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Impact of Bariatric Surgery on Gastroesophageal Reflux Disease: A Cross-Sectional Study

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RESEARCH

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ABSTRACT

Objective

To assess the occurrence of GERD after bariatric surgery and surgery impact on GERD.

Methods

This research employs a cross-sectional study design to investigate the impact of bariatric surgery on Gastroesophageal Reflux Disease (GERD) among individuals who have undergone various types of bariatric surgeries.

Results

The study included 302 participants. The most frequent weight among them was more than 96 kg (n= 130, 43 Per Cent) followed by 76-85 kg (n= 51, 16.9 Per Cent). The most frequent height among study participants was 1.61-1.70 m (n= 100, 33.1 Per Cent) followed by 1.51-1.60 m (n= 99, 32.8 Per Cent). The most frequent body mass index (BMI) value among study participants was more than 35 kg/m2 (n= 126, 41.7 Per Cent) followed by 25-29.9 kg/m2 (n= 67, 22.2 Per Cent). The most frequent age among study participants was 26-36 years (n= 104, 34.4 Per Cent) followed by 15-25 years (n= 83, 27.5 Per Cent). The most frequent gender among study participants was Female (n= 162, 53.6 Per Cent) followed by Male (n= 140, 46.4 Per Cent). Participants were asked about the type of obesity surgery. The most frequent was Gastric sleeve (n=222, 73.5 Per Cent), followed by Gastric bypass (n=33, 10.9 Per Cent).

Conclusion

Study results showed that most of the study participants are extremely obese according to their BMI. The most common obesity surgery type was a Gastric sleeve followed by a Gastric bypass. The most of participants were a non-smoker. Most of them had weight loss. In addition, most of the study participants had good social connection.

Key Words

Bariatric surgery

Background

Comorbidities associated with obesity are on the rise as well; gastroesophageal reflux disease (GERD) is of particular

concern because bariatric surgery can alter many of the physiological barriers to reflux and/or the gastroesophageal pressure gradient, both of which contribute to the development of GERD. Most patients choose for one of two bariatric procedures: sleeve gastrectomy (SG) or Roux-en-Y gastric bypass (RYGB). The greater gastric curvature is mobilized and resected about 6 cm from the pylorus in SG to form a restrictive sleeve [1]. The roux jejunal limb (RYJ) is created during RYGB by stapling the stomach to the upper abdominal wall.

Studies on the effects of bariatric surgery on gastroesophageal reflux disease (GERD) are inconclusive since they are based on the subjective experiences of patients during the first year after surgery and lack sensitivity and objective association with the severity of the reflux. The current literature is limited to small cohorts and does not endoscopically assess the long-term implications of GERD after bariatric surgery or potential physiologic mechanisms conducive to GERD. This means that the natural history and pathophysiologic implications of the disease are not well defined. following SG, several studies found significantly more reflux problems than following RYGB [2,3]. Others have shown improvement after both SG and RYGB [4, 5], and Barr and colleagues found no statistical difference in GERD symptoms at 1 year, but did find a higher overall use of acid-reducing medication in SG patients compared with RYGB patients at 1 year.

Compared to SG, the pathophysiologic mechanism of GERD following RYGB is expected to be different. Due to the fact that RYGB redirects acid and bile away from the distal esophagus, distal esophageal motility and esophagogastric junction (EGJ) function may be affected by both overfilling and food stasis in the small gastric pouch. However, SG does not redirect acidic or alkaline refluxate and instead decreases stomach compliance and raises intragastric pressure [6].

The poor connection between GERD symptoms and endoscopic findings of Erosive Esophagitis (EE) and Barrett's esophagus before to or after these procedures [7-9] further complicates this link. Endoscopic assessment for erosive esophagitis (EE) is undoubtedly the more objective and clinically meaningful result; hence, several research have questioned the subjectivity or clinical value of GERD symptoms. Although post-meal gastroesophageal reflux is physiological, the presence of erosive esophagitis is pathologic because it indicates a breakdown in the esophageal mucosal barrier, poor clearance of the refluxate, and chronic inflammation that can lead to dysplasia if left untreated. There is a strong link between the severity of esophagitis and the patient's body mass index (BMI) [10, 11], with a prevalence of erosive esophagitis ranging from 2.1 Per Cent to 18.7 Per Cent in obese patients prior to bariatric surgery. Small studies have revealed a rise in the occurrence of EE one year following SG [12]. In contrast, EE is known to go down after RYGB [13-16]. This study aims to spot light on the occurrence of GERD after bariatric surgery.

Obesity has reached epidemic proportions globally, with significant implications for public health. Alongside obesity, Gastroesophageal Reflux Disease (GERD) has become increasingly prevalent, impacting individuals' quality of life and healthcare resources. Bariatric surgery, as an effective means of addressing obesity, holds the potential to influence the occurrence and course of GERD. However, the relationship between bariatric surgery and GERD is complex and not fully understood. Therefore, this study aims to investigate the impact of bariatric surgery on GERD through a cross-sectional approach.

Before delving into the consequences of bariatric surgery, it is crucial to comprehend the baseline prevalence and severity of GERD among individuals seeking surgical intervention for obesity. This knowledge will serve as a foundation for evaluating postoperative changes in GERD status. By assessing the prevalence, severity, and symptomatology of GERD in this population before and after undergoing different types of bariatric surgery (such as gastric bypass, sleeve gastrectomy, and adjustable gastric banding), we can discern how surgical interventions affect GERD outcomes [17-20].

Furthermore, understanding the factors that influence postoperative GERD is vital. Demographic, clinical, and lifestyle variables may play significant roles in the development or resolution of GERD following bariatric surgery. Identifying these factors will aid in risk stratification and personalized patient management, ultimately optimizing surgical outcomes. Quality of life is a critical dimension to consider in the context of GERD and bariatric surgery. Assessing how GERD impacts the overall quality of life of bariatric surgery patients before and after the procedure, and how this varies by the type of surgery, provides essential insights into the holistic impact of these surgeries.

The long-term consequences of GERD among bariatric surgery patients are equally important. Understanding whether GERD persists, resolves, or necessitates ongoing

medical management or revisional surgery in the postoperative years is crucial for patients and healthcare providers. This study will help in providing valuable insights into the long-term outcomes of GERD in this specific patient population. Lastly, comparing the incidence and management of GERD between various surgical techniques is paramount. Different bariatric procedures may have distinct effects on GERD, and understanding these differences can guide surgical decision-making and patient counseling. In summary, this cross-sectional study seeks to shed light on the multifaceted relationship between bariatric surgery and GERD, with implications for patient care, surgical practice, and public health policy.

Methods

Study design

This research employs a cross-sectional study design to investigate the impact of bariatric surgery on Gastroesophageal Reflux Disease (GERD) among individuals who have undergone various types of bariatric surgeries.

Study approach

The study will be conducted at [Name of the Hospital/Clinic(s)] where bariatric surgeries are routinely performed. Data collection will take place within the surgical outpatient clinics and postoperative follow-up settings.

Study population

The population under investigation comprises individuals who have undergone bariatric surgery at [Name of the Hospital/Clinic(s)] within the past [Specify Time Frame, e.g., 5 years].

Study sample

A systematic random sampling approach will be utilized to select participants. Medical records of eligible patients will be systematically selected from the hospital's database. Sample size calculation will be performed based on the prevalence of GERD in bariatric surgery patients and the desired level of confidence

Study tool

For the current study, a questionnaire was adopted for data collection, which was also categorized as a study tool.

Data collection

Data will be collected through a thorough review of electronic medical records. Information will include preoperative and postoperative clinical assessments, surgical details, GERD diagnostic criteria, and demographic variables. Trained research personnel will extract and record the data.

Data analysis

Data analysis will involve descriptive statistics to characterize the study population, including mean, median, and standard deviation for continuous variables, and frequencies and percentages for categorical variables. Inferential statistics, such as chi-square tests or logistic regression, will be employed to assess associations between bariatric surgery types and GERD outcomes. Subgroup analyses will be performed based on surgical procedures. Statistical significance will be set at $P<0.05$.

Ethical considerations

This study will adhere to ethical principles, including informed consent and patient confidentiality. Ethical approval will be obtained from the Institutional Review Board (IRB) at [Name of the Institution]. Patients' identities will be anonymized during data collection to protect their privacy and confidentiality. Informed consent will be obtained from participants if necessary, and they will be informed of their right to withdraw from the study at any time without consequences.

Results

The study included 302 participants. The most frequent weight among them was more than 96 kg (n= 130, 43 Per Cent) followed by 76-85 kg (n= 51, 16.9 Per Cent). Figure 1 shows the weight distribution among study participants. The most frequent height among study participants was 1.61-1.70 m (n= 100, 33.1 Per Cent) followed by 1.51-1.60 m (n= 99, 32.8 Per Cent). Figure 2 shows the height distribution among study participants. The most frequent body mass index (BMI) value among study participants was more than 35 kg/m2 (n= 126, 41.7 Per Cent) followed by 25-29.9 kg/m2 (n= 67, 22.2 Per Cent). Figure 3 shows the distribution of BMI among study participants.

The most frequent age among study participants was 26-36 years (n= 104, 34.4 Per Cent) followed by 15-25 years (n= 83, 27.5 Per Cent). Figure 4 shows the age distribution among study participants.

The most frequent gender among study participants was Female (n= 162, 53.6 Per Cent) followed by Male (n= 140, 46.4 Per Cent). Figure 5 shows the gender distribution among study participants.

Participants were asked to assess their symptoms and diseases. Their responses and results are presented in Table 1.

Participants were asked about the type of obesity surgery. The most frequent was Gastric sleeve (n=222, 73.5 Per Cent), followed by Gastric bypass (n=33, 10.9 Per Cent). Figure 6 shows participants' sun exposure per the type of obesity surgery distribution among study participants.

Discussion

Obesity, as defined by the World Health Organization as a body mass index (BMI) of 30 or higher, is an epidemic with significant health consequences [21]. More than 10 Per Cent of the world's population, or more than 200 million men and 500 million women, are estimated to be obese [22]. Cardiovascular disease, osteoarthritis, diabetes, certain cancers (breast, colon, endometrial), and gastroesophageal reflux disease [23-24] are associated with obesity and are associated with significant morbidity and mortality. In addition, greater than twenty percent of the global population is overweight (BMI > 25). In the next 20 years, it is estimated that more than 2.16 billion people will be overweight and 1.12 billion will be obese — figures with significant ramifications for health care systems. 60 Per Cent of the Canadian population is considered overweight, and 24.1 Per Cent is obese [25].

It has been demonstrated that bariatric surgery is the most effective and efficient method for attaining significant and sustainable weight loss in morbidly obese individuals [26]. Primarily restrictive or malabsorptive bariatric surgery is classified as either restrictive or malabsorptive. Regarding the effect of bariatric surgery on gastroesophageal reflux disease (GERD), it is essential to distinguish between the various types of procedures, as anatomy and physiology are altered differently for each. Laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG) are two of the most frequently mentioned restrictive surgical procedures. An LAGB is a procedure that restricts the quantity of food that enters the stomach by securing a band around the fundus that can be tightened with saline injections over time. An LSG is an innovative procedure in which the stomach is divided vertically at its greater curvature, making the stomach sac smaller and more restrictive. In addition to its restrictive properties, LSG has an endocrinologic mechanism that reduces the levels of the hunger-stimulating hormone ghrelin [27]. In both of these restrictive procedures, the pyloric sphincter remains intact, and intestinal absorption is unaffected.

Roux-en-Y gastric bypass (RYGB) and biliopancreatic diversion (BPD) are malabsorptive procedures. The RYGB, the more prevalent of these two procedures, has been shown to result in significant weight loss in morbidly obese patients [28]. It entails creating a gastric pouch with a roux limb from the proximal jejunum to evacuate the pouch. In a controlled clinical trial conducted by Hofso and colleagues [29], patients who underwent RYGB were compared to those who underwent lifestyle modifications, and patients who underwent RYGB lost 22 Per Cent more weight than those who underwent lifestyle modifications. A BPD entails a sleeve gastrectomy and the development of 2 enteric limbs: a gastric limb that transports undigested food and a biliopancreatic limb that is affixed distally in the small intestine, which creates malabsorption.

In bariatric patients, gastroesophageal reflux disease is a prevalent comorbid condition. The exposure of the esophagus to stomach content causes esophageal injury. The etiology is not fully understood, but may involve a combination of hereditary and functional factors, abnormal relaxation of the lower esophageal sphincter (LES), increased frequency of transient sphincter relaxation, or increased pressure from the stomach due to a hiatus hernia or increased intra-abdominal pressure [30-32]. This may cause reflux, regurgitation, dysphagia, odynophagia, increased salivation, and chest discomfort. Long-term GERD can cause reflux esophagitis, a condition in which the epithelial layer of mucosa in the esophagus becomes irritated, resulting in necrosis and ulcerations of the esophagus. Inflammation caused by reflux can also result in esophageal strictures. Barret esophagus is a condition in which intestinal columnar cell epithelium replaces the normally present squamous epithelium in the esophagus. This abnormal metaplasia can ultimately lead to esophageal adenocarcinoma. It is estimated that 10 Per Cent of patients with Barret esophagus will ultimately develop adenocarcinoma of the esophagus [33].

Regarding GERD and its associated symptoms, the difficulty of objectively assessing the severity of symptoms is an important factor to consider. Because GERD is a subjective clinical entity, it is challenging to document the severity of the disease process by correlating subjective symptoms with the actual disease process. Chan and colleagues [34] demonstrated in a recent study the distinction between self-reported symptoms and their correlation to pathologic gastroesophageal reflux. In their study, 336 participants were asked to fill out a self-reported Mayo-GERD questionnaire and were referred for 24-hour esophageal pH monitoring [35-40]. Using a distal esophageal pH of less than 4

or a DeMeester score of greater than 14.7 to demonstrate pathological GERD, the authors used univariate and multivariate analysis to identify questions associated with GERD. Based on objective testing, 51 Per Cent of the 336 patients who participated in this study and reported having severe GERD symptoms did not actually have pathologic GERD. In addition, the authors discovered that male respondents and patients who claimed to have a lengthy history of GERD-like symptoms, nocturnal heartburn, and a history of hiatal hernia were more likely to have an abnormal 24-hour pH measurement; however, these factors lacked clinical utility in predicting pathologic GERD. The authors concluded that it was difficult to correlate subjective claims of GERD and its associated symptoms objectively, making it difficult to analyze studies based on subjective claims [41-48].

Conclusion

Study results showed that most of the study participants are extremely obese according to their BMI. The most common obesity surgery type was a Gastric sleeve followed by a Gastric bypass. The most of participants were a non-smoker. Most of them had weight loss. In addition, most of the study participants had good social connections.

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Tables & Figures

Table 1: symptoms and diseases among study participants.

survey item	Yes	No
Did you have esophageal reflux before your surgical procedure?	113 37.40 Per Cent	189 62.60 Per Cent
Do you smoke?	85 28.10 Per Cent	217 71.90 Per Cent
Do you have high blood pressure?	67 22.20 Per Cent	235 77.80 Per Cent
Do you use antacids regularly?	105 34.80 Per Cent	197 65.20 Per Cent
Have you had an esophageal and stomach endoscopy?	122 40.40 Per Cent	180 59.60 Per Cent
Do you have Abdominal pain?	174 57.60 Per Cent	128 42.40 Per Cent
Do you have Dysphagia?	107 35.40 Per Cent	195 64.60 Per Cent
Do you have Indigestion?	183 60.60 Per Cent	119 39.40 Per Cent
Do you have Heartburn?	221 73.20 Per Cent	81 26.80 Per Cent
Do you have Anemia?	91 30.10 Per Cent	211 69.90 Per Cent
Do you have Weight loss?	113 37.40 Per Cent	189 62.60 Per Cent
Do you have diarrhea?	88 29.10 Per Cent	214 70.90 Per Cent

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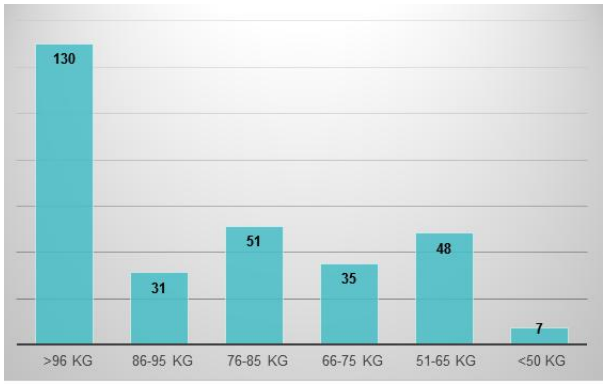

Figure 1: Weight distribution among study participants.

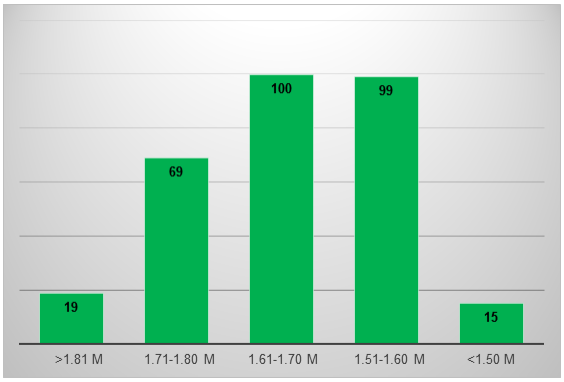

Figure 2: Height distribution among study participants

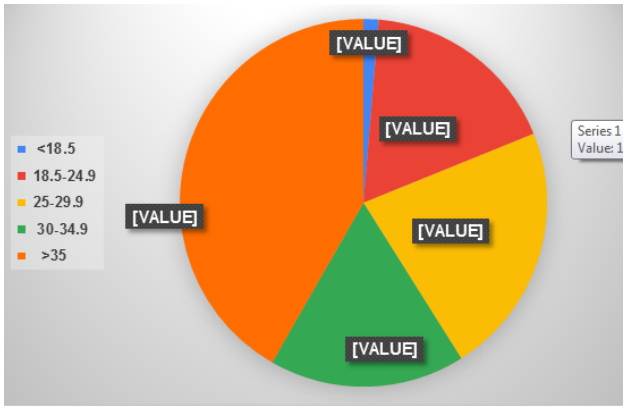

Figure 3: BMI distribution among study participants

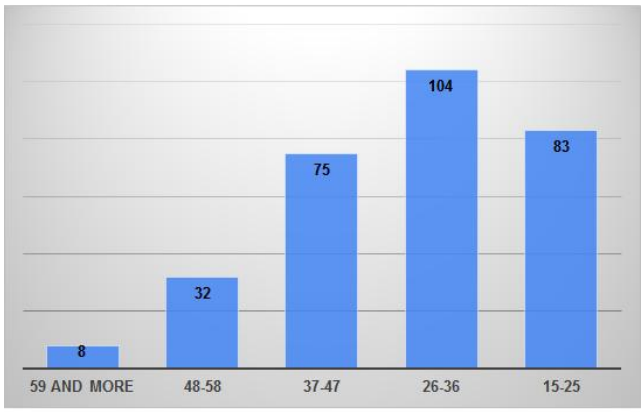

Figure 4: Age distribution among study participants

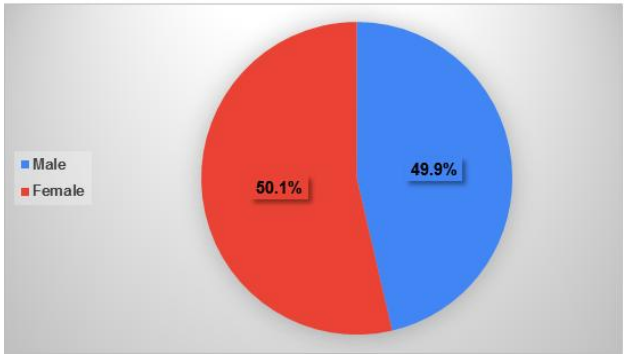

Figure 5: Gender distribution among study participants

ANNEX 1: Data Collection Tool

1. How old are you?
- **15-25**
- **26-36**
- **37-47**
- **48-58**
- **59 and more**

2. What is your gender?
- **Male**
- **Female**

3. What is your weight?
- **<50 Kg**
- **51-65 Kg**
- **66-75 Kg**
- **76-85 Kg**
- **86-95 Kg**
- **>96 Kg**

4. What is your height?
- **<1.50 cm**
- **1.51-1.60 cm**
- **1.61-1.70 cm**
- **1.71-1.80 cm**
- **>1.81 cm**

5. What is your BMI value?
- **<18.5**
- **18.5-24.9**
- **25-29.9**
- **30-34.9**
- **>35**

6. Did you have esophageal reflux before your surgical procedure?
- **Yes**
- **No**

7. Do you smoke?
- **Yes**
- **No**

8. Do you have high blood pressure?
- **Yes**
- **No**

9. Do you use antacids regularly?
- **Yes**
- **No**

10. What type of obesity surgery?
- **Gastric sleeve**
- **Gastric bypass**
- **Gastric banding**
- **Balloon surgery**

11. Have you had an esophageal and stomach endoscopy?
- **Yes**
- **No**

12. Do you have Abdominal pain?
- **Yes**
- **No**

13. Do you have Dysphagia?
- **Yes**
- **No**

14. Do you have Indigestion?
- **Yes**
- **No**

15. Do you have Heartburn?
- **Yes**
- **No**

16. Do you have Anemia?
- **Yes**
- **No**

17. Do you have Weight loss?
- **Yes**
- **No**

18. Do you have diarrhea?
- **Yes**
- **No**

Appendix 2: Participants responses to scale items

variable		Frequency	Percent
Age	15-25	83	27.5 Per Cent
	26-36	104	34.4 Per Cent
	37-47	75	24.8 Per Cent
	48-58	32	10.6 Per Cent
	59 and more	8	2.6 Per Cent
Gender	Male	140	46.4 Per Cent
	Female	162	53.6 Per Cent
weight	<50 Kg	7	2.3 Per Cent
	51-65 Kg	48	15.9 Per Cent
	66-75 Kg	35	11.6 Per Cent
	76-85 Kg	51	16.9 Per Cent
	86-95 Kg	31	10.3 Per Cent
	>96 Kg	130	43.0 Per Cent
height	<1.50 m	15	5.0 Per Cent
	1.51-1.60 m	99	32.8 Per Cent
	1.61-1.70 m	100	33.1 Per Cent
	1.71-1.80 m	69	22.8 Per Cent
	>1.81 m	19	6.3 Per Cent
BMI	<18.5	4	1.3 Per Cent
	18.5-24.9	53	17.5 Per Cent
	25-29.9	67	22.2 Per Cent
	30-34.9	52	17.2 Per Cent
	>35	126	41.7 Per Cent

Table 1: symptoms and diseases among study participants		
survey item	**Yes**	**No**
Did you have esophageal reflux before your surgical procedure?	113	189
	37.4 Per Cent	62.6 Per Cent
Do you smoke?	85	217
	28.1 Per Cent	71.9 Per Cent
Do you have high blood pressure?	67	235
	22.2 Per Cent	77.8 Per Cent

	105	197
Do you use antacids regularly?	34.8 Per Cent	65.2 Per Cent
	122	180
Have you had an esophageal and stomach endoscopy?	40.4 Per Cent	59.6 Per Cent
	174	128
Do you have Abdominal pain?	57.6 Per Cent	42.4 Per Cent
	107	195
Do you have Dysphagia?	35.4 Per Cent	64.6 Per Cent
	183	119
Do you have Indigestion?	60.6 Per Cent	39.4 Per Cent
	221	81
Do you have Heartburn?	73.2 Per Cent	26.8 Per Cent
	91	211
Do you have Anemia?	30.1 Per Cent	69.9 Per Cent
	113	189
Do you have Weight loss?	37.4 Per Cent	62.6 Per Cent
	88	214
Do you have diarrhea?	29.1 Per Cent	70.9 Per Cent

What type of obesity surgery?	**Frequency**	**Percent**
Gastric sleeve	222	73.5 Per Cent
Gastric bypass	33	10.9 Per Cent
Gastric banding	24	7.9 Per Cent
Balloon surgery	23	7.6 Per Cent

Chi-Square

Type.obesity.surgery * esophageal.reflux.before.surgical

Crosstab					
			Esophageal.reflux.before.surgical		
			yes	no	Total
Type.obesity.surgery	Gastric sleeve	Count	75	147	222
		Per Cent of Total	24.8 Per Cent	48.7 Per Cent	73.5 Per Cent
	Gastric bypass	Count	22	11	33
		Per Cent of Total	7.3 Per Cent	3.6 Per Cent	10.9 Per Cent
	Gastric banding	Count	10	14	24
		Per Cent of Total	3.3 Per Cent	4.6 Per Cent	7.9 Per Cent
	Balloon surgery	Count	6	17	23
		Per Cent of Total	2.0 Per Cent	5.6 Per Cent	7.6 Per Cent
Total		Count	113	189	302
		Per Cent of Total	37.4 Per Cent	62.6 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.754[a]	3	0.002
Likelihood Ratio	14.336	3	0.002
Linear-by-Linear Association	.244	1	0.621
N of Valid Cases	302		

Type.obesity.surgery * antacids.regularly

Crosstab					
			antacids.regularly		
			yes	no	Total
type.obesity.surgery	Gastric sleeve	Count	76	146	222
		Per Cent of Total	25.2 Per Cent	48.3 Per Cent	73.5 Per Cent
	Gastric bypass	Count	16	17	33
		Per Cent of Total	5.3 Per Cent	5.6 Per Cent	10.9 Per Cent
	Gastric banding	Count	8	16	24
		Per Cent of Total	2.6 Per Cent	5.3 Per Cent	7.9 Per Cent
	Balloon surgery	Count	5	18	23
		Per Cent of Total	1.7 Per Cent	6.0 Per Cent	7.6 Per Cent
Total		Count	105	197	302
		Per Cent of Total	34.8 Per Cent	65.2 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.509[a]	3	.212
Likelihood Ratio	4.525	3	.210
Linear-by-Linear Association	.446	1	.504
N of Valid Cases	302		

Type.obesity.surgery * esophageal.and.stomach.endoscopy

Crosstab					
			esophageal.and.stomach.endoscopy		
			yes	no	Total
type.obesity.surgery	Gastric sleeve	Count	77	145	222
		Per Cent of Total	25.5 Per Cent	48.0 Per Cent	73.5 Per Cent
	Gastric bypass	Count	24	9	33
		Per Cent of Total	7.9 Per Cent	3.0 Per Cent	10.9 Per Cent
	Gastric banding	Count	13	11	24
		Per Cent of Total	4.3 Per Cent	3.6 Per Cent	7.9 Per Cent
	Balloon surgery	Count	8	15	23
		Per Cent of Total	2.6 Per Cent	5.0 Per Cent	7.6 Per Cent
Total		Count	122	180	302

	Per Cent of Total	40.4 Per Cent	59.6 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.525[a]	3	.000
Likelihood Ratio	19.365	3	.000
Linear-by-Linear Association	2.844	1	.092
N of Valid Cases	302		

Type.obesity.surgery * Abdominal.pain

Crosstab					
			Abdominal.pain		Total
			yes	no	
type.obesity.surgery	Gastric sleeve	Count	128	94	222
		Per Cent of Total	42.4 Per Cent	31.1 Per Cent	73.5 Per Cent
	Gastric bypass	Count	22	11	33
		Per Cent of Total	7.3 Per Cent	3.6 Per Cent	10.9 Per Cent
	Gastric banding	Count	10	14	24
		Per Cent of Total	3.3 Per Cent	4.6 Per Cent	7.9 Per Cent
	Balloon surgery	Count	14	9	23
		Per Cent of Total	4.6 Per Cent	3.0 Per Cent	7.6 Per Cent
Total		Count	174	128	302
		Per Cent of Total	57.6 Per Cent	42.4 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.707[a]	3	.295
Likelihood Ratio	3.697	3	.296
Linear-by-Linear Association	.092	1	.762
N of Valid Cases	302		

Type.obesity.surgery * Dysphagia

Crosstab					
			Dysphagia		Total
			yes	no	
Type.obesity.surgery	Gastric sleeve	Count	75	147	222
		Per Cent of Total	24.8 Per Cent	48.7 Per Cent	73.5 Per Cent
	Gastric bypass	Count	14	19	33
		Per Cent of Total	4.6 Per Cent	6.3 Per Cent	10.9 Per Cent
	Gastric banding	Count	11	13	24
		Per Cent of Total	3.6 Per Cent	4.3 Per Cent	7.9 Per Cent
	Balloon surgery	Count	7	16	23

		Per Cent of Total	2.3 Per Cent	5.3 Per Cent	7.6 Per Cent
Total		Count	107	195	302
		Per Cent of Total	35.4 Per Cent	64.6 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.355[a]	3	.502
Likelihood Ratio	2.306	3	.511
Linear-by-Linear Association	.248	1	.619
N of Valid Cases	302		

Type.obesity.surgery * Indigestion

Crosstab					
			Indigestion		
			yes	no	Total
type.obesity.surgery	Gastric sleeve	Count	136	86	222
		Per Cent of Total	45.0 Per Cent	28.5 Per Cent	73.5 Per Cent
	Gastric bypass	Count	19	14	33
		Per Cent of Total	6.3 Per Cent	4.6 Per Cent	10.9 Per Cent
	Gastric banding	Count	17	7	24
		Per Cent of Total	5.6 Per Cent	2.3 Per Cent	7.9 Per Cent
	Balloon surgery	Count	11	12	23
		Per Cent of Total	3.6 Per Cent	4.0 Per Cent	7.6 Per Cent
Total		Count	183	119	302
		Per Cent of Total	60.6 Per Cent	39.4 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.791[a]	3	.425
Likelihood Ratio	2.793	3	.425
Linear-by-Linear Association	.382	1	.536
N of Valid Cases	302		

Type.obesity.surgery * Heartburn

Crosstab					
			Heartburn		
			yes	no	Total
type.obesity.surgery	Gastric sleeve	Count	163	59	222
		Per Cent of Total	54.0 Per Cent	19.5 Per Cent	73.5 Per Cent
	Gastric bypass	Count	26	7	33
		Per Cent of Total	8.6 Per Cent	2.3 Per Cent	10.9 Per Cent
	Gastric banding	Count	17	7	24

		Per Cent of Total	5.6 Per Cent	2.3 Per Cent	7.9 Per Cent
	Balloon surgery	Count	15	8	23
		Per Cent of Total	5.0 Per Cent	2.6 Per Cent	7.6 Per Cent
Total		Count	221	81	302
		Per Cent of Total	73.2 Per Cent	26.8 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.346[a]	3	.718
Likelihood Ratio	1.332	3	.722
Linear-by-Linear Association	.442	1	.506
N of Valid Cases	302		

Type.obesity.surgery * Anemia

Crosstab					
			Anemia		Total
			yes	no	
type.obesity.surgery	Gastric sleeve	Count	61	161	222
		Per Cent of Total	20.2 Per Cent	53.3 Per Cent	73.5 Per Cent
	Gastric bypass	Count	11	22	33
		Per Cent of Total	3.6 Per Cent	7.3 Per Cent	10.9 Per Cent
	Gastric banding	Count	13	11	24
		Per Cent of Total	4.3 Per Cent	3.6 Per Cent	7.9 Per Cent
	Balloon surgery	Count	6	17	23
		Per Cent of Total	2.0 Per Cent	5.6 Per Cent	7.6 Per Cent
Total		Count	91	211	302
		Per Cent of Total	30.1 Per Cent	69.9 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.668[a]	3	.053
Likelihood Ratio	7.071	3	.070
Linear-by-Linear Association	1.739	1	.187
N of Valid Cases	302		
a. 0 cells (0.0 Per Cent) have expected count less than 5. The minimum expected count is 6.93.			

Type.obesity.surgery * Weight.loss

Crosstab					
			Weight.loss		Total
			yes	no	
type.obesity.surgery	Gastric sleeve	Count	83	139	222
		Per Cent of Total	27.5 Per Cent	46.0 Per Cent	73.5 Per Cent
	Gastric bypass	Count	12	21	33

		Per Cent of Total	4.0 Per Cent	7.0 Per Cent	10.9 Per Cent
	Gastric banding	Count	12	12	24
		Per Cent of Total	4.0 Per Cent	4.0 Per Cent	7.9 Per Cent
	Balloon surgery	Count	6	17	23
		Per Cent of Total	2.0 Per Cent	5.6 Per Cent	7.6 Per Cent
Total		Count	113	189	302
		Per Cent of Total	37.4 Per Cent	62.6 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.899[a]	3	.407
Likelihood Ratio	2.915	3	.405
Linear-by-Linear Association	.074	1	.786
N of Valid Cases	302		

Type.obesity.surgery * diarrhea

Crosstab					
			diarrhea		
			yes	no	Total
type.obesity.surgery	Gastric sleeve	Count	54	168	222
		Per Cent of Total	17.9 Per Cent	55.6 Per Cent	73.5 Per Cent
	Gastric bypass	Count	18	15	33
		Per Cent of Total	6.0 Per Cent	5.0 Per Cent	10.9 Per Cent
	Gastric banding	Count	12	12	24
		Per Cent of Total	4.0 Per Cent	4.0 Per Cent	7.9 Per Cent
	Balloon surgery	Count	4	19	23
		Per Cent of Total	1.3 Per Cent	6.3 Per Cent	7.6 Per Cent
Total		Count	88	214	302
		Per Cent of Total	29.1 Per Cent	70.9 Per Cent	100.0 Per Cent

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.404[a]	3	.000
Likelihood Ratio	18.123	3	.000
Linear-by-Linear Association	1.955	1	.162
N of Valid Cases	302		

Type.obesity.surgery * high.blood.pressure

Crosstab					
			high.blood.pressure		
			yes	no	Total
type.obesity.surgery	Gastric sleeve	Count	40	182	222

		Per Cent of Total	13.2 Per Cent	60.3 Per Cent	73.5 Per Cent
	Gastric bypass	Count	15	18	33
		Per Cent of Total	5.0 Per Cent	6.0 Per Cent	10.9 Per Cent
	Gastric banding	Count	8	16	24
		Per Cent of Total	2.6 Per Cent	5.3 Per Cent	7.9 Per Cent
	Balloon surgery	Count	4	19	23
		Per Cent of Total	1.3 Per Cent	6.3 Per Cent	7.6 Per Cent
Total		Count	67	235	302
		Per Cent of Total	22.2 Per Cent	77.8 Per Cent	100.0 Per Cent

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.617[a]	3	.002
Likelihood Ratio	12.963	3	.005
Linear-by-Linear Association	2.087	1	.149
N of Valid Cases	302		

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