

# One-Year Outcomes of Laparoscopic Sleeve Gastrectomy in Morbidly Obese Patients Regarding Preoperative BMI, Gender, and Age

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**Running title:** complications after LSG regarding preoperative BMI, gender, and age.

## Abstract

The outcome of laparoscopic sleeve gastrectomy (LSG), one of the most common bariatric surgery (BS) procedure, may differ depending on the patient's age, gender, preoperative BMI. In this study, we aimed to evaluate the efficacy of LSG technique on weight loss, obesity-associated comorbidities and complications in patients undergoing LSG over three months and one year, regarding their age, gender, and BMI. The LSG associated complications in participants regarding their preoperative BMI (<39.9 and >39.9), age (30-40 and 40-50), and gender were assessed after

3 and 12 months. Besides, the remission and improvement rates of comorbid conditions in patients were examined after 12 months of LSG. Our results showed that LSG led to a significant weight loss in the resolution of obesity-associated co-morbidities and different complications after one year. No significant difference was found in the improvement and the resolution of obesity-associated co-morbidities according to gender. Also, the class 3 patients had significantly higher rates of hearing loss after 12 months and had higher levels of depression and brittle nails three months after the surgery. The younger patients also showed a significantly higher percentage of dry skin, intolerance to bread, and menstrual disorder compared to the older group.

### **Introduction:**

Obesity has emerged as an epidemic that presents an unprecedented public health challenge <sup>1</sup>. Over the last decades, the prevalence of obesity has rapidly increased worldwide. Approximately, a third of the world's population is now classified as overweight or obese <sup>2</sup>.

The World Health Organization (WHO) defines overweight and obesity as abnormal or excessive fat accumulation that poses a risk to health <sup>3</sup>. Obesity is often misinterpreted by the public to be caused by lack of will leading to inappropriate dietary choices and physical inactivity. Indeed, obesity is a complicated chronic medical condition with remarkable negative impacts on human health and is caused by environmental, humoral, behavioral, and genetic factors <sup>1</sup>.

Obesity negatively influences almost all physiological functions of the body and is correlated to a wide variety of complications and comorbidities. It increases the risk of developing multiple disease conditions, such as type 2 diabetes mellitus, fatty liver disease, hypertension, myocardial infarction, stroke, dementia, osteoarthritis, obstructive sleep apnea, and several cancers, thereby contributing to adversely affect the quality of life, life expectancy, work productivity, and healthcare costs <sup>4</sup>. Additionally, several investigations have shown how obesity considerably affects patients psychologically and may lead to increased rates of mental disorders such as poor self-esteem and depression among them <sup>5</sup>.

Bariatric surgery (BS) has become the most lasting and effective treatment for obesity as it dramatically leads to loss of fat mass and basically alleviates obesity-associated disorders <sup>1</sup>. Laparoscopic sleeve gastrectomy (LSG), one of the most common BS procedures is rather a safe and simple technique with promising short-term and midterm efficacy for severe obesity and type 2 diabetes that has gained great popularity over the last years <sup>6,7</sup>.

Aside from the degree of inherent risk with any surgery, LSG can result in a wide range of physical and mental complications <sup>8</sup>. According to the American Society for Metabolic and Bariatric Surgery (ASMBS) Clinical Issues Committee statement, the total complication rate for LSG is 0–24% <sup>9</sup>.

Postoperative complications can range from chronic to potentially life-altering issues. Acute complications such as bleeding, pain, anastomotic leaks, and blood clots are occur shortly postoperative. On the other hand, some patients may experience gastrointestinal issues such as food intolerance, dyspepsia, nausea, diarrhea, etc. as a complication of LSG. While these may appear immediately postoperative, some patients may experience them for an extended period <sup>10,11</sup>. The present study is one of the large sample size studies examining the complications after LSG. To better understand the impact of different factors including, preoperative BMI, gender, and age on the outcomes of LSG, the present study aimed to evaluate common after-surgery complications following LSG procedures in patients regarding their age, gender, and BMI. To the best of our knowledge, this is the first study to examine the outcomes of LSG based on the patient's age, gender, and preoperative BMI.

## **Results**

### **Preoperative characteristics**

Within the study period (from 2018 to 2020), 135 morbidly obese patients underwent LSG as a primary procedure for obesity treatment. From 135 patients that had completed 1 year of surgery, 126 (82.3%) were available for follow-up. The sociodemographic characteristics of men and women included in this study are shown in Table 1. Among the participants, 30 (23.8%) were men and 96 (76.1%) were women. Nine patients were lost to follow-up primarily due to change of residence. Preoperative mean age was  $37.43 \pm 6.15$  for men and  $37.54 \pm 6.46$  years for women ( $p=0.92$ ). Mean height ( $172.77 \pm 8.54$  vs.  $169.70 \pm 7.30$ ,  $p=0.08$ ), weight ( $142.14 \pm 24.56$  vs.

115.62±20.51, p=0.00), and mean BMI (44.57±5.87 vs. 42.65±5.01 kg/m<sup>2</sup>, p=0.06) were comparable between the two populations.

Table 2 shows a summary of comorbidities and distribution of risk factors among the studied groups. Hyperlipidemia was the most frequent comorbidity in females compared to males (80% vs. 80%, p=0.70), followed by hypertension (36% vs. 35%, p=0.78), hypothyroidism (13% vs. 25%, p=0.11), depression (3% vs. 24%, p=0.007), degenerative joint pain (16% vs. 20%, p=0.14), T2DM (insulin-dependent, 6% vs. 6%, p=0.95; non-insulin-dependent, 13% vs. 13%, p=0.80), obstructive sleep apnea (13% vs. 10%, p=0.81), and stomach ulcer (6 vs. 10%, p=0.44) (Table 2). There was also a significant difference in the prevalence of kidney stone (20% vs. 5%, p=0.02) and gallstone (0% vs. 11%, p=0.04) between the males and females.

### **Type two diabetes mellitus, pre and post-LSG**

Of the 13 female patients with T2DM, nine were on metformin treatment, one patient was on metformin and insulin, and three patients were on diet therapy. Among male patients, three were on metformin treatment; one patient was on diet therapy. At 1 year postoperatively, only three (3/13) diabetic female patients remained on hypoglycemic therapy (2 patients on metformin and 1 patient on insulin) and one diabetic male had to keep taking metformin.

### **Hypertension and hyperlipidemia, pre and post-LSG**

At the preoperative evaluation, there were no significant differences in the prevalence of these comorbidities among male and female groups (Table 2). After one year, hypertension resolved in 60% of cases, in particular, in 63% (7/11) of male patients and 58% (20/34) of female patients. Hyperlipidemia resolved in 71% of patients: 79% (18/24) of male patients and 59% (59/77) of female patients.

### **Obstructive sleep apnoea and degenerative joint pain, pre and post-LSG**

No significant differences in the frequency of obstructive sleep apnoea and degenerative joint pain were revealed among male and female groups (Table 2). After 12 months, obstructive sleep apnoea resolved in 7% of cases (0% (0/4) of male patients and in 10% (1/10) of female patients) and degenerative joint pain was improved in 4% of patients (0% (0/5) of male patients and 5% (1/19) of female patients).

## **Weight loss after LSG**

Three months and one year after LSG, a significant reduction was seen in the BMI of patients. After three months the BMI of patients decreased to  $33.88 \pm 5.12$  and after one year it significantly dropped to  $29.54 \pm 4.41$ . For females, the mean BMI dropped to  $34.09 \pm 5.09$  and  $29.10 \pm 4.40$  in three and one years after surgery, respectively. However, the mean BMI for males was  $36.32 \pm 5.26$  and  $30.57 \pm 3.98$  after three months and one year, respectively. A statically significant difference was found in the reduction of BMI between men and women after three and one years after the surgery ( $P=0.00$ ).

Also, the mean BMI of patients aged between 30-40 was  $44.17 \pm 5.20$  and that decreased to  $34.35 \pm 5.54$  after three months and after a year it was  $29.90 \pm 4.89$ . For patients aged between 40-50, the mean BMI was  $43.80 \pm 5.96$  and reduced to  $35.12 \pm 4.56$  after three months and to  $30.65 \pm 3.72$  after a year. A statically significant difference was found in the reduction of BMI between younger and older patients after three and one years after the surgery ( $P=0.00$ ).

## **LSG-related complications regarding preoperative BMI, gender, and age**

The rates of complications in morbidly obese patients 3 and 12 months after LSG are shown in Table 3. Overall, the LSG-related complications were significantly decreased in 12 months compared to 3 months follow up after LSG. Nevertheless, hearing loss and depression increased in 12 months compared to 3 months follow up after LSG.

The postoperative data and common complications among the studies group regarding their preoperative BMI ( $<39.9$  and  $>39.9$ ) are summarized in Table 4. Our results indicated that the patients during three months and one year showed a significant decrease in the frequency of different complications investigated in this study including constipation, abdominal pain, dysphagia, depression, brittle nails, dry skin, hair loss, fatigue, menstrual disorder, food intolerance to pasta, bread, rice, meat, vegetable, and fruit, and their taste for sour and salty food; however, changes in the frequency of abdominal pain, depression, brittle nails, dry skin, hair loss, and menstrual disorder among patients were more noticeable than the other complications during three and twelve months after surgery. It is also noteworthy that the prevalence of complications including vision loss, hearing loss, severe hair loss, vomiting, and palpitations within the first hour after a meal decreased, but it was not significant.

A sub-analysis was done according to the BMI of patients to investigate changes in the different complications among class 2 and class 3 obese patients during this period. Of 126 morbidly obese patients in this study, 33 and 93 participants had a preoperative BMI higher and lower than 39.9, respectively. Our analysis showed that class 3 patients had significantly higher rates of hearing loss after 12 months and had higher levels of depression and brittle nails three months after the surgery compared to class 2 obese patients. Also, the frequency of intolerance to pasta and meat was significantly increased among patients who had >39.9 BMI in comparison to the other group.

A sub-analysis considering the gender of patients was also performed (Table 5). The study group consisted of 30 men and 96 women and the analysis of the data revealed that female patients had significantly higher rates of dysphagia, brittle nails, and severe hair loss compared to male patients after 1 year of LSG. Moreover, their intolerance to pasta and fruits was significantly higher compared to males after three months. The number of women with the sweet and sour taste was also statistically higher than men.

Our sub-analysis according to the age of patients (Table 6) demonstrated that younger patients (30-40 age group including 78 patients) had a significantly higher percentage of dry skin, intolerance to bread, and menstrual disorder compared to the older group (40-50 age group including 48 patients) three months after the LSG surgery and developed sweet taste increasingly after a year of surgery compared older patients. No significant differences were observed in the evaluation of other complications between these two age groups. Comorbid conditions remission and improvement rates were evaluated in patients after 12 months of LSG showing positive outcomes in remission and substantial improvement rate in comorbidity (Table 7).

## **Discussion**

The outcome of LSG in patients undergoing BS treatment may differ depending on the patient's age, gender, preoperative BMI. Data from this study documented the efficacy of LSG technique on weight loss, obesity-associated co-morbidities and complications in patients undergoing LSG as a solo bariatric procedure over three months and one year, regarding their age, gender, and BMI. It is interesting to note that our results showed that LSG led to a significant weight loss, promising results in remission, and a considerable improvement in the resolution of obesity-associated co-morbidities like T2DM, hypertension, and hyperlipidemia, and also in different complications including constipation, abdominal pain, dysphagia, depression, brittle nails, dry skin, hair loss,

fatigue, and menstrual disorder after one year. No significant difference was found in the improvement and the resolution of obesity-associated co-morbidities according to gender; however, female patients had significantly higher rates of dysphagia, brittle nails, and severe hair loss compared to male patients after 1 year of LSG. Additionally, the class 3 patients had significantly higher rates of hearing loss after 12 months and had higher levels of depression and brittle nails three months after the surgery compared to class 2 obese patients. The younger patients also had a significantly higher percentage of dry skin, intolerance to bread, and menstrual disorder compared to the older group three months after the LSG surgery. To the best of our knowledge, this is the first study reporting the outcomes of LSG depending on the patient's age, gender, and preoperative BMI for three months and one year.

The actual approved indications for bariatric surgery are based on consensus guidelines issued by the National Institute of Health (NIH). They suggest surgery for people with a BMI of over 40 and people with a BMI of 35 or more who have at least two related comorbidities, according to this consensus. As a matter of fact, LSG may be the best option for patients with BMI between 35-40 who does not have two related comorbidities <sup>12</sup>.

BS has been considered as the most effective treatment for obesity and LSG, a frequently used BS technique, has gained great popularity among people over the last years, owing to its low morbidity and fast return to social life. The durability of weight loss, improvement in co-morbidities, and associated risk of mortality and morbidity are the main factors that account for the efficacy of a BS. Different LSG investigations showed a considerable resolution or improvement in comorbid conditions in patients with different age groups <sup>13-15</sup>, and also in high-risk surgical patients after a short <sup>16</sup>, medium- and long-term period <sup>17-19</sup>; however, the results were varying.

In line with previous studies, Sibier et al. in a study including 68 patients undergoing LSG realized that co-morbidities among patients improved considerably after five years and reported remission of type 2 diabetes among them at 85% <sup>14</sup>. A similar pattern of results was obtained in a large study evaluating the long-term effects of LSG on 1050 patients, of whom 72.86% were women. The improvement or remission of comorbidities such as type 2 diabetes, hypertensive, and sleep apnea syndrome was found 57.2%, 19.2%, and 85%, respectively <sup>15</sup>. Similarly, the long-term efficacy of LSG among 96 patients from New Zealand showed significant improvement and resolution rates for type 2 diabetes (79%), hypertension (61%), and obstructive sleep apnea (73%) among

participants. They reported that weight loss outcomes at 5 year follow-up were modest <sup>20</sup>. In a relatively large study including 424 obese patients in India, complete improvement in obstructive sleep apnea, 69.3% improvement in hypertension, 75% improvement in hypothyroidism was shown after LSG <sup>21</sup>.

Kikkas and colleagues in a recent investigation have shown that LSG ensured long-term excess weight loss 61.0% at 5 years. They concluded that laparoscopic sleeve gastrectomy has a long-term effect on the significant improvement of triglycerides, low-density lipoproteins, and high-density lipoproteins, but not on total cholesterol levels <sup>22</sup>. Considerable effects of LSG on different comorbidities were also shown in another study from Spain and the authors of this study introduced LSG to be safe and highly effective in terms of weight loss, particularly in patients with a preoperative BMI lower than 40 kg/m<sup>2</sup> <sup>23</sup>.

Khidir et al. in interesting research indicated the comparable weight loss results among patients based on their age and showed that LSG could lead to better improvement in younger patients <sup>24</sup>. Likewise, Angrisani et al. in a study consisted of 105 patients undergoing LSG over five years considered LSG to be an effective procedure at the long-term, with good weight loss outcomes and with a considerable improvement of obesity-associated co-morbidities. They concluded that younger age had a significantly higher percentage of total weight loss over 5 years <sup>25</sup>. Similar results were observed in another study in Germany. The authors of this study reported that LSG can be performed in younger ages without mortality and resolution rate of comorbidities and also weight loss was significantly higher compared to older ages <sup>26</sup>. As opposed to these studies, Woźniewska et al. in a very recent study in Poland showed significant weight loss in all patients to be independent of age and all individuals (< 45 and ≥ 45 years old) presented significant weight loss at 24 months after the surgery. However, the improvement in lipid and carbohydrate profile was rather faster and stronger in the older group compared to younger patients <sup>27</sup>.

The safety and effectiveness of LSG were frequently demonstrated in different studies <sup>28-32</sup>; however, some studies observed the severity of complications to be higher after LSG than other bariatric procedures <sup>33-35</sup>.

In conclusion, this study further supports the evidence of LSG being an effective technique for substantial and sustainable weight loss in morbidly obese patients. LSG provides promising results in remission and a considerable improvement in the resolution of different obesity-associated co-



morbidities and different after surgery complications. With a significant weight loss at 1 year, resolution of co-morbidities, and less harsh complications after surgery among patients who chose LSG treatment, LSG is probably the procedure of choice in the management of obese patients, especially in developing countries where the rates of obesity are rather high among people. Our study emphasizes the importance and necessity of more research into the factors influencing the outcome of LSG like age, gender, and BMI. Further investigations with a large group of patients and better long-term follow-up are needed.

## **Materials and Methods**

### **Patients' selection**

A total of 126 morbidly obese patients who underwent LSG were enrolled in this longitudinal study from September 2018 to January 2020. All the participants were thoroughly informed about the project and procedures before providing written informed consent. Moreover, inclusion and exclusion criteria were defined according to our previous study <sup>7</sup>.

### **Preoperative measures**

All patients were recommended to go on a low-carbohydrate high-protein diet at least a 2-week pre-operative. Sociodemographic characteristics, underlying medical history, obesity associated co-morbidities, and distribution of risk factors in morbidly obese patients were collected based on a standard questionnaire and general medical examination.

### **Postoperative measures**

In this study, a “Postoperative measure” is defined as any LSG associated complications that occur 3 and 12 months after LSG in participants regarding their preoperative BMI (<39.9 and >39.9), age (30-40 and 40-50), and gender (male and female). Furthermore, we evaluated the remission (disappearance of the signs and symptoms of comorbidity) and improvement (the process that comorbidity moves toward the normal state) rate of comorbid conditions in patients after 12 months of LSG.

### **Statistical analysis**

Data analysis was performed with the Stata software (v. 14). Categorical variables were presented as frequency (percentage) and continuous variables were summarized using median (min-max) or

mean  $\pm$  standard deviation. The chi-square test was used to compare categorical variables, while Student's t-test was used to compare continuous variables. Differences between the groups before and 3 months after the surgery as well as 3 and 12 post-surgery were assessed using t-test and Fisher exact test. To check for normality, Kolmogorov– Smirnov test was used and Mann Whitney U test was used for non-normally distribution data. A p-value less than 0.05 ( $p \leq 0.05$ ) was considered statistically significant.

### **Confirmation statement**

Each listed author is submitting the paper in their own personal, professional capacity, and are not employees of an US-sanctioned government.

### **Declarations**

#### **Ethics approval and consent to participate**

This study was conducted under the principles of the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All the participants were thoroughly informed about the study and procedures before signing consent forms. Participants were assured of anonymity and confidentiality. The Research Ethics Committee of the Pasteur Institute of Iran, Tehran, approved this study (IR.PII. REC.1397.029).

**Availability of data and materials:** All data generated or analyzed in this study are included in the present article.

**Competing interests:** The authors have no conflicts of interest.

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#### **Authors' Contribution:**

MT, MF, and HI writing paper and data analysis. MRY and FE data collecting. ARS and SDS conceptualization, Investigation, Formal analysis, Writing-review & editing. All co-authors commented on the manuscript. All authors read and approved the final manuscript.

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<b>Parameters</b>	<b>Male (N= 30)</b>	<b>Female (N= 96)</b>	<b>Total (N = 126)</b>	<b>P-value</b>
<b>Age</b> (mean $\pm$ SD)	37.43 $\pm$ 6.15	37.54 $\pm$ 6.46	37.45 $\pm$ 6.21	0.92
<b>Height</b> (cm)	172.77 $\pm$ 8.54	169.70 $\pm$ 7.30	170.08 $\pm$ 9.53	0.08
<b>Weight</b> (kg)	142.14 $\pm$ 24.56	115.62 $\pm$ 20.51	122.50 $\pm$ 24.42	<b>0.00</b>
<b>BMI</b> (kg/m <sup>2</sup> )	44.57 $\pm$ 5.87	42.65 $\pm$ 5.01	43.15 $\pm$ 5.29	0.06
<b>Smoking</b>	18(60)	29(30)	47(37)	<b>0.017</b>
<b>Coffee consumption</b>	11(36)	42(44)	53(42)	0.22
<b>Alcohol consumption</b>	10(33)	18(19)	28(22)	0.18
<b>Medications</b>				
Metformin	4(13)	14(14)	18(14)	0.86
Levothyroxine	4(13)	25(26)	29(23)	0.14
Insulin	1(3)	5(5)	6(4)	0.67
Atorvastatin	3(10)	8(8)	11(9)	0.77
Metoral	3(10)	4(4)	7(5)	0.22
<b>Marital status</b>				
Single	12(40)	26(27)	38(30)	0.17
Married	17(56)	67(69)	84(66)	0.18
Divorced	1(3)	3(3)	4(3)	0.95
<b>Educational level</b>				
School level	13(43)	42(44)	55(43)	0.96
University level	17(56)	54(56)	71(56)	0.94
<b>Geographical area</b>				
Urban	19(3)	7(7)	26(20)	<b>0.00</b>
Rural	29(96)	89(92)	118(93)	0.43
<b>Occupation</b>				
Government's employee	16(53)	39(40)	55(43)	0.22
Homemaker	0(0)	47(49)	47(37)	<b>0.00</b>
Self employed	18(60)	0(0)	18(14)	<b>0.00</b>

**Table 1.**  
Sociodemographic and clinical characteristics of morbidly obese patient candidates for LSG.

**Table 2.** Prevalence of obesity associated co-morbidities and distribution of risk factors in morbidly obese patient candidates for LSG.

<b>Clinical status</b>	<b>Male (N= 30)</b>	<b>Female (N= 96)</b>	<b>Total (N = 126)</b>	<b>P-value</b>
<b>Diabetes</b>				
Type 1	2(6)	6(6)	8(6)	0.95
Type 2	4(13)	13(13)	17(13)	0.80
Non- diabetic	29(96)	81(84)	110(87)	0.90
<b>Hypertension</b>	11(36)	34(35)	45(35)	0.78
<b>Hyperlipidemia</b>	24(80)	77(80)	101(80)	0.70
<b>Obstructive sleep apnea</b>	4(13)	10(10)	14(11)	0.81
<b>Degenerative joint pain</b>	5(16)	19(20)	24(19)	0.14
<b>History of depression</b>	1(3)	23(24)	24(19)	<b>0.007</b>
<b>History of gallstone</b>	0(0)	11(11)	11(8)	<b>0.04</b>
<b>History of kidney stone</b>	6(20)	5(5)	11(8)	<b>0.02</b>
<b>Stomach ulcer caused by <i>H. pylori</i></b>	2(6)	10(10)	12(8)	0.44
<b>History of bariatric</b>				
Abdominal liposuction	0(0)	2(2)	2(1)	0.39
Intragastric balloon	2(6)	3(3)	5(4)	0.46
Abdominal lipomatics	0(0)	8(8)	8(6)	0.08
Abdominoplasty	0(0)	4(4)	4(3)	0.23
None	28(93)	85(88)	113(89)	0.15
<b>Hormonal abnormalities</b>				
Hypothyroidism	4(13)	24(25)	28(22)	0.11
Testosterone disorder	0(0)	2(2)	2(1)	0.39
Menstrual disorder	0(0)	4(4)	4(3)	0.23
Hypothyroidism and menstrual	0(0)	2(2)	2(1)	0.39
None	26(86)	68(70)	94(74)	<b>0.018</b>
<b>Fatty liver</b>				
Grade 1	4(13)	12(12)	16(12)	0.92
Grade 2	2(6)	5(5)	7(5)	0.87
Grade 3	1(3)	2(2)	3(2)	0.76
None	27(89)	81(84)	108(86)	0.62
<b>Pregnancy history</b>				
Caesarean	-	42(43)	42(33)	-
Natural	-	11(11)	11(8)	-
Caesarean and natural	-	13(12)	13(10)	-
None	-	34(35)	34(27)	-
<b>Number of pregnancies</b>				
One pregnancy	-	29(30)	29(23)	-
More than one pregnancy	-	37(38)	37(29)	-

**Table 3.** Rate (n/%) of complications 3 and 12 months after LSG in morbidly obese patients.

Complications	3 months post-LSG [n (%)]	12 months post-LSG [n (%)]	P-value
Vision loss	14(11)	12(9)	0.67
Hearing loss	6(4)	9(7)	0.42
Constipation	105(83)	76(60)	<b>0.00</b>
Abdominal pain	93(74)	22(17)	<b>0.00</b>
Dysphagia	86(68)	57(45)	<b>0.00</b>
<b>Food intolerance to</b>			
Pasta	48(30)	9(7)	<b>0.00</b>
Bread	112(88)	41(32)	<b>0.00</b>
Rice	125(99)	48(38)	<b>0.00</b>
Meat	26(20)	9(7)	<b>0.002</b>
Vegetable	14(11)	3(2)	<b>0.006</b>
Fruit	36(28)	7(5)	<b>0.00</b>
Milk	8(6)	3(2)	0.12
Depression	9(7)	52(41)	<b>0.00</b>
Brittle nails	63(50)	23(18)	<b>0.00</b>
Dry skin	107(85)	39(31)	<b>0.00</b>
Hair loss	100(79)	21(16)	<b>0.00</b>
Severe hair loss	26(20)	17(13)	0.13
<b>Types of taste</b>			
Sweet	51(40)	62(49)	0.16
Sour and salty	56(44)	30(24)	<b>0.001</b>
Normal	19(15)	34(27)	<b>0.02</b>
Vomiting	45(36)	32(25)	0.07
Fatigue	77(61)	47(37)	<b>0.00</b>
Menstrual disorder	67(53)	28(22)	<b>0.00</b>
Palpitations within the first hour after a meal	33(26)	24(19)	0.17



Complications	3 months post-LSG [n (%)]			12 months post-LSG [n (%)]		
	<39.9	>39.9	P-value	<39.9	>39.9	P-value
Vision loss	4(12)	10(11)	0.83	2(6)	10(11)	0.43
Hearing loss	1(3)	5(5)	0.58	5(15)	4(4)	<b>0.03</b>
Constipation	28(85)	77(83)	0.78	16(48)	60(64)	0.10
Abdominal pain	27(81)	66(71)	0.22	6(18)	16(17)	0.89
Dysphagia	22(66)	64(69)	0.82	15(45)	42(45)	0.77
<b>Food intolerance to</b>						
Pasta	11(33)	37(40)	0.51	5(15)	4(4)	<b>0.03</b>
Bread	28 (85)	84(92)	0.39	14(42)	27(29)	0.15
Rice	33(100)	92(99)	<b>0.00</b>	16(48)	32(34)	0.15
Meat	9(27)	17(18)	0.27	5(15)	4(4)	<b>0.03</b>
Vegetable	3(9)	11(12)	0.66	2(6)	1(1)	0.10
Fruit	9(27)	27(29)	0.84	2(6)	5(5)	0.88
Milk	1 (3)	7(7)	0.36	0 (0)	3(3)	0.29
Depression	5 (15)	4(4)	<b>0.03</b>	12(36)	40(43)	0.50
Brittle nails	21(7)	42(45)	<b>0.05</b>	4 (12)	19(20)	0.28
Dry skin	29(87)	78(83)	0.89	12 (36)	27(29)	0.43
Hair loss	26(78)	74 (24)	0.92	8 (24)	13(14)	0.17
Severe hair loss	7 (21)	19(20)	0.92	5 (15)	12(13)	0.74
<b>Types of taste</b>						
Sweet	10(30)	40(43)	0.20	16(48)	46(49)	0.92
Sour and salty	16(48)	41(44)	0.66	7(21)	23(25)	0.68
Normal	7(21)	12(13)	0.25	9(27)	24(26)	0.86
Vomiting	12(36)	33(35)	0.92	7(21)	25(27)	0.52
Fatigue	16(48)	61(65)	0.08	10(30)	37(39)	0.33
Menstrual disorder	19(57)	48(51)	0.55	5(15)	23(24)	0.25
Palpitations within the first hour after a meal	7(21)	26(28)	0.44	8(24)	16(17)	0.37

**Table 4.** Comparison of different complications 3 and 12 months after LSG in morbidly obese patients regarding their preoperative BMI (<39.9 and >39.9).

**Table 5.** Frequency and comparison of different complications 3 and 12 months after LSG in morbidly obese patients regarding gender.

Complications	3 months post-LSG [n (%)]			12 months post-LSG [n (%)]		
	Male	Female	P-value	Male	Female	P-value
Vision loss	5(16)	9(9)	0.26	4(13)	8(8)	0.41
Hearing loss	2(6)	4(41)	0.57	0(0)	9(9)	0.08
Constipation	22(30)	83(86)	0.09	17(56)	59(61)	0.64
Abdominal pain	20(66)	73(76)	0.30	7(23)	15(15)	0.15
Dysphagia	23(76)	63(65)	0.25	7(23)	45(47)	<b>0.02</b>
<b>Food intolerance to</b>						
Pasta	6(20)	42(42)	<b>0.01</b>	1(3)	8(8)	0.35
Bread	29(96)	83(86)	0.12	8(26)	33(34)	0.49
Rice	30(100)	95(99)	0.57	8(26)	40(41)	0.14
Meat	5(16)	21(22)	0.53	2(6)	7(7)	0.90
Vegetable	3(10)	11(11)	0.82	0(0)	3(3)	0.32
Fruit	13(43)	24(25)	<b>0.05</b>	3(10)	4(4)	0.22
Milk	1(3)	7(7)	0.43	1(3)	2(2)	0.69
Depression	1(3)	8(8)	0.35	11(36)	41(43)	0.55
Brittle nails	14(46)	49(51)	0.67	2(6)	21(22)	<b>0.05</b>
Dry skin	25(83)	82(85)	0.78	7 (23)	32(33)	0.30
Hair loss	24(80)	66(69)	0.23	3(10)	17(17)	0.31
Severe hair loss	3(10)	23(24)	0.09	1(3)	16(16)	<b>0.05</b>
<b>Types of taste</b>						
Sweet	17(56)	33(34)	<b>0.02</b>	14(46)	48(50)	0.75
Sour and salty	8(26)	48(50)	<b>0.02</b>	6(20)	24(25)	0.57
Normal	5(16)	14(14)	0.78	10(33)	24(25)	0.36
Vomiting	9(30)	36(37)	0.45	5(16)	27(28)	0.20
Fatigue	20(66)	57(59)	0.47	12(40)	35(36)	0.72
Menstrual disorder	0(0)	67(67)	-	0(0)	28(29)	-

Palpitations within the first hour after a meal	8(26)	25(26)	0.94	7(23)	17(17)	0.49
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**Table 6.** Frequency and difference of complications in morbidly obese patients 3 and 12 months after LSG regarding age.

Complications	3 months post-LSG [n (%)]			12 months post-LSG [n (%)]		
	20-30	30-40	P-value	20-30	30-40	P-value
Vision loss	9(11)	5(10)	0.84	10(13)	2(4)	0.10
Hearing loss	4(5)	2(4)	0.80	4(18)	5(10)	0.26
Constipation	66(85)	39(81)	0.62	45(57)	31(46)	0.44
Abdominal pain	55(70)	38(79)	0.28	6(20)	6(12)	0.37
Dysphagia	52(66)	34(71)	0.62	35(45)	22(46)	0.91
<b>Food intolerance to</b>						
Pasta	29(37)	19(39)	0.78	4(18)	5(10)	0.26
Bread	59(75)	43(89)	<b>0.05</b>	24(31)	17(35)	0.58
Rice	77(98)	48(100)	0.43	30(38)	18(37)	0.91
Meat	12(15)	14(29)	0.06	6(7)	3(6)	0.76
Vegetable	8(10)	6(12)	0.69	3(3)	0(0)	0.16
Fruit	23(29)	13(27)	0.77	4(4)	3(6)	0.79
Milk	7(9)	1(2)	0.12	3(3)	0(0)	0.16
Depression	5(6)	4(8)	0.68	32(41)	20(41)	0.94
Brittle nails	44(56)	19(39)	0.06	12(15)	11(23)	0.28
Dry skin	71(91)	36(75)	<b>0.01</b>	28(36)	11(23)	0.12
Hair loss	59(75)	41(85)	0.18	12(15)	7(14)	0.90
Severe hair loss	19(24)	7(14)	0.18	9(11)	8(16)	0.41
<b>Types of taste</b>						
Sweet	40(51)	17(35)	0.08	45(57)	17(35)	<b>0.01</b>
Sour and salty	31(40)	25(52)	0.17	15(19)	15(31)	0.12
Normal	13(16)	6(12)	0.52	18(23)	16(33)	0.20
Vomiting	27(34)	18(37)	0.74	24(31)	8(16)	0.07
Fatigue	48(61)	29(60)	0.90	32(41)	15(31)	0.27
Menstrual disorder	48(61)	19(39)	<b>0.01</b>	22(28)	6(12)	<b>0.03</b>

<b>Palpitations within the first hour after a meal</b>	19(24)	14(29)	0.55	17(22)	7(14)	0.31
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**Table 7.** Remission and improvement of comorbid conditions in morbidly obese patients after 12 months of LSG.

<b>Comorbidity</b>	<b>Remission/ Comorbidity</b>	<b>Improvement/ Comorbidity</b>
Type-2 diabetes mellitus	9/14	1/14
Hypertension	27/45	6/45
Hyperlipidemia	67/101	14/101
Obstructive sleep apnea	1/14	3/14
Degenerative joint pain	1/24	7/24