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The Evaluation of Postural Stability and Fall Risk in Morbidly Obese Preoperative Bariatric Patients: A Cross-Sectional Study

Morbid Obez Preoperatif Bariatrik Hastalarda Postural Stabilite ve Düşme Riskinin Değerlendirilmesi: Kesitsel Bir Çalışma

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Abstract

Aim: It is known that obese individuals show more postural instability and an increased fall risk than non-obese individuals. We aimed to evaluate the postural stability, fall risk and the contributing factors to stability in morbidly obese preoperative bariatric patients.

Material and Method: Thirty-eight morbidly obese preoperative bariatric patients (body mass index (BMI)≥40) and 52 non-obese (BMI <30) healthy individuals were included in our study. Postural stability indices (PSIs) and fall risk index (FRI) of the participants were evaluated by using the Biodex stability system. Fear of falling (FOF) was evaluated by questioning verbally as yes/no and by using the Falls Efficacy Scale-International (FES-I).

Results: In the study group, 18 patients (47.4%) were housewives and sedentary; 15 patients (39.5%) had Diabetes Mellitus Type 2 diagnosis. There was no statistically significant difference between the groups in terms of the presence of verbally questioned fear of falling, the presence of a history of falling, and the number of falls within the last year (p:0.831, p:0.558, p:0.596 respectively). However, FES-I and FRI scores were statistically significantly higher in the study group (p:0.006, p<0.001). A statistically significant positive correlation was found between FRI and weight, BMI, waist and hip circumferance (r:0.708, p<0.001; r:0.697, p<0.001; r:0.699, p<0.001; r:0.715, p<0.001 respectively).

Conclusion: Morbid obesity negatively affects FRI, which is an important dynamic stability indicator. We recommend the implementation of rehabilitation programs focused on dynamic tasks for postural balance training in morbidly obese patients before and after bariatric surgery.

Keywords: Obesity, body mass index, morbid obesity, postural stability, fall risk

Öz

Amaç: Obez bireylerin, obez olmayan bireylere göre daha fazla postural instabilite ve düşme riskinde artış gösterdiği bilinmektedir. Morbid obez preoperatif bariatrik hastalarda postural stabiliteyi, düşme riskini ve postural stabiliteye katkıda bulunan faktörleri değerlendirmeyi amaçladık.

Gereç ve **Yöntem**: Çalışmamıza bariatrik cerrahi öncesi değerlendirilen morbid obez 38 hasta (vücut kitle indeksi (VKİ)≥40) ve 52 obez olmayan (VKİ <30) sağlıklı birey dahil edildi. Katılımcıların postural stabilite indeksleri (PSİ) ve düşme riski indeksi (DRİ) Biodex stabilite sistemi kullanılarak değerlendirildi. Düşme korkusu (DK) sözel olarak düşme korkusu var/yok şeklinde sorularak ve Uluslararası Düşme Etkinlik Ölçeği (DEÖ-U) kullanılarak sorgulandı.

Bulgular: Çalışma grubundaki 18 hasta (%47,4) ev hanımı ve sedanterdi, 15 hastada (%39,5) Diabetes Mellitus Tip 2 tanısı mevcuttu. Gruplar arasında sözel olarak sorgulanan düşme korkusu varlığı, düşme öyküsü varlığı ve son bir yıl içinde düşme sayısı açısından istatistiksel olarak anlamlı fark yoktu (p:0,831, p:0,558, p:0,596 sırasıyla). Ancak DEÖ-U ve DRİ skorları çalışma grubunda istatistiksel olarak anlamlı derecede yüksekti (p:0,006, p<0,001). DRİ ile ağırlık, VKİ, bel ve kalça çevresi arasında istatistiksel olarak anlamlı pozitif korelasyon bulundu (r:0,708, p<0,001; r:0,697, p<0,001; r:0,699, p<0,001; r:0,715, p<0,001 sırasıyla).

Sonuç: Morbid obezite, önemli bir dinamik stabilite göstergesi olan DRİ 'yı olumsuz etkilemektedir. Morbid obez hastalarda bariatrik cerrahi öncesi ve sonrası postural denge eğitimi için dinamik görevlere odaklanan rehabilitasyon programlarının uygulanmasını önermekteyiz.

Anahtar Kelimeler: Obezite, vücut kitle indeksi, morbid obezite, postural stabilite, düşme riski

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INTRODUCTION

Postural stability is an adaptive process defined as the coordinated working process of the neuromuscular system, which involves maintaining the position of the center of gravity (COG) with continuous output from the visual, auditory and other neural senses.[1,2] It is the main component of many daily activities such as sitting, standing, walking and sportive motor skills.[3] Static postural stability is the skill that involves maintaining the position of the COG in very low activity situations. Dynamic postural stability can be thought of as maintaining postural stability in some different activities or on unstable surfaces.[1] Postural stability is associated with age, gender, anthropometric characteristics and support points.[4] There is a strong relationship between the impaired postural stability and falls. Decreasing the increased plantar pressure due to obesity through weight loss improves postural stability and may therefore reduce the fall risk.[5] However, there are limited number of studies investigating the relationship between obesity, postural stability and fall risk.[5-8]

Obesity is thought to be an obstacle in maintaining postural stability, especially after sudden loss of balance.[6] Because the fat accumulation in the body causes the COG to shift to the front in obese individuals compared to non-obese individuals.[9] In the treatment of obesity, which is an important problem of our age, bariatric surgery applications have come to the fore especially in morbidly obese patients, and successful results are observed in the literature. However, bariatric surgical applications are associated with various complications and the indications are currently being discussed.[10] To identify the factors contributing to instability in preoperative morbidly obese bariatric patients can enable to obtain patient-specific physical therapies and pre-operative measures to reduce instability to prevent comorbidities that may develop due to falls and monitor post-operative balance improvements. In addition, objective postural instability and increased fall risk in patients detected before bariatric surgery can motivate patients to lose weight and increase compliance with the diet and exercise program in the post-surgery period.

The main hypothesis of our study is that an increase in the risk of postural instability and fall risk may be detected in morbidly obese patients compared to healthy non-obese individuals. Based on this hypothesis, we aimed to determine postural stability disorders and fall risk in morbidly obese preopaerative bariatric patients using various clinical evaluations and BIODEX stability system (BSS).

MATERIAL AND METHOD

Study Design

Thirty-eight patients (24 females, 14 males; mean age 36.53±11.3) between the ages of 18-65 who applied to general surgery outpatient clinic between December 2018- December 2019 with the complaint of morbid obesity (body mass index (BMI)≥40) and planned bariatric surgery were included as study group. Fifty -two non-obese (BMI <30) healthy individuals (33 females, 19 males; mean age 34.12±9.63) between the ages of 18-65 were included as the control group. The patients were evaluated in the preoperative period. All individuals participating in our study were informed about the study and their verbal and written consents were obtained. Ethical approval was obtained from Tokat Gaziosmanpaşa University Faculty of Medicine Ethics Committee (approval number: 21.11.2018/18-KAEK-224) for our study. Throughout the study, the principles of the Declaration of Helsinki were adhered to.

Patients between the ages of 18-65, who were planned for bariatric surgery due to morbid obesity (BMI 40 kg/m2), who do not have alcohol and/or drug addiction and who do not have uncontrolled psychotic and depressive disorders were included in the study as study group, As the control group, healthy volunteers with a BMI of <30, without labyrinthite or any neurological disease that may affect balance were included. Volunteering was essential in the conditions of participation in the study. Patients with psychiatric and neurological diseases that may affect balance, additional orthopedic problems such as hip, knee, ankle osteoarthritis, lumbar or cervical spondylosis, a history of surgical intervention for lower extremity and spine, with a history of vertigo, scoliosis or kyphosis, or hearing/vision impairment, drug using that may affect balance, a shorter length of more than 2 cm between the lower extremities, and patients who described pain during evaluation or could not complete the evaluations were excluded from the study.

Data Collection

Fear of falling (FOF) was evaluated by questioning verbally as yes/no and by using the Falls Efficacy Scale-International (FES-I). FES-I is an internationally validated assessment questionnaire that consists of 16 simple questions evaluated by the individuals, which allows to assess the FOF during both easy and difficult physical and social activities. FES-I has been validated in Turkish.[11] The number of falls in the last year was also verbally questioned and recorded.

Body weight was measured with a standard beam scale and length, waist and hip circumference was taken according to Lohman et al.[12]

Postural stability indices (PSIs) and fall risk index (FRI) were evaluated by using BSS (Biodex Inc., Shirley, New York), which provides an objective evaluation. BSS consists of a platform which can move between 20º-360º and a LCD display connected to it with a computer software. When the postural stability analysis protocol (PSAP) (**Figure 1**) is applied with BSS; three different scores are obtained as PSIs. These are Mediolateral Stability Index (MLSI), Anteroposterior Stability Index (APSI), and Overall Stability Index (OSI). When the fall risk analysis protocol (FRAP) (**Figure 2**) is applied, the FRI score can be obtained. The MLSI and APSI shows the displacement of the platform center in the frontal and sagittal planes respectively. The OSI indicates the total variance of the movement of the platform center by using MLSI and APSI. These indices are

standard deviations that show the oscillations around the center of the platform, while high scores indicate an increased fall risk for FRAP, worse postural stability for PSAP.[13] In the PSAP protocol, the platform was static in the MLSI and APSI axes. In the FRAP, the platform was unstable, so it could be possible to predict FRI. FRAP consists of 12 dynamic stability levels. The level "12" was the most stable and the level "1" was the most unstable. In this study, platform level " 8 " was used for fall risk analysis and all patients were tested on the same platform level. Patients stood on the platform, with knees flexed slightly (10-15º), barefoot and in the most comfortable position where the patient could balance, foot coordinates were determined on both feet and eyes open (**Figure 1, 2**). Each participant was informed about the tests and the rules that they should follow. The tests were repeated 3 times to improve reliability and obtain the best results. OSI, APSI, MLSI and FRI scores obtained with BSS were recorded. High values obtained in these scores indicate deterioration in balance and increased fall risk. Participants' age, gender, education level and occupational status, height, weight, BMI, waist and hip circumference (in centimeters), presence of verbally questioned FOF, history of falling in the last year and, if any, number of falls in the last year were also recorded.

Statistical analysis

Data are expressed as mean±standard deviation or frequency and percent. Independent sample t test was used to compare the continuous normal data between groups. Mann Whitney U test was used to compare the continuous non-normal data between groups. Chi-Square test was used to compare the categorical data between/among groups. Categorical variables were presented as a count and percentage. Pearson correlation coefficient was used for correlation between variables. A p-value <0.05 was considered significant. Analyses were performed using The SPSS 22.0 (Chicago, IL, USA). G * Power program was used for power analysis. Our study was planned as 38 patients and 52 controls with 80% power, 5% margin of error and 0.35 effect size.

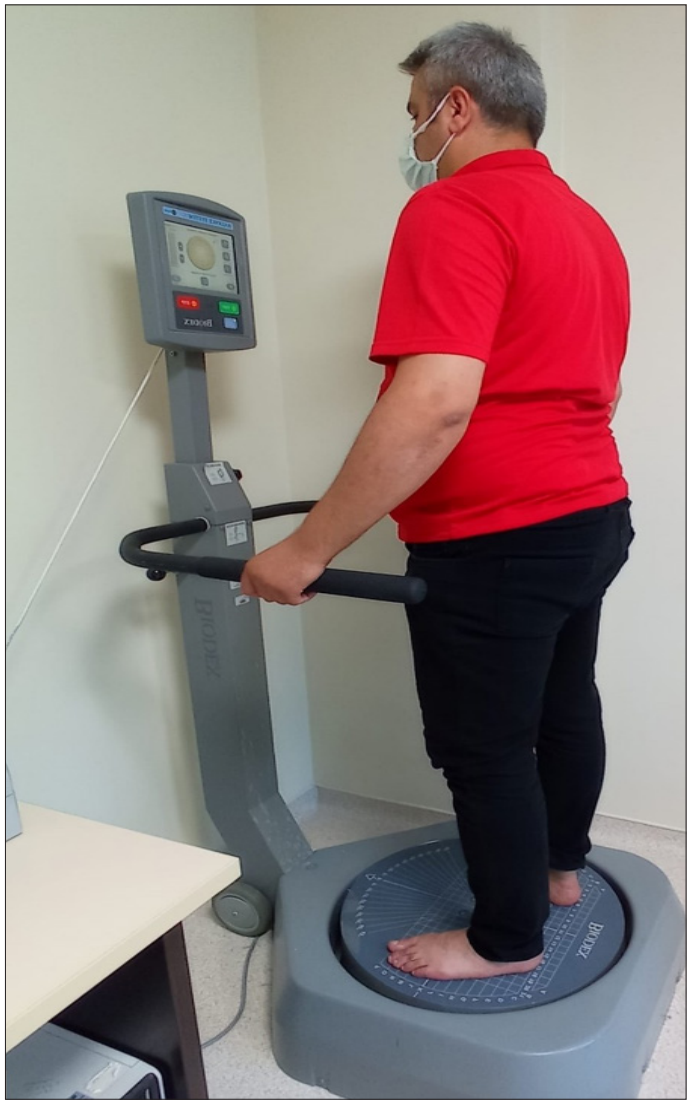

Figure 1. Postural stability analysis protocol

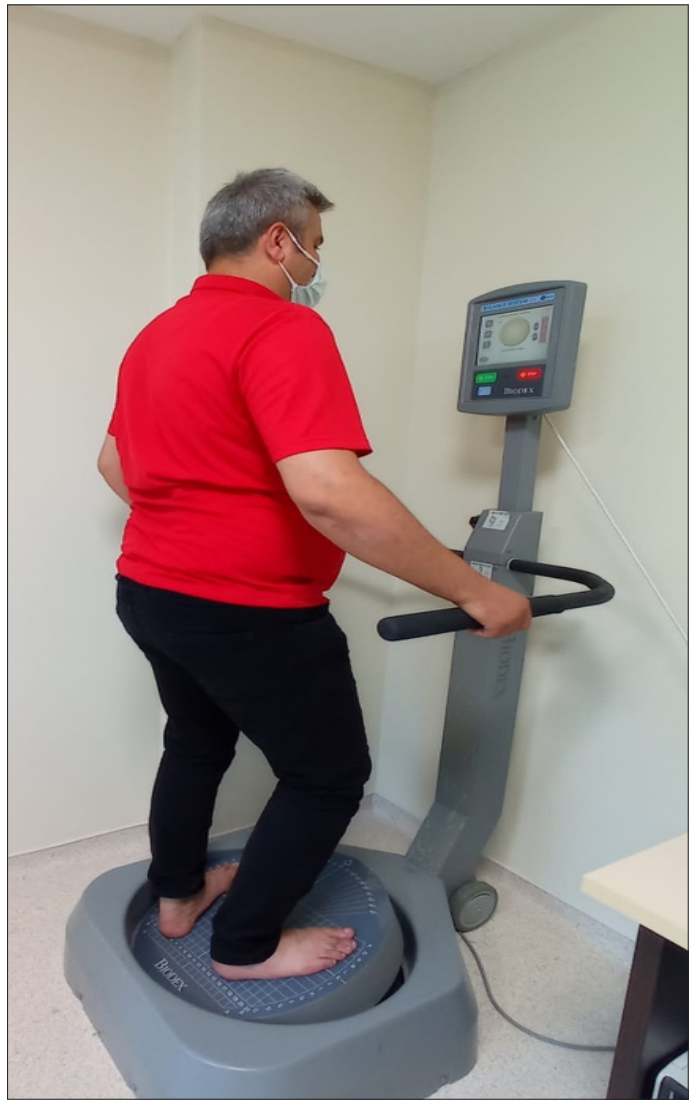

Figure 2. Fall risk analysis protocol

RESULTS

Thirty-eight morbidly obese patients and 52 non-obese healthy volunteers participated in our study. The anthropometric characteristics of the participants are in **Table 1.** Eighteen patients (47.4%) in the study group were housewives and had a sedentary life. In addition, 15 patients (39.5%) in the study group had Diabetes Mellitus Type 2 diagnosis. There was no statistically significant difference between the groups in terms of verbally questioned FOF and a history of falling within the last year (p: 0.831, p: 0.558). The sociodemographic characteristics of the participants in our study are in **Table 2**.

When evaluated in terms of falls number in the last year, no statistically significant difference was found between both groups (p: 0.596), but FES-I and FRI were statistically significantly higher in the study group (p: 0.006, p <0.001). Postural parameters of the participants are in **Table 3**.

In the correlation analyzes performed for all participants, a statistically significant positive correlation was found between FRI and weight, BMI, waist and hip circumferance (r: 0.708, p <0.001; r: 0.697, p <0.001; r: 0.699, p <0.001; r 0.715, p <0.001).

In the correlation analysis performed for the study group, no statistically significant correlation was found between FRI and age, height, weight, BMI, waist and hip circumference, the number of falls in the last 1 year, FES I and PSI. Only a statistically significant positive correlation was found between the number of falls in the last year and BMI, waist circumferance (r: 0.528, p: 0.001; r: 0.331, p: 0.042). In the correlation analyzes performed for the control group, a statistically significant positive correlation was found between FRI and age, weight, BMI, waist and hip circumferance (r:0.311, p:0.025; r: 0.389, p: 0.004; r: 0.413, p: 0.002; r: 0.363, p: 0.008; r: 0.365, p: 0.008).

DISCUSSION

In this study, the effects of morbid obesity on postural stability and fall risk were evaluated. While there was no statistically significant difference in PSIs compared to the control group, it was remarkable that FES-I was statistically significantly higher in the study group.

FOF is a common and serious health problem. Due to FOF, older people may restrict their activities, causing muscle weakness and impaired balance.[14,15] In different patient groups such as diabetes mellitus, hemiplegia, rheumatoid arthritis, hip osteoarthritis;[15] FES-I has been used to evaluate patients' FOF. There was no significant difference between the groups in the verbally questioned FOF in our study. The fact that FES-I was statistically significantly higher in the study group indicates that FES-I is an important and sensitive scale in revealing theFOF that the person has veiled.

In many previous studies, the effects of different nervous system pathologies, vision and hearing loss, and different musculoskeletal system diseases on postural stability and fall risk were investigated, and some studies emphasized that obesity impairs postural stability and causes an increase

Table 1. The anthropometric characteristics of the participants

	Group		p
	Obese	Control	
Age	36.53±11.3	34.12±9.63	0.279
Weight	123.47±22.71	66.48±10.98	<0.001
Length	166.11±10.66	164.81±8.55	0.524
BMI	44.77±7.19	24.44±3.29	<0.001
Waist circumference	126.03±12.68	82.69±11.07	<0.001
Hip circumference	136.89±12.57	98.37±7.08	<0.001

Data are shown as mean±standard deviation. Independent samples t test was used. BMI: Body Mass Index

Table 2. The sociodemographic characteristics of the participants

	Group		p
	Obese n (%)	Control n (%)	
Gender			
Female	24 (63.2)	33 (63.5)	0.976
Male	14 (36.8)	19 (36.5)	
Education			
Primary school	11 (28.9)	6 (11.5)	
Secondary school	20 (52.6)	30 (57.7)	0.085
Undergraduate and above	7 (18.4)	16 (30.8)	
Occupation			
Housewife	18 (47.4)	11 (21.2)	
Student	6 (15.8)	10 (19.2)	0.028
Retired	1 (2.6)	0 (0)	
Officer	13 (34.2)	31 (59.6)	
Smoking			
Present	14 (36.8)	21 (40.4)	0.733
Absent	24 (63.2)	31 (59.6)	
Alcohol using			
Present	9 (23.7)	5 (9.6)	0.069
Absent	29 (76.3)	47 (90.4)	
Accompanying disease			
Diabetes Mellitus	15 (39.5)	2 (3.8)	
Hypertension	6 (15.8)	7 (13.5)	
Hypothyroidism	0 (0)	0 (0)	
Hyperthyroidism	0 (0)	0 (0)	<0.001
Absent	11 (28.9)	43 (82.7)	
Diabetes Mellitus+ Hypertension	5 (13.2)	0 (0)	
Obstructive Sleep Apnea Syndrome	1 (2.6)	0 (0)	
Fear of falling			
Present	8 (21.1)	10 (19.2)	0.831
Absent	30 (78.9)	42 (80.8)	
History of falling			
Present	6 (15.8)	6 (11.5)	0.558
Absent	32 (84.2)	46 (88.5)	

Data are shown as frequency and percentage. Chi-square test was used.

Table 3. Postural parameters of the participants

	Group		p
	Obese	Control	
The number of falls	0.16±0.44	0.12±0.32	0.596
FES-I	21.29±5.06	18.79±3.43	0.006
Overall Stability Index	0.7±0.88	0.47±0.24	0.509*
Antero-Posterior Stability Index	0.52±0.52	0.36±0.2	0.119*
Medio-Lateral Stability Index	0.32±0.7	0.19±0.14	0.717*
Fall Risk Index	4.47±1.91	1.55±0.88	<0.001*

Data are shown as mean±standard deviation. *:Mann Whitney U test was used. Independent samples t test was used for the other ones. FES-I:The Falls Efficacy Scale-international

in fall risk.[16-24] In addition, it is known that obesity increases the fall risk in the elderly in relation to the decrease in the proprioceptive data control capacity of the elderly.[25] In their study with 45 elderly female patients, Mainenti et al.[26] emphasized that increased BMI was associated with impaired postural stability as patients had to balance a greater body mass volume on their support surfaces. However, the mean age of the patients participating in our study was relatively low, so the fact that the postural stability parameters of the patients in the study group were not different from the control group may be related to the low mean age of both groups and similar to each other.

Alonso et al.[27] evaluated the effects of anthropometric characteristics and gender on postural balance with a total of 100 patients, 50 male and 50 female, aged 20-40 years. They found that as the BMI increased, the postural stability in the unstable platform was disturbed and this was associated with an increased fall risk during movement.[27]

Błaszczyk et al.[8] stated that the increase in BMI causes a biomechanical limitation that may adversely affect the adaptation in maintaining upright posture, and this situation causes impaired postural stability and decreased dynamic stability in patients with a BMI of 40 and above. In our study; the high FES-I and FRI scores we detected in the study group, are consistent with the literature.

Owusu et al.[28] reported that hip and wrist fractures among 43 053 men aged 40–75 years increased in relation to waist circumference and waist-to hip ratio. In our study, when all patients including the control group were evaluated, a statistically significant positive correlation was found between FRI and waist, hip circumference measurements. When only the patient group was evaluated, there was a statistically significant positive correlation between the number of falls in the last 1 year and waist circumference. These are consistent with the results of Owusu et al.[28]

CONCLUSION

Postural stability is an essential prerequisite for many physical activities in daily life. Obesity is a disease that causes many complications by disrupting the biopsychosocial well-being of a person. The main result of our study is that morbid obesity negatively affects FRI, which is an important dynamic stability indicator. We recommend the implementation of rehabilitation programs focused on dynamic tasks for postural balance training in obese patients.

ETHICAL DECLARATIONS

Ethics Commite Approval: Ethical approval was obtained from Tokat Gaziosmanpaşa University Faculty of Medicine Ethics Committee (approval number: 21.11.2018/18-KAEK-224) for our study.

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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