Original Article

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# The Effect of Weight Loss on Osteoarthritis Symptoms in Obese Patients with Osteoarthritis

## Osteoartriti Olan Obez Bireylerde Ağırlık Kaybının Osteoartrit Semptomlarına Etkisi

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## ABSTRACT

**Objective:** Knee osteoarthritis (OA) is a very common joint disease and obesity is accepted as a modifiable risk factor for knee OA. This study aims to reduce OA symptoms with dietary intervention that will provide at least 10% body weight loss in volunteers diagnosed as having knee OA and obesity.

**Methods:** As an open, uncontrolled randomized study, it was conducted with patients admitted to İstanbul Fatih Sultan Mehmet Hospital. Fourty volunteers (mean of age: 58±10.9 years, 4 males, 36 females) having knee OA grade ≥2 according to Kellgren-Lawrence radiological classification and obesity [body mass index (BMI) ≥30 kg/m$^2$] were included in the study. Individuals were given a diet program containing 50-60% carbohydrate, 15-20% protein and 25-30% fat for 16 weeks, and they were planned to lose weight and followed up. WOMAC OA index was used for the evaluation of pain, stiffness and physical functions.

**Results:** After 16 weeks, individuals lost an average of 7.5% of their weight. A decrease of 2.75 kg/m$^2$ was observed in the BMI ($p<0.05$). A significant reduction was observed between the first and the last WOMAC pain scores ($p<0.05$). A significant relationship was also found between the decrease in BMI and the decrease in WOMAC score ($p<0.05$).

**Conclusion:** The decrease of 2.75 kg/m$^2$ in BMI and the weight loss of 7.5% provided decrease in WOMAC pain score. Weight

## ÖZ

**Amaç:** Diz osteoartriti (OA), oldukça yaygın olarak görülen bir eklem hastalığıdır ve obezite diz OA'sı için değiştirilebilir bir risk faktörü olarak kabul edilmektedir. Bu araştırmanın amacı; diz OA ve obezite tanısı almış gönüllü bireylerde diyet müdahalesi ile en az %10 vücut ağırlığı kaybı gelişmesi ve OA semptomları arasındaki ilişkinin saptanmasıdır.

**Yöntemler:** Çalışma açık, kontrolsüz randomize bir araştırma olarak İstanbul Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi'ne başvuran hastalarla gerçekleştirildi. Çalışmaya Kellgren-Lawrence radyolojik sınıflamasına göre evre ≥2 diz OA'sına sahip, obezite [vücut kitle indeksi (VKİ) ≥30 kg/m$^2$] tanısı almış, yaş ortalaması 58±10,9 yıl olan, 4 erkek, 36 kadın olmak üzere 40 gönüllü birey dahil edildi. Bireylere 16 hafta boyunca %50-60 karbonhidrat, %15-20 protein ve %25-30 yağ içeren diyet programı verilerek hastaların ağırlık kaybetmeleri planlandı ve hastalar takip edildi. Ağrı, tutukluk ve fiziksel fonksiyonlarının değerlendirilmesinde WOMAC OA indeksi kullanıldı.

**Bulgular:** On altı hafta sonrasında bireyler ağırlıklarının ortalama %7,5'ini verdi. VKİ'de 2,75 kg/m$^2$ düzeyinde bir azalma saptandı ($p<0,05$). İlk ve son WOMAC ağrı skorları arasında anlamlı düşüş gözlendi ($p<0,05$). BKİ'nin azalması ile WOMAC puanının azalması arasında ise anlamlı bir ilişki bulundu ($p<0,05$).

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loss should be the optimal approach in the management of obese patients with knee OA.

**Keywords:** Obesity, osteoarthritis, BMI, diet, WOMAC

**Sonuç:** VKİ'de 2,75 kg/m$^2$ düzeyinde azalma ve %7,5 ağırlık kaybı WOMAC ağrı skorunun azalmasını sağlamaktadır. Ağırlık kaybı, diz OA'sı olan obez hastaların yönetiminde optimal yaklaşım olmalıdır.

**Anahtar sözcükler:** Obezite, osteoartrit, BKİ, diyet, WOMAC

## Introduction

Today, obesity is one of the most common diseases affecting lifestyle. Obesity is the leading cause of death in countries where the majority of the world's population lives. Although the incidence of obesity is constantly increasing, obesity is a preventable disease (1). Obesity significantly increases the risk of development of multiple diseases, including osteoarthritis (OA), which is the most common cause of severe disability among older people in the UK and North America. This situation is similar in Turkey (2).

Numerous studies confirmed the strong association between obesity and knee OA, which was first documented in 1945 (3-5). Obesity is considered as a risk factor for knee OA and every 5 kg increase in body mass increases the risk of OA by 35% (6). Many studies have shown that with advancing age, the burden of chronic musculoskeletal disorders such as OA increases. OA is the most common type of arthritis that affects older individuals. It is a degenerative joint disease that can affect any joint in the body and cause chronic pain, functional restriction and emotional discomfort, and it adversely affects quality of life and causes disability (7). Both obesity and OA reduce mobility in individuals. With the decrease in mobility, energy expenditure decreases and as a result, body weight increases. Increased body weight causes the symptoms of OA to be aggravated and thus to a decrease in mobility. This vicious cycle is an important problem in the treatment of obese patients with OA. For this reason, reducing and controlling body weight have an important place in OA treatment among the steps of non-drug treatment and they are recommended in numerous treatment guidelines (8).

The purpose of this study was to examine the effects of providing at least 10% weight loss with healthy dietary intervention on OA symptoms in voluntary individuals over 40 years of age who were diagnosed as having knee OA (K-L ≥2) and obesity [body mass index (BMI) ≥30 kg/m$^2$].

## Method

The research was an open, uncontrolled and randomized study. This study was conducted with the patients who were diagnosed as having knee OA and obesity in the Orthopedics and Traumatology Outpatient Clinic of İstanbul Fatih Sultan Mehmet Training and Research Hospital between June 2018 and March 2019 with the approval of Clinical Research Ethics Committee of İstanbul Fatih Sultan Mehmet Training and Research Hospital.

### Individuals

Fourty voluntary individuals who were diagnosed as having knee OA and obesity and who were admitted to the clinic and approved the voluntary form were randomly included in the study.

Patients who were diagnosed as having OA according to the criteria of the American Association of Rheumatology (ACR), were over 40 years old, had a BMI of 30 kg/m$^2$ and above, had a diagnosis of OA for at least 6 months, and had at least Ggrade 2 OA according to the Kellgren-Lawrence (K-L) Evaluation in the radiographs taken over the last 6 months, were included in the study. Patients who had a operation for knee or hip, received physical therapy in the last 3 months, had intraarticular injection to the knee or hip joint in the last 3 months, suffered severe physical trauma in the last 3 months, or had severe psychological trauma in the last 3 months, were excluded from the study. Among the patients who were included in the study, patients who underwent a surgical operation, did not apply the diet program for 1 month, or had physiotherapy or intraarticular injection to the knee joint were excluded from the study. Firstly, 40 volunteers were questioned in terms of age, gender, height, BMI, chronic diseases, continuous medications, food consumption, cigarette and alcohol consumption. Body analysis and weight change follow-up of individuals were performed with TANITA MC 780ST model body analyzer.

### WOMAC Osteoarthritis Index

The WOMAC OA Index was used to evaluate pain, stiffness and physical functions of the individuals. WOMAC is a valid, reliable criterion specific to OA and includes 24 questions in three subheadings: pain, stiffness and physical function. Each question is scored on the Likert scale from 0 to 4 (0 = none, 1 = mild, 2 = moderate, 3 = severe, 4 = very severe). The score of each section is calculated within itself, and the total score ranges from 0 to 100. High scores indicate increased pain and stiffness and impaired physical function (9). The WOMAC OA index was applied twice to individuals as at the beginning of the study and after 16 weeks.

### Diet Program

According to the results of the anthropometric measurements, a healthy diet program was administered by the dietician, with which individuals could lose at least 10% of their body weight for 16 weeks. In this diet program, a healthy weight loss program was prepared by calculating the daily energy needs according to the weight, Basal Metabolic Rate value, gender, age and comorbidities of OA patients. The energy distribution of this

diet program consisted of an average of 50-60% carbohydrates, 15-20% protein and 25-30% fat according to the needs of the individual (10). The individuals participating in the study were followed up with weekly and monthly controls and energy changes were made and weight loss of at least 10% in 16 weeks was targeted.

**Radiological Evaluation**

Lateral and anterior-posterior graphs of the right and left knees of the individuals included in the study were classified by the specialist radiologist according to the radiological classification of K-L. The OA grades are as follows:

- Grade 0: Normal,
- Grade 1: Suspected osteophytes, normal range of joint,
- Grade 2: Significant osteophyte, suspected narrowing of joint gap,
- Grade 3: Moderate osteophytes, moderate narrowing of the joint gap, mild sclerosis,
- Grade 4: Large osteophytes are identified as advanced narrowing of the joint gap, pronounced subchondral bone sclerosis, cysts.

The patients' weight, BMI, body fat and muscle mass percentage, WOMAC scores and K-L grades were recorded in the follow-up forms of monthly periods.

**Statistical Analysis**

Averages of continuous variables, standard deviation and median; the frequency and percentages of categorical variables were calculated. For data showing normal distribution; the Independent Sample t-test and the Dependent Sample t-test were used to compare the previous and subsequent measurements. For data not showing normal distribution; The Mann-Whitney U test was used to compare the previous and subsequent measurements, and the Wilcoxon test was used to compare the previous and subsequent measurements. Spearman Rank Differences Correlation analysis and McNemar test were used to examine the relationship between the data. The SPSS 21 (Statistical Package for the Social Sciences) package program was used for the data analysis. The analysis was tested for 95% confidence and 5% error margin. Statistically, the limit of significance was considered $p<0.05$.

## Results

This study which was carried out to examine the effect of weight loss on disease symptoms in individuals diagnosed as having obesity and knee OA, was conducted with a total of 40 adult volunteers, including 36 women and 4 men, between June 2018 and March 2019. Individuals voluntarily attended to the 16-week weight loss program in a period between these dates. The ages of individuals ranged from 40 to 80 years, and their average age was 58±10.90 years.

Regarding the anthropometric measurements of the individuals, mean body weight was determined as 91.2±15.76 kg, mean BMI as 36.96±4.49 kg/m$^2$, average body fat percentage as 39.14±4.23%, and average muscle mass percentage as 57.85±4.05%. Considering the anthropometric measurements after 16 weeks, mean body weight was determined as 84.34±14.78 kg, mean BMI as 34.21±4.51 kg/m$^2$, mean body fat percentage as 36.93±5.46%, and mean muscle mass percentage as 59.88±5.23. Individuals lost an average of 7.52±3.5% of their body weight in 16 weeks. While the highest body weight loss percentage was 18.2%, it was determined that one of the individuals gained body weight of 1.7% without weight loss (Table 1).

In terms of the classifications by their BMI, 37.5% of the patients were obese in the first degree, 37.5% were obese in the second degree, and 25% were morbidly obese at the beginning of the study. According to K-L radiological evaluation, 60% of the individuals were diagnosed as having grade 2 and 40% as grade 3 OA.

When the initial WOMAC OA indexes of the individuals were evaluated, the mean value was found to be 45.25±21.94 points. When the WOMAC OA indexes were evaluated after 16 weeks, the mean value was found to be 28.44±18.93 points. When the difference between the first and the last WOMAC OA indexes of the individuals was examined, the average pain scores decreased by 16.81±11.02 points (Table 1). According to the results of the WOMAC test, which was administered at the beginning and after 16 weeks, in consideration of the individuals' pain scores; it was detected that 35% of the patients had a 1-10 scoring decrease, 30% had a 10-20 scoring decrease, 15% had a 20-30 scoring decrease, 17.5% had a 30-40 scoring decrease, and 2.5% had a 40-45 score decrease.

**Table 1.** Differences between the initial and final anthropometric measurements and WOMAC OA index scores

| Weight (kg) | Mean | sd | Min | Max |
|---|---|---|---|---|
| Initial | 91.2 | 15.76 | 69.9 | 151.9 |
| Final | 84.34 | 14.78 | 61.5 | 138.7 |
| **BMI (kg/m$^2$)** | | | | |
| Initial | 36.96 | 4.49 | 30.4 | 48.4 |
| Final | 34.21 | 4.51 | 27.0 | 45.1 |
| **Body fat (%)** | | | | |
| Initial | 39.14 | 4.23 | 27.9 | 47.7 |
| Final | 36.93 | 5.46 | 23.2 | 50.5 |
| **Muscle mass (%)** | | | | |
| Initial | 57.85 | 4.05 | 49.7 | 69.0 |
| Final | 59.88 | 5.23 | 47.0 | 73.0 |
| **WOMAC score** | | | | |
| Initial | 45.25 | 21.94 | 9.4 | 92.0 |
| Final | 28.44 | 18.93 | 3.0 | 84.0 |
| **WOMAC difference** | | | | |
| | 16.81 | 11.02 | 2.0 | 40.0 |
| **Weight loss (%)** | | | | |
| | 7.52 | 3.50 | -1.7 | 18.2 |

Min: Minimum, Max: Maximum

According to the results of the Wilcoxon test performed to determine whether there was a difference between the initial score of the WOMAC OA index, BMI and muscle mass percentage, and their values after 16 weeks; a statistically significant difference was observed between two periods in terms of WOMAC OA index scores (Z = -5.51; p<0.05), BMI values (Z = -5.50; p<0.05) and muscle mass percentage (Z = 4.70; p<0.05) (Table 2).According to the result of the Dependent sample t-test conducted to determine whether there was a difference between the calculated body fat percentage (%) before and after the diet of individuals and the body fat percentage (%) after 16 weeks; a statistically significant difference was observed [t (39) = 6.21; p<0.05] (Table 2).

According to the result of Mann-Whitney U test conducted to investigate whether there was a difference between groups in terms of reduction in WOMAC OA index scores of individuals with grade 2 OA and grade 3 OA by means of K-L score, no statistically significant difference was observed (U= 137.00; p>0.05) (Table 2). Similar results were observed in the individuals with grade 2 OA and grade 3 OA.

According to correlation analysis, a statistically significant relationship between WOMAC OA index scores and weight loss in the 16-week weight loss process of individuals was not found (p>0.05). There was a statistically significant positive mid-level correlation between decreased WOMAC OA index scores of individuals and decreased BMI (p<0.05) (Table 3).

Statistically significant positive intermediate relationship between the age of individuals and the first WOMAC pain scores and recent WOMAC pain scores (p<0.05), and statistically significant positive intermediate relationship between the initial WOMAC pain scores of individuals and the initial weights were found (p<0.01) (Table 3).

According to the results of the McNemar test, it was observed that there was a statistically significant difference between the WOMAC pain scores of the individuals at baseline and after 16 weeks (p<0.01). The WOMAC pain score of 12 individuals was above 30 and after the diet, it decreased below 30 (Table 4).

**Table 2.** Changes in WOMAC, BMI, muscle mass percentage, body fat percentage and K-L grades after the diet was applied

| | n | Z | p |
|---|---|---|---|
| **WOMAC difference *** | | | |
| | 40 | -5.51 | .00 |
| **BMI difference *** | | | |
| | 39 | -5.50 | .00 |
| **Muscle mass percentage difference*** | | | |
| | 32 | -4.70 | .00 |
| | n | t | p |
| **Body fat percentage difference**** | | | |
| | 40 | 6.21 | .00 |
| | n | U | p |
| **K-L degree ***** | | | |
| Grade 2 | 24 | 137.00 | 0.13 |
| Grade 3 | 16 | | |

*Wilcoxon test, **Dependent Sample t-test, ***Mann-Whitney U test

## Discussion

OA is the leading cause of chronic disability in elderly adults. Obesity and the age factor are important known risk factors for knee OA. These two factors cause an increase in disease symptoms, but obesity is a changeable risk factor (11). Decreased body mass through dietary intervention leads to significant improvements in knee OA, reduced degeneration, and improved quality of life. As a result of the study conducted by Aaboe et al. (12), it was found that the peak load on the knee decreased by 2.2 kg with every 1 kg reduction in the body.

A statistically significant positive moderate correlation was found between the age of individuals and the first WOMAC pain scores and the last WOMAC pain scores (p<0.05). As the age increases, it can be stated that individuals' WOMAC pain scores may increase. As mentioned before, age is the most important risk factor for knee OA. In a study conducted by Atamaz et al. (13), it was shown that obesity, aging, female gender and advanced radiological grade were factors associated with pain and disability.

**Table 3.** Correlation analysis

| | n | r | p |
|---|---|---|---|
| **BMI difference correlation with weight difference correlation*** | | | |
| | 40 | 0.205 | 0.205 |
| **BMI difference correlation with WOMAC difference*** | | | |
| | 40 | 0.307 | **0.044** |
| **Age correlation with first WOMAC*** | | | |
| | 40 | 0.362 | **0.022** |
| **Age correlation with last WOMAC*** | | | |
| | 40 | 0.461 | **0.003** |
| **Weight correlation with first WOMAC*** | | | |
| | 40 | 0.409 | **0.009** |

*Spearman Rank Correlation Coefficient Analysis was applied

**Table 4.** Comparison of the initial and subsequent WOMAC pain scores

| | | First WOMAC score * | | Total | p |
|---|---|---|---|---|---|
| | | <30 points | >30 points | | |
| Last WOMAC score * | <30 points | 11 | 12 | 25 | **0.000** |
| | | 44.0% | 56.0% | 100.0% | |
| | >30 points | 0 | 15 | 7 | |
| | | 0.0% | 100.0% | 100.0% | |
| **Total** | | 11 | 29 | 40 | |
| | | 100.0% | 100.0% | 100.0% | |

*McNemar test was applied

When the disease conditions of individuals were examined, it was observed that 22.5% of the individuals had diabetes, 50% had hypertension, 27.5% hypercholesterolemia and 15% had hypothyroidism.

When individuals were classified according to BMI, 37.5% were found to be first degree obese, 37.5% as second degree obese and 25% as morbid obese. In a study by Reyes et al. (14), it was reported that being overweight increased the knee OA risk 2 times, being first degree obese 3.1 times, and being second degree obese 4.7 times. Similar results were obtained in this study, and it was observed that the WOMAC pain score increased due to the increase in body weight ($p<0.01$).

According to K-L radiological evaluation, 60% of the individuals were diagnosed as having grade 2 OA and 40% grade 3 OA. There was no statistically significant difference between individuals with grade 2 OA and grade 3 OA in terms of the WOMAC OA pain scores ($p>0.05$). Individuals diagnosed as having grade 2 OA and grade 3 OA had similar pain scores. This could be due to the fact that there were no patients diagnosed as having grade 1 OA and grade 4 OA in the study group.

Anthropometric measurements of the individuals were evaluated after 16 weeks. The average body weight loss of individuals was 6.86 kg and the average BMI loss was 2.75 kg/m$^2$ ($p<0.05$). Body fat was decreased by 2.22% ($p<0.05$), and muscle mass was increased by 2.03% ($p<0.05$) after 16 weeks. In a study by Bartels et al. (15), 13.6 kg loss was achieved by using diet intervention in obese patients with knee OA in 16 weeks. In another study, 12.8 kg loss was achieved in 16 weeks (16). It was found that individuals who participated in the study lost an average of 7.5% of their body weight with dietary intervention within a 16-week period. In the patient group with a BMI average of 36 kg/m$^2$, Aaboe et al. (12) achieved an average of 13.5% reduction in body weight with diet in 16 weeks. The aim of the study was to achieve at least 10% weight loss in individuals, but it might be considered that individuals were unable to physically engage due to knee OA and could not reach the target due to their comorbidities.

The average WOMAC pain scores before dietary intervention in individuals was 45.3 points. In Tütün et al.'s (17) study, the mean BMI of 50 knee OA patients was 33.2 kg/m$^2$ and the average WOMAC pain score was 55.7 points. In the study of Doğan et al. (18), the average WOMAC pain score of 83 individuals with an average age of 59.5 years was 56.3 points. These data are similar to the current study, and although the WOMAC test is a subjective test, it is considered to be reliable.

The individuals lost an average of 7.5% of their body weight during the study, and the difference between the first and last WOMAC pain scores decreased significantly ($p<0.05$). There was a positive moderately significant correlation between the reduction of BMI in the 16-week diet intervention process and the reduction of WOMAC pain scores ($p<0.05$). A reduction of 2.75 kg/m$^2$ in BMI may reduce WOMAC pain. In the case report presented by Sevinç (19) in 2014, significant decrease in WOMAC pain score and increase in physical activity were observed in the female individual whose BMI decreased from 40 kg/m$^2$ to 32.5 kg/m$^2$.

In many cohort studies, it has been shown that after bariatric surgery, body weight loss improves symptoms of knee OA, quality of life and daily activities (20-23). In addition, it was shown that the development of postoperative complications after total knee arthroplasty was less in morbid obese patients who underwent bariatric surgery than in morbid obese patients who did not undergo bariatric surgery (24).

As a result of the research, individuals achieved 7.5% weight loss showed a significant difference in WOMAC pain scores and individuals did not have to achieve at least 10% weight loss. In a study conducted by Messier et al. (25), it was reported that 5% weight loss reduced pain, improved function and increased activity. While at the beginning of this study, the WOMAC pain score of 12 individuals was above 30, it decreased to less than 30 after dietary intervention.

### Study Limitations

Most of the individuals participating in the study verbally reported that their knee pain decreased, their physical activity increased, their eating habits changed, and their quality of life improved.

## Conclusion

As a result; obesity is a risk factor for the progression of OA, increases the incidence of OA and adversely affects the outcome of the disease. Weight loss might relieve knee OA symptoms, improve functions and improve quality of life. Weight loss and exercise should be the optimal approach in managing obese patients with OA. Individuals were not required to lose at least 10% weight. A decrease in BMI of 2.75 kg/m$^2$ and a weight loss of 7.5% resulted in a statistically significant decrease in WOMAC pain score. For all obese patients with OA, it may be recommended to lose at least 5% of body weight. Typically, arthritis is treated when overweight or obese patients are admitted with symptomatic OA, but the underlying diseases are not treated.

Fighting against both obesity and OA as an ideal treatment approach and providing weight loss will be an important step in treating this globalizing problem. Treatment of patients with a multidisciplinary approach involving physicians, dieticians, physiotherapists and nurses may play a significant role in the coming years and is thought to improve the overall health of the patient and to help reduce the healthcare expenditure at the same time.

### Ethics

**Ethics Committee Approval:** This study was conducted with the patients who were diagnosed as having knee OA and obesity in the Orthopedics and Traumatology Outpatient Clinic of Fatih Sultan Mehmet Training and Research Hospital between June 2018 and March 2019 with the approval of Clinical Research Ethics Committee of İstanbul Fatih Sultan Mehmet Training and Research Hospital.

**Informed Consent:** Obtained.

**Peer-review:** Externally peer reviewed.

**Authorship Contributions**

Concept: N.D., M.A., Design: N.D., B.Y., Data Collection or Processing: N.D., Analysis or Interpretation: N.D., B.Y., Literature Search: N.D., Writing: M.A.

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