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Original Article

Physical activity, musculoskeletal disorders, sleep, depression, and quality of life before and after bariatric surgery

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ABSTRACT

Objectives: This study aims to evaluate physical activity, sleep, depression, quality of life, and musculoskeletal problems pre- and postoperatively in morbidly obese patients who underwent bariatric surgery and analyze the factors that are strongly associated with physical activity.

Patients and methods: This prospective study conducted between January 2016 and May 2017 included 27 patients (4 males, 23 females; mean age 37.1±10.4 years; range, 18 to 52 years) who underwent bariatric surgery and 20 healthy controls (3 males, 17 females; mean age 32.0±5.7 years; range, 26 to 46 years). All patients were evaluated by using the short form of International Physical Activity Questionnaire (IPAQ), Pittsburgh Sleep Quality Index (PSQI), Beck Depression Inventory (BDI), and short form 36 (SF-36). Patients were evaluated for regional musculoskeletal pain including back, waist, hip, knee, ankle, heel, and metatarsal pain using visual analog scale. Presence of pes planus was recorded. The examinations and tests performed in the preoperative period were repeated at postoperative six months and the results were compared with the control group.

Results: The body mass index was 46.2±5.2 kg/m² preoperatively and 33.8±5.0 kg/m² postoperatively (p<0.001). The total IPAQ was 345.4±172.8 metabolic equivalent (MET)-min/week preoperatively and 672.8±227.8 MET-min/week postoperatively (p<0.001). Pittsburgh Sleep Quality Index was 7.6±3.0 preoperatively and 3.5±2.4 postoperatively, whereas BDI was 20.2±8.5 preoperatively and 9.9±7.4 postoperatively. The results were statistically significant (p<0.001, p<0.001, respectively). A statistically significant improvement was found in all subsections of the SF-36. Pre- and postoperative results of the 27 patients were compared with those of the control group.

Conclusion: Obesity is significantly associated with joint pain, physical function impairment, depression, and sleep disorders. Significant weight loss after bariatric surgery improves functional recovery and patient's psychology in a short time.

Keywords: Bariatric surgery, depression, musculoskeletal pain, obesity, physical activity, sleep.

In recent years, obesity has become an important global health problem with an increasing incidence.[1] Obesity, estimated to affect 315 million adults worldwide, is defined as having a body mass index (BMI) greater than 30 kg/m^2. Obesity, which is an important risk factor for the development of many chronic diseases such as coronary artery disease, hypertension, dyslipidemia, and diabetes mellitus, brings great health and economic burden. Also, it has additional important effects on psychosocial and musculoskeletal health, such as arthropathy, musculoskeletal pain, sleep disturbance, loss of mobility, and loss of physical capacity.[1-4]

Over the past 30 years, with the worsening of sleep quality, the number of overweight and obese patients has also increased.[4] It is shown through experimental evidence that the shortening of sleep duration has a causal role in obesity.[5] The quality and duration of sleep are also associated with other health problems, including psychological problems.[6] Severe obese patients with pain are at increased risk of depression, disability, and loss of work.[3] For this reason, the effect of bariatric surgery on physical function and consequently its impact on quality of life (QoL) and productivity could be important.[2]

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Excess weight can lead to joint damage and pain, which result in restriction of activity and difficulty in walking.[7] Physical activities including lifting weights and group fitness aerobic exercises as well as exercise education encourage a healthy lifestyle.[8-10] In adults, limitations of functional mobility that are determined using gait testing are associated with low QoL, chronic pain, and premature mortality.[11] High BMI changes the structure and composition of joint cartilage by causing abnormal load increase in joints. Obesity, under the influence of genes and environmental factors, is the most important modifiable risk factor for the progression of osteoarthritis and other musculoskeletal disorders.[2,12] Before bariatric surgery, 65-100% of severe obese patients have musculoskeletal symptoms and pain in the hip, knee, ankle, and lumbar spine.[3] Bariatric surgery reduces the long-term risk of developing work-restricting musculoskeletal pain and increases the likelihood of recovering from such pain.[13]

Bariatric surgery for severe obesity is associated with long-term weight loss, improved risk factors, and decreased overall mortality.[14] There are a large number of studies investigating musculoskeletal disorders, QoL, and functional capacity in obese patients undergoing bariatric surgery.[1,2,7,11,12,15] Ryder et al.[11] argued that greater QoL was strongly associated with weight loss among patients who underwent gastric bypass surgery. El-Khani et al.[2] showed that musculoskeletal pain decreased after obesity surgery.

To our knowledge, studies to date have not analyzed the effects of depression, sleep disorder, age, and BMI on physical activity. In this study, we aimed to evaluate physical activity, sleep, depression, QoL, and musculoskeletal problems pre- and postoperatively in morbidly obese patients who underwent bariatric surgery and analyze the factors that are strongly associated with physical activity.

PATIENTS AND METHODS

This prospective study was conducted at Ankara Numune Training and Research Hospital between January 2016 and May 2017. The study included 27 patients (4 males, 23 females; mean age 37.1±10.4 years; range, 18 to 52 years) with a BMI of 37 kg/m² or more who were performed bariatric surgery and then followed-up by the Department of General Surgery. The control group consisted of 20 healthy subjects (3 males, 17 females; mean age 32.0±5.7 years; range, 26 to 46 years) who applied to the physical medicine and rehabilitation outpatient clinic for different reasons and whose laboratory studies were conducted. The excluding criteria were low limb fracture, neurological diseases, immunological (rheumatic) disease, and using wheelchair. The study protocol was approved by the Ankara Numune Training and Research Hospital Ethics Committee (decision no: 505-2015). A written informed consent was obtained from each participant. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Demographic data (age, gender, marital status, and professional occupation) were recorded. Body mass index of the participants were analyzed. They were classified according to their BMI values: those between 18-25 kg/m² as normal weight, 25.1-29.9 kg/m² as overweight, and those over >30 kg/m² as obese.[16]

Prior to bariatric surgery, all patients were evaluated in terms of comorbid conditions, the medications used, and eating habits by a committee including endocrine, psychiatric, and general surgery specialists, and the operation decision was established for eligible patients.

All patients were evaluated for their physical activity levels by using the Turkish version of the short form of International Physical Activity Questionnaire (IPAQ).[17-19] The duration of vigorous physical activity (basketball, weight lifting, etc.) and moderate physical activity (light weight bearing, dance, etc.), walking, and daily sitting times in the last seven days were evaluated with this questionnaire. The total physical activity score (metabolic equivalent [MET]-min/week) was calculated by converting vigorous, moderate activities, and walking and sitting time to MET, which corresponded to the basal metabolic rate.[17] According to total physical activity score, participants' physical activity levels were classified as low, medium, and high. Low level was accepted as below 600 MET-min/week, medium level as between 600-3000 MET-min/week, and high level as above 3000 MET-min/week.

Turkish version of Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep problems.[20,21] Pittsburgh Sleep Quality Index is a self-reported scale with seven components including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. If the total score is greater than 5, it indicates bad sleep quality.

Beck Depression Inventory (BDI) was used to evaluate the psychological status.[22] Having a score of ≥9 BDI indicates depression. The QoL was evaluated using Short Form-36 (SF-36).[23,24]

All patients participating in this study were evaluated for regional musculoskeletal pain including back, waist, hip, knee, heel, and metatarsal pain using a 10-cm visual analog scale (VAS). Presence of pes planus was recorded.

The examinations and tests performed in the preoperative period were repeated at postoperative sixth month and the results were compared with the control group.

Statistical analysis

Power analysis was performed for the sample size with G*Power version 3.0.10 program (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). It was determined that at least 27 patients should be included for the pre-post test analysis to obtain a power (1-β) of 0.80. The IBM SPSS for Windows 20.0 software (IBM Corp., Armonk, NY, USA) was used for statistical analyses. Shapiro-Wilk test was used to test normality. General descriptive statistics were summarized as mean ± standard deviation and median (minimum-maximum) for continuous variables. Categorical data were summarized with number and percentage. Chi-square test was used for comparison of nominal variables between groups. Continuous variables were compared with Mann-Whitney U test or Student's t-test. Pre- and postoperative outcomes were evaluated by paired samples t-test or Wilcoxon test. Spearman correlation coefficient was used to analyze the association between QoL and clinical variables. Multiple linear regression analysis was performed to identify variables that were potentially associated with IPAQ. Analyses provided the regression assumptions including the linear relationship between IPAQ and the independent variables, homoscedasticity, and suitable sample size. The results were evaluated in a confidence interval of 95% and statistical significance was set at $p<0.05$.

RESULTS

Mean BMIs of the patients and controls were 46.2 kg/m² (37-58 kg/m²) and 22.9 kg/m² (19-30 kg/m²), respectively. The comparative demographic data are shown in Table 1.

Patients were evaluated preoperatively and at postoperative sixth month using BMI, physical activity, sleep, depression, and QoL scales. The mean BMI was 46.2±5.2 kg/m² preoperatively and 33.8±5.0 kg/m² postoperatively, with a statistically significant difference ($p<0.001$). The total IPAQ was 345.4±172.8 MET-min/week preoperatively and 672.8±227.8 MET-min/week postoperatively ($p<0.001$). Mean walking time was 318.3±167.6 MET-min/week preoperatively and 601.9±234.7 MET-min/week postoperatively ($p<0.001$). The moderate activity score was 18.4±54.4

TABLE 1
Demographic characteristics of patient and control groups

	Patients (n=27)			Controls (n=20)			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			37.1±10.4			32.0±5.7	>0.05
Gender							>0.05
Female	23			17			
Male	4			3			
Body mass index (preoperative)			46.2±5.2				
Pes planus							<0.05
(+)	10	37		1	5		
(-)	17	63		19	95		
Marital status							>0.05
Married	17	63		16	80		
Single	10	37		4	20		
Occupation							<0.001
Active	10	37		19	95		
Inactive	17	63		1	5		
Comorbid conditions							<0.05
Hypertension	5	18.5		1	5		
Diabetes mellitus	4	14.2		0	0		
No comorbidity	18	66.7		19	95		

SD: Standard deviation.

TABLE 2
Comparison of clinical parameters of patient group pre- and postoperatively

	Preoperative			Postoperative			
	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	*p*
Body mass index	46.2±5.2			33.8±5.0			<0.001
IPAQ	345.4±172.8			672.8±227.8			<0.001
Walking time	318.3±167.6			601.9±234.7			<0.001
Moderate activity	18.4±54.4			73.3±96.3			<0.001
Vigorous activity	00.0±00.0			28.1±87.9			<0.001
PSQI	7.6±3.0			3.5±2.4			<0.001
Sleep quality	1.2±1.2			0.4±0.9			0.004
Sleep latency	1.5±0.7			0.8±0.7			0.008
Sleep duration	1.0±0.1			0.5±1.0			0.008
Habitual sleep efficiency	0.9±0.3			0.1±0.0			0.002
Sleep disturbance	2.0±0.5			1.3±0.4			<0.001
Use of sleeping medication	1.3±0.8			0.5±0.5			<0.001
Daytime dysfunction	0.6±0.1			0.2±0.1			0.013
Beck Depression Inventory	20.2±8.5			9.9±7.4			<0.001
SF-36-physical function	38.7±19.8	35	10-85	89.0±10.5	90	70-100	<0.001
SF-36-physical role	22.2±31.3	0.00	0.00-100	86.1±28.9	100	0.00-100	<0.001
SF-36-pain	45.7±17.3	41	22-100	72.8±24.7	74	12-100	<0.001
SF-36-general health	33.3±16.7	35	0-72	72.1±15.3	77	27-100	<0.001
SF-36-energy	37.6±20.0	35	5-75	73.5±16.8	70	40-100	<0.001
SF-36-social functions	49.5±25.4	50	12.5-100	82.9±19.0	87.50	25-100	<0.001
SF-36-emotional role	34.6±39.7	33.30	0.00-100	93.3±23.8	100	0-100	<0.001
SF-36-mental health	56.7±17.8	60	20-92	75.1±14.9	76	28-96	<0.001
VAS-back	3.0±3.0	3.00	0-10.00	1.4±2.1	0.00	0- 8.00	0.004
VAS-waist	4.0±3.2	4.00	0-10.00	1.3±2.4	0.00	0-10.00	0.001
VAS-hip	2.1±2.7	0.00	0-8.00	0.4±0.9	0.00	0-3.00	0.001
VAS-knee	4.8±3.8	4.00	0-10.00	0.8±1.4	0.00	0-5.00	<0.001
VAS-heel	3.6±3.5	3.00	0-10.00	0.6±1.4	0.00	0-5.00	<0.001
VAS-metatars	3.9±3.3	4.00	0-10.00	0.3±1.3	0.00	0-5.00	<0.001

IPAQ: Short form of International Physical Activity Questionnaire; PSQI: Pittsburgh Sleep Quality Index; SF-36: Short Form-36; VAS: Visual analog scale.

MET-min/week preoperatively and 73.3±96.3 MET-min/week postoperatively ($p<0.001$). Vigorous activity score was 28.1±87.9 MET-min/week postoperatively, although it was 00.0±00.0 MET-min/week preoperatively ($p<0.001$). Pittsburgh Sleep Quality Index was 7.6±3.0 preoperatively and 3.5±2.4 postoperatively ($p<0.001$), and all of the subgroups of PSQI were improved postoperatively in obese patients ($p<0.05$). Beck Depression Inventory was 20.2±8.5 preoperatively and 9.9±7.4 postoperatively ($p<0.001$). A statistically significant improvement was found in all subsections of the SF-36 (Table 2).

Patients were examined for their musculoskeletal system. Statistically significant improvement in VAS was observed in all regions of the patient group postoperatively when compared with preoperative values (Table 2).

Factors affecting IPAQ score were analyzed in all 47 participants. Pittsburgh Sleep Quality Index total score was not different among males and females (IPAQ females: 476.78; IPAQ males: 722.6±799.2; $p=0.709$). Multiple linear regression analysis was performed for the factors that were correlated with IPAQ. Results indicated that the only factor associated with IPAQ was BMI (Table 3).

The preoperative results of the patients were compared with those in the control group. Preoperatively, the mean BMIs of the patient and control groups were 46.2±5.2 kg/m^2 and 22.9±2.4 kg/m^2, respectively, with a statistically significant difference

TABLE 3
Relationship between short form of International Physical Activity Questionnaire and clinical variables

IPAQ	B	SE	p*	95% CI	
Age	-7.54	8.34	0.371	-24.73	9.29
Beck Depression Inventory	0.98	9.66	0.922	-18.53	20.45
Body mass index	-16.38	7.67	0.038	-28.95	-6.78
R^2=0.21 F=3.69					

IPAQ: Short form of International Physical Activity Questionnaire; B: Regression coefficient; SE: Standard error; CI: Confidence interval; * Multivariate regression analyses; R^2: Coefficient of determination.

(p<0.001). It was seen that IPAQ of the patients was 345.4±172.8 MET-min/week preoperatively whereas it was 740.3±698.6 MET-min/week in the control group with a statistically significant difference (p=0.021). Preoperatively, the PSQI of the patients was 7.6±3.0, while in the control group it was 5.4±2.6 with a statistically significant difference (p=0.007). Preoperatively, patient and control groups' BDIs were 20.2±8.5 and 6.0±3.6, respectively, with a statistically significant difference (p<0.001). A statistically significant difference was found in all subsections of the SF-36. The results were significantly higher in the control group (Table 4).

The results of the patient group at postoperative sixth month were compared with the control group again. Postoperatively, the mean BMIs of the patient and control groups were 33.8±5.0 kg/m² and 22.9±2.4 kg/m², respectively, with a statistically significant difference (p<0.001). The patients still had more weight than the controls. Postoperatively,

TABLE 4
Comparison of clinical parameters of control group with pre- and postoperative values of patient group

	Preoperative values of patients	Controls		Postoperative values of patients	Controls	
	Mean±SD	Mean±SD	p	Mean±SD	Mean±SD	p
Body mass index	46.2±5.2	22.9±2.4	<0.001	33.8±4.98	22.9±2.4	<0.001
IPAQ	345.4±172.8	740.3±698.6	0.021	672.8±227.8	740.3±698.6	0.258
PSQI	7.6±3.0	5.4±2.6	0.007	3.5±2.4	5.4±2.6	0.027
Beck Depression Inventory	20.2±8.5	6.0±3.6	<0.001	9.9±7.4	6.0±3.6	0.084
SF-36-physical function	38.7±19.8	93.2±11.7	<0.001	89.0±10.5	93.2±11.7	<0.001
SF-36-physical role	22.2±31.3	89.5±20.9	<0.001	86.1±28.9	89.5±20.9	0.427
SF-36-pain	45.7±17.3	74.1±17.0	<0.001	72.8±24.7	74.1±17.0	0.008
SF-36-general health	33.3±16.7	66.4±13.2	<0.001	72.1±15.3	66.4±13.2	0.615
SF-36-energy	37.6±20.0	69.2±11.2	<0.001	73.5±16.8	69.2±11.2	0.153
SF-36-social functions	49.5±25.4	87.3±13.9	<0.001	82.9±19.0	87.3±13.9	<0.001
SF-36-emotional role	34.6±39.7	96.4±10.7	<0.001	93.3±23.8	96.4±10.7	<0.001
SF-36-mental health	56.7±17.8	60.1±43.7	<0.001	75.1±14.9	60.1±43.7	<0.001
VAS-back	3.0±3.0	3.1±2.7	0.843	1.4±2.1	3.1±2.7	0.028
VAS-waist	4.0±3.2	3.0±1.7	0.252	1.3±2.4	3.0±1.7	<0.001
VAS-hip	2.1±2.7	0.9±2.2	0.034	0.4±0.9	0.9±2.2	0.948
VAS-knee	4.8±3.8	4.8±3.8	<0.001	0.8±1.4	1.2±2.2	0.855
VAS-heel	3.6±3.5	1.3±2.2	0.009	0.6±1.4	0.6±1.4	0.407
VAS-metatarsal	3.9±3.3	1.2±2.3	0.002	0.3±1.3	0.7±1.3	0.873

IPAQ: Short Form of International Physical Activity Questionnaire; PSQI: Pittsburgh Sleep Quality Index; SF-36: Short Form-36; VAS: Visual analog scale.

TABLE 5
Association between quality of life and pre- and postoperative clinical variables

r	Physical function	Physical role	Pain	General health	Energy	Social functions	Emotional role	Mental health
Preoperative values								
BMI	-0.189	-0.070	-0.282	-0.140	0.167	0.141	-0.243	0.218
IPAQ	0.043	-0.035	0.139	0.238	-0.055	-0.284	0.226	-0.042
BDI	-0.044	-0.484*	-0.329	-0.312	-0.535**	-0.213	-0.610**	-0.486*
PSQI	-0.340	-0.397*	-0.468*	-0.422*	-0.462*	-0.304	-0.543**	-0.097
Postoperative values								
BMI	-0.036	0.250	0.249	-0.436*	0.084	0.179	0.226	-0.105
IPAQ	-0.74	0.188	-0.220	0.285	-0.077	0.043	0.047	-0.128
BDI	-0.270	-0.463*	-0.409*	-0.237	-0.668**	-0.661**	-0.428*	-0.545**
PSQI	-0.403*	-0.506*	-0.613**	-0.301	-0.538**	-0.547**	-0.403*	-0.388*

BMI: Body mass index; IPAQ: Short form of International Physical Activity Questionnaire; BDI: Beck Depression Inventory; PSQI: Pittsburgh Sleep Quality Index; * p<0.05; ** p<0.01; r: Correlation coefficient.

IPAQ values of the patient and control groups were 672.8±227.8 MET-min/week and 740.3±698.6 MET-min/week, respectively, with no statistically significant difference (p=0.258). Postoperatively, PSQI values of the patient and control groups were 3.5±2.4 and 5.4±2.6, respectively, with a statistically significant difference (p=0.027). Postoperatively, BDI values of the patient and control groups were 9.9±7.4 and 6.0±3.6, respectively, with no statistically significant difference (p=0.084). There was no statistically significant difference between the patient and control groups in the physical role functioning, general health, and vitality sub-units of the SF-36, but there was a statistically significant difference in the other sub-units. A significant improvement was observed in favor of the patient group (Table 4).

There was no significant difference in preoperative back and low back pain between the two groups while the severity of hip, knee, heel, and metatarsal pain was statistically significantly higher in the patient group compared with the control group (p=0.034, p<0.001, p=0.009, p=0.002) (Table 4).

There was a significant difference between the two groups in terms of postoperative lumbar and back pain (p=0.028, p<0.001) while there was no difference in terms of other joint pain. At the end of the sixth month, there was a marked improvement in the pain level of the patients in all regions compared with the controls (Table 4).

The relationship between the QoL of the patients pre- and postoperatively and age, BMI, IPAQ, PSQI,

TABLE 6
Association between musculoskeletal pain and pre- and postoperative clinical variables

r	Back-VAS	Waist-VAS	Knee-VAS	Hip-VAS	Heel-VAS	Metatars-VAS
Preoperative values						
BMI	-0.259	-0.185	-0.111	-0.221	-0.172	-0.207
IPAQ	-0.037	-0.055	-0.244	-0.083	0.038	-0.217
BDI	-0.179	0.144	0.133	0.500	0.098	0.242
PSQI	0.368	0.243	-0.084	0.280	0.086	0.146
Postoperative values						
BMI	-0.212	-0.245	0.119	0.001	-0.115	-0.228
IPAQ	0.082	0.083	-0.064	-0.090	0.051	0.257
BDI	-0.034	0.294	0.357	0.010	0.280	0.239
PSQI	0.146	0.429	0.181	0.178	0.251	0.181

BMI: Body mass index; IPAQ: Short Form of International Physical Activity Questionnaire; BDI: Beck Depression Inventory; PSQI: Pittsburgh Sleep Quality Index; * p<0.05, ** p<0.01; r: Correlation coefficient.

and BDI was evaluated. Short Fom 36 was found to be associated with BDI and PSQI ($p<0.05$) (Table 5).

There was no significant correlation between regional musculoskeletal pain pre- and postoperatively and age, BMI, IPAQ, PSQI, and BDI (Table 6).

There was a positive correlation between BDI and PSQI in the pre- and postoperative period ($r=0.417$, $p=0.030$, $r=0.517$, $p=0.006$, respectively), while there was a negative correlation between IPAQ and age and BMI in the same period ($r= -4.22$, $p=0.028$, $r= -0.605$, $p=0.01$, respectively).

DISCUSSION

Morbid obesity is a serious public health problem that is increasing significantly, regardless of gender, age, ethnicity, or education level.[25] It is strongly associated with joint pain, gait abnormalities, worsening physical function, depression, and sleep disorders.[3,4,7] In this study, patients undergoing bariatric surgery were evaluated preoperatively and at sixth month postoperatively. We found that patients had significant improvements in joint pain, sleep disturbances, depression, physical activity, and QoL at the end of six months. The patient group was also compared with the age- and gender-matched control group with normal weight. In the preoperative period, it was observed that the patient group was significantly worse than the control group in all parameters, while improvement was observed in the patient group after six months.

Physical inactivity is considered to be a global health problem; however, there is no standardized approach to measurement and follow-up and international comparisons are challenging.[26] Obese individuals have been reported to have a sedentary life style and low physical activity in most cases.[27] The vast majority of bariatric surgical candidates are not active enough to be considered physically adequate.[28] Bond et al.[29] evaluated physical activity changes before and after bariatric surgery using self-reported and accelerometer measurements. Participants reported that their physical activity increased in self-reported measurements, while no significant difference was found in objective accelerometer measurements.[29] King et al.[7] evaluated the physical activity of their patients before bariatric surgery and at the end of the first year. In contrast to previous studies, self-reported statements reported little change in physical activity. Moreover, Berglind et al.[28] evaluated their patients who underwent gastric-bypass surgery by using accelerometer and anthropometric measurements preoperatively and at postoperative ninth month. Although there was a significant reduction in BMI, they have not found any differences in physical activity or sedative behavior after surgery. In this respect, although the results in the literature are different from each other, it is seen that self-reported measurements about physical activity seem to be over-reported among obese patients.[28,29] In our study, we evaluated our patients for physical activity preoperatively and at postoperative sixth month by using IPAQ. The change in the physical activity of our patients was statistically significant. However, when we compared them with the control group at the sixth month, there was no significant difference. In our patients, there was a negative correlation between physical activity and age and BMI in the preoperative period. When we examine the association between physical activity and related factors, multiple linear regression analyses showed that the only factor closely related with IPAQ was BMI. It is known that physical activity and exercise encourage a healthy lifestyle and in adults, limitations of functional mobility are associated with low QoL, chronic pain, and premature mortality.[8-11] Our results indicated that the main problem preventing physical activity was high BMI values. We think that physical activity will be increased with weight loss after bariatric surgery and supporting increased physical activity with regular exercise programs may maintain healthy weight and improve health problems associated with obesity and low physical activity.

Recently, there is a great interest in the role of sleep quality and duration in the initiation and progression of obesity. To explain the relationship between sleep and obesity, various mechanisms are considered, including increased fatigue and psychological distress, and decreased physical activity.[6] In addition, obesity is a known risk factor for obstructive sleep apnea syndrome (OSA).[30] Bariatric surgery, considered an effective treatment for severe obesity and the accompanying comorbidities, may also have a beneficial effect in the remission of sleep disorders.[4] Dixon et al.[31] investigated sleep disturbance and daytime insomnia in morbidly obese patients undergoing weight-loss surgery. They reported significant improvement in sleep disturbance of patients at one-year follow-up postoperatively. Pinto et al.[4] found significant improvement in the PSQI scores of patients after bariatric surgery. Sharkey et al.[30] reported that severity of OSA was not associated with daytime sleepiness or sleep dysfunction in patients who underwent bariatric surgery for obesity treatment. In our study, patients who underwent bariatric surgery had a significant improvement in sleep disturbance evaluated by PSQI. Many studies have been conducted on sleep disorders seen in obese patients, while the etiology has not been elucidated.[4-6,30,31] Other obesity-related symptoms such as gastroesophageal reflux, depression, back and joint pain, or exercise dyspnea can lead to sleep disorders. In this study, a correlation was found between sleep disturbance and depression. Again, regional musculoskeletal pain, which was commonly present in our patients, showed significant improvement after the operation. According to our results, postoperative improvements in other comorbid conditions with weight loss may contribute to the relief of sleep disorders in patients.

In modern society, obesity is the most common physical disease, while the psychological disorder with the highest prevalence is depression.[32] Epidemiologic studies have shown that the prevalence of depression is higher among obese people (5-23%).[33] However, the relationship between obesity and depression remains unclear. Psychiatric problems such as major depression and binge eating disorders can contribute to severe obesity development. Some patients reported that they were eating more food during the depressive episode.[34] Studies have reported that depressive symptoms improve following weight loss through bariatric surgery, pharmacological interventions, behavioral therapy, and nutritional regulation.[31,35,36] Hayden et al.[35] evaluated depression in the preoperative period and at postoperative first year in obese patients who underwent bariatric surgery. They reported that depression continued with a marked decrease in BDI values. Dixon et al.[32] reported that patients who dropped all excess weight had even greater decreases in BDI scores. Depressive symptoms are significantly correlated with body image dissatisfaction. In addition, stigmatization, discrimination, and psychosocial distress that severe obese people are exposed to may increase depressive symptoms.[33] Depressive mood in obese patients leads to decrease in physical activity while bad lifestyle habits make it difficult to lose weight.[33] In our study, we found a significant decrease in BDI scores in obese patients after bariatric surgery. Postoperative BDI scores were higher than healthy controls; however, there was no statistically significant difference between the two groups. Our results are consistent with the literature and support that significant weight loss and return to active life after surgery contribute to the reduction of depressive disorders.

Obesity is associated with impairment in mobility and musculoskeletal system disorders and can lead to disability and deterioration in the QoL.[1,25] Individuals with severe obesity are more likely to have psychological morbidity, disability, and low QoL.[6] Hooper et al.[36] found significant improvement in all parts of SF-36 in obese patients after bariatric surgery compared to preoperative period and postoperative results were as good as the control group. Nickel et al.[37] evaluated the QoL with SF-36 in patients who underwent gastric banding and they found significant improvement in the eight subgroups compared to the patients who did not undergo surgery. Araghi et al.[6] have shown that sleep disorders are strongly associated with depression, anxiety, and low QoL in patients with severe obesity. In our study, we found that patients who underwent bariatric surgery had a significant improvement in their QoL at the end of the sixth postoperative month. At the end of the sixth month, although there was a significant improvement in the QoL scores when compared to normal weight individuals, statistical differences persisted in subgroups other than physical role strength, general health, and vitality. In addition, in our patient group, BMI was still statistically significantly higher than healthy controls despite a significant decrease in postoperative period. There was a significant relationship between depression and sleep disturbance and QoL pre- and postoperatively in our patient group. Our results are consistent with the literature. Obese individuals generally score lower in their QoL assessment tools than those who are not obese and this depends on BMI, additional medical conditions, whether or not the person wants obesity treatment, or gender.[36] Rapid positive physical changes after bariatric surgery may increase patients' QoL perception. Improvements in depression and sleep disturbances and rapid weight loss can motivate the individual to make a lifestyle change for long-term success.

Obesity is one of the variables that cause musculoskeletal disorders by increasing the stress applied to the bone structure.[38] Musculoskeletal symptoms, mainly from the lower extremity, have been reported to have a higher prevalence in obese individuals. Joint disease due to excessive weight, resulting in overloading of musculoskeletal structures, which are mainly responsible for stabilizing and moving the body, can cause some of these symptoms.[1] Hooper et al.[36] evaluated the spinal, upper, and lower extremity pain of patients who underwent bariatric surgery in the pre- and postoperative period. After weight loss, they found a significant decrease in all musculoskeletal pain except shoulder, hip, and trochanteric bursa pain. Vincent et al.[25] reported that there was a significant improvement in low back and knee pain in patients who underwent bariatric surgery. Furthermore, Speck et al.[15] examined numerous studies in their review and observed that in patients who underwent bariatric surgery, musculoskeletal pain with high preoperative prevalence decreased significantly in the postoperative period. Calenzai et al.[1] did not find any association between BMI and musculoskeletal symptoms in their study. We found a statistically significant improvement in musculoskeletal pain at sixth postoperative month in patients with lower back and lower limb pain. In the postoperative period, we found significant improvement in musculoskeletal pain when compared to the control group. Our results are consistent with the literature.[1,15,25,36] Pain experience, particularly musculoskeletal pain, is a problem for bariatric surgery patients because it may limit their relationship to physical activity and exercise.[15] Rapid reduction of musculoskeletal pain after bariatric surgery can be explained by two mechanisms. These are the positive effect of lower fat tissue mass on cartilage remodeling with reduced systemic inflammation and lower mechanical stress due to weight loss.[25]

The limitation of this study was the relatively small patient population. Studies with larger sample numbers will corroborate our preliminary findings.

In conclusion, significant weight loss after bariatric surgery improves functional recovery and patient's psychology in a short time. We conclude that the results of bariatric surgery may be successful in carefully selected patients with comorbid conditions.

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