The Egyptian Journal of Hospital Medicine (July 2025) Vol. 100, Page 3256-3261

Using Patient Body Composition (InBody Value) as a Tool of Evaluation of Candidates of Bariatric Surgery in Comparison to BMI

Arsany Talaat Saber Wassef, Mafrag Rezq Mubarak Mutahar,
Amr Mohamed AbdelFattah Ayad, Mohammed Ahmed El-Gelany Azab*
Departments of General Surgery, Faculty of Medicine, Cairo University, Egypt
***Corresponding author:** Mohammed Ahmed El-Gelany Azab, **Mobile:** +20 10 08138556, **E-Mail:** mgelany844@gmail.com

ABSTRACT

Background: Body mass index (BMI) is widely used to assess eligibility for bariatric surgery, but it does not accurately reflect body fat or muscle distribution. Bioelectrical impedance analysis (BIA) offers more detailed body composition data, potentially improving candidate selection and postoperative monitoring.

Objective: To compare BMI and body composition measurements in patients undergoing bariatric surgery and assess their roles in surgical decision-making and postoperative follow-up.

Patients and Methods: This prospective study included 50 morbidly obese patients undergoing bariatric procedures at Cairo University Hospitals. All participants were assessed pre- and three months postoperatively using both BMI and BIA-derived body composition parameters, including body fat percentage and muscle mass.

Results: Bariatric surgery led to significant reductions in BMI and body fat percentage, with no significant changes in muscle percentage postoperatively. Both BMI and body composition assessments were similarly effective in determining surgical eligibility; however, BIA was more informative for postoperative follow-up, as some patients exhibited greater muscle loss than fat loss.

Conclusion: While BMI and body composition analysis are both useful in assessing bariatric surgery candidates, BIA provides superior insight during postoperative follow-up, highlighting the need for individualized nutritional monitoring.

Keywords: Patient Body Composition, Bariatric Surgery, BMI.

INTRODUCTION

The current criteria for bariatric and metabolic surgery predominantly rely on body mass index (BMI), even though BMI cannot differentiate between body composition elements such as body fat percentage and visceral fat. This limitation often leads to the inaccurate estimation of true body fat, which may result in certain patients with a significant fat burden being excluded from surgical consideration despite potentially benefiting from intervention [(1)].

One alternative is to assess body composition using bioelectrical impedance analysis (BIA), which evaluates the differing electrical properties of various body tissues. BIA is recognized for being simple, affordable, reproducible, and reasonably accurate for clinical use[(2)]. While several studies have explored body composition through BIA, making comparisons with BMI, and examining correlations between percentage of body fat, visceral adiposity, and obesity-related comorbidities, the clinical adoption of BIA as a standard diagnostic or decision-making tool in obesity management remains limited[(3)].

Obesity has become a pressing public health challenge worldwide, with its prevalence increasing rapidly across all age groups. The condition is intricately linked to a broad spectrum of metabolic, cardiovascular, and musculoskeletal complications, which can significantly reduce both quality of life and life expectancy. As health systems face a growing burden of obesity-related comorbidities, the urgency for effective interventions and reliable methods for risk stratification has never been greater. Traditional anthropometric measurements, while convenient and cost-effective, may fail to capture the true complexity and impact of excess adiposity, especially in diverse populations with varying body habitus and fat distribution[(3)].

Body mass index remains the cornerstone for diagnosing obesity and establishing eligibility for bariatric surgery; however, its utility is increasingly questioned. BMI does not differentiate between fat mass and lean mass, nor does it reflect the anatomical distribution of adipose tissue, particularly visceral fat, which carries a higher metabolic risk. Consequently, individuals with high muscle mass may be misclassified as obese, while those with significant visceral adiposity but normal BMI may be overlooked. This misclassification can result in both under-treatment and over-treatment, highlighting the limitations of relying solely on BMI for clinical decision-making[(3)].

In response to these limitations, there has been a paradigm shift towards more precise and individualized approaches to obesity assessment and management. Body composition analysis, particularly through modalities such as bioelectrical impedance analysis (BIA), offers a more nuanced understanding of fat and muscle distribution. This technique enables clinicians to assess body fat percentage and visceral fat area, providing valuable information for tailoring treatment strategies and monitoring postoperative progress. As bariatric surgery continues to evolve as a cornerstone in the management of severe obesity, integrating advanced body composition metrics into preoperative evaluation and follow-up protocols may enhance patient selection, optimize outcomes, and reduce the risk of complications related to muscle mass loss or malnutrition[(3)].

Received: 11/03/2025
Accepted: 11/05/2025

Although BIA provides a direct and reliable measurement of body fat percentage and visceral fat, there is still a lack of consensus and clear guidelines on integrating BIA findings into the routine evaluation and selection of candidates for bariatric surgery. Most current protocols continue to rely heavily on BMI cut-offs, potentially overlooking individuals at risk due to excessive fat but with "normal" BMI. This gap highlights the need for more research into how body composition analysis might enhance or even replace BMI as a criterion for surgical eligibility.

This work aimed to evaluate the value of using body composition parameters, specifically body fat percentage and visceral fat, as more accurate indicators than BMI for assessing candidates for bariatric surgery.

PATIENTS AND METHODS

This cross-sectional study included 50 patients who underwent bariatric surgery and were evaluated using body composition measurements at Cairo University Hospitals. The study was conducted between March and September 2024.

Inclusion and exclusion criteria:
Eligible participants were adults with morbid obesity, defined as a BMI >35 kg/m² with comorbidities or >40 kg/m² without comorbidities. Exclusion criteria were BMI <30 kg/m², pregnancy, psychiatric disorders, or mental disability.

Sample size calculation:
A sample size of 48 patients was calculated to achieve 80% power with a two-sided alpha of 0.05, based on EpiCalc 2000®. To accommodate possible dropouts, 50 patients were ultimately included.

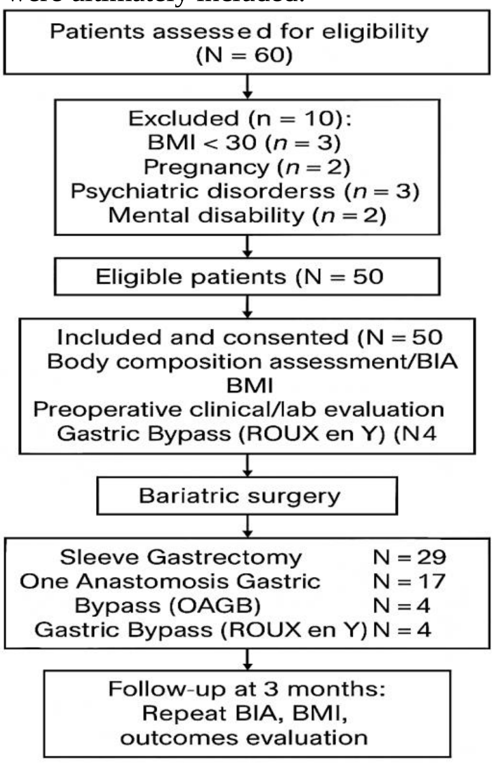

Figure (1): Flowchart of cases.

Data collection:

Clinical evaluation:
All patients underwent a comprehensive evaluation that included:

Personal and medical history: Age, gender, residence, occupation, smoking, comorbid conditions (hypertension, cardiac, chest, renal, liver, hematologic diseases), prior surgeries, and family history of obesity.

Physical examination: General assessment and vital signs (blood pressure, heart rate, respiratory rate, as well as temperature), plus inspection for pallor, cyanosis, jaundice, and lymphadenopathy.

Anthropometric and laboratory measurements:

Weight (kg): Measured with a calibrated SECA scale on a hard, flat surface, with minimal clothing.

Height (cm): Measured barefoot, using a wall-mounted stadiometer, ensuring proper posture and anatomical alignment.

Waist and Hip Circumference (cm): Measured with non-stretchable tape at standardized anatomical sites, with patients standing relaxed.

Laboratory Investigations: Routine blood tests included complete blood count, renal function (creatinine, urea), liver profile (AST, ALT, albumin, bilirubin, GGT), and urine analysis.

Body composition analysis:
Method: Bioelectrical impedance analysis (BIA, InBody platform) was performed after 2–4 hours fasting, with patients barefoot and free from heavy clothing.

Parameters assessed: Total body water, lean body mass, body fat mass, body fat percentage, visceral fat area, skeletal muscle mass, basal metabolic rate, and segmental lean mass distribution[(4)].

Body mass index (BMI): BMI was assessed by weight (kg) divided by height (m²). Values were classified as underweight (<18.5), normal (18.5–25), overweight (25–29.9), and obese (>30), with further thresholds for surgical eligibility [(5)].

Bariatric procedure:
Laparoscopic sleeve gastrectomy: The surgery was performed using a standard five-port laparoscopic approach, with detailed steps to ensure safety, appropriate sleeve calibration (36 Fr bougie), and preservation of key anatomical landmarks.

Follow-Up: Patients were followed for three months postoperatively. Both body composition (BIA) and BMI were reassessed to compare their diagnostic accuracy for tracking weight and fat reduction after surgery.

Outcomes:
Primary: Changes in body composition (fat and muscle mass); assessment of body fat percentage and visceral

fat as diagnostic criteria for bariatric surgery and post-surgical monitoring.

Secondary: Patient demographics, detailed body composition measurements, and postoperative outcomes.

Ethics consideration:
This study has been approved by Cairo Faculty of Medicine's Ethics Committee. All patients were informed of the study's goals, risks, and benefits in detail before they were asked to participate. Approval was sought by written informed consent. Strict control over access to personally identifiable information and encrypted data storage methods guaranteed privacy. The study adhered to the Helsinki Declaration throughout its execution.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Quantitative factors were summarized as mean ± standard deviation (SD), whilst qualitative variables were shown as counts and percentages. Values above the threshold of $p < 0.05$ were deemed not significant, and this was the level of statistical significance.

RESULTS

According to this table, mean age of the studied group was 31.6±7.9. 36 patients (72%) of the studied group were females.

Table (1): Basic data of the studied patients

	Studied group (N=50)	
	Mean	**± SD**
Age	31.6	7.9
Sex	**N**	**%**
Male	14	28%
Female	36	72%

According to this table, the majority of patients (58%) had sleeve gastrectomy (SG).

Table (2): Distribution of type of operation in the studied group

	Studied group (N=50)	
	N	**%**
Sleeve gastrectomy (SG)	29	58%
One Anastomosis Gastric Bypass (OAGB)	17	34%
Gastric Bypass (ROUX en Y)	4	8%

This table (3) shows that compared to pre- and postoperative values, there was a statistically significant drop in BMI, percentage of muscle, and percentage of fat.

The percentages of muscle and fat in the body did not differ significantly from one another in the preoperative data. A lower percentage of body fat was observed in the postoperative data compared to a lower percentage of body muscle.

Table (3): Comparison of body mass index and body composition (fat, muscles) between pre- and postoperative in the studied group

	Preoperative	Postoperative	P value
	Mean±SD	**Mean±SD**	
BMI	**45.5±4.4**	**42.4±4.0**	**< 0.001**
Body muscle percentage	**44.9±16.0**	**38.6±14.9**	**0.04**
Body fat percentage	**47.2+8.7**	**43.7+8.3**	**0.03**
P1	**0.37**	**0.04**	

P1: P value between body muscle percentage and body fat percentage.

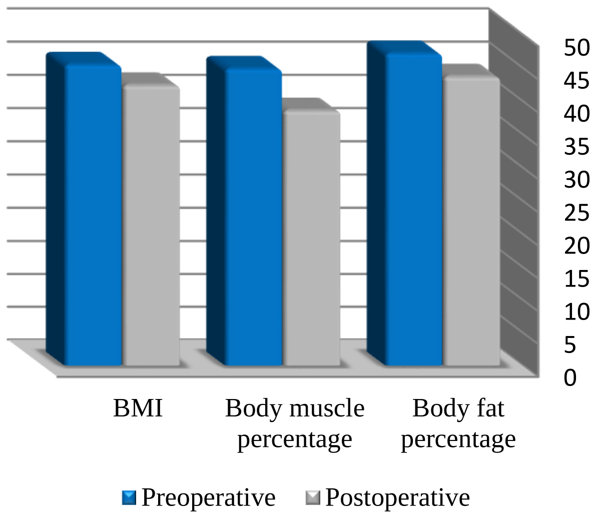

Figure (2): Distribution of body mass index and body composition (fat, muscles) pre and postoperative among the studied groups

According to table 4, 24 patients (48%) of the studied group had diabetes mellitus and 22 patients (44%) did abdominal operation.

Table (4): Distribution of comorbidities in the studied group

	Studied group (N=50)	
	N	**%**
Diabetes mellitus	24	48%
Other medical disorders	20	40%
Abdominal operation	22	44%
Other abdominal disorders	19	38%

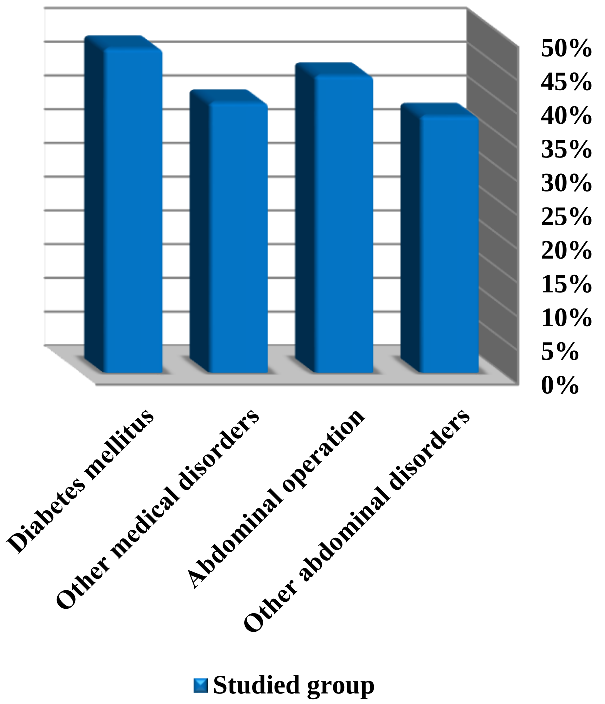

Figure (3): Distribution of comorbidities in the studied group.

DISCUSSION

Obesity is a known worldwide health problem that keeps people vulnerable to a host of long-term health problems. Over the past few decades, bariatric surgery (BS) has been increasingly popular as a means to address the metabolic issues associated with severe obesity [(6)].

Bariatric surgery has a positive effect on weight loss and linked complications like metabolic syndrome and diabetes are often resolved after the procedure, making it a better choice than more conservative methods. According to research looking at the long term, bariatric surgery also offers the longest duration of weight loss compared to other methods [(7)].

Currently, the most frequently performed bariatric procedures are sleeve gastrectomy (SG), Roux-en-Y gastric bypass (RYGB), adjustable gastric banding, biliopancreatic diversion (BPD) with or without duodenal switch, and one anastomosis gastric bypass (OAGB). The selection of the optimal surgical technique is largely individualized, with surgeons considering factors such as patient risk stratification, therapeutic objectives, comorbid conditions, personal preferences, and their own clinical experience and judgment. However, it is important to note that there are still no standardized, evidence-based protocols guiding this decision, and choices often rely on expert opinion and patient-specific factors. To qualify for bariatric surgery (BS), patients must currently meet certain criteria, including a high BMI and the presence of obesity-related health problems [(6)].

To begin assessing overall health concerns, BMI is a good starting point. For example, anomalies in blood glucose, dyslipidemia, and low serum levels of certain vitamins have all been linked to an elevated BMI. Both the pattern of body fat distribution and a higher body mass index are linked to health hazards. Metabolic risk factors for cardiovascular disease and type 2 diabetes are highly linked to the excessive buildup of visceral fat. Vitamin D deficiency is also more likely to occur in individuals with higher levels of visceral fat.

Thirty percent of individuals who undergo bariatric surgery either do not lose enough weight or do not recover from obesity-related complications. Frustration, wrath, and depression are some of the emotions that patients express along with a decrease in health-related quality of life due to this failure. It follows that it is essential to find new factors that predict how a person will react to BS. In order to maximize the use of healthcare resources, this approach will help us determine which patients are ideal candidates for BS and which BS technique to use [(8)].

The current gold standard for classifying obesity is the BMI. Nevertheless, there are significant limitations to BMI, as it does not provide information about individuals' metabolic condition or body composition (BC) [(9)].

Sarcopenia, or sarcopenic obesity (SO), and an increase in homeostasis model assessment of insulin resistance (HOMA-IR) are both conditions that patients with obesity may be at increased risk of developing. Patients experiencing sarcopenia following BS may not fully recover, even after losing weight [(10-12)].

Our study aimed to use a more accurate indicator to assess candidates for bariatric surgery as body composition with more accurate assessment of body fat percentage and visceral fat. The current study was conducted at Cairo University hospitals and included 50 patients who underwent bariatric procedures and were assessed by body composition measurements (In Body values).

The main results of this study were as follows: Regarding demographic data in the studied group, our results showed that the mean age was 31.6 ± 7.9 years. Fourteen patients (28%) were males, while 36 patients (72%) were females. This was in agreement with **Maiz *et al.*** [(11)] who reported a mean age of 45.54 ± 3.38 years, with 72.9% females and 27.1% males in their bariatric surgery group. Similarly, **Alves *et al.*** [(2)] found a mean age of 36 ± 9 years, with 78.6% females and 21.4% males.

Da Cruz *et al.* [(4)] also reported that among their cohort, 90.69% were females and 9.31% males, with a mean age of 38.51 ± 11.87 years. **Vassilev *et al.*** [(5)] observed a mean age of 41.9 ± 11.1 years, with 76.5% females and 23.5% males. **Lee *et al.*** [(13)] described a mean age of 42.3 years (range: 19.0–63.0), with 62.5% females and 37.5% males.

According to the distribution of operation type in the studied group, 58% underwent SG, 34% underwent OAGB, and 8% underwent gastric bypass (ROUX-en-Y).

This was in line with **Martínez *et al.*** [3]**,** who reported that 43% of patients underwent sleeve gastrectomy.

Maiz *et al.* [11] found that 74.7% of patients had SG as well as 25.2% had laparoscopic Roux-en-Y gastric bypass (LRYGB). **Zaveri *et al.*** [12] observed that 45.3% of patients had LAGB, 26.4% had LRYGB, and 28.3% had single anastomosis duodenal switch (SADS). **Zhang *et al.*** [14] found that 35.8% underwent laparoscopic sleeve gastrectomy (LSG) and 64.2% underwent LRYGB. **Bioletto *et al.*** [15] reported that 77.7% of patients had sleeve gastrectomy and 22.3% had RYGB. **Lee *et al.*** [13] showed that 84.4% had sleeve gastrectomy and a minority had other types of bypass procedures.

The study group's BMI and composition (fat, muscle) were compared before and after surgery; while the percentage of muscle did not change much, the percentages of both fat and BMI decreased significantly.

These findings were consistent with **Martínez *et al.*** [3] who reported a significant decrease in fat mass from 1 to 12 months after bariatric surgery. Following bariatric surgery, **de Oliveira *et al.*** [16] observed a significant reduction in both BMI (from 42.9 ± 5.7 to 34.8 ± 6.0 kg/m²) and fat mass (from 55.4 ± 12.5 to 36.8 ± 9.6 kg), with both changes reaching statistical significance ($p < 0.001$). After surgery, **Alves *et al.*** [2] also discovered that body fat percentage and BMI were significantly reduced ($p < 0.001$). **Otto *et al.*** [17] found a preoperative mean BMI of 43±5 kg/m², reduced to 31±10 kg/m² at 6 months postoperatively.

Tangjittrong *et al.* [18] showed that 12-month post-bariatric surgery patients had a lower body fat percentage than non-operative controls (30.6% vs. 35.9%, p=0.001), and higher skeletal muscle mass (27.5 vs. 23 kg, p=0.003). **de Paris *et al.*** [19] found statistically significant decreases in BMI, fat mass, and percent fat mass at 12 months postoperatively. **Lee *et al.*** [13] also reported significant reductions in BMI after surgery.

Regarding comorbidities, 48% of patients had diabetes mellitus, 40% had other medical disorders, 44% had prior abdominal operations, and 38% had other abdominal disorders.

Zhang *et al.* [14] reported that hypertension was the most common obesity-related comorbidity, seen in 52% of both LSG and LRYGB groups. Sleep apnea was more common in the LSG group, but other comorbidities (GERD, hyperlipidemia, T2DM, musculoskeletal disease) showed no significant difference between groups. **Serafim *et al.*** [20] also found that 30% of patients had a diagnosis of diabetes mellitus.

Advantages and Limitations

This study provides valuable insight into the comparative utility of body mass index and body composition analysis in assessing candidates for bariatric surgery and monitoring postoperative outcomes. One major advantage is the use of bioelectrical impedance analysis (BIA), which offers a more nuanced evaluation of body fat percentage and visceral fat, allowing for a more individualized approach to patient care. The prospective design and inclusion of detailed body composition data strengthen the findings and may inform clinical practice.

However, several limitations should be acknowledged. The results may not be applicable to a broader population due to the small sample size and single-center approach. The three-month postoperative follow-up period may not have been long enough to detect changes in the distribution of muscle and fat, or clinical outcomes that persist over the long term. Additionally, potential confounders such as variations in diet, physical activity, and adherence to postoperative care were not fully controlled. Further multicenter studies with larger cohorts and longer follow-up are needed to validate these findings and optimize bariatric surgery assessment protocols.

CONCLUSION

Bariatric surgery significantly reduces BMI and body fat percentage, with no notable change in muscle percentage. While BMI and In Body values are comparable for surgical indication, In Body is more effective for postoperative monitoring, as it can detect disproportionate muscle loss. Careful nutritional follow-up is essential for optimal outcomes.

No funding.
No conflict of interest.

REFERENCES

1. **Adrenito N, Olatunji G, Kokori E *et al.* (2023):** Recent advances in bariatric surgery: a narrative review of weight loss procedures. Annals of Medicine and Surgery, 85(12): 6091-6104.
2. **Alves L, Mattiello R, Todescatto A *et al.* (2020):** Bariatric patient's body composition: An option to BMI? Clinical Nutrition ESPEN., 40: 121-124.
3. **Martínez M, Meli E, Candia F *et al.* (2022):** The impact of bariatric surgery on the muscle mass in patients with obesity: 2-year follow-up. Obesity Surgery, 32(3):625–633.
4. **da Cruz M, Branco-Filho A, Zaparolli M *et al.* (2018):** Predictors of success in bariatric surgery: the role of BMI and pre-operative comorbidities. Obesity Surgery, 28: 1335-1341.
5. **Vassilev G, Galata C, Finze A *et al.* (2022):** Sarcopenia after Roux-en-Y gastric bypass: detection by skeletal muscle mass index vs. bioelectrical impedance analysis. Journal of Clinical Medicine, 11(6): 1468. doi: 10.3390/jcm11061468.
6. **Sherf-Dagan S, Sinai T, Goldenshluger A *et al.* (2021):** Nutritional assessment and preparation for adult bariatric surgery candidates: clinical practice. Advances in Nutrition, 12(3): 1020-1031.
7. **Sivakumar J, Chong L, Ward S *et al.* (2020):** Body composition changes following a very-low-calorie pre-operative diet in patients undergoing bariatric surgery. Obesity Surgery, 30: 119-126.
8. **Ciudin A, Fidilio E, Gutiérrez-Carrasquilla L *et al.* (2021):** A clinical-genetic score for predicting weight

loss after bariatric surgery: the OBEGEN study. Journal of Personalized Medicine, 11(10): 1040. doi:10.3390/jpm11101040.

9. **Palmas F, Ciudin A, Guerra R *et al.* (2023):** Comparison of computed tomography and dual-energy X-ray absorptiometry in the evaluation of body composition in patients with obesity. Frontiers in Endocrinology, 14: 1161116. doi: 10.3389/fendo.2023.1161116.
10. **Baad V, Bezerra L, de Holanda N *et al.* (2022):** Body composition, sarcopenia and physical performance after bariatric surgery: Differences between sleeve gastrectomy and Roux-En-Y gastric bypass. Obesity Surgery, 32(12): 3830-3838.
11. **Maiz C, Alvarado J, Quezada N *et al.* (2015):** Bariatric surgery in 1119 patients with preoperative body mass index < 35 (kg/m^2): results at 1 year. Surgery for Obesity and Related Diseases, 11(5): 1127-1132.
12. **Zaveri H, Surve A, Cottam D *et al.* (2016):** A comparison of outcomes of bariatric surgery in patient greater than 70 with 18 month of follow up. Springerplus, 5(1):1740. doi: 10.1186/s40064-016-3392-x.
13. **Lee J, Park Y, Kim K *et al.* (2021):** Comparison of bioelectrical impedance analysis and computed tomography on body composition changes including visceral fat after bariatric surgery in Asian patients with obesity. Obesity Surgery, 31: 4243-4250.
14. **Zhang N, Maffei A, Cerabona T *et al.* (2013):** Reduction in obesity-related comorbidities: is gastric bypass better than sleeve gastrectomy? Surgical Endoscopy, 27: 1273-1280.
15. **Bioletto F, Pellegrini M, D’Eusebio C *et al.* (2021):** Development and validation of a scoring system for pre-surgical and early post-surgical prediction of bariatric surgery unsuccess at 2 years. Scientific Reports, 11(1): 21067.
16. **de Oliveira P, Montenegro A, Bezerra L *et al.* (2020):** Body composition, serum sclerostin and physical function after bariatric surgery: performance of dual-energy X-ray absorptiometry and multifrequency bioelectrical impedance analysis. Obesity Surgery, 30: 2957-2962.
17. **Otto M, Färber J, Haneder S *et al.* (2015):** Postoperative changes in body composition comparison of bioelectrical impedance analysis and magnetic resonance imaging in bariatric patients. Obesity Surgery, 25: 302-309.
18. **Tangjittrong S, Udomsawaengsup S, Boonchaya-Anant P *et al.* (2023):** Comparison of body composition variables between post-bariatric surgery patients and non-operative controls. Clinical Medicine Insights: Endocrinology and Diabetes, 16: 11795514231206731. doi: 10.1177/11795514231206731.
19. **de Paris F, Padoin A, Mottin C *et al.* (2019):** Assessment of changes in body composition during the first postoperative year after bariatric surgery. Obesity Surgery, 29: 3054-3061.
20. **Serafim M, Santo M, Gadducci A *et al.* (2019):** Very low-calorie diet in candidates for bariatric surgery: change in body composition during rapid weight loss. Clinics, 74: e560. doi: 10.6061/clinics/2019/e560.