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NUTRITIONAL RISK, NUTRITIONAL STATUS AND SOME BIOCHEMICAL PARAMETERS IN ADULT BURN PATIENTS IN BURN INTENSIVE CARE UNIT: A PROSPECTIVE STUDY

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Abstract: Nutritional therapy is very important in burn patients and plays a role in the prevention and treatment of malnutrition. Therefore, it is necessary to assess nutritional status, prevent or minimize nutritional problems, and monitor nutritional therapy. This study was conducted to determine the nutritional risk, nutritional status and biochemical parameters of adult burn patients in the burn intensive care unit. The 59 patients (women: 16, men: 43) between the ages of 19-64 were included in the study. Parameters such as NRS-2002 (admission and discharge), dietary intake, nutritional support status, serum albumin, and total protein (admission and discharge) were evaluated to determine the nutritional risk and nutritional status of the patients. In addition, body weight, mid-upper arm circumference, and triceps skinfold thickness were measured and body mass index was calculated (admission and discharge). The duration of hospitalization and burn percentage of men patients were higher than women (P<0.05). A significant decreases were determined in the mean body weight, body mass index, and triceps skinfold thickness of men patients at discharge compared to admission (P<0.05). In men patients, a statistically significant difference was found in serum albumin, hemoglobin, and hematocrit values between admission and discharge (P<0.05). A statistically significant difference was found in NRS-2002 scores at admission and discharge in both genders, and the scores increased (P<0.05). While a significant relationship was found between immunonutrition support and gender (P<0.05), no relationship was found between genders in terms of the diet given and the consumption status of the diet intake (P>0.05). No statistically significant difference was found between genders in terms of feeding duration with nutritional support products, energy intake with nutritional support products and diet, macronutrients, and total energy expenditure values (P>0.05). Since burn injuries can cause serious metabolic disorders, impaired nutritional status was encountered during hospitalization. While the treatment process was positively affected by the increase in the NRS-2002 score during hospitalization, a decrease in parameters such as albumin, total protein, and anthropometric measurement values brought about by the catabolic process was encountered. Therefore, to prevent or treat malnutrition, the nutritional status of patients should be evaluated at the time of hospitalization and they should be able to receive the necessary nutritional support.

Keywords: Burn, Nutritional risk, NRS-2002, Nutritional status, Albumin, Total protein

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1. Introduction

Burn injuries can cause serious metabolic disorders. Among critically ill patients, the group with the highest metabolic rate is burn patients (Ostadrahimi et al., 2016). Major burns increase this rate almost 2-fold (Shields et al., 2013). Therefore, it is recommended that energy and protein load be replaced well to limit metabolic deficit (Czapran et al., 2015).

Comprehensive nutritional therapy is of great importance in managing burn patients (Suri et al., 2006). If this goal is not achieved, malnutrition may develop (Rodriguez, 2004). Moreover, strong associations have been established between nutritional deficiencies in critically ill patients, prolonging the duration of intensive care or hospital stay, and increasing morbidity and mortality (Sungurtekin et al., 2008). Therefore, timely assessment of nutritional status in critically ill patients is important to prevent or minimize nutritional problems and monitor nutritional therapy (Hejazi et al., 2016).

Clinicians should determine the nutritional status of patients with appropriate assessment tools and reveal their need for nutritional support (Maday, 2017). Anthropometric measurements (such as body weight, height, body mass index, mid-upper arm circumference, triceps skinfold thickness), biochemical findings (such as total protein, albumin, and pre-albumin), immune markers (such as lymphocyte count), and nutritional screening tools can be used to determine the nutritional status of critically ill patients (Hejazi et al., 2016). However, certain limitations are encountered regarding anthropometric measurements and biochemical findings in burn patients (Machado et al., 2011). The frequently used Nutritional Risk Screening 2002 (NRS-2002) is the tool recommended by The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines primarily for determining indications for nutritional support (Kondrup et al., 2003; Poulia et al., 2017).

This study was conducted to determine the nutritional risk, nutritional status and biochemical findings of adult burn patients in burn intensive care unit.

2. Materials and Methods

2.1. Participants

The study was carried out at the Burns Treatment Center of Ankara Numune Education and Research Hospital between November 1st, 2012 and March 1st, 2013 and among the hospitalized patients, 59 patients composed of 43 men and 16 women at the age range of 19 to 64 was included. All adult patients hospitalized between the dates of the study were included in the study.

2.2. Data Collection

An information form was applied within the scope of the study. The information form was prepared by the researchers as a result of the literature review and consists of six sections (sociodemographic and burn-related information, anthropometric measurements, biochemical parameters, NRS-2002 form, total energy requirements, dietary intake, and nutritional support status).

2.2.1. Anthropometric measurements

Height, body weight, body mass index (BMI), mid-upper arm circumference (MUAC), and triceps skinfold thickness (TSFT) were used as anthropometric measurements of the patients. Height was obtained from the patient file at admission. Body weight, MUAC, and TSFT were measured twice, at the time of admission and discharge. Body mass index (kg/m^2) values were calculated twice from the body weight (kg) and height (cm) measurements at the time of admission and discharge. Body mass index was calculated by dividing body weight by height in m^2 (WHO, 2010).

The body weight of patients who could stand up was determined using an electronic scale with ±0.1 kg sensitivity in the hospital, and the body weight of patients who could not stand up was determined using beds that could measure weight. It was measured by the MUAC and TSFT techniques (McDowell et al., 2008). Measurements of patients with arm burns could not be taken. TSFT was performed using a Holtain brand skinfold caliper. BMI was evaluated according to the World Health Organization (WHO) classification (WHO, 2010).

2.2.2. Biochemical assessment

It includes the standard parameters determined by the hospital for burn treatment. The patient's serum total protein, albumin, hemoglobin, and hematocrit values at admission and discharge were recorded in the information form.

2.2.3. Nutritional risk screening 2002 (NRS-2002) form

To determine the nutritional status of the patients, the NRS-2002 form was filled in twice, at admission and discharge. NRS-2002 was developed by Kondrup et al. in 2002 (Kondrup et al., 2003). Its validity and reliability in Turkish were performed by Bolayır in 2014. It has been shown that NRS-2002 is a valid and reliable method that can be used in hospitalized patients (Bolayır, 2014). This form aims to detect inadequate nutrition and malnutrition risk and to identify patients who may benefit from nutritional support. It is recommended by ESPEN to reveal possible conditions or changes that improve or worsen after illness or surgery (Lochs et al., 2006). The scoring system consists of two sections, ‘nutritional status’ and ‘disease severity’, and provides scoring as “no problem”, “mild”, “moderate” and “severe”. Scoring is between 0-3 for each section. In patients over the age of 70, an additional 1 point is added to the score due to age, and patients with a total score of ≥3 are considered to be at nutritional risk (Kreymann et al., 2006; Nişancı Kılınç et al., 2023).

2.2.4. Total energy requirement

The total energy requirements of patients at admission were calculated using the Curreri formula (equation 1) (Chan et al., 2018), which incorporates the total body surface area (TBSA) burn.

Curreri formula: (25 kcal × body weight) + (40 kcal × %TBSA), when the TBSA is >50%, it is calculated as 50%. (1)

2.2.5. Dietary intake and nutritional support status

The nutritional intake of the patients was determined according to the percentage of the hospital diet given to them that was consumed. The nutritional intake of the patients was determined by the researcher's follow-up, the patient's declaration, and the waste control results of the nurses and waiters working in the hospital. The patients' menus were obtained from the hospital's responsible dietician. If the patient's hospitalization period was more than 7 days, energy and nutrients were determined according to the average dietary intake of 7 randomly selected days. If the patient's hospitalization period was less than 7 days, all intakes during the hospitalization period were evaluated. The energy and nutrients taken were calculated in the “Computer Assisted Nutrition Program, Nutrition Information System (BEBIS) 6.1” program developed for Turkey. In addition, enteral or parenteral nutrition product usage was determined and evaluated in terms of energy and nutrients.

2.2.6. Statistical analysis

Statistical analyses of the data were performed using IBM SPSS for Windows Version 21.0 package program. Numerical variables are shown as mean±standard deviation ($\bar{X}$±SD), categorical variables are shown as number (n) and percentage (%), and Median (min-max). Before comparing the groups in terms of numerical variables, parametric test assumptions (normality and homogeneity of variances) were checked. Whether the numerical variables showed normal distribution was evaluated with the Shapiro-Wilks test. The homogeneity of the variances of the compared groups was examined using the Levene test. If the parametric test assumptions were met, a one-way analysis of variance was used to investigate whether there was a difference between two independent groups in terms of numerical variables. If the parametric test assumptions were not met, Mann Whitney U test was used in comparisons between groups, and the Wilcoxon signed rank test was used in dependent sample comparisons within groups. Whether there was a difference between groups in terms of categorical variables was examined with chi-square goodness of fit and Chi-square independence test or Fisher's exact test. The significance level was determined as P<0.05 (Önder, 2018).

3. Results

The mean age of the patients was 41±14.87 years (45.50±16.74 years in women, 39.49±13.98 years in men) (P=0.170). The hospitalization period of women patients were 14.68±10.53 days, while it was 24.97±17.51 days for male patients (P=0.026). The mean burn percentage of women patients was 4.68±4.04, and men patients were 17.00±22.85 (P=0.010). A statistically significant dependence was found between burn type and gender (P=0.001). The observed dependence was because hot liquid burns were higher in women (68.8%), flame burns were higher in men (58.1%), and electrical burns were higher in men (14.0%). It was determined that lower arm, upper arm, hand, face, and trunk burns were more common in men than in women (P<0.05). First and fourth degree burns were more common in men but not in women (P<0.05) and second degree deep burns were more common in women than in men (P=0.008) (Table 1).

There was no statistically significant difference among genders regarding body weight, BMI, MUAC, and TSFT at admission and discharge (P>0.05). A decrease was determined in body weight, BMI, and TSFT values of men patients at discharge compared to admission (P<0.05).

Table 1. Age of patients, duration of hospitalization and burn status

	Women (n=16)		Men (n=43)		Total (n=59)		P
	n	%	n	%	n	%	
Age, year (Mean±SD)	45.50±16.74		39.49±13.98		41.00±14.87		0.170[a]
Hospitalization day (Mean±SD)	14.68±10.53		24.97±17.51		22.18±16.49		0.026[a]
TBSA burn, % (Mean±SD)	4.68±4.04		17.00±22.85		13.66±20.32		0.010[a]
Burn cause							
Hot liquid	11	68.8	6	14.0	17	28.8	
Flame	4	25.0	25	58.1	29	49.2	
Contact	1	6.3	4	9.3	5	8.5	0.001[b]
Electric	-	-	6	14.0	6	10.2	
Chemical	-	-	2	4.7	2	3.4	
Burn area*							
Lower leg	8	50.0	18	41.9	26	44.1	0.404[c]
Upper leg	4	25.0	16	37.2	20	33.9	0.128[c]
Lower arm	1	6.3	11	25.6	12	20.3	0.001[c]
Upper arm	3	18.8	15	34.9	18	30.5	0.029[c]
Hand	3	18.8	20	46.5	23	39.0	0.001[c]
Face	3	18.8	20	46.5	23	39.0	0.001[c]
Head	1	6.3	3	7.0	4	6.8	0.782[c]
Neck	-	-	6	14.0	6	10.2	0.058[c]
Foot	6	37.5	11	25.6	17	28.8	0.134[c]
Trunk	3	18.8	15	34.9	18	30.5	0.029[c]
Burn depth*							
First degree	-	-	4	9.3	4	6.8	0.011[c]
Superficial second degree	5	31.3	16	37.2	21	35.6	0.467[c]
Deep second degree	14	87.5	24	55.8	38	64.4	0.008[c]
Third degree	4	25.0	17	39.5	21	35.6	0.063[c]
Forth degree	-	-	3	7.0	3	5.1	0.034[c]

TBSA= total body surface area, * More than one option is marked, [a] Mann-Whitney U test, [b] Chi square independence test, [c] Chi square goodness of fit test..

Table 2. Anthropometric measurements, biochemical findings and NRS-2002 scores of the patients at admission and discharge

	Women (n=16)	Men (n=43)	Total (n=59)	P
	Mean±SD	Mean±SD	Mean±SD	
Height (m)	1.61±0.06	1.70±0.07	1.68±0.07	<0.001[y]
Body weight (kg) (A)	72.43±12.00[¶]	75.70±12.58[¶]	74.84±12.41[¶]	0.386[y]
Body weight (kg) (D)	72.33±12.00[¶]	74.56±13.05[§¶]	73.93±12.69[§¶]	0.569[y]
P	0.823[a]	0.006[a]	0.008[a]	
BMI (kg/m^2) (A)	27.73±5.44[¶]	25.92±4.31[¶]	26.40±4.65[¶]	0.198[y]
BMI (kg/m^2) (D)	27.67±5.29[¶]	25.64±4.63[§¶]	26.21±4.86[§¶]	0.172[y]
P	0.725[a]	0.007[a]	0.009[a]	
MUAC (cm) (A)	31.75±2.89[¥]	30.55±4.17[¥]	30.82±3.89[¥]	0.520[y]
MUAC (cm) (D)	31.83±7.14[¥]	30.32±3.77[§¥]	30.67±3.56[§¥]	0.375[y]
P	0.771[a]	0.342[a]	0.420[a]	
TSFT (mm) (A)	17.83±11.09[¥]	10.75±2.89[¥]	12.38±6.34[¥]	0.196[z]
TSFT (mm) (D)	17.83±10.72[¥]	10.45±2.94[§¥]	12.15±6.29[§¥]	0.139[z]
P	1.000[b]	0.047[b]	0.057[b]	
Total protein, mg/dl (A)	67.8±6.51	63.3±11.14	64.3±10.40	0.264[y]
Total protein, mg/dl (D)	63.7±6.65	58.8±12.61[§]	59.4±12.06[§]	0.525[y]
P	0.344[a]	0.987[a]	0.921[a]	
Albumin, g/dl (A)	40.5±5.18	39.1±8.08	39.4±7.47	0.576[y]
Albumin, g/dl (D)	33.3±9.86	37.5±13.93[§]	37.0±13.38[§]	0.546[y]
P	0.823[a]	0.008[a]	0.008[a]	
Hemoglobin, g/dl (A)	12.4±2.67	14.6±2.54	14.1±2.7	0.005[y]
Hemoglobin, g/dl (D)	10.7±2.35	11.3±2.49[§]	11.2±2.44[§]	0.600[y]
P	0.270[a]	<0.001[a]	<0.001[a]	
Hematocrit, % (A)	38.2±6.81	43.6±7.10	42.2±7.36	0.014[y]
Hematocrit, % (D)	34.5±6.61	34.8±7.24[§]	34.7±7.03[§]	0.973[y]
P	0.370[a]	<0.001[a]	<0.001[a]	
NRS-2002 score (A)	0.50±0.89	0.86±1.20	0.76±1.13	0.282[y]
NRS-2002 score (D)	1.62±1.02	2.37±1.21[§]	2.16±1.20[§]	0.033[y]
P	0.002[a]	<0.001[a]	<0.001[a]	

A= admission, D= discharge, BMI= body mass index, MUAC= mid-upper arm circumference, TSFT= triceps skinfold thickness, NRS-2022= nutritional risk screening 2002, [¶]The body weights of one women and one men patient could not be measured during hospitalization due to the severity of the illness, [§] Four men patients died during the study, [¥] Measurements could not be taken in 3 women and 15 men patients due to upper arm burns, [a] t-test in dependent samples, [b] Wilcoxon signed rank test in dependent samples, [y] ANOVA, [z] Mann-Whitney U test.

No statistically significant difference was determined within genders for MUAC values at admission and discharge (P>0.05). No statistically significant difference was determined between genders regarding total protein value and within genders at admission and discharge (P>0.05). A statistically significant difference was determined in serum albumin, hemoglobin, and hematocrit values between admission and discharge in men patients (P<0.05). Serum albumin, hemoglobin and hematocrit values of men patients decreased. A statistically significant difference was determined between genders in terms of the NRS-2002 score at discharge (P<0.05), and it was found that the NRS-2002 score was lower in women than in men. A statistically significant difference was determined in NRS-2002 scores at admission and discharge in both genders (P<0.05). The NRS-2002 scores of the patients increased (Table 2).

In BMI classification, it was determined that BMI scores at admission and discharge were not dependent on gender (P>0.05). There was no statistically significant difference between BMI values at admission and discharge in women patients (P>0.05), but there was a significant difference in men patients (P<0.05), and the BMI value of men patients decreased (Table 3).

No significant differences were determined between food consumption and gender (P>0.05). It was determined that there was a significant relationship between immunonutrition support and gender (P<0.05); it was determined that there was no need for immunonutrition support in women patients. It was determined that there was a significant relationship between trace element support and gender (P<0.05), and that trace element support was used more in men patients than in women patients. No relationship was determined with gender in terms of the diet given and the consumption status of the given diet (P>0.05) (Table 4).

Table 3. Distribution of patients' BMI values at admission and discharge according to the World Health Organization classification

BMI classification	Women (n=16)		Men (n=43)		Total (n=59)		
	n	%	n	%	n	%	P
BMI, kg/m² (A)¶							
18.5-24.9 normal	6	40.0	17	40.5	23	40.4	
25.0-29.9 overweight	4	26.7	20	47.6	24	42.1	
30.0-34.9 obesity class I	4	26.7	3	7.1	7	12.3	
35.0-39.9 obesity class II	-	-	2	4.8	2	3.5	0.088[a]
≥40.0 obesity class III	1	6.6	-	-	1	1.7	
BMI, kg/m² (D) ¶§							
<18.5 underweight	-	-	1	2.6	1	1.9	
18.5-24.9 normal	6	40.0	17	44.7	23	43.4	
25.0-29.9 overweight	4	26.7	15	39.5	19	35.8	
30.0-34.9 obesity class I	4	26.7	4	10.5	8	15.1	0.504[a]
35.0-39.9 obesity class II	1	6.7	1	2.6	2	3.8	
BMI (A) [Median (Min-Max)]	3 (2:6)		3 (2:5)		3 (2:6)		0.389[c]
BMI (D) [Median (Min-Max)]	3 (2:5)		3 (1:5)		3 (1:5)		0.274[c]
P	0.317[b]		0.046[b]		0.025[b]		

BMI= body mass index, A= admission, D= discharge, ¶ The body weights of one women and one men patient could not be measured during hospitalization due to the severity of the illness, § Four men patients died during the study, [a] Chi-square test of independence, [b] Wilcoxon signed rank test, [c] Mann-Whitney U test.

Table 4. Patients' food consumption, immunonutrition and trace element support, and dietary status

	Women (n=16)		Men (n=43)		Total (n=59)		
	n	%	n	%	n	%	P
Food consumption							
Only oral	15	93.8	28	65.1	43	72.9	
Oral+Enteral	1	6.2	12	28.0	13	22.0	0.178
Oral+Parenteral	-	-	1	2.3	1	1.7	
Not fed	-	-	2	4.6	2	3.4	
Immunonutrition support							
Yes	-	-	13	30.2	13	22.0	0.009
No	16	100.0	30	69.8	46	78.0	
Trace element support							
Yes	5	31.3	27	62.8	32	54.2	0.031
No	11	68.8	16	37.2	27	45.8	
Diet type							
Normal diet	12	75.0	36	83.7	48	81.4	
Diabetic diet	1	6.3	1	6.3	2	3.4	
Salt-free diet	1	6.3	2	4.7	3	5.1	
Heart protective diet	-	-	1	2.3	1	1.7	0.272
Diabetic & salt-free diet	2	12.5	-	-	2	3.4	
Heart protective & salt-free diet	-	-	1	2.3	1	1.7	
Not fed	-	-	2	4.7	2	3.4	
Percentage of diet consumption							
%100	9	56.3	24	55.8	33	55.9	
%75	4	25.0	9	20.9	13	22.0	0.842
%50	3	18.8	8	18.6	11	18.6	
%0	-	-	2	4.7	2	3.4	

Chi-square test of independence.

There were no statistically significant difference was found between genders in terms of the duration of feeding with nutritional support products, the energy intake with nutritional support products and diet, macronutrient elements, and total energy expenditure values (P>0.05) (Table 5).

Table 5. The duration of patients' nutritional support, the energy and macronutrient intake with nutritional support and diet, and total energy requirement values

	Women (n=16)	Men (n=43)	Total (n=59)	
	Mean±SD	Mean±SD	Mean±SD	P
Duration of enteral feeding (day)	12.00	18.00±14.41	17.57±13.94	
Duration of parenteral feeding (day)	-	30.00	30.00	
Duration of feeding with immunonutrition product (day)	-	26.07±14.16	26.07±14.16	0.901[a]
Energy intake with enteral product (kcal)	505.00	814.70±334.54	797.50±332.66	
Carbohydrates intake with enteral product (g)	64.00	120.56±52.52	117.42±52.67	0.489[a]
Protein intake with enteral product (g)	20.00	38.65±14.17	117.42±52.67	0.138[a]
Fat intake with enteral product (g)	18.50	19.77±9.02	19.70±8.76	0.196[a]
Energy intake with parenteral product (kcal)	-	108.00	108.00	0.921[a]
Protein intake with parenteral product (g)	-	27.00	27.00	
Dietary energy (kcal)	1834.32±480.04	1900.40±609.21	1861.00±88.20	0.698[b]
Dietary protein (g)	77.13±20.18	79.91±25.61	78.40±17.60	0.698[b]
Dietary protein (%TE)	16.57±4.33	17.17±5.50	17.10±3.43	0.698[b]
Dietary fat (g)	103.59±27.11	107.32±34.40	104.20±7.44	0.698[b]
Dietary fat (%TE)	36.56±9.56	37.87±12.14	37.30±2.81	0.698[b]
Dietary carbohydrates (g)	270.93±70.90	280.69±89.98	274.10±21.60	0.698[b]
Dietary carbohydrates (%TE)	44.23±11.57	45.82±14.69	45.10±3.33	0.698[b]
TER (with the Curreri formula) (kcal)	1912.46±259.71	2428.50±833.39	2292.70±760.21	0.543[b]

TE= Total energy, TER= Total energy requirement, [a] Mann-Whitney U test, [b] ANOVA.

4. Discussion

Non-fatal burn injuries are among the leading causes of morbidity in the world. Depending on the degree and size of burns, they cause a stress response and metabolic changes in the body. In order to create an adequate response to these changes in the burn patient, it is necessary to determine the nutritional status and nutritional risk of the burn patient. Adequate nutrition increases anabolic metabolism, accelerates wound healing and shortens the length of hospital stay of the burn patient (Karahan et al., 2021). Therefore, this study was conducted to determine the nutritional risk, nutritional status and biochemical findings of adult burn patients in burn intensive care unit.

In this study, the average age of the hospitalized burn patients was 41.00±14.87 years. In a study conducted by Sözen et al., the average age was 32.55±21.96 years (Sözen et al., 2015). While the TBSA burn was %22.18±16.49, it was determined as %16.0±18.2 in another study (Gürbüz and Demir, 2022). While the patients were most frequently burned by flames, another study determined that the most common cause of burns was hot liquids (74.2%) (Albayrak et al., 2018). In this study, the most common burns were in the lower leg region of the body and second-degree deep burns were detected. In contrast, in another study, it was found that the upper and lower extremities were the most frequently burned areas compared to other parts of the body and second-degree superficial burns were encountered most frequently (Sözen et al., 2015). Since burns are traumatic events that occur unexpectedly, it is thought that a wide variety of results can be encountered in the literature regarding the descriptive data of patients regarding age and burns.

In this study, anthropometric measurements such as body weight, BMI, MUAC, and TSFT were used. In this study, it was found that burn patients lost 0.9 kg (loss rate 1.2%) of their body weight from admission to discharge. In a study, burn patients lost an average of 5.8 kg (loss rate 8.1%) during hospitalization (Windle, 2004). Although less body weight loss was determined than in the literature, it was thought that the loss could have been greater. The body weight at follow-up may not reflect the truth due to reasons such as the patients being exposed to dressings with wet gauze and experiencing intense edema. From another perspective, it is also possible to regain the weight lost during hospitalization. The complexity of the clinical course of burn patients and the fact that sometimes the desired intervention cannot be made cause difficulties in obtaining anthropometric measurements.

In this study, it was determined that the BMI value of burn patients at admission was mostly in the range of 25.0-29.9 kg/m^2 (%42.1), and at discharge it was mostly in the range of 18.5-24.9 kg/m^2 (%43.4) ($P<0.05$). In a study, it was reported that 13.2% of burn patients had a BMI below 20 kg/m^2 at admission, while 28.9% of patients had a BMI below 20 kg/m^2 at discharge (Windle, 2004). In this study, the mean MUAC of women burn patients at admission was 31.7 cm and 31.8 cm at discharge; and for men, it was determined as 30.5 cm at admission and 30.3 cm at discharge ($P>0.05$). The TSFT measurement mean was similar for women for admission and discharge, while a decrease was found in men ($P<0.05$). As far as is known, there is no study in the literature that determines the changing MUAC and TSFT values of burn patients from hospital admission to discharge. It is also important to examine the subcutaneous fat tissue and muscle tissue in hospitalized patients. Therefore, information can be obtained about how much the decreased body weight and BMI detected in the study are related to fat and/or muscle loss thanks to MUAC and TSFT.

Some biochemical parameters such as serum total protein, albumin, hemoglobin, and hematocrit are also used to determine nutritional risk (Durmuş et al., 2016). Blood concentration of albumin and total protein decreases in poor nutritional status and inflammation. In clinical practice, albumin is considered a negative acute phase protein (Kuşcu et al., 2021). In this study, it was determined that serum total protein, albumin, hemoglobin, and hematocrit values in the blood decreased in both genders from admission to discharge, by the literature. However, the decrease in serum albumin, hemoglobin, and hematocrit values only in men was found to be statistically significant ($P<0.05$).

Nutritional risk is defined by ESPEN as “the chance of a better or worse outcome from disease or surgery according to actual or potential nutritional and metabolic status” (Lochs et al., 2006). In this study, the total NRS-2002 score was found to be below three in both genders both at admission and discharge. An increase in the total score was found in both men and women during the period from admission to discharge ($P<0.05$). This situation shows that the patients were not at nutritional risk. It is thought that the increase in the total NRS-2002 score at discharge was because no significant weight loss occurred during hospitalization and that the necessary interventions were made for patients who needed nutritional support. In addition, the patients were mostly able to eat orally and had sufficient energy.

Immunonutrition supplementation can also be administered to burn patients who need nutritional support. Guidelines do not provide definitive recommendations on the use of these products. Although it is difficult to recommend a definitive dose, route of administration, or duration of administration for glutamine, it is an amino acid that becomes necessary for burn patients depending on the situation. It can be mentioned that it positively affects infectious complications, hospital stay, and mortality. There is no evidence to recommend arginine supplementation in burn patients (Rousseau et al., 2013). In this study, it was determined that 22% of the patients received both enteral products and immunonutrition support.

In this study, it was determined that burn patients were fed with an average of 1861 kcal diet. While one study determined that patients consumed an average of 2000 kcal per day and were in a positive energy balance, another study found that the average daily energy intake of patients was 1700-2300 kcal (Herndon et al., 2001; Douglas et al., 2007). The balance of macronutrients is as important as the adequacy of energy intake in the nutrition of burn patients. Carbohydrates are well known as the main energy source for burn patients, but high carbohydrate intake can lead to hyperglycemia, increased exogenous insulin requirements, and delayed wound healing. Adequate fat consumption reduces the patient's carbohydrate needs and prevents essential fatty acid deficiencies. However, excessive fat intake may hurt the immune function of burn patients. Protein is essential for burn patients and protein requirements are increased (Ren et al., 2023). ESPEN reports that the proportion of total energy coming from carbohydrates should be limited to 60% and the proportion coming from lipids should be <30% (Rousseau et al., 2013). In contrast to the recommendations in this study, the proportions were determined as 37.30% for fat and 45.10% for carbohydrates. Diets containing 25-40% fat can be widely used in the early stages of the diet of burn patients (Saffle, 2007). This situation allows fat to come to the forefront due to its high energy supply and low CO_2 production. However, it was concluded from this study that the diet pattern to be given to burn patients should be better adjusted. Dietary protein should be increased a little more, and foods containing direct fat should be reduced and replaced with healthy carbohydrate sources.

5. Conclusion

Burn patients may be at nutritional risk depending on the burn percentage and area. This may affect treatment, hospitalization time, and survival. Therefore, the nutritional and nutritional risk status of burn patients receiving inpatient treatment should be monitored. Because a decrease is detected in the anthropometric measurements and biochemical findings of the patients during their hospitalization. Patient-specific anthropometric measurements such as BMI, MUAC, TSFT, NRS-2002 form, biochemical parameters such as serum total protein, albumin, and hemoglobin, and the amount of hospital food consumed can be used. In this way, the necessary nutritional support can be provided to every new patient to prevent or treat malnutrition.

Author Contributions

The percentage of the author(s) contributions is presented below. All authors reviewed and approved the final version of the manuscript.

	Ç.Ö.	G.K.
C	60	40
D	60	40
S	70	30
DCP	100	
DAI	70	30
L	100	
W	80	20
CR	40	60
SR	70	30
PM	70	30

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Approval/Informed Consent

This study was approved by Ethics Committee of Başkent University Non-Interventional Clinical Trials (approval date: April 03, 2013, protocol code: 13/45). A signed written consent form was obtained from each participant by face-to-face interview.

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