

RESEARCH ARTICLE

Effects of Bariatric Surgery on Body Composition and the Triglyceride-Glucose Index: A Comparative Preoperative and Postoperative Study TGI and Body Composition After Surgery
Bariatrik Cerrahinin Vücut Kompozisyonu ve Trigliserit-Glukoz İndeksi Üzerindeki Etkileri: Ameliyat Öncesi ve Sonrası Karşılaştırmalı Bir Çalışma
Ameliyat Sonrası TGI ve Vücut Kompozisyonu

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ABSTRACT

Objective: Insulin resistance and other metabolic problems are frequently linked to obesity, which is a significant global public health issue. For people with severe obesity, bariatric surgery is regarded as one of the best therapy options for attaining substantial and long-lasting weight loss. The purpose of this study was to compare body composition measures and preoperative and postoperative triglyceride-glucose index (TGI) levels in individuals having bariatric surgery.

Material and Method: Ninety-nine patients who were admitted to Samsun Training and Research Hospital's Internal Medicine outpatient clinic and satisfied the inclusion criteria were included in this study. Prior to bariatric surgery, preoperative measures were taken, and six months following the procedure, postoperative measurements were taken. Fasting blood glucose, LDL and HDL cholesterol, triglycerides, HbA1c, body-mass index (BMI), fat and fat-free mass, muscle mass, mineral content, protein level, and TGI were evaluated. Appropriate parametric and nonparametric statistical tests were applied according to data distribution.

Results: Comparative analysis revealed statistically significant differences between preoperative and postoperative measurements for all parameters except protein level. The mean TGI decreased from 2.05 ± 0.13 preoperatively to 1.96 ± 0.10 postoperatively. Similarly, the mean BMI decreased from 40.9 ± 8.2 to 29.3 ± 5.7 . Significant reductions were also observed in fat mass, muscle mass, and fat-free mass in the postoperative period.

Conclusion: Bariatric surgery significantly improves TGI and body composition parameters in patients with severe obesity, supporting its beneficial effects on metabolic health and insulin resistance. Further long-term studies with larger sample sizes are needed to confirm the durability of these effects.

Keywords: Bariatric Surgery, Obesity, Triglyceride Glucose Index, Body Composition Analysis.

ÖZET

Amaç: İnsülin direnci ve diğer metabolik sorunlar sıklıkla obezite ile ilişkilendirilmekte olup, obezite önemli bir küresel halk sağlığı sorunudur. Şiddetli obezitesi olan kişiler için bariatrik cerrahi, önemli ve uzun süreli kilo kaybı elde etmek için en iyi tedavi seçeneklerinden biri olarak kabul edilmektedir. Bu çalışmanın amacı, bariatrik cerrahi geçiren bireylerde vücut kompozisyonu ölçümlerini ve ameliyat öncesi ve sonrası trigliserit-glukoz indeksi (TGI) düzeylerini karşılaştırmaktır.

Gereç ve Yöntem: Samsun Eğitim ve Araştırma Hastanesi İç Hastalıkları polikliniğine başvuran ve dahil edilme kriterlerini karşılayan 99 hasta bu çalışmaya dahil edilmiştir. Bariatrik cerrahiden önce ameliyat öncesi ölçümler alınmış ve işlemten altı ay sonra ameliyat sonrası ölçümler yapılmıştır. Açlık kan şekeri, LDL ve HDL kolesterol, trigliseritler, HbA1c, vücut kitle indeksi (VKİ), yağ ve yağsız kütle, kas kütlesi, mineral içeriği, protein düzeyi ve TGI değerlendirilmiştir. Veri dağılımına göre uygun parametrik ve parametrik olmayan istatistiksel testler uygulanmıştır.

Bulgular: Karşılaştırmalı analiz, protein düzeyi hariç tüm parametreler için ameliyat öncesi ve sonrası ölçümler arasında istatistiksel olarak anlamlı farklılıklar ortaya koymuştur. Ortalama TGI, ameliyat öncesi $2,05 \pm 0,13$ 'ten ameliyat sonrası $1,96 \pm 0,10$ 'a düşmüştür. Benzer şekilde, ortalama BMI $40,9 \pm 8,2$ 'den $29,3 \pm 5,7$ 'ye düşmüştür. Ameliyat sonrası dönemde yağ kütlesi, kas kütlesi ve yağsız kütlede de anlamlı azalmalar gözlemlenmiştir.

Sonuç: Bariatrik cerrahi, şiddetli obezitesi olan hastalarda TGI ve vücut kompozisyonu parametrelerini önemli ölçüde iyileştirerek metabolik sağlık ve insülin direnci üzerindeki faydalı etkilerini desteklemektedir. Bu etkilerin kalıcılığını doğrulamak için daha büyük örneklem boyutlarına sahip daha uzun vadeli çalışmalara ihtiyaç vardır.

Anahtar Sözcükler: Bariatrik Cerrahi, Obezite, Trigliserit Glikoz İndeksi, Vücut Kompozisyon Analizi.

Increased morbidity and early mortality are linked to obesity, a chronic, complex disease caused by psychological disorders, environmental variables, and genetic susceptibility (1). According to the World Health Organization (WHO), obesity is defined as a body mass index (BMI) of ≥ 30 kg/m² and is considered one of the top ten worldwide health concerns (2). Morbidly obese people have a much greater risk of metabolic and cardiovascular problems if their BMI is ≥ 40 kg/m² (3). For patients with severe obesity (BMI ≥ 40 kg/m²), bariatric surgery is universally acknowledged as the most effective therapeutic option for attaining sustained weight loss. Bariatric surgery has become much more common worldwide in recent years due to its demonstrated effectiveness in improving metabolism and reducing weight (4). Bariatric surgery has been demonstrated to alleviate or resolve obesity-related comorbidities, such as hypertension, type 2 diabetes mellitus, obstructive sleep apnea, and hyperlipidemia, in addition to causing significant weight loss (5). Common bariatric surgical techniques include sleeve gastrectomy, biliopancreatic diversion, vertical banded gastroplasty, jejunioileal bypass, laparoscopic adjustable gastric banding, duodenal switch, and Roux-en-Y gastric bypass (6). Sleeve gastrectomy has gained popularity due to its relative technical simplicity and favorable short- and mid-term outcomes; however, long-term data remain limited, and as a restrictive procedure, it carries a risk of protein malnutrition (7). In contrast, extensive data are available on the long-term metabolic effects of Roux-en-Y gastric bypass, which combines gastric restriction with intestinal malabsorption (8). The gold standard for determining insulin resistance is the hyperinsulinemic–euglycemic clamp technique (9). However, because of its high cost, technical complexity, and time constraints, its routine clinical application is restricted (10). Insulin resistance is pathophysiologically based on long-term increases in plasma glucose and lipid levels. In this regard, the triglyceride–glucose index (TGI), which shows a substantial connection with insulin resistance as determined by the hyperinsulinemic–euglycemic clamp technique, has become a straightforward and trustworthy surrogate marker (11). The following formula is used to determine TGI:

$$TGI = \frac{\left[\ln \left(\text{Fasting Triglyceride Level} \left(\frac{mg}{dL} \right) \right) * \text{Fasting Blood Glucose} \left(\frac{mg}{dL} \right) \right]}{2}$$

TGI readings above 4.69 are typically regarded as suggestive of insulin resistance, despite the fact that different cutoff values have been suggested (12). Anthropometry is the study of human body composition by measuring elements including bone tissue, muscle mass, fat mass, and lean mass (13). These measurements offer important insights into the distribution of adipose tissue, protein content, and general nutritional health. Anthropometric measurements are frequently

employed in nutritional monitoring, growth assessment, and the assessment of obesity in a variety of age groups (14). Body composition analysis relies heavily on parameters like lean body mass, height, and body weight (15).

In this context, the present study aimed to comparatively evaluate preoperative and postoperative triglyceride–glucose index values and body composition parameters in patients undergoing bariatric surgery.

MATERIAL AND METHOD

Categorical variables were expressed as frequencies and percentages (n (%)). Continuous variables were presented as mean \pm standard deviation (mean \pm SD) for normally distributed data, and as median (minimum–maximum) for non-normally distributed data. The chi-square test was used for the analysis of independent categorical variables. Independent continuous variables were analyzed using the Student's t-test. For dependent continuous variables, the paired samples t-test was applied when the data followed a normal distribution, whereas the Wilcoxon signed-rank test was used for non-normally distributed data. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 99 patients were enrolled in the study, including 77 females (77.8%) and 22 males (22.2%). The mean age of the cohort was 39.6 ± 11.1 years. Female patients had a mean age of 39.3 ± 11.5 years, while male patients had a mean age of 40.7 ± 9.5 years, with no statistically significant difference observed between sexes ($p = 0.605$).

Postoperative analyses demonstrated significant reductions in anthropometric and body composition parameters. The mean body mass index (BMI) decreased from 40.9 ± 8.2 kg/m² preoperatively to 29.3 ± 5.7 kg/m² postoperatively ($p < 0.001$). Fat-free mass was reduced from 60.9 ± 12.3 kg to 53.7 ± 11.3 kg ($p < 0.001$), and mineral content decreased from 3.9 ± 1.0 kg to 3.4 ± 0.8 kg ($p < 0.001$). Protein content showed a slight, non-significant reduction from 11.7 ± 2.4 kg to 11.4 ± 2.1 kg ($p = 0.102$). Muscle mass decreased from a median of 54 kg (range: 37–92 kg) to 50.2 ± 10.3 kg ($p < 0.001$), while fat mass decreased markedly from a median of 46 kg (range: 16–94 kg) to 23 kg (range: 7–50 kg) ($p < 0.001$), reflecting substantial postoperative improvements in body composition. BMI, Fat-free mass, muscle mass and fat mass, and mineral content and protein content parameters for all participants are summarized in figure 1 and 2.

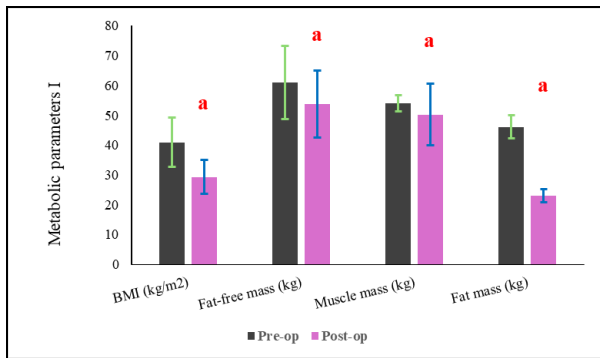


Figure 1. Changes in body mass index (BMI), fat-free mass, muscle mass and fat mass before and six months after bariatric surgery in all study participants. a: pre-op group vs post-op group (p < 0.001).

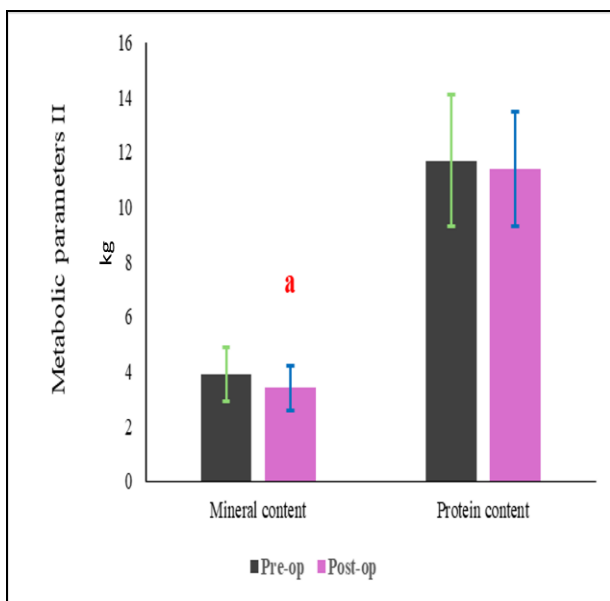


Figure 2. Changes in mineral and protein content before and six months after bariatric surgery in all study participants. a: pre-op group vs post-op group (p < 0.001).

Postoperative analyses revealed significant improvements in all metabolic parameters. Fasting blood glucose decreased from 113.4 ± 32.6 mg/dL preoperatively to 95.7 ± 18.7 mg/dL postoperatively (p < 0.001). LDL-cholesterol levels were reduced from 130.5 ± 41.9 mg/dL to 105.1 ± 27.3 mg/dL (p < 0.001), whereas HDL-cholesterol increased significantly from 45.4 ± 14.5 mg/dL to 52.1 ± 11.1 mg/dL (p < 0.001). Triglyceride levels decreased from a median of 109 mg/dL (range: 37-313 mg/dL) to 88 mg/dL (range: 37-274 mg/dL) (p < 0.001, Figure 3), and HbA1c levels declined from $5.6 \pm 1.2\%$ to $5.0 \pm 0.8\%$ (p < 0.001). Consistently, the triglyceride-glucose index (TGI) decreased from 2.05 ± 0.13 preoperatively to 1.96 ± 0.10 postoperatively (p < 0.001), indicating a marked improvement in insulin sensitivity following bariatric surgery (Figure 4).

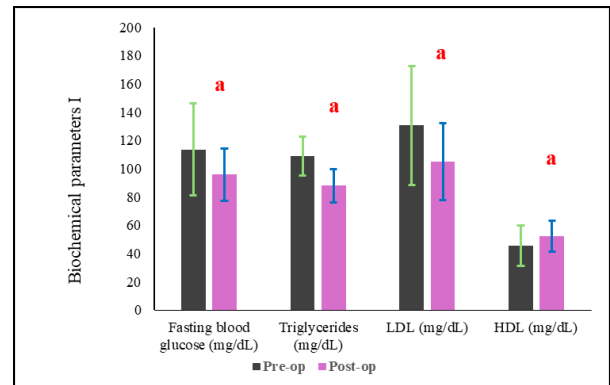


Figure 3. Changes in fasting blood glucose, triglycerides, LDL-cholesterol, and HDL-cholesterol before and six months after bariatric surgery. a: pre-op group vs post-op group (p < 0.001).

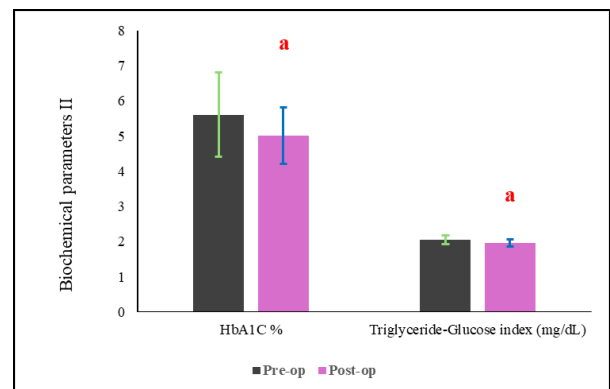


Figure 4. Changes in HbA1c and triglyceride-glucose index (TGI) before and six months after bariatric surgery. a: pre-op group vs post-op group (p < 0.001).

DISCUSSION

This study shows that in people who are severely obese, bariatric surgery significantly improves metabolic and body composition indices. Following surgery, there was a significant drop in fasting blood glucose, triglycerides, LDL cholesterol, and HbA1c levels, but an increase in HDL cholesterol, indicating improved lipid profile and glycemic management. The triglyceride-glucose index (TGI) consistently demonstrated improved insulin sensitivity, with a substantial decrease from 2.05 ± 0.13 to 1.96 ± 0.10 (p < 0.001). These results are in line with previous studies reporting significant postoperative reductions in TGI, irrespective of the type of bariatric procedure (16-18). Weight loss, improved insulin signaling, and modulation of gut hormones like GLP-1, ghrelin, PYY, and GIP-which together control appetite, glucose homeostasis, and β -cell function-are thought to be the mechanisms underlying improvements in TGI (19, 20). Through decreased inflammation, improved intestinal barrier function, and FXR/TGR5-mediated glucose and lipid regulation, changes in gut microbiota and bile acid metabolism also contribute to metabolic benefits (21-23).

Significant decreases in body composition measures were noted concurrently. BMI dropped from 40.9 ± 8.2 to 29.3 ± 5.7 kg/m² ($p < 0.001$), fat mass significantly decreased, and muscle and fat-free mass also fell, but to a lesser degree. Protein content did not alter statistically, indicating that vital metabolic processes were maintained. These results are consistent with earlier research demonstrating that, especially in the early postoperative phase, bariatric surgery largely targets fat tissue while reducing lean mass loss (24, 25). A more thorough evaluation of the quality and metabolic significance of postoperative weight reduction can be obtained by tracking body composition rather than depending just on the proportion of excess weight loss (26, 27).

When considered collectively, these findings show that bariatric surgery successfully promotes positive changes in body composition while improving insulin resistance and general metabolic health. The procedure's

clinical usefulness in the treatment of morbid obesity is highlighted by the fact that it not only promotes significant weight loss but also maintains lean mass and improves metabolic function. Long-term studies with bigger cohorts are necessary to corroborate these findings and assess the sustainability of metabolic and body composition changes because the study's primary limitations are its relatively small sample size and short follow-up duration of six months.

Conflict of interest

The authors declare that there is no conflict of interest.

Financial support

The authors do not declare any financial support.

Ethical Approval

This study received ethical approval from the Samsun University Clinical Research Ethics Committee with decision number SÜKA EK 2023 20/7 dated 01.11.2023.

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