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Research Article

**BARIATRIC SURGERIES AND ASSOCIATED  
COMPLICATIONS IN KSA**

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**Abstract:**

*This study aims to assess the prevalence of bariatric surgeries and their associated complications in the Kingdom of Saudi Arabia. **Methods and sample:** This is an analytical cross-sectional study conducted on 1636 persons of the general population through an online questionnaire. The sample size was calculated using OpenEpi. Data was then entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 17. Descriptive statistics were displayed as frequencies and percentages for categorical variables. **Results:** Our study found that only 271 (16.6%) out of 1636 had a personal history of bariatric surgery, while those with a family history were 1202 (73.5%). Sleeve gastrectomy was found to be the most common procedure (233 cases) (86%), followed by Stomach balloon surgery (15 cases) (5.5%) and Gastric bypass (13 cases) (4.8%). The most common complications noted were Vitamin Deficiency (32.1%) and the formation of gall stones (9.6%). **Conclusion:** Our data indicate the prevalence of bariatric surgeries in Saudi society and confirm the previously noted postoperative complications, especially nutritional deficiencies and gallstones.*

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**INTRODUCTION:**

Bariatric surgery, as defined by NIDDK (National Institute of Diabetes and Digestive and Kidney Diseases), is an operation that makes changes to your digestive system in order to lose weight. There are various types of bariatric surgeries; some decrease the capacity of your stomach; others influence the absorption of nutrients and calories through making changes to the small intestine, with the most common four types being: Roux-en-Y gastric bypass, sleeve gastrectomy, adjustable gastric band, and the duodenal switch (5).

Losing weight in overweight to obese patients is the main purpose of this type of surgery. Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A body mass index (BMI) over 25 is considered overweight, and over 30 is obese.

About 13% of the world's adult population (11% of men and 15% of women) were obese in 2016. (WHO global estimate and definition). In KSA, there was an overall obesity prevalence of 35.5%, according to a community-based national epidemiological health survey (2005) (6). A recent cross-sectional study conducted in the southwestern region of Saudi Arabia found that the overall prevalence of overweight and obesity among 1681 adults were, respectively, 38.3% and 27.6% (7). Another cross-sectional study conducted in Alkharj, Saudi Arabia, found that the percentage of overweight and obese was 54.3% compared with 45.7% being non-obese.

In multiple studies, women were found to have a higher prevalence of obesity than men (11, 12); one study conducted by *Memish et al.* in Saudi Arabia found women to be dominating with 33.5% vs. 24.1% (11). In the same study, it was established that obesity is linked to the prevalence of various diagnoses such as diabetes, hypercholesterolemia, and hypertension (11).

Obesity is usually accompanied by a set of health implications such as; cardiovascular disease (mainly heart disease and stroke), type 2 diabetes, musculoskeletal disorders like osteoarthritis, and some cancers (endometrial, breast, and colon). It is also associated with increased rates of mortality, according to the CDC (Center for Disease Control and Prevention).

And so, as the numbers of Obesity increase, the need for more bariatric surgeries rises. According to IFSO (International Federation for the Surgery of Obesity and Metabolic Disorders), the total number of bariatric/metabolic procedures performed in 2016 was 685,874 (8) compared with 594,242 in 2014 (9) and 468,609 in 2013 (10).

Bariatric surgeries have a tremendous postoperative positive impact, not only on weight loss but also on associated comorbidities. In the case of type 2 DM (Diabetes Mellitus), it can lead to full and rapid remission of it. In a follow-up study (with a mean of 9.4 yr) done on 146 patients with diabetes, 121 (83%) presented with full and durable remission of diabetes after undergoing gastric bypass surgery (13). It was also suggested to improve CVS (cardiovascular system) long-term parameters after enhancing blood lipid profile and metabolic condition. However, we need to take into consideration the increased risk of operating on patients with obesity cardiomyopathy or pulmonary hypertension. (14)

Despite the well-noted advantages of bariatric surgeries, we can't deny the possible side effects of them. Bariatric surgeries, especially duodenal switch, have been associated with micronutrient deficiency. In a follow-up study conducted on 59 surgically treated patients, vitamin A and D deficiencies were noted in the first year after surgery and thiamine deficiency in the initial months after surgery (15). Bariatric surgeries were also associated with a condition of iron deficiency; the prevalence of iron deficiency varies between 18 and 53 % after Roux-en-Y gastric bypass and between 1 and 54 % after sleeve gastrectomy (16).

Other possible, yet still under investigation, side effects include bone fracture risk, new-onset nephrolithiasis, cholelithiasis, hypoglycemia, (17) neurological and psychological complications, and risk of developing Barrett's esophagus after sleeve gastrectomy. (18)

It is then evidently essential for bariatric patients to strictly adhere to supplements supporting them with their deficient micronutrients (18), and hence a routine follow-up consisting of laboratory investigations should be done to avoid hazards of deficiencies and to determine individual needs precisely. (19)

**Rationale**

As there is no enough research within the kingdom, this paper aims to build upon preceding global literature through assessing the prevalence and complications accompanied by bariatric surgeries, in addition to attempting to fill in the local gap in knowledge.

Identifying the most common complications for any disease can help us better examine patients for them and notice any correlation, and hence help us avoid or manage them.

**Research aim**

To Determine Associated complications after bariatric surgeries.

**Objectives**

1. To determine the relationship of age to increase the incidence of complications.
2. To determine the prevalence of bariatric surgeries in KSA.
3. To know the majority of BMI who considered suffer from obesity.
4. To determine the most common complications
5. To determine the gender effected most by obesity
6. To determine the most common gender underdoing bariatric surgeries
7. To determine the most common type of bariatric surgeries done.
8. An evaluation of the degree of satisfaction with the action or avoidance of obesity surgery.

**METHODOLOGY:****Study design**

This is an analytical cross-sectional study.

**Study Setting and period**

This was conducted on the general population of the Kingdom of Saudi Arabia from a period of 25/6/2020 to 25/9/2020.

**Study population and sampling**

The study was conducted on 1636 individuals, representing the general population from 5 geographical regions in Saudi Arabia.

### Study participants

#### Inclusion criteria

Participants included were adults, able to read the questionnaire and agree to participate in the study.

#### Exclusion criteria

Individuals aged below 18 years, illiterate, or with a history of other surgical operations in the last two years were excluded from the study.

#### Measurements

Explanatory variables:

1. Sociodemographic characteristics: status, gender, age, and nationality.
2. Disease-related information: BMI, doing bariatric surgeries, a relative of who doing bariatric surgeries, type of bariatric surgeries, complications, The extent of thinking about undergoing obesity surgery when suffering from excessive weight.

#### Outcome measures

The outcome measure is composed of counting the ratio of the number of patients who have a past history of doing bariatric surgery. This was measured by determining the extent of the complications that occurred associated with bariatric surgery.

A pilot study was carried out to test the questionnaire if easily understood and the response of the participants. Data from the pilot study was not included in the final sample.

#### Data management and statistical analysis

Data was entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics were performed, and categorical data were displayed as frequencies and percentages, while measures of central tendencies and measures and dispersion were used to summarize continuous variables. Statistical significance is set at a P value of 0.05 or less.

#### Ethical considerations

Administrative approval was obtained from the unit of the biomedical ethics research committee. Ethical approval was obtained from the ethical committee of the faculty of medicine, King Abdulaziz University,

KSA. Informed consent was obtained from the participants.

### RESULTS:

The present cross-sectional study included 1636 participants (60.4% Females and 39.6% Males); 58.1% of which were between 18-35 years of age. The majority were Saudi (89.5%) and from the western region (68.1%) (Table 1).

BMI was calculated with the majority (38.1%) found at a normal BMI, followed by the percentages of overweight and obese being almost equal (28.2% and 28.7% respectively), with a total mean of  $26.1 \pm 6.5$ .

Only 271 out of 1636 (16.6%) had a personal history of bariatric surgeries, 116 (7.1%) were considering them, and 1202 (73.5%) had a family history of bariatric surgeries.

We examined the type of operation in each one of the 271 cases and found sleeve gastrectomy to be the most common (233 cases) (86%), followed by Stomach balloon surgery (15 cases) (5.5%) and Gastric bypass (13 cases) (4.8%).

The most common complication was found to be Vitamin Deficiency (32.1%), with the formation of gall stones coming second (9.6%). However, it is important to note that almost half of the cases (50.9%) didn't report to have any postoperative complications. (Table 2)

In terms of the association between BMI and complications, the development of internal hernia, Leakage, or Low blood sugar was found to be significantly associated with BMI. Also, the development of no complications had a P-value < 0.05 (0.022), indicating the presence of an association between BMI and the non-development of complications. (Table 3)

As for the association between age and complications, only Internal hernia was statistically significant (P-value = 0.008). (Table 4)

After studying the association between sex and complications, none of the complications was shown to be statistically significant except for Gastric bleeding with a P-value of 0.022. (Table 5)

In studying the association between age, sex, nationality, BMI, and region with a history of bariatric surgery (Table 6), it was found that: Age, nationality, BMI, and region are statistically significant (P-value < 0.05).

**Table (1): Sociodemographic data of the participants, KSA, 2020 (N=1636).**

Parameter	Frequency	Percent
<b>Age</b>		
• 18-35 years	950	58.1%
• 35-45 years	409	25.0%
• 46-50 years	277	16.9%
<b>Gender</b>		
• Male	648	39.6%
• Female	988	60.4%
<b>Nationality</b>		
• Saudi	1465	89.5%
• Non-Saudi	171	10.5%
<b>Region</b>		
• Central Region	150	9.2%
• Eastern Region	101	6.2%
• Northern Region	179	10.9%
• Southern Region	92	5.6%
• Western Region	1114	68.1%

Table (2): BMI, personal and family history, type of operation, and complications among participants, KSA, 2020 (N=1636).

Parameter	Frequency	Percent
<b>BMI</b>		
• Underweight	82	5.0%
• Normal	623	38.1%
• Overweight	460	28.2%
• Obese	469	28.7%
Mean±SD	26.1±6.5	
<b>Personal history of bariatric surgery</b>		
• Yes	271	16.6%
• No	1249	76.3%
• No, but I am considering it	116	7.1%
<b>Family history of bariatric surgery</b>		
• Yes	1202	73.5%
• No	434	26.5%
<b>Type of operation (N=271)</b>		
• Gastric band or rubber girdle surgery	6	2.2%
• Stapling process	4	1.5%
• Stomach balloon surgery	15	5.5%
• Gastric bypass	13	4.8%
• Sleeve gastrectomy	233	86.0%
<b>Complications (N=271)</b>		
• Anastomotic stricture	2	0.7%
• Gallstones	26	9.6%
• Gastric bleeding	3	1.1%
• High blood pressure	3	1.1%
• Internal hernia	8	3.0%
• Leakage	16	5.9%
• Low blood sugar	20	7.4%
• Vitamin deficiency	87	32.1%
• Stomach ulcer	10	3.7%
• Wound infection	2	0.7%
• Gastric band slippage	1	0.4%
• Gastric band erosion	4	1.5%
• Small bowel obstruction	5	1.8%
• Pulmonary embolism	1	0.4%
• No complications	138	50.9%

Table (3): Association between BMI and complications among participants with a history of a bariatric operation, KSA, 2020 (N=271).

Parameter	BMI				P-value*
	Underweight	Normal	Overweight	Obese	
• Anastomotic stricture	0.0%	50.0%	0.0%	50.0%	0.753
• Gallstones	0.0%	34.6%	42.3%	23.1%	0.212
• Gastric bleeding	0.0%	0.0%	66.7%	33.3%	0.588
• High blood pressure	0.0%	33.3%	66.7%	0.0%	0.482
• Internal hernia	0.0%	25.0%	12.5%	62.5%	0.587
• Leakage	0.0%	56.3%	6.3%	37.5%	<b>0.016</b>
• Low blood sugar	0.0%	20.0%	70.0%	10.0%	<b>0.002</b>
• Vitamin deficiency	2.3%	25.3%	40.2%	32.2%	<b>0.025</b>
• Stomach ulcer	0.0%	30.0%	30.0%	40.0%	0.977
• Wound infection	0.0%	0.0%	100.0%	0.0%	0.242
• Gastric band slippage	0.0%	0.0%	100.0%	0.0%	0.554
• Gastric band erosion	0.0%	25.0%	75.0%	0.0%	0.263
• Small bowel obstruction	0.0%	0.0%	40.0%	60.0%	0.612
• Pulmonary embolism	0.0%	100.0%	0.0%	0.0%	0.392
• No complications	0.0%	21.0%	29.0%	50.0%	<b>0.022</b>

\*P-value is calculated by Chi-Square Test  
P-value <0.05 is statistically significant

Table (4): Association between age and complications among participants with history of a bariatric operation, KSA, 2020 (N=271).

Parameter	Age			P-value*
	18-35	35-45	46-50	
• Anastomotic stricture	50.0%	0.0%	50.0%	0.488
• Gallstones	50.0%	42.3%	7.7%	0.140
• Gastric bleeding	66.7%	33.3%	0.0%	0.665
• High blood pressure	100.0%	0.0%	0.0%	0.217
• Internal hernia	37.5%	0.0%	62.5%	<b>0.008</b>
• Leakage	43.8%	18.8%	37.5%	0.209
• Low blood sugar	60.0%	30.0%	10.0%	0.440
• Vitamin deficiency	56.3%	23.0%	20.7%	0.230
• Stomach ulcer	70.0%	30.0%	0.0%	0.224
• Wound infection	0.0%	50.0%	50.0%	0.345
• Gastric band slippage	100.0%	0.0%	0.0%	0.603
• Gastric band erosion	0.0%	75.0%	25.0%	0.086
• Small bowel obstruction	40.0%	60.0%	0.0%	0.252
• Pulmonary embolism	100.0%	0.0%	0.0%	0.603
• No complications	47.8%	32.6%	19.6%	0.523

\*P-value is calculated by Chi-Square Test  
P-value <0.05 is statistically significant

Table (5): Association between sex and complications among participants with history of a bariatric operation, KSA, 2020 (N=271).

Parameter		Sex		P-value*
		Male	Female	
Complications	• Anastomotic stricture	50.0%	50.0%	0.691
	• Gallstones	30.8%	69.2%	0.521
	• Gastric bleeding	100.0%	0.0%	<b>0.022</b>
	• High blood pressure	33.3%	66.7%	0.908
	• Internal hernia	37.5%	62.5%	0.954
	• Leakage	18.8%	81.3%	0.128
	• Low blood sugar	40.0%	60.0%	0.738
	• Vitamin deficiency	26.4%	73.6%	0.018
	• Stomach ulcer	40.0%	60.0%	0.816
	• Wound infection	100.0%	0.0%	0.061
	• Gastric band slippage	100.0%	0.0%	0.187
	• Gastric band erosion	0.0%	100.0%	0.126
	• Small bowel obstruction	20.0%	80.0%	0.438
	• Pulmonary embolism	0.0%	100.0%	0.447
• No complications	39.1%	60.9%	0.365	

\*P-value is calculated by Chi-Square Test  
P-value <0.05 is statistically significant

Table (6): Association between age, sex, nationality, BMI and region with history of bariatric surgery, KSA, 2020 (N=1636).

Parameter		History of bariatric surgery		P-value*
		No	Yes	
Age	• 18-35 years	85.8%	14.2%	<b>0.010</b>
	• 35-45 years	80.4%	19.6%	
	• 46-50 years	79.8%	20.2%	
Sex	• Male	84.7%	15.3%	0.257
	• Female	82.6%	17.4%	
Nationality	• Saudi	82.7%	17.3%	<b>0.025</b>
	• Non-Saudi	89.5%	10.5%	
BMI	• Underweight	97.6%	2.4%	<b>0.000</b>
	• Normal	89.1%	10.9%	
	• Overweight	80.9%	19.1%	
	• Obese	75.9%	24.1%	
Region	• Central Region	68.0%	32.0%	<b>0.000</b>
	• Eastern Region	77.2%	22.8%	
	• Northern Region	95.0%	5.0%	
	• Southern Region	85.9%	14.1%	
	• Western Region	84.0%	16.0%	

\*P-value is calculated by Chi-Square Test  
P-value <0.05 is statistically significant

**DISCUSSION:**

This was an analytical cross-sectional study conducted on a sample size of 1636 in the Kingdom of Saudi Arabia through an online questionnaire in order to assess the prevalence of bariatric surgeries and their complications. In addition to the association between complications and other patients' demographics 9-such as BMI, age, and sex. The demand for bariatric surgeries is increasing worldwide, especially in nations where obesity is most prevalent. It is estimated that 15,000 bariatric operations are performed annually in Saudi Arabia. (25) Our study had 271 bariatric patients out of 1636 in addition to 116 (7.1%) were considering undergoing the surgeries, and 1202 (73.5%) had a family history of bariatric surgeries, which suggests a higher prevalence in case of presence of a larger sample.

Our data support the preceding literature in that sleeve gastrectomy is the most common procedure. According to The IFSO Global Registry collected data from 51 different countries, 87,467 sleeve gastrectomy operations were done since 2014 (46.0%), followed by 72,645 Roux en Y gastric bypass operations (38.2%), which comes in competition with stomach balloon surgery in our sample.

Bariatric surgeries are known to cause vitamin deficiency, most common amongst all complications (15, 16), which has also been confirmed by our data (87 cases out of 271, 32.1%). The second most common in our complications list was found to be gallstones formation. In normal conditions, obese people present a higher probability of forming gallstones compared with the general population due to the evident increase in cholesterol concentration in the bile (26). And this probability increases furthermore upon following one of VLCD (very-low-calorie diets) (27). So, it can sound self-evident to say that there is a risk of developing gallstone issues after bariatric surgeries, which count basically on weight loss (28, 29, 30). In a prophylactic approach to gallstones formation, some studies suggest prophylactic cholecystectomy (31).

Post-bariatric anemia is one complication that could not be assessed in this study despite its vitality due to the lack of prognostic data and laboratory investigation, so we encourage future studies to closely monitor it. Many patients with mild anemia can be symptomless and hence difficult to spot by simple questionnaires. Anemia can result from iron, B12, or folic acid deficiencies, with iron being the most common cause. (32)

Despite the possible complications evident in the literature as well as our study, the majority of bariatric patients ended with zero complications.

Bariatric surgeries are used worldwide as an effective approach against obesity, especially for those with comorbidities like diabetes. In a 5-year follow-up study conducted in Italy, bariatric surgeries were found to be more effective than medical treatment for long-term control of diabetes type 2 in obese patients. (20)

They are also usually associated with decreased mortalities in the obese population. In a prospective study conducted in Sweden in 4047 obese subjects, it was found that there were 129 deaths in the control group and only 101 deaths in the surgery group. (21) In a systematic review including 18 articles, it was found that bariatric surgery significantly improved

hormonal balance and sexual functions in both males and females, sperm count in males, and pregnancy in females. (22)

Despite the presence of some studies that report an increase in the suicidality of postoperative bariatric patients, there is a significant difference in cohort characteristics and duration of follow-up compared with the general population, which makes it difficult to precisely estimate the suicidal risk in bariatric patients. Indeed, present evidence better supports the positive impact bariatric surgeries have on mental health. (33)

In a Portuguese cross-sectional study, including a total of 51 patients assessing the overall quality of life pre-post operation, results were found to support the trend in the belief that bariatric surgeries contribute to a better quality of life. (23) In another cross-sectional study conducted in Al-Qassim Region, Saudi Arabia, Patients' quality of life was found to be improved tremendously post sleeve gastrectomy. (25)

We cannot, however, overlook the possible bias posed by socioeconomic factors; since they play a major role in determining who does and does not undergo bariatric surgery, despite medical eligibility. (24) This indicates the need for a larger sample to better assess the prevalence with minimal bias.

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**We thank the data collectors** who collected the data from the patients, they worked hard to collect data greatly, and a large sample number was collected for their great effort.

**Limitations**

This, being a cross-sectional study, lacks the prognostic data required to precisely assess the long-term complications of bariatric surgeries, so further follow-up studies are encouraged. Also, since this was done through an online questionnaire, it is difficult to confirm the absence of certain complications in a case without clinical evaluation. Pre-post assessment of participants was needed to determine whether complications pre-existed before undergoing the surgeries or not.

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