 7.5
Fat [g]	50.2 ± 20.5
SFA [g]	16.26 ± 7.48
MUFA [g]	21.84 ± 10.10
PUFA [g]	7.94 ± 3.14
Cholesterol [g]	174 ± 97
Carbohydrate [g]	183.5 ± 46.4
Sucrose [g]	31.2 ± 18.4
Fibre [g]	15.7 ± 4.7
Sodium [mg]	1339 ± 481
Potassium [mg]	2480 ± 549
Calcium [mg]	403 ± 166
Phosphorus [mg]	842 ± 261
Magnesium [mg]	218 ± 64
Iron [mg]	8.4 ± 2.6
Zinc [mg]	7.39 ± 2.32
Copper [mg]	0.84 ± 0.23
Vitamin A [µg]	684 (67–5223) [1]
Vitamin D [µg]	1.78 ± 1.10
Vitamin E [mg]	8.34 ± 3.18
Vitamin B_1 [mg]	1.022 ± 0.375
Vitamin B_2 [mg]	1.216 ± 0.490
Niacin [mg]	12.87 ± 4.15
Vitamin B_6 [mg]	1.48 ± 0.40
Folate [µg]	281.9 ± 109.2
Vitamin B_{12} [µg]	2.13 ± 1.15
Vitamin C [mg]	107.7 ± 43.2

[1] in case of nonparametric distribution – median, minimum and maximum values are presented

ranging 0.44g/kg – 1.69g/kg. Simultaneously, the animal protein consumption ranged 0.25g/kg – 1.29g/kg, and the plant protein 0.18g/kg – 0.79g/kg.

Fat provided 33.0±6.7% of energy in the diet (24.8 – 51.4%). The SFA constituted 10.7±3.0% of energy (5.3 – 17.0%), MUFA – 14.4±3.8% (7.7 – 24.6%) and PUFA – 5.4±1.7% (2.6 – 9.8%). Carbohydrates provided 55.7±6.6% of energy, while sucrose consumption constituted 9.3±5.1% (0.9 – 21.0%). No influence of BMI on energy and nutrients intake was observed.

Nutrients content and energy value of diet, in comparison with the recommendations, are presented in Table 4. Almost all patients were characterised by lower energy intake than the recommended level (only 2 individuals met the recommendation). Protein consumption was lower than the 0.6g/kg of ideal body weight in 6.6% of patients or higher than 0.8g/kg of ideal body weight in 35.5%. The animal protein share in total protein, in most patients, was on a satisfactory level. Fat and carbohydrate intake, in most of the analysed patients, were not higher than recommended, except for SFA intake, which was higher. Minerals and vitamins intake in the majority of analysed patients was lower than the recommendations or was on the recommended level, except for vitamin C consumption, which in the majority of analysed patients was higher than recommended.

Table 4. Nutrients content and energy value of diet in analysed group of CKD predialysis female patients, in comparison with recommendations

	% of group characterised by consumption		
	below recommended level	on recommended level	above recommended level
Energy	93.4	6.6 [1]	0.0
Total protein (recommendation: 0,6 g/ kg of ideal body weight)	6.6	12.9 [1]	64.5
Total protein (recommendation: 0,8 g/ kg of ideal body weight)	38.7	25.8 [1]	35.5
Animal protein	6.4	93.6	x
Fat	3.2	61.3	35.5
SFA	x	6.4	93.6
MUFA	x	93.6	6.4
PUFA	x	100.0	0.0
Cholesterol	x	70.9	29.1
Carbohydrate	x	74.2	25.8
Sucrose	x	64.5	35.5
Fibre	93.6	3.2	3.2
Sodium	96.8	3.2 [1]	0.0
Potassium	100.0	0.0 [1]	0.0
Calcium	100.0	0.0	0.0
Phosphorus	x	83.9	16.1
Magnesium	87.1	9.7 [1]	3.2
Iron	71.0	12.9 [1]	16.1
Zinc	54.8	25.8 [1]	19.4
Copper	48.4	25.8 [1]	25.8
Vitamin A	38.7	22.6 [1]	38.7
Vitamin D	100.0	0.0 [1]	0.0
Vitamin E	41.9	19.4 [1]	38.7
Vitamin B_1	51.6	22.6 [1]	25.8
Vitamin B_2	38.7	29.0 [1]	32.3
Niacin	54.8	22.6 [1]	22.6
Vitamin B_6	38.7	32.3 [1]	29.0
Folate	77.4	12.9 [1]	9.7
Vitamin B_{12}	61.3	16.1 [1]	22.6
Vitamin C	6.5	29.0 [1]	64.5

[1] recommended value ± 10%

The correlations of protein intake with energy and other analysed nutrients intake are presented in Table 5. Total protein was correlated with both animal and plant protein intake, but animal protein was not correlated with plant protein intake. Total animal and plant protein were also positively correlated with the energy value of diet, and with amount of most of nutrients.

Table 5. Correlation of total, animal, plant protein with nutrients content and energy value of diet

	Total protein		Animal protein		Plant protein	
	p	R	p	R	p	R
Total protein	-	-	0.000*	0.8987	0.002*	0.5243
Animal protein	0.000*	0.8987	-	-	0.600	0.0979
Plant protein	0.002*	0.5243	0.600	0.0979	-	-
Energy	0.000*	0.7299	0.001*	0.5750	0.002*	0.5398
Fat	0.000*	0.6069	0.003*	0.5138	0.036*	0.3783
SFA	0.001*	0.5596	0.003*	0.5204	0.164	0.2565
MUFA	0.000*	0.6140	0.002*	0.5265	0.040*	0.3703
PUFA	0.083	0.3160	0.412	0.1529	0.018*	0.4214
Cholesterol	0.000*	0.7356	0.000*	0.6253	0.010*	0.4550
Carbohydrate	0.004*	0.5083	0.084	0.3154	0.002*	0.5419
Sucrose	0.758	0.0576	0.629	0.0902	0.820	-0.0427
Fibre	0.209	0.2322	0.642	0.0869	0.048*	0.3584
Sodium	0.005*	0.4927	0.019*	0.4203	0.102	0.2992
Potassium	0.000*	0.7220	0.001*	0.5798	0.003*	0.5130
Calcium	0.000*	0.5998	0.003*	0.5097	0.040*	0.3700
Phosphorus	0.000*	0.8356	0.000*	0.6745	0.001*	0.5865
Magnesium	0.001*	0.5457	0.092	0.3076	0.000*	0.6415
Iron	0.000*	0.6378	0.035*	0.3799	0.000*	0.7087
Zinc	0.000*	0.8294	0.000*	0.6681	0.001*	0.5830
Copper	0.013*	0.4404	0.216	0.2287	0.001*	0.5553
Vitamin A	0.304	0.1908	0.932	-0.0161	0.009*	0.4642
Vitamin D	0.005*	0.4907	0.006*	0.4866	0.365	0.1684
Vitamin E	0.090	0.3095	0.449	0.1410	0.016*	0.4302
Vitamin B_1	0.000*	0.7428	0.000*	0.6706	0.034*	0.3817
Vitamin B_2	0.000*	0.8303	0.000*	0.7496	0.016*	0.4280
Niacin	0.000*	0.7767	0.000*	0.6938	0.020*	0.4166
Vitamin B_6	0.000*	0.7316	0.000*	0.7286	0.181	0.2464
Folate	0.004*	0.5083	0.089	0.3110	0.001*	0.5504
Vitamin B_{12}	0.001*	0.5758	0.000*	0.6545	0.852	0.0350
Vitamin C	0.358	0.1709	0.575	0.1048	0.324	0.1832

* p ≤ 0,05 – correlation statistically significant

Correlations between the chosen laboratory measurements with energy, protein and phosphorus intake are presented in Table 6. Values of GFR positively correlated with animal protein intake, while phosphate and creatinine in blood negatively correlated with total and animal protein intake, but not with plant protein and phosphate intake.

DISCUSSION

The BMI of the majority of patients initiating the renal replacement therapy is within the normal range, and other

Table 6. Correlation of GFR, creatinine, urea and phosphate with nutrients content and energy value of diet

	GFR		Creatinine		Urea		Phosphate	
	p	R	p	R	p	R	p	R
Energy	0.787	0.0507	0.487	-0.1295	0.399	-0.1569	0.668	-0.0802
Total protein	0.114	0.2899	0.032*	-0.3868	0.207	-0.2332	0.050*	-0.3549
Animal protein	0.049*	0.3561	0.025*	-0.4015	0.180	-0.2474	0.042*	-0.3669
Plant protein	0.855	-0.0341	0.604	-0.0970	0.795	-0.0487	0.610	-0.0954
Phos-phorus	0.172	0.2515	0.063	-0.3373	0.332	-0.1801	0.288	-0.1969

* p ≤ 0,05 – correlation statistically significant

factors of nutritional status are also correct [22]. In the analysed group, a similar situation was observed – not only no one was malnourished (the lowest BMI was 18.7kg/ m^2), but the majority of patients were even overweight or obese. It may be stated that patients were characterised by typical BMI in comparison with a group of healthy women of similar age [23]. It needs to be emphasized that during dialysis therapy,a higher BMI (25–28kg/m^2) is more beneficial [24], and the inverse relationship between BMI and mortality during long-standing dialysis therapy was observed [25, 26, 27]. Higher BMI is beneficial, especially if it is accompanied by high muscle mass [28]. Predialysis patients of the analysed group will be potentially dialysed in the future, therefore a higher BMI should also be beneficial for them. However, in general population obesity is associated with decreased survival [26].

The energy value of diet of the analysed group was very diverse and only 2 patients met the recommendations. In other studies of CKD patients, the same situation was observed [5, 29]. Steiber [4] noted extremely low mean energy intake – 46kJ (11kcal)/kg, with the highest value of 113kJ (27kcal)/kg, and only 15% of patients in the mentioned research reached 75% of their energy needs. The presented similarities in low energy intake suggest it is a common problem to provide suitable energy level in diet of CKD patients. Other researchers observed that energy intake of individuals with CKD on the LPD failed to meet energy expenditure, which may contribute to the development of malnutrition in some patients [30]. It should be mentioned that low energy intake, even accompanied by high protein intake, may significantly elevate creatinine and urea nitrogen in the blood [31].

The recommended protein level for predialysis patients is 0.6 or 0.8g/kg of body weight, depending on the recommending association (Tab. 1). Huang et al. [31] stated that high protein intake, in combination with low energy intake, is one of the factors worsening GFR and deteriorating renal function. Patients in the presented research had no nutritional training associated with CKD, and it was observed that total protein intake was very diverse and therefore perceived as satisfactory may be that 57.9% of individuals provided protein intake between 0.6 – 0.8g/kg of ideal body weight range (Tab. 4). Duenhas et al. [5] observed that 63.7% of patients had a protein intake higher than 0.8g/kg of body weight, while in the presented study it was only 35.5%. It must be mentioned that this difference may be associated with the fact that in the Duenhas' study data were collected during the first visit of the patients in the clinic, while in the presented research patients were diagnosed a minimum of 1 year before the study. However, in both cases, patients had no previous dietary intervention. It is possible that after diagnosis some patients are able to limit the quantity of consumed protein, even without dietary intervention, but not all of them are able to reach the goal. Also, in the MDRD Study [29], protein intake was higher than the recommended level in the case of the majority of patients.

On the other hand, there were also some CKD patients characterised by too low protein intake (lowest intake – 0.44g of protein/kg of ideal body weight). Such a low protein intake was also noted in other research, where in the group of CKD patients, mean protein intake was 0.42g of protein/kg [4].

In other research, similar to the presented one, a high diversity of protein intake in CKD patients diet was observed [4]. This may suggest that CKD patients have a serious problem with proper balance of the LPD. Practical possibilities of its appliance in CKD treatment, especially without any special dietetic training, is discussed [32]. However, this diet, when properly followed, is effective not only in preventing deterioration of renal function, but also in maintaining nutritional state [33].

In the presented research, an excessive amount of protein in the diet was observed in the case of 36% of patients. The organism is not able to store protein, and its excessive amount is used as an energetic substrate [34]. This leads to the production of a redundant quantity of the protein metabolic products – which is not a problem in healthy persons, but in the case of CKD patients, may lead to increase in the urea blood level [35].

The average animal protein share in total protein intake in analyzed patients' diet was higher than 50%, as recommended. On the other hand, patients characterised by a too low intake of total protein, even if the share of animal protein is on the recommended level, may not have enough essential amino acids (EAA) in the diet. This may lead to negative protein balance [36].

The energy intake is likely to have as much influence on tissue amino acid balance, as does the protein intake itself. Even with proper protein intake, in the case of inadequate energy intake, protein may be oxidised as an energetic substrate instead of being used for body protein synthesis [34]. In the presented study, even patients with a proper or too high protein intake were characterised by too low energy intake. Such a situation may lead to the unintentional utilisation of a part of the protein. As a result of the described situation, excessive metabolic waste products may be generated. It should be mentioned that only if energy requirements are met, LPD may be used in the long-term by predialysis patients [37].

The diet of the analysed patients was not properly balanced. The majority had a low intake of most vitamins and minerals, which may have a negative health impact. The too low iron intake observed in the analysed group may be one of the causes of anaemia development, which is a common problem in this group [38]. Vitamin D deficiency is widespread in the general population, and even more common in CKD patients [39]. Deficiency of this vitamin and poor calcium intake, also observed in the presented research, may lead to a decrease in bone mass in CKD patients and to osteoporosis development [40]. Individuals at all stages of CKD have markedly elevated risk of cardiovascular diseases, which has been attributed to many potential causes, including hyperhomocysteinaemia [41]. The co-factors of the homocysteine metabolism are vitamin B_{12}, vitamin B_6 and folate. Deficiency of the above-mentioned vitamins, also observed in the analysed group, and renal impairment account for the majority of cases of increased homocysteine level [42]. Although there is no clear evidence for or against oral folate, vitamin B_6, and B_{12} supplementation, individuals with high homocysteine level and high cardiovascular diseases risk, should be strongly advised to consume the recommended amount of folate, vitamin B_6 and B_{12} in their diet [43].

The deficiency of energy, protein, vitamins and minerals may have a negative impact on kidney function, but dietetic intervention may maintain or improve nutritional status in this group [44]. Research indicates that early use of properly balanced LPD in predialysis patients in the 3rd stage of CKD has a positive influence on their nutritional status and may inhibit GFR lowering [45].

In the presented study, patients consuming less total protein were simultaneously characterised by lower intake of energy and most other nutrients (Tab. 5). The same dependence was also observed in the case of plant and animal protein. This may result from the fact that patients limit the quantity of all consumed products in order to limit the level of protein in diet. Protein intake reduction should be mainly focused on limiting products which are the sources of plant protein, not of animal protein. This indicates the necessity for nutritional education that would stress the importance of not reducing consumption of all of the products, but only the products that are not recommended in LPD. Patients should also have access to information about low protein products [46] – very useful in LPD because they create the possibility to maintain the proper energy value of diet and, at the same time, to limit the quantity of products containing plant protein. Also, other research indicates the necessity for close dietary monitoring which should be recommended for the predialysis care [47].

In the presented research, patients with more advanced disease were characterised by significantly lower protein intake, which was associated with limiting animal protein (Tab. 6). In other research [5, 29], but not in all of them [31], it was also observed that in patients with no previous dietary intervention, GFR was correlated positively with energy and protein intake, which indicates a spontaneous decrease in energy and protein intake, following a renal function decline. Simultaneously, in the presented study, plant protein intake did not correlate with the indicators of CKD progression. This may result from the fact that patients eliminate animal products from the diet, but not plant products which, in their opinion, do not constitute a substantial source of protein. This may lead to deficiency of EAA which, in such a situation, are obtained from the body's own proteins, and may have a negative impact on the nutritional status.

To summarise, almost all CKD female predialysis patients had a lower energy intake than the recommended level, and majority of them had an intake of most minerals and vitamins that was lower than the recommendations. Protein intake was lower than the 0.6g/kg of ideal body weight in some of patients, and higher than the 0.8g/kg of ideal body weight in one-third of the patients. Values of GFR positively correlated with animal protein intake, while phosphate and creatinine in blood negatively correlated with total and animal protein intake, but not with plant protein and phosphate intake.

CONCLUSIONS

1. The diet of CKD predialysis patients with no previous dietary intervention is not properly balanced.
2. Such an improperly balanced diet may be caused by lack of knowledge about the role of diet in predialysis phase of CKD.

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