



# Effect of ozone therapy added to the diet in the treatment of obesity\*

## Obezite tedavisinde diyetle eklenen ozon terapinin etkisi

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### ABSTRACT

**Aim:** This study aimed to investigate the effects of the recommended weight loss diet and ozone therapy in the treatment of obesity on biochemical parameters related to weight loss and lipid and carbohydrate metabolism. **Materials and Methods:** With the approval of the ethics committee, it was carried out with 40 obese patients who applied to a Training and Research Hospital in Istanbul with weight problems. Diet therapy was applied for one month to the patients divided into two groups. One group, unlike the other, was given an ozone capsule to be consumed in the morning on an empty stomach. The effectiveness of the treatment was examined taking biochemical values and anthropometric measurements of the patients at the baseline and after one month. **Results:** There was a significant decrease in weight, body mass index, waist circumference, VLDL cholesterol and triglyceride values in the Diet and Diet + Ozone group at the baseline and at the end of one month ( $p < 0.01$  for each). A significant decrease was observed in the initial LDL cholesterol values only in the diet group at the end of the first month ( $p < 0.01$ ). **Conclusion:** As a result, it was found that there was a significant decrease in body weight, BMI, fat percentage, waist circumference, hip circumference, total cholesterol and LDL measurements in the Diet and Diet + Ozone group, while the change was slightly higher in the ozone therapy group.

### ÖZ

**Amaç:** Bu çalışma, obezite tedavisinde önerilen zayıflama diyeti ve ozon tedavisi uygulamasının ağırlık kaybı ve lipid ve karbonhidrat metabolizmasıyla ilişkili biyokimyasal parametreler üzerine etkilerini incelemek amaçlanmıştır. **Gereç ve Yöntem:** Etik kurul onayı alınan bu çalışma, İstanbul'daki bir Eğitim ve Araştırma Hastanesi'ne başvuran kırk obez hasta ile yürütülmüştür. Hastalar iki gruba ayrılarak bir ay boyunca diyet tedavisi uygulanmıştır. Bir gruba, diğer gruptan farklı olarak, sabah aç karnına tüketilmek üzere ozon kapsülü verilmiştir. Tedavinin etkinliği, hastaların başlangıçta ve bir ay sonra antropometrik ölçümleri ve biyokimyasal değerleri alınarak incelenmiştir. **Bulgular:** Diyet ve Diyet + Ozon grubunda başlangıçta ve bir ay sonunda vücut ağırlığı, beden kütle indeksi, bel çevresi, VLDL kolesterol ve trigliserid değerlerinde anlamlı bir azalma görülmüştür (her biri için  $p < 0,01$ ). Sadece diyet grubunda, ilk ayın sonunda başlangıç LDL kolesterol değerlerinde anlamlı bir düşüş gözlenmiştir ( $p < 0,01$ ). **Sonuç:** Sonuç olarak, Diyet ve Diyet + Ozon grubunda kilo, BKİ, yağ yüzdesi, bel çevresi, kalça çevresi, toplam kolesterol ve LDL ölçümlerinde anlamlı bir düşüş olduğu, ozon tedavisi grubunda ise değişimin daha fazla olduğu bulunmuştur.

### Key Words:

Diet, Dyslipidaemia, Obesity, Ozone Therapy, Weight Loss

### Anahtar Kelimeler:

Ağırlık Kaybı, Dislipidemi, Diyet, Obezite, Ozon Tedavisi

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## INTRODUCTION

Obesity, as a serious global health problem, should be managed through individualized treatment plans, preferably evaluated by a multidisciplinary team, with careful consideration of the intervention's safety, efficacy, and cost. An adequate and balanced nutrition approach is emerging as a safe, effective, and sustainable option for obesity treatment (Sundbom et al., 2024). While obese individuals may appear to have adequate nutritional intake, they often experience nutritional deficiencies due to their preference for unhealthy, high-fat, and high-carbohydrate foods. Therefore, the program should consider factors such as food composition, energy distribution between meals, and the volume created in the stomach by the selected foods, ensuring an appropriate feeling of satiety. (Kızıltan & Saka, 2018). Given that the vast majority of patients with type 2 diabetes are obese, obesity is considered one of the most consistent comorbidities that increase the risk of developing diabetes (Chandrasekaran & Weiskirchen, 2024).

Ozone therapy is a form of treatment in which ozone gas is applied for therapeutic purposes using various methods. It can be administered systemically or locally, depending on the desired effects on the body. Both parenteral routes (intravenous, intra-arterial, intramuscular, subcutaneous, intra-articular, and intrapleural) and local routes (nasal, oral, intradiscal, vaginal, colorectal, and cutaneous) can be used in ozone therapy (Kesikburun & Yaşar, 2017). Ozone, primarily in gaseous form, can be administered in various forms, including ozonated oils and ozonated water, making it versatile in various clinical situations (Rezaeianjam et al., 2025). It is combined with carrier oils, such as olive oil, to extend its half-life, allowing ozone to be administered orally in stomach-resistant capsules. (Ugazio et al., 2020). Ozone exerts multifaceted biological effects on various organs and systems of the body. In the context of obesity, it is thought to stimulate lipolysis in adipocytes, thereby accelerating the metabolism of subcutaneous fat tissue and potentially contributing to body weight regulation (Sherov, 2022). Additionally, ozone helps reduce hyperglycemia and contribute to diabetes management by increasing the more effective transport and metabolism of glucose into cells (Tapia & Sánchez, 2012).

This study aims at investigating the effects of the weight-loss diet recommended for the treatment of obesity and the ozone therapy applied with ozonated olive oil capsule added to the diet on the biochemical parameters associated with weight loss and lipid and carbohydrate metabolism.

## METHODS

### Participants

The study was conducted 40 patients with a BMI  $\geq 30$  kg/m<sup>2</sup>, who applied to the University of Health Sciences, Sultan Abdulhamid Han II Training and Research Hospital Traditional and Complementary Medical Application Centre with a weight problem and signed the voluntary consent form receiving information about the study. Pregnant women, those with uncontrolled hypertension and individuals with glucose 6 phosphate dehydrogenase deficiency (favism) were excluded from the study.

### Measurements

After taking the general history taking of the patients included in the study, first of all, anthropometric measurements and blood values were checked. The height of the participants was measured with a wall-mounted height meter while standing without shoes. Waist (midpoint

between the lowest rib and iliac bone) and hip (the widest circumference when viewed from the side of the individual) were measured using a rigid tape measure. Body composition measurements (muscle mass, fat percentage) were performed using Tanita 580 (Tartı Medikal, Istanbul, Turkey) body analysis measuring device, which works with the BIA method. HbA1c, triglyceride and cholesterol (HDL, LDL and Very Low Density Lipoprotein (VLDL) cholesterol) as biochemical parameters in blood taken from patients were analysed in the biochemistry laboratory of University of Health Sciences Sultan Abdulhamid Han II Training and Research Hospital.

## **Interventions**

A weight-loss diet program was prepared in accordance with the dietary principles of all patients included in the study, according to their age, gender and diseases.

-Diet group (n:20): Anthropometric measurements and blood samples were collected, and participants underwent a one month personalized diet program.

-Diet+Ozone group (n:20): Following the collection of anthropometric measurements and blood samples, participants underwent a one month personalized diet program. In addition, they were instructed to swallow two ozonated olive oil capsules without chewing every morning on an empty stomach with a glass of water, and to consume a diet-appropriate breakfast 10 minutes later. The capsules are approved as a food supplement by the Ministry of Agriculture and Forestry (Good and Health Laboratories, Mert Cosmetics, Izmir, Turkiye). In terms of compliance to the study, the patients were called both on the 15th day by phone and a phone number was also provided to them so that they could contact the researchers if needed. Since all of the patients were obese individuals with BMI  $\geq 30$  kg/m<sup>2</sup>, the body weights to be used in basal metabolic rates was calculated by using the ideal weight that should be and the current weights. Basal metabolic rate (BMR) by gender was calculated using the Herreris-Benedict formula and the daily calorie needs of individuals were calculated by adding the physical activity factor to the determined BMR. Then, a program was written with appropriate calories by reducing calories in a way to lose one kg of weight per week.

## **Statistical Analysis**

SPSS 24.0 program was used for statistical analysis. While evaluating the study data, Pearson correlation analysis as well as descriptive statistical methods (Mean, Standard Deviation, Median, Frequency, Ratio, Minimum, Maximum) were used to analyse the relationship between the scales. Wilcoxon Signed Rank Test was used for comparisons of non-normally distributed two-time follow-up measurements. Mann-Whitney U Test was used for the comparison of two groups that did not show normal distribution. Significance was evaluated at  $p < 0.01$  and  $p < 0.05$  levels.

## **RESULTS**

The descriptive statistics of the individuals participating in the study are given in Table 1. Diet+Ozone group genders were 40% (n=8) male and 60% (n=12) female, with a mean age of  $41.5 \pm 13.5$  years and a height of  $165.6 \pm 9.6$ . The genders of the diet group were 35% (n=7) male and 65% (n=13) female, with a mean age of  $49.7 \pm 8.4$  years and a height of  $165 \pm 10.5$ .

**Table 1.** Descriptive Statistics

	n	Diet+Ozone	Diet
Female	25	12	13
Male	15	8	7
Total	40	20	20
Age	Mean±SD	41.5±13.5	49.7±8.4
	Min-Max (Median)	16-65(44)	35-67(48)
Height	Mean±SD	165.6±9.6	165±10.5
	Min-Max (Median)	149-181(163)	142-183(162)

The comparison of the anthropometric measurements of the groups at the baseline and at the end of the 1st month is given in Table 2. According to the initial weight, body mass index, waist circumference and fat percentage measurements, the decrease observed in the Diet+Ozone and Diet groups at the end of the first month was statistically significant ( $p=0.001$ ;  $p<0.01$ ). According to the initial waist/hip ratio measurement, the change in the Diet+Ozone and Diet groups at the end of the 1st month was not found statistically significant ( $p>0.05$ ). According to the initial muscle mass measurement, the decrease in the Diet+Ozone group at the end of the 1st month was statistically significant ( $p=0.042$ ;  $p<0.05$ ), while the change in the Diet group was not found statistically significant ( $p>0.05$ ).

**Table 2.** Evaluation of Anthropometric Measurements

	n	Mean±Sd	Min-Max (Median)	Difference	ap	
Body Weight						
Diet+Ozone	Baseline	20	98,6±21,5	74,1-144,5 (92)	3,69±2,97	0,001**
	1st Month	20	94,9±21,3	68,6-144,5 (88,7)		
Diet	Baseline	20	99,2±13,1	74,7-124,1 (95,8)	2,01±1,64	0,001**
	1st Month	20	97,2±12,4	72-119 (96,35)		
Body Mass Index						
Diet+Ozone	Baseline	20	35.7±5.7	30.1-48.3 (33.5)	1.41±1.09	0.001**
	1st Month	20	34.3±5.5	28.6-48 (32.7)		
Diet	Baseline	20	36.4±3.6	31.5-45.2 (35.85)	0.78±0.62	0.001**
	1st Month	20	35.7±3.4	30.4-43.4 (35.1)		
Waist Circumference						
Diet+Ozone	Baseline	20	108.1±15.2	81-141 (105.5)	4.72±3.21	0.001**
	1st Month	20	103.3±14.5	78-138 (102)		
Diet	Baseline	20	110.5±9.5	90.5-123 (111.25)	3.03±2.84	0.001**
	1st Month	20	107.5±8.6	89-120 (108)		
Hip Circumference						
Diet+Ozone	Baseline	20	119.8±11.3	102-144 (118)	-4.48±3.69	0.001**
	1st Month	20	115.4±10.3	98-139 (114.75)		
Diet	Baseline	20	120.8±6.9	107.5-136 (119.5)	-1.75±2.94	0.015*
	1st Month	20	119.1±7.2	104-134 (117.75)		

**Table 2 (Continue).** Evaluation of Anthropometric Measurements

		n	Mean±Sd	Min-Max (Median)	Difference	<sup>a</sup> p
<b>Waist/Hip Ratio</b>						
Diet+Ozone	Baseline	20	0.9±0.1	0.71-1.06 (0.88)	0.01±0.04	0.451
	1st Month	20	0.9±0.1	0.73-1.08 (0.88)		
Diet	Baseline	20	0.9±0.1	0.78-1.03 (0.91)	0.01±0.02	0.072
	1st Month	20	0.9±0.1	0.78-0.99 (0.91)		
<b>Fat Percentage</b>						
Diet+Ozone	Baseline	20	37.4±6.7	27.5-52.7 (39.35)	1.6±1.28	0.001**
	1st Month	20	35.8±6.8	23.9-51 (37.25)		
Diet	Baseline	20	38.3±6	29.1-50.9 (38.9)	1.32±1.2	0.001**
	1st Month	20	37±6.3	27-49 (37)		
<b>Muscle Mass</b>						
Diet+Ozone	Baseline	20	58.3±12.2	42.6-83 (55.6)	-0.83±1.63	0.042*
	1st Month	20	57.5±12.2	43.3-83.1 (54.95)		
Diet	Baseline	20	58.4±11.4	44-77.7 (53.1)	0.21±1.05	0.295
	1st Month	20	58.2±11	43.5-78 (53.2)		

<sup>a</sup>Wilcoxon Signed Rank Test \*\*p<0.01 \*p<0.05

The comparison of the biochemical measurements of the groups at the baseline and at the end of the 1st month is given in Table 3. According to the initial HbA1c measurement, the change in the Diet+Ozone and Diet groups at the end of the 1st month was not found statistically significant ( $p>0.05$ ). The increase in HDL cholesterol measurement and the decrease in LDL cholesterol measurement in the Diet group at the beginning and at the end of the 1st month were found to be statistically significant ( $p<0.01$ ), while the changes in the Diet+Ozone group were not found statistically significant ( $p>0.05$ ). According to the initial VLDL cholesterol and triglyceride measurements, the decrease observed in the Diet+Ozone and Diet groups at the end of the 1st month was statistically significant ( $p<0.01$ ).

**Table 3.** Evaluation of Biochemical Measurements

		n	Mean±SD	Min-Max (Median)	Difference	<sup>a</sup> p
<b>HbA1c</b>						
Diet+Ozone	Baseline	20	5.8±1.1	4.7-8.9 (5.5)	0.2±0.51	0.119
	1st Month	20	5.6±0.7	4.4-7.3 (5.4)		
Diet	Baseline	20	6±1	4.9-9.4 (5.6)	0.14±0.29	0.061
	1st Month	20	5.8±0.8	4.9-8.5 (5.55)		
<b>HDL</b>						
Diet+Ozone	Baseline	20	42.5±10	30-70 (40)	0.2±5.86	0.837
	1st Month	20	42.3±10	30-59 (43)		
Diet	Baseline	20	40.7±8.1	29-56 (39.5)	-2.05±3.02	0.009**
	1st Month	20	42.8±7.2	32-54 (41.5)		

**Table 3 (Continue).** Evaluation of Biochemical Measurements

		n	Mean±SD	Min-Max (Median)	Difference	<sup>a</sup> p
<b>LDL</b>						
Diet+Ozone	Baseline	20	137.4±45.6	75-289 (137)	6.48±20.3	0.117
	1st Month	20	131±38.1	54-235 (120)		
Diet	Baseline	20	149.7±29.5	79-214 (149.5)	11.13±15.97	0.010*
	1st Month	20	138.6±35.6	70-233 (131)		
<b>VLDL</b>						
Diet+Ozone	Baseline	20	30.7±17.7	0.92-80.4 (24.9)	7.56±10.07	0.006**
	1st Month	20	23.1±13.5	0.94-58.6 (19.1)		
Diet	Baseline	20	50.5±52	9.6-258.8 (35.6)	7.03±14.28	0.009**
	1st Month	20	43.5±40.2	7.9-200 (34.7)		
<b>Total Cholesterol</b>						
Diet+Ozone	Baseline	20	211.5±50.6	147-365 (210.5)	14.9±23.78	0.012*
	1st Month	20	196.6±45.1	101-310 (195)		
Diet	Baseline	20	238.1±51.1	137-389 (229.5)	14.15±19.62	0.006**
	1st Month	20	223.9±54.7	127-375 (216)		
<b>Triglyceride</b>						
Diet+Ozone	Baseline	20	158.1±82.7	60-402 (124.5)	36.8±49.9	0.005**
	1st Month	20	121.3±62.2	61-293 (100.5)		
Diet	Baseline	20	268.7±273	48-1294 (178)	28.55±51.25	0.006**
	1st Month	20	240.2±235	45-1100 (173.5)		

<sup>a</sup>Wilcoxon Signed Rank Test \*\*p<0.01 \*p<0.05

In Table 4, the percentages of decrease or increase in the data at the end of the 1st month were calculated and compared according to the groups. Change rates of weight, BMI, waist/hip ratio, fat percentage, muscle mass, HbA1c, HDL, LDL, VLDL, total cholesterol and triglyceride measurements between Diet+Ozone and Diet groups were not found statistically significant ( $p>0.05$ ). The rate of change in waist circumference between the Diet+Ozone and Diet groups was statistically significant ( $p=0.049$ ;  $p<0.05$ ). This rate was higher in the Diet+Ozone group. The rate of change in hip circumference between the Diet+Ozone and Diet groups was statistically significant ( $p=0.023$ ;  $p<0.05$ ). This rate was higher in the Diet+Ozone group.

**Table 4.** Evaluation of Percentage Changes in Diet+Ozone and Diet Groups

Percentage Change	Diet+Ozone Group		Diet Group		Z	<sup>b</sup> p
	Mean±SD	Min-Max (Median)	Mean±SD	Min-Max (Median)		
Body Weight	3,8±2,8	0-8,4 (3)	2,0±1,5	-1,1-4,3 (2,1)	-1,854	0,064
BMI	3,8±2,8	0-8,3 (2,9)	2,0±1,5	-0,8-4,3 (2,2)	-1868	0,062
Waist	4,3±2,6	0,5-9,8 (3,7)	2,7±2,4	-1,7-7,5 (2,7)	-1,935	0,049*
Hip	3,7±2,7	-0,8-11,8 (3,4)	1,6±2,4	-5-4,7 (1,7)	-2,274	0,023*
Waist/Hip	1,1±4,2	-10,2-9 (1,7)	1,3±3,2	-5,5-7,8 (1,2)	-0,271	0,799

**Table 4 (Continue).** Evaluation of Percentage Changes in Diet+Ozone and Diet Groups

Percentage Change	Diet+Ozone Group		Diet Group		Z	bP
	Mean±SD	Min-Max (Median)	Mean±SD	Min-Max (Median)		
Body Fat	4,4±4	-2,3-14,4 (4,5)	3,9±3,0	-1,4-11,2 (3,6)	-0,514	0,620
Muscle mass	1,5±2,7	-3,7-7,5 (1,3)	0,8±1,6	-2,3-4,5 (0,9)	-0,893	0,383
HbA1c	2,6±6,5	-3,9-20,2 (0,9)	2,0±4,2	-5,2-9,6 (1,8)	-0,311	0,758
HDL	0,2±13,4	-27,7-20,5 (3)	-5,3±8,3	-18,8-7,1 (-4,7)	-1,867	0,063
LDL	3,3±15,8	-42,1-28 (6,9)	7,9±10,3	-8,9-26,9 (9,4)	-0,609	0,547
VLDL	17,9±25,8	-26,7-64,6 (21,6)	7,5±21,4	-66,7-37,4 (10,8)	-1,434	0,157
Total Cholesterol	6,5±12,7	-31,3-32,2 (7,7)	6,3±7,8	-13,7-19,8 (6,9)	-0,122	0,904
Triglyceride	17,9±25,8	-26,7-64,6 (21,6)	7,5±21,4	-66,7-37,4 (10,8)	-1,434	0,157

<sup>b</sup>Mann Whitney U Test

\*p&lt;0,05

## DISCUSSION

Obesity, which is increasing day by day, brings with it different health problems and impaired blood findings. In parallel with the increase in obesity, studies on its prevention and treatment are also increasing. In the treatment of this disease, some supplements can be used to support the treatment, in addition to the nutritional programs applied as the basis.

In a study conducted at the Diabetes Polyclinic of Istanbul Training and Research Hospital in order to see how obesity affects the lipid profile in diabetic individuals, it was determined that as BMI values increase, total cholesterol, LDL cholesterol and triglyceride values also increase, while HDL cholesterol values decrease (Özdoğan et al., 2015). In our study, as BMI values decreased, a significant decrease was observed in VLDL cholesterol, total cholesterol and triglyceride values, and a significant increase in HDL cholesterol values in the Diet group. The relationship between BMI values and some biochemical values was similar to the studies conducted. Studies have shown that there is a relationship between anthropometric measurement values of obese people and dyslipidaemia. Obesity is characterized by decreased HDL-cholesterol level and increased triglyceride, LDL cholesterol and total cholesterol level.

Hernandez et al., in their study conducted by patients with cardiac infarction to see the effect of intravenous ozone therapy on serum lipid pattern and antioxidant defence system activity in patients with cardiac attack, reported a statistically significant decrease in total cholesterol and LDL cholesterol in patients who received 15 sessions of ozone therapy (Hernández et al., 1995). In a study conducted by Leszek et al. with 9 sessions of ozone therapy on chronic haemodialysis patients with lower extremity atherosclerotic ischemia to evaluate the effect of ozone therapy used in the treatment of lower extremity atherosclerotic ischemia on serum lipids and endothelial damage, a significant decrease was observed in total cholesterol and LDL cholesterol, and a significant increase in HDL cholesterol (Tylicki et al., 2004). In a study by Sroczynski et al. with rabbits with diet-induced atherosclerosis, a decrease in total cholesterol and LDL cholesterol was observed after intravenous ozone administration (Sroczynski et al., 1994). Lu et al., in their study with psoriasis patients in China Xiangya Hospital to see the effectiveness of ozone therapy in psoriasis, reported a decrease in total cholesterol and triglyceride, and an increase in HDL cholesterol after 10 sessions of ozone therapy. No change was found in LDL cholesterol (Lu et al., 2020). In the study by Moreno et al. conducted by 20 fibromyalgia patients in Spain to evaluate the effectiveness of ozone therapy in the treatment of fibromyalgia, glucose, total cholesterol, LDL cholesterol and triglyceride levels decreased and HDL cholesterol increased after 10 sessions of

ozone therapy (Moreno-Fernández et al., 2019). In our study, the decrease in VLDL cholesterol, total cholesterol and triglyceride values at the end of a 1-month period in the Diet + Ozone group treated with ozone treatment was found significant, while the change in HDL cholesterol and LDL cholesterol values was not significant. By increasing the amount of oxygen in the blood with vasodilator feature, ozone is thought to have a cholesterol-lowering effect and improve organ functions.

Morsy et al. in a study conducted in Egypt to examine the possible role of ozone therapy in improving oxidative stress and inducing renal antioxidant defence in diabetic rats induced by streptozotocin, reported a significant decrease in HbA1c values in rats treated with ozone (Morsy et al., 2010). In a 2-year study conducted by Rapone et al. in order to see the reducing effect of periodontal treatment on HbA1c values and to compare the effectiveness of standard periodontal treatment applied to reduce HbA1c values in patients with type 2 diabetes and the combined use of periodontal treatment and ozone treatment, HbA1c levels were measured at 3, 6, 9, and 12 months. While HbA1c values showed significant decreases in the case group at the 3rd and 6th months compared to the control group, the HbA1c level did not show a significant difference with a 7% decrease in the case group and a 6% decrease in the control group at the 12th month. These results were attributed to the local use effect of gaseous ozone. This study showed that ozone therapy was beneficial compared to conventional periodontal therapy in HbA1c reduction, although there was no significant difference (Rapone et al., 2020). In a study conducted by Martínez et al. to investigate and compare the therapeutic efficacy of ozone therapy in the treatment of patients with type 2 diabetes and diabetic feet, hyperglycaemia decreased and glucose concentrations were within the normal reference range in the ozone group after 20 days of treatment. The antidiabetic effect of ozone therapy was associated with the antioxidant property of ozone (Martínez-Sánchez et al., 2005). In the study by Tsevenmyadag et al. with patients diagnosed with type 2 diabetes in Wellness Med Hospital in Mongolia to see the results after ozone therapy in individuals diagnosed with diabetes, it was found that HbA1c decreased statistically significantly after 10-12 sessions of ozone treatment. This has been attributed to the multiple protective antioxidant effect of ozone (Tsevenmyadag et al., 2018). In our study, it was found that ozone therapy had a lowering effect on HbA1c values, but this was not statistically significant. When the studies were examined, it was seen that ozone therapy had a regulating effect on blood sugar.

In the study of Ciborowski et al. to see the effect of ozone therapy on human blood and the processes occurring, an increase in pyruvic and lactic acids was observed after ozonation of the blood. This situation was explained by increased glycolysis after ozonation (Ciborowski et al., 2012). In the study conducted by Xie et al. in rats weighing 300-360 g with diabetic retinopathy to investigate the effect of ozone on inflammatory cytokines in rats with diabetic retinopathy, it was found that there was no significant change in blood sugar, but a decrease in their weight after ozone treatment (Xie et al., 2016).

In a study conducted by Kızıltan and colleagues to investigate the antitumor and antiedema effects of ozone therapy applied at different concentrations and to assess the in vivo contribution of medical ozone therapy to radiotherapy outcomes, mice were divided into six groups. Groups 1 and 2 received medical ozone therapy for 10 days. Group 3 received 5 days of radiotherapy. Groups 4 and 5 received 10 days of ozone therapy and 5 days of radiotherapy. Groups 1 and 4 received ozone at = 20 mg/L concentration, while groups 2 and 5 at = 40 mg/L concentration. Group 6 was determined as the control group. Body weight and abdominal circumference of each mouse were measured before and after administration. After the treatment, there was a decrease in the

body weights of the 1st and 3rd groups, while an increase was observed in the 2nd and 5th groups. While there was a significant decrease in the abdominal circumference measurements of group 1, there was a significant increase in group 4. It has been reported that medical ozone therapy has an antiedema effect and this effect is seen with the decrease in body weight and abdominal circumference measurements in the 1st and 3rd groups (Kiziltan et al., 2015). As a result of our study, it was found that there was a significant decrease in weight, BMI, waist circumference, hip circumference and fat percentage measurements in the Diet + Ozone and Diet groups, while the change was slightly higher in the ozone group. According to studies conducted, ozone therapy is thought to help lose weight with its metabolism-accelerating effect.

## CONCLUSION

In this study, it was found that both the weight loss diet and the ozone capsules given in addition to the weight loss diet had a positive effect on the biochemical parameters associated with weight loss, lipid and carbohydrate metabolism. Blood parameters and anthropometric measurements examined following treatment were found to be statistically significant. The return of blood parameters to normal and the reduction in anthropometric values following treatment reduce the risk of obesity-related health problems. In conclusion, although higher differences were observed in some measurements in the ozone-treated group, more comprehensive studies with longer duration and increased number of volunteers are required to be able to suggest a conclusion about the effect of ozone therapy. Thus, the results for the effect of ozone therapy on obese individuals will be enriched. Since our study is the first study on this subject, we believe that it will be a guide for future studies on this subject.

## REFERENCES

- Chandrasekaran, P., & Weiskirchen, R. (2024). The role of obesity in type 2 diabetes mellitus—An overview. *International journal of molecular sciences*, 25(3), 1882.
- Ciborowski, M., Lipska, A., Godzien, J., Ferrarini, A., Korsak, J., Radziwon, P., Tomasiak, M., & Barbas, C. (2012). Combination of LC-MS-and GC-MS-based metabolomics to study the effect of ozonated autohemotherapy on human blood. *Journal of proteome research*, 11(12), 6231-6241.
- Hernández, F., Menéndez, S., & Wong, R. (1995). Decrease of blood cholesterol and stimulation of antioxidative response in cardiopathy patients treated with endovenous ozone therapy. *Free Radical Biology and Medicine*, 19(1), 115-119.
- Kesikburun, S., & Yaşar, E. (2017). Ozon tedavisi. *Totbid Dergisi*, 16, 196-202.
- Kıziltan, G., & Saka, M. (Eds.). (2018). *Bariatrik Cerrahi ve Beslenme. Türkiye Diyetisyenler Derneği*.
- Kiziltan, H. S., Bayir, A. G., Yucesan, G., Eris, A. H., İdin, K., Karatoprak, C., Aydın, T., Akcakaya, A., & Mayadagli, A. (2015). Medical ozone and radiotherapy in a peritoneal, Erlich-ascites, tumor-cell model. *Altern Ther Health Med*, 21(2), 24-29.
- Lu, J., Ding, S., Tang, Z., Tong, X., Dou, J., Gao, L., & Zeng, J. (2020). Ozone autohemotherapy elevates PPAR-expression to lower blood lipid in treatment for psoriasis. 1-16.
- Martínez-Sánchez, G., Al-Dalain, S. M., Menéndez, S., Re, L., Giuliani, A., Candelario-Jalil, E., Álvarez, H., Fernández-Montequín, J. I., & León, O. S. (2005). Therapeutic efficacy of ozone in patients with diabetic foot. *European journal of pharmacology*, 523(1-3), 151-161.
- Moreno-Fernández, A., Macías-García, L., Valverde-Moreno, R., Ortiz, T., Fernández-Rodríguez, A., Molini-Estrada, A., & De-Miguel, M. (2019). Autohemotherapy with ozone as a possible effective treatment for Fibromyalgia. *Acta reumatologica portuguesa*, 44(3), 244-249.
- Morsy, M. D., Hassan, W. N., & Zalat, S. I. (2010). Improvement of renal oxidative stress markers after ozone administration in diabetic nephropathy in rats. *Diabetology & metabolic syndrome*, 2(1), 29.
- Özdoğan, E., Özdoğan, O., Altunoglu, E. G., & Köksal, A. R. (2015). Tip 2 diyabet hastalarında kan lipid düzeylerinin hba1c ve obezite ile ilişkisi. *Şişli Etfal Hastanesi Tip Bülteni*, 49(4), 248.
- Rapone, B., Ferrara, E., Corsalini, M., Converti, I., Grassi, F. R., Santacroce, L., Topi, S., Gnoni, A., Scacco, S., & Scarano, A. (2020). The effect of gaseous ozone therapy in conjunction with periodontal treatment on glycosylated hemoglobin level in subjects with type 2 diabetes mellitus: An unmasked randomized controlled trial. *International journal of environmental research and public health*, 17(15), 5467.
- Rezaeianjam, M., Khabazian, A., Khabazian, T., Ghorbani, F., Abbasi, T., Asghari, S., Heidari, F., Shiri, A., & Naderi, M. (2025). Efficacy of ozone therapy in dentistry with approach of healing, pain management, and therapeutic outcomes: a systematic review of clinical trials. *BMC Oral Health*, 25(1), 433.
- Sherov, U. (2022). Efficacy of metformin in combination ozone therapy in children and adolescents with metabolic syndrome. *Central asian journal of theoretical and applied sciences*, 03(10), 256-259.
- Sroczynski, J., Grzeszczak, W., & Rudzki, H. (1994). Effects of intravenous ozone application on some parameters of lipid metabolism in experimental atherosclerosis in rabbits. *Ann Acad Med Siles*, 17(Suppl), 65-72.
- Sundbom, M., Järholm, K., Sjögren, L., Nowicka, P., & Lagerros, Y. T. (2024). Obesity treatment in adolescents and adults in the era of personalized medicine. *Journal of internal medicine*, 296(2), 139-155.

- Tapia, A. S., & Sánchez, G. M. (2012). La ozonoterapia y su fundamentación científica. *Revista Española de Ozonoterapia*, 2(1), 163-198.
- Tseveenmyadag, M. M., Khurelbaatar, S. M., & Tseveenmyadag, M. (2018). Some results of the outcome after ozone therapy diagnosed with diabetes, 5(3), 102-102.
- Tylicki, L., Biedunkiewicz, B., Nieweglowski, T., Chamienia, A., Slizien, A. D., Luty, J., Lysiak, Szydłowska, W., & Rutkowski, B. (2004). Ozonated autohemotherapy in patients on maintenance hemodialysis: influence on lipid profile and endothelium. *Artificial organs*, 28(2), 234-237.
- Ugazio, E., Tullio, V., Binello, A., Tagliapietra, S., & Dosio, F. (2020). Ozonated oils as antimicrobial systems in topical applications. Their characterization, current applications, and advances in improved delivery techniques. *Molecules*, 25(2), 334.
- Xie, T., Yan, W., Lou, J., & Chen, X. (2016). Effect of ozone on vascular endothelial growth factor (VEGF) and related inflammatory cytokines in rats with diabetic retinopathy. *Genet Mol Res*, 15(2), 1-11.