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The nutritional status and nutrition habits in a group of patients with end stage renal failure treated with hemodialysis

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ABSTRACT

Aim. The aim of the study was to assess the nutritional status and nutrition habits in a group of patients with end stage renal failure treated with hemodialysis.

Material and Methods. The study group consisted of 50 patients treated with hemodialysis, including 16 women and 34 men. The average age of researched patients was 67.02 ± 10.71 years. We used an authorial questionnaire in the research, which contained questions about feeding behavior and nutritional status. In addition, patients underwent anthropometric measurements.

Results. The research revealed that the nutritional status of patients with chronic kidney disease treated with hemodialysis was poor. The supply of energy, carbohydrates, protein and dietary fiber in the studied group were 1583.41 ± 379.55 kcal, 222.68 ± 55.08 g, 63.75 ± 15.25 g and 55.75 ± 18.55 g respectively, which were all below the standard daily requirement. The deficiencies of magnesium, iron and vitamins were also observed. More than half of respondents (52%) ate only 3 meals a day.

Conclusions. The results of research show that both – nutritional state and eating habits of patients were abnormal and deviated from the dietary recommendations for this group of patients. Changes of the nutrition will positively influence the nutritional state of patients, as well as improve their quality and length of life.

Keywords: nutrition; hemodialysis; malnutirion.

Introduction

Chronic kidney disease (CKD) recently has been included into a group of civilization diseases. CKD is a special entity in this group of diseases, because it can be both a cause and a result of cardiac syndrome X. The increase in the frequency of occurrence of CKD contributes to the need for dialysis treatment on a greater scale, complicated with malnutrition. Research by Aparicio et al [1] on a large group (n = 7000) of patients with CKD showed, that the lower albumin level (<35 g/l), prealbumin (<300 mg/l) and nPNA (normalized protein nitrogen appearance) (<1 g/kg body mass/24h) applies to respectively 20%, 36% and 35% of them. As Carrero et al. states [2] poor nutritional state is diagnosed in 35–60% of dialyzed patients and is linked to two types of disturbances. One of them is protein energy malnutrition (PEM), which is a factor that increases mortality both in conservative treatment as well as during the dialysis treatment. Already in the early phases of CKD a reduction in the non-fat body mass can be observed. Lower concentration of protein in the blood serum and decreased cellular immunity are also characteristic. Deficiencies of mineral elements i.e. zinc, iron, selenium and vitamins: B6, C, D, folic acid and carotenoids. The main cause of PEM during a chronic kidney disease are: increased loss of nutritional elements, metabolic acidosis, decreased intake of food caused by appetite loss as well as hormonal and metabolic disturbances. Sec-

ond type of malnutrition is malnutrition induced by the pro-inflammatory cytokines secreted as a result of CKD concomitant illnesses [3]. This type is called malnutrition inflammation complex syndrome (MICS) and often coexists with atherosclerosis as malnutrition inflammation atherosclerosis (MIA) syndrome [4]. The activation of the inflammatory process results in an increased cytokine synthesis and intensification of secretion of pro-inflammatory cytokines i.e. TNF-α, IL-1 and IL-6. This cases an increase in the basal energy expenditure with simultaneous decrease in appetite, hypercatabolism of proteins and suppression of transferrin and albumin synthesis in the liver. In this type of malnutrition more frequent dialysis or change in the way of nutrition in not effective. The comorbid diseases need to be treated, especially inflammatory states [5, 6].

Because of the fact that poor nutritional state is an element impinging on the course of treatment as well as on the quality and length of life of dialyzed patients we need to put special attention on the necessity for its assessment. Taking on an appropriate nutritional therapy, based on both the education as to the adequate energy supply, macro and microelemnts (**Table 1** and **2**) as well as supervision as to the application of dietary recommendations in daily meal planning, is also crucial. Only due to such an approach an effective countermeasure against malnutrition and development of comorbid metabolic disturbances, among others, disturbances in lipid metabolism (i.e. hypergliceridemia, lowering the level of high-density cholesterol (HDL) and an increase in the low-density cholesterol concentration (LDL)) as well as deregulation in the carbohydrate metabolism expressed as insulin resistance, is possible.

Aim

The aim of the study was the nutritional state assessment of patients with chronic kidney disease treated with hemodialysis. The assessment was done through the analysis of anthropometric measurements (body mass, BMI) and chosen biochemical parameters. Furthermore, the dependencies between the anthropometric measurements and chosen biochemical parameters as well as the consumption of nutritional components were analyzed. On the basis of qualitative and quantitative analysis of conducted 24-hour interviews the way of nutrition was evaluated with particular con-

Table 1. Recommendations for energy, macro- and microelements dietary supplementation for the patient treated with dialysis [7–9]

	KDOQI (Kidney Disease Outcomes Quality Initiative)	ESPEN 2009 (The European Society for Clinical Nutrition and Metabolism)	NKF (National Kidney Foundation)
Energy	35 kcal/kg body mass/24h		35 kcal/kg body mass/24h in patients up to 60 years old 30–35 kcal/kg body mass/24h in patients > 60 years old
Protein	1.0–1.2 g/kg body mass/24h	1.2–1.4 g/kg body mass/24h (> 50% HBV) In patients treated with chronic peritonial dialysis 1.2–1.5 g/kg body mass/24h (> 50% HBV)	1.2 g/kg body mass/24h (> 50% HBV) In patients treated with chronic peritonial dialysis 1.2–1.3 g/kg body mass/24h (> 50% HBV)
Carbohydrates	50–60%	–	
Fiber	20–30 g/24h		
Fats	25–30% < 7% saturated fatty acids, approximately 10% polyunsaturated fatty acids, 20% monounsaturated fatty acids.		
Fluids	1–1.5 l/24h may be increased by the 24h urine volume	1l + urine volume	–
Sodium	1800–2500 mg/24h	1800–2500 mg/24h	–
Potassium	1500–2000 mg/24h	2000–2500 mg/dl	
Phosphorus	800–1000 mg/24h	800–1000 mg/24h	
Folic acid	1 mg/24h		
Vitamin B1	10–20 mg/24h		
Vitaminy C	30–60 mg/24h		

Table 2. Recommended supplementation doses of vitamins and minerals according to the European Best Practice Guidelines (EBPG) [10, 11]

Vitamin / mineral element	Dosage
B1 (thiamine)	1.1–1.2 mg
B2 (riboflavin)	1.1–1.3 mg
B5 (pantothenic acid)	5 mg
B6 (pyridoksine)	10 mg
B12 (cobalamin)	2.4 µg
C (ascorbic acid)	75–90 mg
PP (niacin)	14–16 mg
H (biotin)	30 µg
Folic acid	1 mg
A (retinol)	supplementation is not required
D	0.25–1 µg
E (L-tocopherol)	400–800 jm
K	supplementation is not required
Phosphorus	800–1000 mg/24h
Calcium	2000 mg
Sodium	2000–2300 mg/24h
Potassium	50–70 mmol (1950–2730 mg/24h)
Iron	8 mg for men, 23 mg for women
Magnesium	200–300 mg
Zinc	10–15 mg for men, 8–12 mg for women (supplementation is not required)
Selenium	55 µg (supplementation is not required)

sideration of caloric values of consumed meals and contribution of macroelements in coverage of the daily energy demand.

Materials and Methods

The study was conducted on the group of 50 people with the diagnosis of end stage renal insufficiency treated with hemodialysis. Among the patients were 16 women and 34 men. The data was collected during the period between February and March 2014 in the Hemodialysis Laboratory of the Nephrology, Transplantology and Internal Diseases Department of Heliodor Swiecicki Clinical Hospital at Poznan University of Medical Science and the Dialysis Station – Dialysis Center Fresenius Station no.71 in Poznan. After informing the respondents about the aim, voluntary aspect and anonymity of the conducted research and after obtaining a written consent to perform them, the way of nutrition was assessed and anthropometric and biochemical measurements were performed.

In order to assess the way of nutrition an original questionnaire survey, containing both open and closed ended questions. The survey questions concerned socio-statistical data and nutritional habits. On the basis of 24-hour interview from 3 randomly chosen days (2 week days and 1 day free from work) daily demand coverage for energy, makro- and microelements were assessed. The results obtained were than analyzed with the use of a Dietician 2012 computer program and compared with the nutritional norms for particular population groups (Human Nutrients and Nutritional Norms of the Food and Nutrition Institute updated in 2012) as well as recommendations of ESPEN (The European Society for Clinical Nutrition and Metabolism).

Body mass measurements were performed with the use of standard medical scale with the accuracy to 0.5 kg, and the height measurement with the use of a measuring rod with the accuracy to 0.5 cm. Based on the acquired anthropometric characteristics the body mass index (BMI) was calculated, by dividing the body mass value in kilograms by the square value of the height measurement in meters. Furthermore in patients the arm circumference was measured (on the arm of the non-dominant hand in the middle of the length between the acromion and the olecranon process) with the use of a measuring tape with the accuracy to 0.5 cm.

The daily energy requirement (DER) of patients was calculated by multiplying the value of basal metabolic rate (BMR) set by the Harrison-Benedict equation, by the appropriate active metabolic rate (AMR) for each evaluated patient.

Statistical analysis of results

The data analysis was performed with the use of a descriptive statistical method of a computer program Statistica10. In order to assess the nutritional status and nutrition habits in a group of patients the Shapiro-Wilk test of normality was used in the first step. For the statistical description of variables, functions such as: arithmetic mean and standard deviation (square root of variance, in other words the square root from the second central moment), were used. The differences between variables were assessed with the appraisal of statistical significance (p). In all tests a p value ≤ 0.05 was considered to be statistically significant. Statistical hypothesis were verified on the level of significance: very high significance ($p \leq 0.001$), high significance ($p \leq 0.01$) and significance of result ($p \leq 0.05$).

Results

Average age of the researched population was 67.02 ± 10.71 years. Studies showed statistically significant positive correlation between the duration of the disease and the length of dialysis treatment (p = 0.010, r = 0.359). The characteristics of researched population are shown in **Table 3**.

Table 3. Characteristics of researched population

Characteristic	Number (n)	Percent (%)
Place of residence:		
Rural area	3	6
City < 100000 inhabitants	14	28
City > 100000 inhabitants	33	66
Education:		
Vocational edication	24	48
Secondary education	16	32
Primary education	6	12
Higher education	4	8
Financial situation:		
Good	21	54
Average	27	42
Bad	2	4
Duration of disease	9.66 ± 10.86 years	
Length of dialysis treatment	2.53 ± 2.10 years	
Concomitant diseases	41	82
Including:		
Diabetes	16	32
Hypertension	17	34
Thyroid diseases	3	6
Cardiovascular diseases	12	24
Other	27	54

Assesment of nutritional state

Based on the conducted anthropometric studies it was assessed that the average body mass in the studied population was 76.45 ± 15.42 kg, height 1.70 ± 0.08 m and the value of BMI 26.51 ± 4.97 kg/m^2, where its lower level was noted in women. A statistically significant, positive correlation was shown between the patients financial status and BMI value (p = 0.028, r = 0.31035). Average level of albumin in the patient group with CKD was at the lower level of the norm (36.64 ± 4.02 g/l) and significantly correlated with the blood serum iron concentration (p = 0.011, r = 0.358) (**Table 4**).

Assessment of consumption

Conducted analysis of nutrition manner based on the 24-hour interview, showed that the average supply of energy oscillated on the level of 1583.41 ± 379.55 kcal and was too low in relation to the population demand, which was on average 2401.59 ± 499.89 kcal. Significant deficit was observed in the demand coverage for carbohydrates (222.68 ± 55.08 g), protein (63.75 ± 15.25 g) and fat (55.75 ± 18.55 g), although the percent dispersion of daily energy requirement for the particular macroelements was appropriate. Insufficient 24-hour consumption of calcium (387.45 ± 206.64 mg), magnesium (218.54 ± 66.84 mg), iron (8.13 ± 2.31 mg) and vitamin D (1.90 ± 2,67 µg) were also noted (**Table 5**). Despite considerable vitamin and mineral deficiencies in the diet of patients studied, only 12% of them admitted that they are taking the supplementation that was recommended by the doctor – mostly calcium formulations.

A statistically significant correlation was found in the study between the energy consumption and the value of daily energy requirement in patients (respectively p = 0.035, r = 0.300). Furthermore, a negative dependency was observed between consumed energy and the frequency of snacking (p = 0.015, r = -0.344).

Table 4. Measurements and anthropometric indices of nutritional state

	Mean	SD	Minimum	Maximum
Height [cm]	1.70	0.08	1.50	1.90
Body mass [kg]	76.45	15.42	45.00	114.00
BMI [kg/m^2]	26.51	4.97	17.58	39.45
Arm cercumference [cm]	29.54	3.54	19.00	38.00
Albumins [g/l]	36.64	4.02	27.00	45.00
Iron [mg/dl]	64.46	21.60	16.00	117.00

Table 5. Daily food rations consumption levels

	Mean	SD	Minimum	Maximum
Energy	1583.41	379.55	695.91	2360.03
Energy from fat [%]	31.02	5.74	18.32	46.43
Energy from protein [%]	16.37	2.92	12.25	24.56
Energy from carbohydrates [%]	52.62	5.92	37.98	66.88
Total protein [g]	63.75	15.25	23.09	97.89
Total fat [g]	55.75	18.55	15.16	92.35
Total carbohydrates [g]	222.68	55.08	113.53	335.30
Dietary fiber [g]	18.13	5.48	8.93	34.54
Sodium [mg]	1872.22	581.99	850.91	3085.14
Potassium [mg]	2408.82	638.82	1331.86	3915.20
Calcium [mg]	387.45	206.64	130.70	1301.83
Phosphorus [mg]	969.13	240.98	341.62	1735.72
Magnezium [mg]	218.54	66.84	109.49	468.37
Iron [mg]	8.13	2.31	4.04	14.28
Vitamin D [µg]	1.90	2.67	0.17	19.41

Nutritional manner assessment

Most surveyed people (52%) admitted, that they consume three meals during the day. A total of 19 patients (38%) admitted to the planning of 4–5 meals in their daily menu. Only 5 patients (10%) disclosed that they most often consume 1–2 meals per day, however none of the people asked answered that they eat more than 5 meals per day. More than 3/4 (76%) of the respondents ate their meals always or very often at the same times, wherein 24 people (48%) declared, that they keep at least a 3 hour break between the last meal of the day and sleep time. Somewhat shorter – 2 hour break was kept by 20 people (40%) and 6 patients revealed that they usually eat 30–60 minutes before going to sleep. Among the surveyed 26 people (52%) declared irregularity in the times of meal consumption. There exists a negative correlation, between the regularity of meal consumption and the frequency of snacking ($p = 0.033$, $r=-0.301$). Patients, who declared that they eat their meals always at the same time admitted, that they do not have the habit of snacking between their meals. Among the foods preferred as snacks, most (30%) of people chose fruits, 12% sweets, 8% a piece chose nuts and sandwiches. Individual people admitted, that when snacking they choose vegetables or milk products.

Among the surveyed only 19 people (32%) chose whole grain wheat products. Mixed grain baked goods were eaten by 15 people (30%) and 16 patients (32%) were in favor of white bread. Besides bread, the most often chosen flower products by patients were traditional wheat pasta (26%) and white rice (16%).

Amidst patients with CKD treated with dialysis 19 people (38%) answered, that they consume meat 3–4 times per week, 13 (26%) of the respondents consumes meat products daily and 12 (24%) eat meat once a week. Among the studied the preferred kind of meat was poultry – 17 people (34%) chose it. Fourteen investigated (28%) consume both poultry and pork meat in similar proportions.

Over half of the patients – 28 (56%) people eat fish once a week, 11 people (22%) sporadically, 5 (10%) few times a month, 4 people (8%) do not eat fish at all, and only 2 people (4%) eat fish 3–4 times per week.

With regard to eating dairy products, close to half of the respondents (48% of people) declare, that they eat milk products daily, 20 people (40%) 3–4 times per week, 3 patients (6%) eat dairy once a week, 2 (4%) sporadically and 1 person (2%) does not eat dairy products at all.

Satisfactory results were obtained on the field of consumption of fruits and vegetables. Considerable share of evaluated (close to 70%) ate fruits daily (35 people) and vegetables (34 people). Five people (10%) ate fruits sporadically, 4 people (8%) once a week and 3 of the surveyed (6%) ate fruits 3–4 times per week. Only 2 patients did not eat fruits at all. In turn, 10 people (20%) declared consumption of vegetables 3–4 times per week and 3 patients each (6%) admitted to eating vegetables once a week or sporadically. A total of 21 patients (42%) consumed fruits and vegetables in the raw form, the same amount of people prefered fruits and vegetables both in raw and

cooked forms. Only 8 of the evaluated (16%) chooses only cooked fruits and vegetables.

When asked about the amount of fluids consumed, almost half of the people (48%) answered, that they normally ingest 1.5–2 liters of fluids per day. Most patients, exactly 24% of them, drink mineral water, coffee and tea. The least amount of people, only 2% consume solely coffee or only fruit juices and tea.

On the question concerning appetite 44 people (88%) answered, that in the period of last three months their appetite has not changed. Three people (6%) noticed slight, and one person considerable appetite loss. Only one from the surveyed patients observed in themselves increased appetite.

Most often used type of fat for the purpose of spreading it on bread was butter (60% of evaluated), whereas during cooking and hot meal preparation patients usually chose vegetable oils (76%). Among the techniques of food preparation, the surveyed preferred mostly boiling in water and baking. Only 12% of the studied admitted, that they eat solely fried meals. When selecting appropriate spices no significant differences among the respondents were seen – similar percent of the researched used all – salt, pepper, herbs as well as ready-made mixtures of spices.

Most of the studied, 18 people (36%) consumed sweets sporadically, 14 (28%) of them every day, 8 (16%) 3–4 times per week, 6 (12%) of the questioned never ate sweets, 3 (6%) ate sweets once a week and only one person (2%) few times a week.

Full abstinence from alcohol was declared by a total of 76% of the evaluated. Twelve percent of the respondents admitted that they drink alcohol less frequently then once a month, 8% reaches for it 2–3 times a month, whereas 2 patients disclosed that they consume alcohol more frequently than once a week. Most often chosen by the surveyed alcoholic beverage was beer and wine. Considerable fraction of the researched (84%) does not smoke cigarettes.

The results of the question concerning physical activity shows promise. Close to 40% of the respondents disclose that they undertake physical activity daily, 20% works out 3–4 times a week, 10% 5–6 times a week and 4% 1–2 times a week or sporadically. Only 22% of the studied do not undertake any physical activity (**Figure 1**).

Discussion

People treated with dialysis are vulnerable for the development of malnutrition, what in consequence significantly lowers patient's quality of life, and increases the occurrence risk for cardiovascular incidents. Thorough analysis of the nutrition manner and the state of nutrition is an effective tool allowing for the early detection of poor nutrition state as well as dietary mistakes made by patients, leading to an effective countermeasure against their negative results.

As the study showed, in 62% of patients the BMI was > 25 kg/m^2. Numerous epidemiological data concerning the general population show the existence of positive dependency between obesity and mortality [12, 13]. However in patients with CKD treated with hemodialysis, the occurrence of a so called "reversed epidemiology" phenomenon is being described. This phenomenon states, that higher BMI assures longer survival and improves patients prognosis [14]. In studies on large (over 5 thousand people) populations of patients treated with hemodialysis Chazot et al. showed that, in people with overweight or obesity, the risk of death is lower as compared with people having normal or lower body mass [15]. Similarly, Fleischmann et al. observed, that increase in BMI of one unit above 24.99 kg/m^2 decreases the risk of death of patients with CKD even by 30% [16].

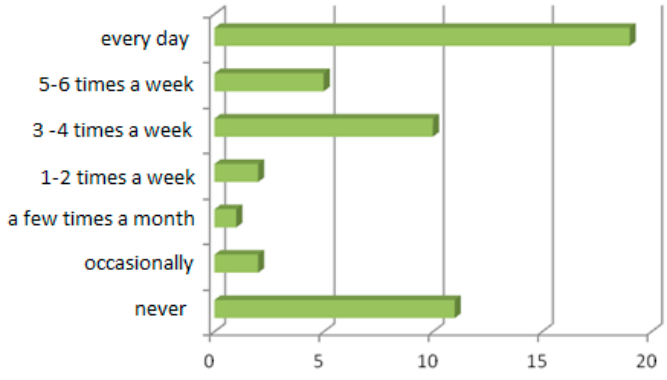

Figure 1. Frequency of physical activity undertaking

Well balanced diet of patients with CKD complements pharmacological treatment in a significant way, slows down the disease progress and enhances nutrition state [17, 18]. As the conducted study showed, the average energetic value of the respondents diet was 1554.49 ± 435.04 kcal/day and was significantly lowered in comparison to the patients demand, which according to the norm reaches 2401.59 ± 499.89 kcal/day. Similar results were obtained by Rocco et al., who showed that, the average energy supply of patients with chronic renal failure was at a level of 1566 ± 636 kcal/day [19]. In the study by Lou et al. the coverage of the energy demand was slightly higher and totaled 2018.5 ± 104.0 kcal/day which still comprises unsatisfactory value in relation to the ESPEN recommendations [20]. Furthermore, the analysis of 24-hour interviews showed deficient supply of protein in the diet of patients with chronic renal insufficiency treated with dialysis. The same results were obtained by Alshatwi et al [21] disclosing, that in almost 82% of patients the protein consumption was lower than 1.2 g/kg BM and on average totaled 0.8 ± 0.4 g/kg BM. Morais et al. studies [18] also showed inadequate protein consumption in the diet of dialyzed patients – the average protein supply in the population mentioned was 74.3 ± 16.6 g/d. Despite the promising share of fruits and vegetables in the respondent diet, inadequate consumption of dietary fiber was observed. Similar results were also obtained in different studies [17, 22–24].

Data analysis showed that substantial deficiencies of calcium and iron occur in the diet of studied patients. These are caused by inadequate contribution of the products which are its good sources in the coverage of daily food rations. Similar results were acquired by Gajewska et al [25] and Lou et al [20]. Therefore, in dialysis treated patients with CKD supplementation with calcium formulations, active form of vitamin D and iron is advised [26].

In the case of sodium, potassium and phosphorus, adequate coverage of the demand in the diet was observed, although other researchers suggested the occurrence of deregulation (both too low and too high level) in regard to the supply of the mentioned microelements [17, 20, 22, 23, 27].

Conclusions

1. Patients with chronic kidney disease treated with dialysis comprise a heterogenic group with regard to nutritional state and the manner of nutrition.
2. Patient's diet is characterized by too low energy supply as well as inadequate consumption of macroelements – in particular carbohydrates and protein.
3. Deficiencies of mineral components and vitamins occur in studied patients' diet.
4. Anthropometric indicators of patients with chronic renal disease treated with dialysis point to disturbances in nutrition state.
5. Well balanced diet of patients with CKD compliments pharmacological treatment in a significant way, impedes the disease progress and improves the nutritional state. Therefore it is important to draw special attention of the medical community on the need to change patients manner of nutrition with particular consideration of nutritional education and the supervision of adherence to the dietary recommendations.

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