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Effects of Healthy Nutrition Barriers on the Quality of Life, Body Composition, and Depression Status of Breast Cancer Patients

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ABSTRACT Objective: The gap between the desire to promote health and adherence to healthy eating recommendations highlights the need to identify barriers for breast cancer (BC) survivors to achieve a healthy lifestyle. The present study aimed to reveal the barriers to healthy eating in BC patients and to evaluate the effects of these barriers on the body composition, quality of life, and depression status of BC patients. **Material and Methods:** Body composition was determined by bioelectric impedance analysis. The scale adapted from the literature was used to evaluate the perceived nutritional barriers (PNBs). The Short Form-36 (SF36) Health Survey was used to assess the quality of life, while the Center for Epidemiologic Studies Depression (CES-D) Scale was used to assess depression status. **Results:** The patients were interviewed after a median of 28 months (range: 6-192 months) after the diagnosis of BC. A weak negative correlation was observed between age and the PNB score (r=-0.209; p=0.020). Significant negative correlations were found between the PNB scores and the scores of all SF36 subscales ($p<0.05$ for all). Moreover, as the PNB scores of the patients increased, the CES-D scores also increased (r=0.25; $p<0.01$). **Conclusion:** Following the active treatment process, determining the nutritional barriers of BC patients, creating a nutrition plan, and regular monitoring could be effective steps to prevent obesity, which is a prognostic factor, and to improve the quality of life of BC patients.

Keywords: Breast cancer; nutrition; body composition; quality of life; depression

Noncommunicable diseases are responsible for 74% of all deaths worldwide each year, and cancer is the second most prevalent cause of death after cardiovascular diseases both globally and in Türkiye.[1] According to previous reports, globally 9,3 million people die from cancer each year; moreover, cancer was the cause of death for 1 of every 6 people in 2020.[2,3] Breast cancer (BC) incidence and mortality worldwide are expected to increase from 2,26 million to 3,19 million cases and from 685,000 to 1,04 million cases, respectively, by 2040.[4] BC constitutes the largest portion of cancer-related deaths in women.[5] The life expectancy of women with early-stage BC is similar to that of their peers; hence, secondary cancer risks and comorbid conditions should be reduced in this population group.[6]

Obesity, unhealthy diet, physical inactivity, smoking, and alcohol use are the modifiable risk factors for cancer.[1] Patients with BC constitute the largest segment of female cancer survivors. According to recent reports, there were 3,8 million BC survivors in the US in 2019, and this number has increased because of early diagnosis and treatment.[7,8] The 5-year survival rates of BC patients were 90% for all stages, 77% for all stages of triple-negative cancer, and 39% for inflammatory BC.[9-11] A significant finding is that both premenopausal and menopausal women are more likely to develop BC; this highlights the need for early detection and access to treatment.[12,13]

Healthy nutrition is being increasingly recognized as a critical factor in the prevention process fol-

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lowing cancer treatment.[14,15] Increase in body weight and body adipose tissue and obesity are of particular concern in BC patients as these factors can increase cancer recurrence.[16] Body composition is a modifiable risk factor for BC prognosis. Previous studies have emphasized that interventions targeting fat mass loss and strengthening of skeletal muscle mass can yield clinically significant and positive results. Randomized controlled trials of diet and exercise interventions in BC patients showed favorable results for indicators such as reduced adiposity, patient survival, risk of cancer recurrence, and prognosis.[14,15]

Healthy lifestyle behaviors, which could decrease cancer risk, also affect the survival processes of patients following cancer treatment.[17] Therefore, cancer diagnosis may affect patients' individual motivations for lifestyle behavioral change.[18] However, although cancer survivors want to change their lifestyle habits after the treatment process, many of them are reported to have suboptimal dietary intake and insufficient levels of physical activity.[7,19] Changes in taste preferences, appetite loss, gastrointestinal discomfort, pain, exhaustion, anxiety, and depression may develop because of cancer itself or due to cancer therapy, and these factors may prevent a person from adhering to healthy food and exercise patterns.[7] Additionally, despite high survival rates, patients' quality of life decreases due to cancer treatment.[19,20] Thus, there is a need to identify the barriers to adherence to recommendations for healthy lifestyle behaviors, such as healthy nutrition and physical activity required for improving and protecting health, and to plan interventions to overcome these barriers.[7]

The notion of nutritional obstacles has been investigated only by a few research studies in Turkish society-specific literature. Therefore, the present study aimed to identify perceived barriers to healthy eating in BC survivors and to examine their effects on the quality of life, depression status, and body composition of BC survivors.

MATERIAL AND METHODS

PARTICIPANTS

This cross-sectional study was conducted by retrospectively evaluating the file records of BC patients who underwent consultation at the Acıbadem Altunizade Hospital Diet Polyclinic between 2019 and 2022. The study included BC patients who were over 18 years of age, had completed the treatment process (surgery, chemotherapy, and radiotherapy were completed, and hormonal therapy was being continued), and had consulted the outpatient department of diet polyclinic at least 6 months after the completion of the treatment.

To calculate the effect size for determining the sample size, the calculation method and the findings of the study published by Lopes et al. in 2018, which investigated the quality of life of BC survivors, were used.[21,22] In Lopes et al. study, 13 variables affecting the patients' quality of life were examined, and 3 variables (body composition changes, negative self-assessment, and cancer-related concerns) were found to be independent factors related to the quality of life.[22] In this context, for the linear regression model, in which the effect of approximately 20 independent variables on a dependent variable is measured, a sample size of 122 participants was calculated using the G-Power is a free power analysis program for avariety of statistical tests (Faul.F 2009) (version 3.1) with the following parameters: d=0.25, 95% confidence level (1-α), and 90% test power (1-β). The study was approved by the Acıbadem Mehmet Ali Aydınlar University and Acıbadem Healthcare Institutions Medical Research Ethics Committee (date: December 30, 2022; no: 2022/20), and the study was conducted in accordance with guidelines of the Declaration of Helsinki. The study was performed by obtaining the informed consent of the participants.

STUDY PROTOCOL

Patient information was recorded in a survey comprising 6 sections: demographic features, cancer diagnosis and treatment, anthropometric measurements, perceived nutritional barriers (PNBs), Short Form-36 (SF36) Health Survey, and Center for Epidemiologic Studies Depression (CES-D) Scale.

DEMOGRAPHIC FEATURES

Questions were asked regarding age, education status, employment status, marital status, menopause status, regular physical activity, and adherence to a diet program.

CANCER DIAGNOSIS AND TREATMENT

Information was obtained on the following aspects: the time elapsed since the diagnosis, the treatment regimen received by the patient, the presence of lymphedema, and additional diseases.

ANTHROPOMETRIC MEASUREMENTS

Body weight (kg) and body composition [fat mass (kg), lean body mass (kg), and body fat percentage (%)] of the patients were measured by [bioelectrical impedance analysis (BIA) TANITA(Tanita, Tokyo, Japan) MC 980 Multi Frequency Segmental Body Analyzer] by using standard procedures after 12 h of night fasting. The height was measured using a Seca brand electronic height-measuring device, with the feet of the individual placed side-by-side and the head in the Frankfort plane. Weight was divided by the square of height to calculate body mass index (BMI) (kg/m^2). Waist circumference was determined between the lowest rib and the crista iliaca, and the circumference line passing through the midpoint was measured using a non-filexible tape measure. The hip circumference was measured using a non-stretchable measuring tape from the highest point, while standing on the side of the individual.[23] Waist-hip ratio (WHR) was calculated by dividing the waist circumference measurement (cm) by the hip circumference measurement (cm). All measurements were performed by a single dietitian.

PNB

The PNB score was determined by a 19-item questionnaire adapted and used by Ventura et al. after obtaining permission from the authors.[15] On a 5-point Likert scale, the participants were asked how often they experienced a list of nutritional barriers in the last month. The entire score was divided by the number of elements to obtain a mean score, and the higher the score on this scale, the greater the nutritional barriers.[15] Cronbach's alpha coefficient for this domain was 0.81 in this study.

SF36

The SF36 questionnaire consisted of 8 subscales and was used to evaluate patients' quality of life. The Turkish adaptation of the SF36 questionnaire was developed by Demiral et al. in 2006. In this questionnaire, the following eight sections were examined with 36 items: physical functioning (PF), social functioning (SF), role limitation due to physical problems (RP), role limitation due to emotional problems (RE), mental health (MH), energy and vitality (VT), bodily pain (BP), and general perception of health (GH). A total score for each subscale is assigned instead of a single total score, and the scores range from 0 to 100, implying that the higher the score, the higher the quality of life.[24] Cronbach's alpha coefficients for each subscale in this study were determined individually and ranged from 0.73 to 0.76.

CES-D

The depression status of the patients was evaluated with the CES-D. The scale was developed by Spijker et al., and the Turkish adaptation of the scale was made by Lehmann et al.[25,26] This scale is used to measure depressive symptoms and identify individuals at risk for depressive disorders. The scale is scored between 0 and 60 points, with higher scores indicating more severe depressive symptoms. The scale includes 20 items scored between 0 and 3, with 0 representing "rarely or never" and 3 "mostly or always."[26] A score of 16 and above is accepted as an indicator of depressive symptoms. Cronbach's alpha for CES-D was 0.74 for this study.

STATISTICAL ANALYSIS

All data were analyzed using SPSS version 25.0 (IBM Corp.,Armonk,NY, USA). The Kolmogorov-Smirnov test was used to test the normality of the variables. Mean and standard deviation were used to express the results of descriptive analysis, while number (n) and ratio (%) were used for categorical variables. Cronbach's alpha reliability coefficients were determined to measure the reliability of the scales for this study. The Mann-Whitney U test and the Kruskal-Wallis H test were used for comparing quantitative data between 2 groups and among more than 2 groups, respectively. The Bonferroni test was used to determine the groups that caused the difference in the Kruskal-Wallis H test results. The relationship level between two continuous variables was examined with Spearman's correlation test. Statistical significance was defined as $p<0.05$.

RESULTS

PATIENT CHARACTERISTICS

Table 1 shows the characteristics of the included patients. A total of 125 BC patients with a median follow-up of 28 months (range: 6-192 months) were interviewed for the study. The mean age of the patients was 48.75±9.65 years (range: 32-80 years); 57.6% of the patients were under the age of 50 years, 67.2% were married, 55.2% were university graduates, and 50.4% of the patients were actively working (Table 1, Table 2). A total of 8.0% of the patients

TABLE 1: Some characteristics of the patients.

			PNB			CES-D			
Variables (n=125)	**n**	**%**	**X̄**	**SD**	**p value**	**X̄**	**SD**	**p value**	
Age	<50 years	72	57.6	42.54	10.50	0.106[a]	36.22	6.78	0.386[a]
	≥50 years	53	42.4	39.28	10.97		35.58	8.17	
Education	Primary	17	13.6	39.00	11.20	0.605[b]	37.88	10.43	0.945[b]
	High school	39	31.2	40.77	10.93		36.13	7.82	
	University	69	55.2	41.91	10.67		35.38	6.18	
Employment status	Yes	63	50.4	42.40	10.95	0.202[a]	35.54	6.42	0.978[b]
	No	62	49.6	39.90	10.55		36.37	8.27	
Marital status	Married	84	67.2	41.44	11.53	0.987[a]	35.89	7.54	0.821[a]
	Single	41	32.8	40.59	9.17		36.07	7.11	
Menopause status	Yes	115	92.0	40.98	10.78	0.492[a]	35.90	7.36	0.971[a]
	No	10	8.0	43.20	11.15		36.50	7.96	
BMI	Normal	38	30.4	41.29	12.32	0.798[b]	35.87	7.73	0.474[b]
	Overweight	47	37.6	41.02	9.95		36.17	6.06	
	Obese	40	32.0	41.20	10.43		35.78	8.54	
Weight change in the last 6 months	Increased	36	28.8	41.44	9.96	0.551[b]	36.03	6.68	0.373[b]
	Decreased	30	24.0	38.53	8.56		34.80	7.86	
	No change	59	47.2	42.32	12.12		36.49	7.58	
Dieting status	Yes	53	42.4	39.00	10.34	**0.036[a]***	34.49	6.95	**0.042[a]***
	No	72	57.6	42.75	10.89		37.03	7.54	
Regular physical activity	Yes	67	53.6	39.09	8.80	**0.034[a]***	34.76	7.39	**0.044[a]***
	No	58	46.4	43.55	12.35		37.33	7.18	
Chronic disease	Yes	65	52.0	41.11	10.15	0.635[a]	35.65	8.12	0.229[a]
	No	60	48.0	41.22	11.51		36.28	6.53	
The time elapsed since the diagnosis	6-36 months[1]	77	61.6	40.84	10.99	**0.028[b]* dif**:3<2**	35.34	6.88	0.706[b]
	37-60 months[2]	28	22.4	45.21	11.25		37.54	8.55	
	≥61 months[3]	20	16.0	36.70	7.10		36.10	7.55	
Type of surgical treatment	Mastectomy	33	26.4	41.48	11.38	0.797[a]	37.36	7.74	0.137[a]
	Breast-conserving surgery	92	73.6	41.04	10.62		35.45	7.22	
Chemotherapy	Yes	103	82.4	40.50	10.53	0.203[a]	36.16	7.05	0.382[a]
	No	22	17.6	44.27	11.65		35.00	8.86	
Radiotherapy	Yes	99	79.2	41.22	11.25	0.793[a]	35.91	7.15	0.954[a]
	No	26	20.8	40.92	8.96		36.12	8.32	
Anti-HER2	Yes	29	23.2	40.41	10.27	0.535[a]	36.38	6.06	0.281[a]
	No	96	76.8	41.39	10.97		35.82	7.76	
Hormone therapy	Yes	103	82.4	41.60	11.23	0.487[a]	36.17	7.91	0.917[a]
	No	22	17.6	39.09	8.24		34.95	4.01	
Lymphedema	Yes	43	34.4	41.23	12.57	0.938[a]	34.88	8.39	0.098[a]
	No	82	65.6	41.12	9.80		36.51	6.78	
Constipation	Yes	23	18.4	39.09	8.70	0.450[a]	33.87	4.99	0.306[a]
	No	102	81.6	41.63	11.18		36.42	7.76	

*p<0.05; **Bonferroni test; [a]Mann-Whitney U test; [b]Kruskal-Wallis H test; dif: difference; PNB: Perceived nutritional barriers; CES-D: Center for Epidemiologic Studies Depression Scale; SD: Standard deviation; BMI: Body mass index.

TABLE 2: The relationship between age, anthropometric measurements, PNB and CES-D scores.

		PNB		CES-D	
	X̄±SD	r value	p value	r value	p value
Age (year)	48.75±9.65	-0.209	0.020*	-0.125	0.164
BMI (kg/m²)	28.30±5.48	0.064	0.481	-0.046	0.613
Lean mass (%)	64.90±6.35	-0.107	0.235	0.132	0.144
Muscle mass (%)	61.16±7.76	-0.106	0.240	0.112	0.215
Fat mass (%)	34.65±6.38	0.132	0.142	-0.118	0.190
Skeletal muscle mass (%)	37.20±3.54	-0.177	0.072	0.040	0.684
BMR (kkal/day)	1513.81±1126.8	0.018	0.845	-0.080	0.374
Abdominal fatness	7.14±3.10	0.077	0.438	-0.006	0.953
WHR	0.81±0.08	-0.047	0.600	-0.104	0.250

*p<0.05, Spearman's correlation test; PNB: Perceived nutritional barriers; CES-D: Center for Epidemiologic Studies Depression Scale; SD: Standard deviation; BMI: Body mass index; BMR: Basal metabolic rate; WHR: Waist-hip ratio.

were in the premenopausal stage. Furthermore, 42.4% of the patients followed a diet program, and 53.6% of the patients performed physical activity regularly (Table 1).

Regarding treatment, 82.4%, 79.2%, and 23.2% of the patients were treated with chemotherapy, radiotherapy, and anti-Her2 therapy, while 82.4% of the patients continued hormonal therapy. Forty-three (34.4%) patients reported the development of lymphedema after the treatment (Table 1).

Based on the BMI classification, 30.4% of the patients had normal weight, 37.6% were overweight, and 32.0% were obese. Furthermore, 52.0% of the patients reported the existence of a chronic disease (Table 1). The mean BMI, lean mass percentage, muscle mass percentage, fat mass percentage, skeletal muscle mass percentage, and WHR of the patients were 28.30±5.48 kg/m², 64.9%, 61.1%, 34.6%, 37.2%, and 0.81, respectively (Table 2).

PATIENT CHARACTERISTICS ACCORDING TO PNB AND CES-D SCORES

The PNB and CES-D scores of the patients who followed a diet program (p=0.036 and 0.042, respectively) and performed regular physical activities (p=0.034 and 0.044, respectively) were lower than those of the patients not following a diet program and not performing regular physical activities. Furthermore, patients diagnosed with BC for 5 years or earlier showed significantly lower PNB scores than other patients (p=0.028). No significant differences in the mean PNB and CES-D scores were noted between the groups based on age, education, marital status, employment status, BMI, weight change, comorbidity, presence of lymphedema, and cancer treatment (p>0.05) (Table 1).

PNB, SF36, AND CES-D SCORES

In the PNB scale statements, the first three items for which the patients disagreed the most were "I do not like the taste of fruits and vegetables" (1.32±0.77), "I do not know how to cook vegetables" (1.46±0.93), and "I do not know where to find low fat foods" (1.56±0.96). The first three items with the patients agreed the most were "I feel like eating whatever I want" (3.51±1.18), "There are no healthy foods in the food vending machines" (3.14±1.58), and "Holidays and special occasions are a problem" (2.71±1.29) (Table 3).

For the SF36 subscales, the PF, RP, RE, VT, MH, SF, BP, and GH scores were as follows: 75.79±20.03, 68.61±37.56, 71.73±33.88, 64.68±20.84, 70.13±19.16, 79.00±22.54, 71.70±22.56, and 65.61±18.9, respectively. The mean PNB and CES-D scores of the patients were 41.16±10.78 and 35.95±7.38, respectively (Table 4).

RELATIONSHIP BETWEEN PNB, SF36, AND CES-D SCORES AND ANTHROPOMETRIC PARAMETERS

The age of the patients was negative correlated with the PNB score (r=-0.209, p=0.020) and the SF36-PF score (r=-0.382, p<0.001) (Table 2, Table 5). Posi-

TABLE 3: Item distribution and averages of the healthy eating barriers scale.

PNB items	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Very often n (%)	X̄±SD
Holidays and special occasions are a problem	30 (24.0)	23 (18.4)	38 (30.4)	21 (16.8)	13 (10.4)	2.71±1.29
I feel like eating whatever I want	10 (8.0)	13 (10.4)	32 (25.6)	43 (34.4)	27 (21.6)	3.51±1.18
High fat foods taste better	37 (29.6)	28 (22.4)	34 (27.2)	15 (12.0)	11 (8.8)	2.48±1.27
I eat a lot of meals away from home	33 (26.4)	42 (33.6)	34 (27.2)	10 (8.0)	6 (4.8)	2.31±1.10
It's easier to grab another type of snack and eat in my car	62 (49.6)	34 (27.2)	17 (13.6)	7 (5.6)	5 (4.0)	1.87±1.10
It takes too much time planning to eat a healthier diet	45 (36.0)	24 (19.2)	36 (28.8)	14 (11.2)	6 (4.8)	2.30±1.21
High fat foods are a traditional part of my culture	62 (49.6)	21 (16.8)	24 (19.2)	13 (10.4)	5 (4.0)	2.02±1.22
Healthier foods are too expensive	55 (44.0)	22 (17.6)	35 (28.0)	8 (6.4)	5 (4.0)	2.09±1.16
There are no healthy food options at sporting events	36 (28.8)	27 (21.6)	46 (36.8)	10 (8.0)	6 (4.8)	2.38±1.13
I can't keep track of what I need to eat	41 (32.8)	33 (26.4)	28 (22.4)	17 (13.6)	6 (4.8)	2.31±1.20
Fruits and vegetables don't fill me up	47 (37.6)	28 (22.4)	28 (22.4)	13 (10.4)	9 (7.2)	2.27±1.27
Fruits and vegetables take too long to prepare	63 (50.4)	20 (16.0)	22 (17.6)	8 (6.4)	12 (9.6)	2.09±1.34
I don't know how to cook healthier meals	83 (66.4)	21 (16.8)	6 (4.8)	7 (5.6)	8 (6.4)	1.69±1.19
There are no healthier foods in vending machines	29 (23.2)	18 (14.4)	25 (20.0)	12 (9.6)	41 (32.8)	3.14±1.58
I don't like the taste of healthier foods	74 (59.2)	22 (17.6)	19 (15.2)	4 (3.2)	6 (4.8)	1.77±1.12
My family doesn't support me for eating more healthfully	77 (61.6)	14 (11.2)	16 (12.8)	9 (7.2)	9 (7.2)	1.87±1.30
I don't like the taste of fruits and vegetables	100 (80.0)	16 (12.8)	5 (4.0)	2 (1.6)	2 (1.6)	1.32±0.77
I don't know how to cook vegetables	93 (74.4)	16 (12.8)	11 (8.8)	1 (0.8)	4 (3.2)	1.46±0.93
I don't know where to find low fat foods	85 (68.0)	19 (15.2)	15 (12.0)	3 (2.4)	3 (2.4)	1.56±0.96

PNB: Perceived nutritional barriers; SD: Standard deviation.

TABLE 4: Means, Cronbach's alpha values and correlations of scale scores.

No.	Scales	X̄±SD	α	1	2	3	4	5	6	7	8	9
1	SF36-PF	75.79±20.03	0.85	NA								
2	SF36-RP	68.61±37.56	0.82	0.441**								
3	SF36-RE	71.73±33.88	0.62	0.243**	0.478**							
4	SF36-VT	64.68±20.84	0.75	0.330**	0.259**	0.377**						
5	SF36-MH	70.13±19.16	0.78	0.233**	0.212*	0.416**	0.713**					
6	SF36-SF	79.00±22.54	0.68	0.347**	0.459**	0.513**	0.532**	0.559**				
7	SF36-BP	71.70±22.56	0.77	0.419**	0.461**	0.345**	0.431**	0.365**	0.533**			
8	SF36-GH	65.61±18.90	0.77	0.431**	0.387**	0.324**	0.544**	0.427**	0.447**	0.421**		
9	CES-D	35.95±7.38	0.74	-0.139	-0.227*	-0.467**	-0.412**	-0.485**	-0.457**	-0.235**	-0.210*	
10	PNB	41.16±10.78	0.81	-0.054	-00.138	-0.287**	-0.290**	-0.338**	-0.244**	-0.181*	-0.210*	0.254**

*p<0.05; **p<0.01; Spearman's correlation test; α: Cronbach's alpha; SD: Standard deviation; SF36: Short Form-36 Health Survey; PF: Physical functioning; RP: Role limitation due to physical problems; RE: Role limitation due to emotional problems; VT: Energy and vitality; MH: Mental health; SF: Social functioning; BP: Bodily pain; GH: General perception of health; CES-D: Center for Epidemiologic Studies Depression Scale; PNB: Perceived nutritional barriers; NA: Not available.

tive correlations were observed between the SF36-PF score and lean mass ratio (r=0.278, p=0.002), muscle ratio (r=0.291, p=0.001), and skeletal muscle ratio (r=0.360, p<0.001). Furthermore, negative correlations were noted between the SF36-PF score and BMI (r=-0.306, p=0.001), fat percentage (r=-0.297, p=0.001), intra-abdominal fat percentage (r=-0.427, p<0.001), and WHR (r=-0.352, p<0.001) (Table 5).

Negative correlations were also found between the CES-D score and the scores of SF36-RP (r=-0.227, p<0.05), SF36-RE (r=-0.467, p<0.01), SF36-VT (r=-0.412, p<0.01), SF36-MH (r=-0.485, p<0.01), SF36-BP (r=-0.457, p<0.01), and SF36-GH (r=-0.235, p<0.01). Furthermore, the CES-D and PNB scores showed a positive correlation (r=0.254, p<0.01) (Table 4).

TABLE 5: The relationship between demographic characteristics, anthropometric measurements and SF36 scores.

		SF36							
Variables		**SF36-PF**	**SF36-RP**	**SF36-RE**	**SF36-VT**	**SF36-MH**	**SF36-SF**	**SF36-BP**	**SF36-GH**
Age	r value	-0.382	0.044	0.156	0.028	0.080	0.106	-0.063	-0.025
	p value	**<0.001***	0.630	0.083	0.756	0.377	0.240	0.482	0.780
Education	r value	0.119	-0.076	-0.142	-0.068	0.020	-0.022	-0.010	-0.105
	p value	0.185	0.397	0.114	0.454	0.827	0.808	0.914	0.245
BMI	r value	-0.306	-0.130	0.037	0.051	-0.012	0.001	-0.182	-0.074
	p value	**0.001***	0.148	0.685	0.573	0.894	0.995	0.042*	0.412
The time elapsed since the diagnosis	r value	-0.109	0.106	0.115	-0.062	-0.074	0.000	-0.011	-0.057
	p value	0.225	0.240	0.203	0.494	0.410	0.999	0.901	0.525
Lean mass (%)	r value	0.278	0.057	-0.057	-0.023	-0.036	-0.092	0.106	0.092
	p value	**0.002***	0.531	0.527	0.799	0.689	0.306	0.237	0.307
Muscle mass (%)	r value	0.291	0.072	-0.045	-0.040	-0.022	-0.075	0.129	0.097
	p value	**0.001***	0.424	0.618	0.660	0.812	0.409	0.151	0.282
Fat mass (%)	r value	-0.297	-0.066	0.077	-0.016	0.004	0.076	-0.145	-0.116
	p value	**0.001***	0.465	0.393	0.858	0.968	0.397	0.106	0.196
Skeletal muscle mass (%)	r value	0.360	0.068	-0.023	0.041	0.044	-0.038	0.186	0.105
	p value	**<0.001***	0.494	0.818	0.678	0.661	0.704	0.059	0.288
BMR	r value	-0.169	-0.116	0.003	0.057	-0.064	-0.023	-0.097	0.088
	p value	0.059	0.196	0.970	0.531	0.476	0.801	0.281	0.328
Abdominal fatness	r value	-0.427	-0.088	0.101	-0.019	-0.016	-0.010	-0.208	-0.087
	p value	**<0.001***	0.376	0.309	0.847	0.870	0.924	0.034	0.382
WHR	r value	-0.352	0.008	0.129	-0.030	-0.036	0.003	-0.159	-0.101
	p value	**<0.001***	0.933	0.153	0.738	0.691	0.976	0.077	0.262

*p<0.05; Spearman's correlation test; SF36: Short Form-36 Health Survey; PF: Physical functioning; RP: Role limitation due to physical problems; RE: Role limitation due to emotional problems; VT: Energy and vitality; MH: Mental health; SF: Social functioning; BP: Bodily pain; GH: General perception of health; BMI: Body mass index; BMR: Basal metabolic rate; WHR: Waist-hip ratio.

DISCUSSION

In the present study that aimed to evaluate the barriers to healthy nutrition in BC patients, the most frequently reported perceived barriers were "I feel like eating whatever I want," "there are no healthier foods in vending machines," and "holidays and special occasions are a problem." We also found that the PNB scores of patients performing regular physical activities (p=0.034) and following a diet program (p=0.036) were lower, and the PNB scores increased particularly between 3 and 5 years after diagnosis (p=0.028). Moreover, with the increase in the PNB scores, the SF36 subscale scores decreased, and the CES-D scores increased (p<0.05 for all).

According to the current literature, the evaluation and follow-up of the nutritional status of cancer patients are the main characteristics of post-oncological treatments. Although there has been a steep increase in the incidence of BC in women, recent advances in treatment methods have also led to a gradual increase in BC survivors.[27-29]

The identification of barriers to healthy eating, which is one of the modifiable risk factors for BC survivors, can provide insights into the barriers to healthy eating patterns and healthy food choices. In this context, to the best of our knowledge, the present study is the first to investigate nutritional barriers faced by BC patients in Türkiye. The identification of nutritional barriers at the societal level can enable to recognize the appropriate steps for BC patients to establish a healthy eating pattern and provide an opportunity to redefine nutritional strategies to prevent BC in healthy individuals. Keaver et al. reported the following observations from their study:

1) Approximately 84.4% of BC survivors made at least one positive behavior change related to healthy eating and physical exercise after cancer diagnosis,

2) The main barrier to implement these changes is fatigue, and

3) Because of these barriers experienced by BC survivors for making changes in their lifestyle behaviors, oncology care should include specific intervention programs and nutritional monitoring.[7] Our results support these findings.

Although the causes of weight gain after BC diagnosis remain unclear, weight gain is associated with increased cancer recurrence and decreased survival. More importantly, fat mass increases more than lean body mass, resulting in the development of sarcopenic obesity in BC patients.[30] The BMI equation does not reflect the distribution of body composition. Hence, more advanced and accurate methods are required to understand the effect of body composition on BC. BIA and dual energy X-ray absorptiometry are the most commonly used methods in clinical practice and epidemiological studies to evaluate body composition. In recent years, BIA has been the preferred method because it is both economical and noninvasive.[31,32] A previous study validated BIA for assessing body composition in BC patients; the study reported that the values of body fat percentage measured by BIA were lower than the actual values with a deviation of 5% and presented correction formulas for use during this measurement.[33] In our present study, the BIA method was used to evaluate body composition for investigating the nutritional barriers of BC patients. Ventura et al., whose study design was the closest to that of our present study, reported an independent positive relationship between nutritional barriers and BMI.[15] However, we found no correlation between BMI and the PNB scores. Because the study of Ventura et al. was conducted through an online survey method, all anthropometric measurements were based on the statements given by the participants.[15] In contrast, in our present study, although we evaluated patient records retrospectively, all our data were assessed by an experienced oncology dietitian. This is one of the strengths of our study.

Being overweight or obese and dietary choices, which are the modifiable lifestyle factors, are linked to both BC incidence and recurrence risk.[34,35] In particular, obesity is associated with worse overall survival and increased mortality in postmenopausal women with BC.[36] Although our present study found no relationship between the PNB scores and BMI ($p>0.05$), we noted that as the lean mass ratio, muscle mass ratio, and skeletal muscle ratio increased, the SF36-PF score increased, and as the BMI, fat ratio, lipid level, and WHR increased, the quality of life related to physical function decreased ($p<0.05$). Moreover, a negative but nonsignificant correlation was found between the PNB scores and body composition parameters, namely lean body mass (%) ($r=-0.107$), muscle (%) ($r=-0.106$), and skeletal muscle (%) ($r=-1.77$), while a positive correlation was found between the body fat ratio and the PNB score ($r=0.132$). This may provide an opportunity to predict the changes in prognostic negative markers in body composition by detecting nutritional barriers. A recent systematic review reported that obese BC patients had a higher overall mortality rate than BC patients with ideal weight.[37] Another study reported that the risk of distant metastasis increased by 46% in obese (BMI≥30 kg/m^2) BC patients 10 years after diagnosis.[16] Furthermore, a previous study found that a 5% increase in BMI increased the risk of BC-specific mortality by 29% and the overall mortality risk by 8% in BC patients followed up for 12 months after diagnosis and beyond.[38] The use of BIA measurement for evaluating the nutritional status of BC patients may prevent overlooking the possible impact of nutritional barriers and dietary preferences on body composition.

We hope that our results can provide the right direction for future research. The fact that we used the scale developed by Ventura et al. without validation in a Turkish population could be a limitation of our present study.[15] The Cronbach's alpha (α) coefficient calculated for the scores of the healthy eating barrier scale was 0.81; hence, we think that our data are sufficiently reliable. We also believe that this scale, which examines the level and subscales of nutritional barriers in BC patients, could be useful for follow-up in several oncology centers and BC clinics, if it is translated into Turkish language, validated, and adopted in daily practice. Because individual nutritional assessment cannot be regularly conducted in every clinic, we consider that such scales could guide

health professionals to take appropriate treatment-related decisions. Thus, it might be beneficial to expand the use of the scale we used in our research for adoption in oncology centers after language validation to evaluate nutritional barriers.

Quality of life of BC patients is interconnected with complex factors such as demographic, socioeconomic, and treatment features; psychological factors; depression; anxiety; fatigue; and fear of recurrence.[39,40] Long-term survivors may face issues that persist even after the completion of their treatment. The evaluation of quality of life can prevent these late issues from being overlooked; it is therefore important to improve symptom relief, care, and rehabilitation of patients. Quality of life is also an important parameter for medical decision-making and is an indicator of treatment success. Thus, it is becoming more crucial to include quality of life while conducting clinical studies.[41] Nutritional status is a reliable indicator of quality of life in cancer patients.[42] Firth et al. reported that the sense of low mood may be caused by inadequate nutrition, and the intake of better food could help to maintain both physical and MH.[43] Among the complementary recommendations for a sustainable quality of life, increased MH and vitality, physical activity, and healthy nutrition management are considered to be effective components.[43-45] These important components are candidates for essential components of the active treatment process for BC patients, although they are presently deemed to be optional, nonmandatory measures for BC patients.[46]

The results of our present study shed light on potentially targetable risk factors for lifestyle changes in BC survivors. A limitation of our present study is that we did not determine the nutritional status of patients with food records. Healthy eating barrier scores were lower in patients who performed regular physical activity (p=0.034) and followed a diet program (p=0.036). The use of valid tools (food records, food frequency questionnaire, pedometer, etc.) to evaluate nutritional status and physical activity level in future studies may provide a clear picture of the relationship between these parameters and nutritional barriers. We also found that patients who followed a diet program and performed regular physical activity had a lower depression-related CES-D score (p=0.042 and 0.044, respectively) and showed a positive correlation with SF36-VT scores (data not shown; p=0.008 and 0.031, respectively). The positive correlation between the PNB and CES-D scores could be effective to manage the nutritional barriers in BC patients identified in the present study and could enable to improve the depression status and quality of life of BC patients.

CONCLUSION

In oncology clinics, evaluating the nutritional status of BC patients immediately after diagnosis, determining possible physical activity and nutritional barriers, and using interventions to overcome these obstacles at regular visits during the treatment and follow-up period can ensure that BC patients maintain a healthy diet and healthy body composition. Future studies should focus on interdisciplinary collaboration in routine clinical practice.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Dilşat Baş;* ***Design:*** *Dilşat Baş;* ***Control/Supervision:*** *Dilşat Baş, Nihan Çakır Biçer;* ***Data Collection and/or Processing:*** *Dilşat Baş, Nihan Çakır Biçer;* ***Analysis and/or Interpretation:*** *Dilşat Baş, Nihan Çakır Biçer;* ***Literature Review:*** *Dilşat Baş, Nihan Çakır Biçer;* ***Writing the Article:*** *Dilşat Baş, Nihan Çakır Biçer;* ***Critical Review:*** *Dilşat Baş, Nihan Çakır Biçer;* ***References and Fundings:*** *Dilşat Baş, Nihan Çakır Biçer;* ***Materials:*** *Dilşat Baş, Nihan Çakır Biçer.*

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