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ORIGINAL ARTICLE

The relationship between nutrition screenings and nutritional status determined by malnutrition in hemodialysis patients

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Abstract

Objective: It is aimed to evaluate the relationship of food consumptions, biochemical blood parameters, and some anthropometrics with the screening tests using in the nutritional status of hemodialysis patients with end stage renal failure. **Materials and Methods:** The survey were conducted with 110 hemodialysis patients who hospitalized at the Nephrology Clinic in Akdeniz University Hospital. The routine biochemical blood parameters of the patients were analyzed and their anthropometric measurements were performed. The food consumptions were recorded by the dietician and Nutritional Risk Screening 2002 (NRS 2002), Malnutrition Universal Screening Tool (MUST) and Subjective Global Assessment (SGA)has screening tests using were performed. **Results:** The average age of the patients participating in the study was 55 ± 19 years. In MUST, 42.7% of the patients were at high risk, 18.2% of them at moderate risk by malnutrition. Statistically significant relationship was also negatively determined between body weight, dry weight, BMI, the waist circumference, and MUST and SGA ($p<0.05$). A negatively significant relationship was statistically found among albumin, creatinine, hemoglobin and calcium readouts by NRS2002, among albumin, BUN, calcium and phosphorus readouts by MUST, among albumin, hemoglobin and calcium readouts by SGA ($p<0.05$). **Conclusion:** It was observed that the dialysis patients could not get the advised nutritional quantities, thence malnutrition progressed. It is concluded that anthropometric measurements are more concordant with MUST and the biochemical symptoms with NRS2002, and therefore both must be taken into consideration in the assessment of nutritional status correctly of the end-stage renal patients undergoing hemodialysis.

Article information

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1 Introduction

Chronic kidney disease is irreversible kidney failure due to kidney structure and loss of function leading to several metabolic abnormalities. End-stage renal failure occurs after the fifth stage of chronic kidney disease. Renal replacement therapy, which is most suitable for patients, should be applied to those with end-stage renal failure [1].

The prevalence of chronic kidney disease has increased in Turkey and around the world in recent years. The cost of treating the disease is rather high [2]. According to the joint report of the Turkish Nephrology Association and the Ministry of Health in 2018, 81.055 patients attached renal replacement therapy in Turkey. It was reported that 60.643 of those (74.8%) received hemodialysis treatment, 3.192 (3.9%) peritoneal dialysis, and 17.220 (21.1%) kidney transplantation. In Turkey, the number of end-stage renal failure patients raised from 314 per one million population in 2001 to 933 in 2016, tripling in 15 years [3].

The nutrition of dialysis patients is essential for decelerating the progression of the disease and for the positive response of the treatment. Adequate and balanced nutrition plays a vital role in the prevention of malnutrition development, the supply of fluid-electrolyte balance, the reduction of gastrointestinal symptoms, and in the disorders of bone-mineral metabolism of patients. The most frequent complications such as cardiovascular diseases, inflammation, renal anemia, arthralgias, loss of appetite, nausea, and vomiting could be prevented through the individually prepared nutrition program [4].

Protein-energy malnutrition occurs synchronously in dialysis patients. As the loss of kidney function increases, the patient suffers both a hypercatabolic state and decreases appetite. Uremic symptoms associated with non-compliance with diet can lead to an abnormal load of serum potassium and phosphorus values [5]. Malnutrition in hospitalized patients negatively affects the length of hospital stay as well as mortality and morbidity. Delaying the recovery process, the presence of malnutrition leads to prolonged hospital stay and increases susceptibility to infection, and ultimately decreases quality of life and increases the risk of mortality. Understand the underlying pathophysiology of the disease, the nutritional status of patients should be closely monitored, and comprehensive treatments to reduce protein-energy malnutrition should be administered taking into consideration the potential benefits and risks [6]. Malnutrition is highly frequent in the hemodialysis population. Nutritional screening is crucial to identify patients at risk of malnutrition [7]. There is not a gold standard in assessing the nutritional status of dialysis patients, and no single method per se is considered sufficient to determine the diagnosis of malnutrition. To evaluate the nutritional status of patients, determination of nutritional intake/consumption status, anthropometric measurements, physical examination, biochemical tests, clinical evaluation, screening tests, medical history, and psychosocial data should be assessed in detail [8].

This study aimed to evaluate the relationship between food consumption, biochemical blood parameters, certain anthropometrics data, and screening tests used in the evaluation of the nutritional status of hemodialysis patients with renal failure.

2 Material and Methods

2.1 Study design and population

In the current survey, 110 hemodialysis patients over the age of 18 and hospitalized at the nephrology clinic in Akdeniz University Hospital between the dates of November 2018 and April 2019 were included into a cross-sectional study. According to the power analysis, the sample of the study was determined as 100 people in order to achieve a power of 80% at the level of $\propto$=0.05. Taking into account the possible losses, more patients were included and therefore completed with a total of 120 volunteers. Ten participants did not comply with the inclusion criteria and consequently were excluded from the study. Patients who possessed a transplant, being pregnant and breastfeeding were excluded too. Regarding the evaluation of nutritional habits as well as the measurement of anthropometric parameters, a questionnaire form was administered to patients through the face-to-face interview method. This study was conducted in accordance with the Principles of the Declaration of Helsinki.

In order to determine the nutritional status, the food consumption of the patients over three days was recorded. By showing the "Food and Nutrition Photo Catalog" to our patients or their relatives, the size and amount of food they consume were recorded through face-to-face interview method with a daily dietician [9]. The daily food consumption and amount of energy and nutrient intake of every patient were analyzed by "Computer-Aided Nutrition Program, Nutrition Information System (BEBIS)" developed for research in Turkey [10]. Patients' height, dry body weight measurements were taken by the investigators. The body weight measurement was taken after dialysis to determine the dry body weight of our patients. The height length measurement was taken by stadiometer where the patients were standing upright in gait, head parts were at Frankfort level, the heel of foot was adjusted side by side. The BMI (kg/m^2) classification of the World Health Organization was used, and calculation was determined by dry body weight (kg)/height length (m^2) equation [11]. The biochemical blood parameters used for the study were obtained from the routine findings of the patients at Akdeniz University Hospital Biochemistry Laboratory. Fasting blood glucose, albumin, creatinine, blood urea nitrogen (BUN), C-reactive protein (CRP), hemoglobin, calcium, sodium, potassium, and phosphorus values in the patient's biochemical blood records were reported. Nutritional Risk Screening 2002 (NRS 2002)[12], Malnutrition Universal Screening Tool (MUST) [13], Subjective Global Assessment (SGA) [14] were used to evaluate the nutritional status of patients. NRS2002 takes into account the impaired nutritional status (low, moderate, or severe) and the severity of disease (low, moderate or severe), with an adjustment for age of ≥70 years. The final scoring of NRS-2002 ranges from 0 to 7, and a score of ≥3 denotes nutritional risk [12]. The SGA was performed as previously described using a questionnaire that incorporates the patient's history (body weight loss, changes in dietary intake, gastrointestinal symptoms and functional capacity), physical examination (muscle, subcutaneous fat, sacral and ankle edema, ascites) and the clinician's overall judgment of the patient's status (a: well nourished; b: suspected malnourished or moderately malnourished; and c: severely malnourished) [14]. ESPEN and British Association for Parenteral and Enteral Nutrition (BAPEN) recommend the use of and MUST to determine malnutrition in adults. MUST test is widely used in hospitals because it provides practical and fast results in terms of use [15]. The MUST includes three clinical parameters and rates. Each parameter as 0, 1 or 2 as follows: BMI>20 kg/m^2 = 0; 18.5–20.0 kg/m^2 = 1; <18.5 kg/ m^2 = 2; weight loss <5% = 0; 5–10% = 1; >10%= 2; acute disease: absent = 0; if present = 2. Overall risk of malnutrition is established as follows: 0 = low risk; 1 = medium risk; 2 = high risk 12. The tests were applied directly by the investigator and recorded on the questionnaire. This study was approved by Acıbadem University and Acıbadem Healthcare Institutions Medical Research Ethics Committee (Project no: 2018/18).

2.2 Statistical evaluation of data

In the statistical evaluation of the data, SPSS 17.0 (Statistical Package for Social Sciences) was used for analyzing the statistical package program. In the evaluation of the data, the measurement data were tested by means of average and standard deviation, and nominal and ordinal values by frequency analysis. The Chi-square test was used in the gap analysis of nominal and ordinal values. Before analyzing the measurement data, the distribution of normality was analyzed by the Kolmogorov Smirnov test. Mann-Whitney U was used in binary comparisons of parameters that do not fit the normal distribution and Spearman's rho analysis in the correlation analysis. The findings obtained in the tests were used in the 95% confidence interval and 0.05 critical value.

3 Results

110 hemodialysis patients participated to the study, 63.6% of whom were male (70 volunteers). According to the BMI classification, 57.5% were women and 51.5% were male and 53.6% of all patients were found to have a BMI below 23 kg/m^2. It was observed that 42.5% of women, 48.5% of male patients and %46.4 of all patients had BMI of 23 kg/m^2 and above. The BMI classification of the patients showed a statistically significant difference between the genders ($p<0.05$) (Table 1).

Table 1. Distribution of some parameters relationship with malnutrition

Parameters	Women (n=40)		Men (n=70)		Total (n=110)	
	N	%	N	%	N	%
BMI (kg/m^2)						
<23	23	57.5	36	51.5	59	53.6
≥ 23	17	42.5	34	48.5	51	46.4
Dialysis Treatment Time						
Less than 3 years	28	70	50	71.5	67	70.9
More than 3 years	12	30.0	20	28.6	32	29.1
Inter-Dialysis Fluid						
Less than 2 kilograms	17	42.5	40	57.1	57	51.8
More than 2 kilograms	23	57.5	30	42.8	53	42.8

n: Number of patients; S: Number; %: Percentile; Chi-square Test; p<0.05

It was found that 70.0% of women and 71.5% of men who participated to the study received dialysis treatment for less than three years. Dialysis treatment duration did not show a statistically significant difference in male and women ($p>0.05$) (Table 1). It was found that body weight gain between two dialysis was less than 2 kg in 42.5% and more than 2 kg in 57.5% of women respectively. It was also found that body weight gain between two dialysis was less than 2 kg in 57.1% and more than 2 kg in 42.8% of male respectively. The difference in body weight of women and male between the two dialysis was not found statistically significant ($p>0.05$) (Table 1).

The average age of the patients participating in the study was 55 ± 21 years in women and 55 ± 18 years in men. The age distribution of women and men did not show statistically significant difference ($p>0.05$). It was determined that FBG levels of women were 114 ± 53 mg / dL and for male patients 136 ± 63 mg / dL. There was a statistically significant difference between the FBG levels and genders of the patients ($p<0.05$). The albumin levels of women were 3 ± 1 g/dL and of male patients 3 ± 1 g/dL. There was not statistically significant difference between the levels of albumin and genders in our patients ($p> 0.05$). Creatinine levels of women were 4 ± 2 mg/dL and male patients had creatinine levels of 5 ± 5 mg/dL. The difference between the creatinine levels of the patients by gender was not statistically significant ($p>0.05$). BUN levels of women were determined as 42 ± 19 mg/dL and for male patients as 48 ± 23 mg/dL. The difference between BUN levels and genders in patients was not statistically significant ($p>0.05$). The difference in the CRP, hemoglobin, calcium, sodium, potassium, and phosphorus levels between the genders was not statistically significant ($p>0.05$) (Table 2).

Table 2. Distribution of age and biochemical blood results

Values^y	Women (n=40) $\bar{X}$±SD	Men (n=70) $\bar{X}$±SD	Total (n=110) $\bar{X}$±SD	P-value	Reference
Age (year)	55±21	55 ±18	55 ±19	0.442^a	-
FBG (mg/dL)	114±53	136 ±63	128 ±1	0.025^b	74-106
Albumin (g/dL)	3±1	3 ±1	3 ±1	0.467^c	3.2-4.8
Creatinine (mg/dL)	4±2	5 ±5	5±4	0.051^b	0.7-1.3
BUN (mg/dL)	42±19	48 ±23	45 ±22	0.192^b	9-23
CRP (mg/dL)	6±6	6 ±5	6 ±5	0.901^b	0-0.5
Hemoglobin (g/dL)	10±2	10±2	10±2	0.396^c	12-16
Calcium (mg/dL)	8±1	8 ±1	8 ±1	0.788^c	8.7-10.4
Sodium (mg/dL)	136 ±4	135 ±3	136±3	0.305^c	136-145
Potassium (mg/dL)	4±1	4±1	4 ±1	0.986^c	3.5-5.1
Phosphorus (mg/dL)	4 ±2	4 ±1	4 ±1	0.985^c	2.4-5.1

n: Number of patients; $\bar{X}$: Average; SS: Standard deviation; FBG: Fasting blood glucose; BUN: Blood urea nitrogen; CRP:C-reactive protein; a Chi-square Test; b Mann Whitney U Test; c Unpaired T-Test; y Reference values of Akdeniz University Hospital Biochemistry Laboratory; p<0.05.

In the MUST screening test applied to patients, 39.1% of the patients were at low risk, 18.2% of them at moderate risk, and 42. 7% of them at high risk of malnutrition.

In the SGA test, 41.8% of the patients were well-nourished, 36.4% of them had moderate malnutrition, and 21.8% of them at serious malnutrition. In the NRS 2002 test, it was observed that 58.2% of those received over 3 points and were at nutritional risk. There was no statistically significant relationship between the difference of MUST values of the patients by gender ($p>0.05$). The difference of the mean of SGA and NRS 2002 between the patients by gender showed a statistically significant relationship ($p<0.05$) (Table 3).

Table 3. Distribution of screening and evaluation results

Screening tools	Risk	Women (n=40)		Men (n=70)		Total (n=110)			
		N	%	***N***	%	***N***	%	X²	p
MUST	- Low risk	11	27.5	32	45.5	43	39.1	5.721	0.057
	- Moderate risk	6	15.0	14	20.0	20	18.2		
	- High risk	23	57.5	24	34.3	47	42.7		
SGA	- Well-nourished	10	25.0	36	51.4	46	41.8	11.359	0.003
	- Moderate malnutrition	15	37.5	25	35.7	40	36.4		
	- Seriously malnutrition	15	37.5	9	12.9	24	21.8		
NRS 2002	- Screening should be repeated every week (<3 point)	11	27.5	35	50.0	46	41.8	5.296	0.017
	- The patients is at nutritional risk (≥3 point)	29	72.5	35	50.0	64	58.2		

n: Number of patients; S: Number; %: Percentile; MUST: Malnutrition Universal Screening Tool; SGA: Subjective Global Assessment; NRS 2002: Nutritional Risk Screening 2002; Chi-square Test; p<0.05

The average daily energy intake of the participants was 807 ± 416 kcal in women and 1110 ± 399 kcal in male patients. The difference in daily energy intake averages between the patients by gender was found statistically significant (p<0.05). It was observed that the average protein intake in their daily diet was 33 ± 18 g in women and 16.6% of the energy from protein and the average protein intake in male patients was 48 ± 17 g and 17.2% of the energy from protein. The difference in daily protein intake averages by gender was found statistically significant (p<0.05) (Table 4). It was found that the average daily fat intake of the women through diet was 34 ± 16 g and 38.3% of the energy from the fat, and 46 ± 16 g and the 38.8% of the energy from the fat for male patients. (p<0.05).

The average daily fat intake of the patients showed a statistically significant relationship between the genders.

It was found that the average daily carbohydrate intake of women was 90 ± 54 g and the ratio of energy from carbohydrates is 45.0%, and 124 ± 54 g and the rate of energy from carbohydrate was 43.4% for the male patients. The average daily carbohydrate intake of the patients showed a statistically significant difference between the genders (p<0.05). The average daily fiber intake was determined to be 7 ± 6 g in women and 10 ± 6 g in male patients. The daily fiber intake averages of the patients showed a statistically significant difference between the genders (p<0.05). The average intakes of cholesterol, SFA, MUFA, PUFA, omega-3, omega-6, and omega-3 and omega-6 nutrients were statistically significant by gender (p<0.05) (Table 4).

In the relationship between the patients' biochemical findings and screening tests, a mild, negatively relationship was found between the NRS-2002 test and values of albumin, creatinine, hemoglobin, and calcium levels (p<0.05); A mild and positively statistically significant relationship with CRP value (p<0.05). A mild, negatively, and statistically significant relationship was found between the MUST test and albumin, BUN, calcium, and phosphorus values (p<0.05). A mild and statistically significant relationship was determined negatively between the albumin, hemoglobin, and calcium and SGA test, and a mild, positively with CRP (p<0.05) (Table 5). There was a mild, negative and statistically, a significant relationship was also determined between body weight, dry weight, BMI with

Table 4. Distribution of energy and macronutrient consumption in the daily diet of patients

Energy and Macronutrients	Women (n=40)		Men (n=70)		Total (n=110)		p-value
	$\bar{X}$ ± SD	Median (min-max)	$\bar{X}$ ± SD	Median (min-max)	$\bar{X}$ ± SD	$\bar{X}$±SD	
Energy (kcal)	807 ± 416	750 (55-1772)	1110 ± 399	1074.5 (344-1801)	1000 ± 429	912.25(55-1801)	0.000[a]
Protein (g)	33 ± 18	28.50 (6-70)	48 ± 17	49 (13-87)	43 ± 19	38.75(6-87)	0.000[a]
Protein (TE%)	17 ± 3	16.9 (11-24.7)	17 ± 2	16.7 (12-25.4)	17 ± 2	16.8 (11-25.4)	0.273[a]
Fat (g)	34 ± 16	33.9 (7-64)	46 ± 16	46.30 (12-74)	42 ± 17	40.1(7-74)	0.000[a]
Fat (TE%)	38 ± 8	35.2 (20-57.6)	39 ± 6	37.2 (30-51.3)	39 ± 7	36.6 (20-57.6)	0.297[a]
CHO (g)	90 ± 54	75.70(18-233)	124 ± 54	123 (30-217)	112 ± 55	99.35(18-233)	0.001[a]
CHO (TE%)	45 ± 8	46.9 (23.2-68)	43 ± 6	44.6 (28-52.2)	44 ± 7	45.4 (23.2-68)	0.234[a]
Fiber (g)	7 ± 6	6 (1-24)	10 ± 6	10.3 (2-25)	9 ± 6	8.15(1-25)	0.001[a]
Cholesterol (mg)	173 ± 126	216 (32-372)	237 ± 116	259.5 (29-431)	214 ± 123	237.75(29-431)	0.008[a]
SFA (g)	13 ± 6	12.3 (2-26)	17 ± 7	18 (2-29)	15 ± 7	30.3(2-29)	0.002[a]
MUFA (g)	10 ± 5	9 (3-21)	14 ± 6	14.1 (5-31)	13 ± 6	11.55(3-31)	0.000[a]
PUFA (g)	8 ± 5	7.9 (1-20)	11 ± 6	12.20 (4-21)	10 ± 6	10.05(1-21)	0.002[a]
n-3 (g)	0 ± 0	0.4 (0-1)	1 ± 0	0.6 (0-1)	1 ± 0	0.5(0-1)	0.005[a]
n-6 (g)	7 ±5	7.5 (2.2-18.7)	10 ± 5	11.3 (3.9-19.8)	9 ± 5	9.4(2.2-19.8)	0.004[a]
n-3/ n-6 (g)	0 ± 0.	0.083 (0.02-0.22)	0 ± 0	0.083 (0.02-0.22)	0 ± 0	0.078(0.02-0.03)	0.004[a]

n: Number of patients; $\bar{X}$: Average; SS: Standard deviation; kcal: Kilocalorie; TE: Total energy; %: Percentile; CHO: Carbohydrate; SFA: Saturated fatty acid; MUFA: Monounsaturated fatty acid; PUFA: Polyunsaturated fatty acid; n-3: Omega-3; n-6: Omega-6; a Unpaired T-Test; p<0.05

the NRS-2002 test ($p<0.05$). There was a statistically, negatively, and moderately significant relationship between body weight, dry weight, BMI of patients and the MUST test ($p<0.05$). A moderately, negatively, and statistically significant relationship was also determined between the body weight, dry weight, BMI of the patients, and the SGA test ($p<0.05$) (Table 5). A negatively and higher significant relationship was found between the NRS 2002 and SGA test of the patients, and energy, carbohydrate, protein, and fat values ($p<0.05$). A mild and negatively significant relationship was also found between the MUST test of the patients and values of energy, carbohydrate, protein, and fat ($p<0.05$) (Table 5).

Table 5. Relationship between biochemical findings, anthropometric measurements, food consumption and screening tests of patients

	NRS 2002	MUST	SGA
Fasting blood glucose (mg/dL)	-0.029	-0.088	-0.016
Albumin (g/dL)	-0.310**	-0.336**	-0.263**
Creatinine (mg/dL)	-0.209*	-0.168	-0.149
BUN (mg/dL)	-0.145	-0.243*	-0.155
CRP (mg/dL)	0.322**	0.152	0.331**
Hemoglobin (g/dL)	-0.194*	-0.162	-0.204*
Calcium (mg/dL)	-0.278**	-0.232*	-0.299**
Sodium (mg/dL)	-0.127	-0.031	-0.096
Potassium (mg/dL)	-0.157	-0.077	-0.127
Phosphorus (mg/dL)	-0.097	-0.189*	-0.158
Body weight (kg)	-0.271**	-0.537**	-0.469**
Dry weight (kg)	-0.269**	-0.541**	-0.470**
BMI (kg/m^2)	-0.247**	-0.455**	-0.429**
Energy (kcal)	-0.674**	-0.331**	-0.699**
Carbohydrate (TE%)	-0.658**	-0.255**	-0.630**
Protein (TE%)	-0.649**	-0.316**	-0.706**
Fat (TE%)	-0.621**	-0.402**	-0.693**

BUN: Blood urea nitrogen; CRP:C-reactive protein; NRS 2002: Nutritional Risk Screening 2002; MUST: Malnutrition Universal Screening Tool; SGA: Subjective Global Assessment; BMI: Body mass index; Spearman's Rho Correlation; *p<0.05 **p<0.01

4 Discussion

Traditional grains used frequently to make complementary foods for children between 6-23 months in Africa are millet, pearl millet, sorghum, and finger millet (Table 1).

The prevalence of chronic kidney disease increases day by day, with the extensive pathological condition and many symptoms that negatively affect the quality of life of patients[16]. This study aimed to evaluate the relationship between food consumption, biochemical blood parameters, some anthropometrics, and the screening tests using in the evaluation of the nutritional status of hemodialysis patients with renal failure.

As the age increases in hemodialysis patients, the risk of morbidity and mortality rises, either nutritional problems occur [17]. According to the data of the Turkish Nephrology Association, 34.8% of dialysis patients in Turkey are between the ages of 45-64, and 54.2% are 65 years and over [4]. It was found that 42.5% of women and 50.0% of men joining this study were over 60 years old. The average age was 55±21 years in women and 55±18 years in male patients. Age distribution of women and men did not show a statistically significant difference ($p>0.05$).

It has been found that a BMI higher than 23 kg/m^2 in hemodialysis patients has a protective effect [18]. Caetano *et al.*[19] as a result of the follow-up of 697 HD patients for one year, patients with BMI <18.5 kg/m^2 were associated with a high mortality rate; HD patient group with a BMI of 25-29.9 kg/m^2 displayed a protective effect on mortality. According to the BMI classification of the patients participating in the current study, 57.5% of women, 51.5% of men and 53.6% of all patients were found to have a BMI below 23 kg/m^2. A statistically significant difference was found in the BMI classification of the patients according to gender ($p<0.05$).

According to, Bargezar *et al.* [20] prolongation of dialysis treatment duration was associated with poor quality of life in patients who received hemodialysis, and the duration of hemodialysis treatment was determined as 34 months. It was found that 70.0% of women and 71.5% of men participating in the study received less than three years of dialysis treatment. Dialysis treatment time did not show a statistically significant difference in men and women ($p>0.05$).

In 2010, Haider *et al.* [21] in the study which they examined glucose metabolism of hemodialysis patients, the FBG values of the patients were found to be 105 mg/dL. FBG values in the hemodialysis patients included in the study were 114±53 mg/dL in women and 136±63 mg/dL in men. FBG values of the patients were seen to be statistically significant between genders ($p<0.05$).

One of the nutritional recommendations for dialysis patients in the KDIGO guideline is that serum albumin value is >4 g/dL [22]. According to Hanafusa *et al.* [23] who reported that the average serum albumin value of the patients was 4±0 g/dL and the presence of inflammation should be taken into consideration during the examination of this parameter. In this study, albumin values in the hemodialysis patient group were found to be 3 ± 0 g/dL in women and 3 ± 1 g/dL in men. Serum albumin values of the patients did not show a statistically significant difference according to gender ($p>0.05$).

In a study conducted with hemodialysis patient group, BUN levels were reported as 71.4 mg/dL in men and 66.3 mg/dL in women [24]. BUN levels of hemodialysis patients participating in this study were found to be 48±23 mg/dL in men and 42±19 mg/dL in women. Serum BUN levels of the patients did not show a statistically significant relationship by the gender (p>0.05).

The use of nutritional screening tools that are useful in the clinic is essential to be able to identify the nutritional issues, predict the mortality risk, and assess the patient's response to treatment [25].

In Führ *et al.* ‘s study [26], aiming to search the nutritional risks of HD patients, using two screening tools, the authors observed that 26.8% of the patients had a score above 3 points in the NRS-2002 test and 35.5% of the patients had moderate-severe malnutrition in the SGA test. In another study, SGA and NRS-2002 tests were used to determine the risk of malnutrition, and a significant relationship was found between the tests [27]. In the study carried out by Yamada *et al.* [28] for classifying the nutritional risk of 422 HD patients by using five different screening tools, it was found that the NRS 2002 test was more sensitive than MUST for risk analysis. In the current study, a positive and higher significant relationship was found statistically between NRS 2002, MUST, and SGA tests (p<0.05).

In 2009, Santin *et al.* [29] in a study conducted on 104 HD patients with a one-year follow-up, it was reported that the patients' body weight and BMI values decreased with an increase of one unit in SGA scores. A significant and negative relationship was found between SGA score and body weight, and BMI values among hemodialysis participants (p<0.05). Eminsoy *et al.* [30] noticed a significant and negative relationship between the SGA test, serum albumin, and serum creatinine values in their study on hemodialysis patients. In the present study, a mild and negatively significant relationship was found between the SGA test of hemodialysis patients and serum albumin, hemoglobin, and calcium levels (p <0.05).

According to Müller *et al.* [31] it was found that serum sodium and serum albumin values increased and serum creatinine values decreased in patients with a score of less than 3 in the NRS 2002 test compared to those with a score above 3. In our study, a mild and negatively significant relationship was found between the NRS 2002 test and the values of albumin, creatinine, hemoglobin, calcium, but a mild, positive, and statistically significant relationship with the CRP value (p <0.05).

In the study of Maurya *et al.* [32], it was observed that the energy intake of the patients was 1643 ± 149 kcal/day in the first month and 1373 ± 144 kcal/day in the third month. It has been stated that the decrease in monthly energy intake of patients may be related to psychosocial conditions and metabolic stress. In our study, daily energy intakes were 807 ± 416 kcal/day in women and 1110 ±399 kcal/day in men. The average energy intake of the women was lower and the difference by gender being statistically significant (p <0.05).

The guidelines recommend high dietary protein intake in end stage renal diseases patients undergoing dialysis treatment (1.0 to 1.2 g/kg/day), to avoid aggravation of protein energy wasting [33]. In the study of Kang *et al.* [34], the authors found that the total protein intake of 144 hemodialysis patients was 34 ± 6 g/day and provided 13.7% of the energy intake from protein. In our study, it was also found that 27.0% of the patients died and the surviving patients consumed more protein than the deceased patients. In this study, it was observed that the protein intake of women receiving hemodialysis treatment was 33±18 g/day and it provided 16.6% of the energy rate from protein, the average protein intake in men was 48±17 g/day and the ratio of energy from protein was 17.2%. It was determined that the daily protein intake of women was lower than that of men. The difference in daily protein intake averages by gender was found statistically significant (p<0.05).

According to Silva *et al.* [35] who determined that the carbohydrate intake of the patients was estimated to 238 ± 40 g/day providing 63.5% of the total energy intake. In our study, it was found that carbohydrate intake was 90 ± 54 g/day in women and provided 45.0% of energy from carbohydrates, the average daily carbohydrate intake of men was 124±54 g/day and it provided 43.4% of energy from carbohydrates. The daily carbohydrate intake of the patients showed a statistically significant relationship between the genders (p <0.05).

According to, Sahin *et al.*’s study [36] on 150 hemodialysis patients, a negative relationship was observed between the SGA test and energy/fat intake, and no relationship was found between carbohydrates and protein intake. Susetyowati *et al.* [37] in a hospital's hemodialysis unit, did not registered any relationship between the energy intake of patients and the NRS 2002 test. A relationship was observed between the protein intake of the patients and the NRS 2002 test. In our study, a negatively and higher significant relationship was found statistically between energy, carbohydrates, proteins, and fat intakes and NRS 2002 and SGA tests, and a mild significant relationship was found with the MUST test (p<0.05).

5 Conclusions

It was observed, through the current investigation, that malnutrition developed in hemodialysis patients because they could not reach the recommended amounts of nutrients in addition to the factors caused by the disease. It is concluded that anthropometric measurements are more accordant with MUST, the biochemical symptoms with NRS 2002, and therefore both must be taken into consideration in the assessment of the nutritional status of the end-stage renal patients undergoing hemodialysis.

Limitations of the study: The number of publications on this subject is limited. It is an important need of this field to carry out multicenter studies in the future.

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