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Assessment of the Long-Term Negative Impact of Bariatric Surgery on Health in Saudi Adults, over 3 Years after Surgery: A Cross-Sectional Study

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Abstract

Background: Bariatric surgery is a highly effective therapy for serious obesity. However, it has certain long-term complications that are due to deficiencies in nutrients, malabsorption, and weight loss. This study aimed to estimate the prevalence of long-term complications and associated factors after bariatric surgery among Saudi Arabian adults.

Methodology: A cross-sectional survey was conducted in Saudi Arabia between March 1-14, 2021. The sample was 497 subjects above 18 years of age, both sexes, and greater than 3 years post-bariatric surgery. A specially designed and validated online questionnaire was posted on social media.

Results: The sample was 495 subjects (36.6% male, 63.4% female). The average BMI upon study was 29.07. Frequent long-term complications included hair loss (68.5%), mood swings (50.5%), bone pain (43.8%), lethargy (41.2%), anemia (23.4%), and gallstone diagnosis (19.3%). Gallstone development had a significant association with a post-operative time of over 5 years (p=0.020). Bone pain (p=0.000) and muscle cramps (p=0.000) were reported by females than by males. Moreover, significant weight regain was observed in the subjects operated 5 or more years ago, with an average BMI of 31.48±7.351 (p=0.000).

Conclusion: This study indicates the high prevalence of long-term micronutrient deficiency symptoms and other associated health problems following bariatric surgery in the Saudi population despite presumed compliance with supplementation programs. Weight regain is also reported to be a significant problem after 5 years. The findings highlight the importance of intensive long-term follow-up, patient-centered nutritional management, and public education initiatives about the potential lifelong consequences of bariatric surgery.

Keywords: Adverse effect, bariatric surgery, long-term, nutritional deficiencies, Saudi Arabia, weight regain

Introduction

Obesity is a global health pandemic of our times, appropriately described as a pandemic.(1) The World Health Organization (WHO) defines obesity as abnormal excess fat mass posing a health risk, with a body mass index of more than 25 as overweight and greater than 30 as obese.(2) Bariatric surgery has emerged as the strongest treatment for significant and sustained weight reduction in morbidly obese individuals.(3)

In Saudi Arabia, obesity prevalence ranks highest in the world at 15th with an incidence rate of 35%.(4) As such, bariatric surgery demand has increased, with more than 30,000 procedures being undertaken each year, as reported by the Ministry of Health.(5) While the efficacy of bariatric surgery for weight loss and the remission of comorbidities of obesity has been amply demonstrated, new evidence indicates that these procedures are accompanied by serious long-term negative health outcomes.(6) These complications, often the byproduct of the altered anatomy causing nutritional malabsorption and undue weight loss, can persist long after weight stabilizes.(7)

1.1. Research Problem

The rapid diffusion of bariatric surgery in Saudi Arabia has not been preceded by large-scale public information campaigns regarding its potential long-term complications. Patients themselves may not be adequately prepared to cope with the continued dietary adjustments, nutritional supplements, and medical follow-up required to offset these risks.

1.2. Hypothesis

This study operates under the assumption that the long-term negative effects of bariatric surgery will be greater than the benefits to a significant percentage of patients, particularly considering the widespread prevalence of nutritional deficiency and other chronic complications that develop years after surgery.

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2. Literature Review

2.1. Obesity Overview

The prevalence of global obesity has risen by over two times since 1980.(8) If not addressed, this trend anticipates that by 2025, 18% of men and 21% of women worldwide will be obese. High rates of this contribute greatly to death worldwide, primarily through associated complications such as type 2 diabetes, cardiovascular disease, high blood pressure, and certain cancers, especially if accompanied by physical inactivity.(9) It has come to be realized in recent times that obesity is a potent risk factor for severe COVID-19, with higher rates of hospitalization and mechanical ventilation.(10,11) The financial cost is just as huge, with the United States obesity-related spending alone totaling over $90 billion annually.(12)

2.2. Most Frequent Bariatric Operations

Bariatric operations are categorized into three main types based on their mechanism of action: restrictive, malabsorptive, and mixed procedures. Restrictive procedures, such as Sleeve Gastrectomy (SG) and Adjustable Gastric Banding (AGB), operate primarily by reducing the volume of the stomach, thereby physically limiting the quantity of food that is taken in. Malabsorptive procedures like the Biliopancreatic Diversion (BPD) alter the anatomy of digestion to reduce the functional length of the intestine, thereby reducing the absorption of calories and nutrients. The third category, mixed procedures, combines both restriction and malabsorption aspects; the Roux-en-Y Gastric Bypass (RYGB) is the paradigm of this procedure.

Globally, the most prevalent surgeries are the Sleeve Gastrectomy (SG), Roux-en-Y Gastric Bypass (RYGB), and Adjustable Gastric Banding (AGB). (13) The Sleeve Gastrectomy, in which a large amount of the stomach is resected surgically to be left with a narrow, tubular pouch, has gained popularity across the board for its relative technical simplicity and favorable safety profile. (14) The Roux-en-Y Gastric Bypass is a more complex procedure that involves the formation of a small pouch from the stomach and rerouting the small intestine to feed directly into this pouch, thereby bypassing the majority of the stomach as well as the duodenum. (15) On the other hand, Adjustable Gastric Banding is the operation where an inflatable silicone band is placed around the proximal upper stomach to create a small proximal pouch that contributes to an early feeling of fullness and restricts food intake. (16)

2.3. Long-Term Adverse Effects of Bariatric Surgery

Abrupt weight loss has been a well-known risk factor for gallstone formation for many years because of its disturbance of bile composition, leading to cholesterol supersaturation.(17,18) Postsurgical bariatric patients have an incidence of gallstones of approximately 28%, significantly higher than the 5%-10% found in the overall patient population.(19,20) Risk factors include a pre-surgical BMI >40 kg/m², ≥25 kg weight loss in six months, and the type of surgery, RYGB being at greater risk than SG.(21)

Bariatric surgery adversely affects bone metabolism by several mechanisms, including nutritional malabsorption (specifically of calcium and vitamin D), rapid weight loss, and endocrine hormonal changes.(22) Research has identified a significant decline in bone mineral density (BMD) after surgery. For instance, calcium absorption significantly decreases after RYGB in spite of adequate supplementation,(23) and weight stabilization doesn't stop bone loss.(7) Though RYGB has classically been considered more detrimental, recent evidence suggests that SG also leads to significant reductions in bone density with long-term follow-up.(24,25)

Micronutrient deficiency is an important long-term concern. 50% of patients can end up with deficiencies of minerals and vitamins such as vitamin D, B12, iron, and folate 2-5 years post-surgery.(26) The most worrying is iron deficiency, with a prevalence as high as 25% at 24 months post-surgery.(27) A local Madinah, Saudi Arabia, study noted that 22.9% of the patients had developed anemia within two years, all of whom were females.(6) Urgent as it seems, these deficiencies can occur even among patients on regular multivitamin supplements, suggesting that current guidelines may not be sufficient.(28)

The relationship between bariatric surgery and mental health is complex. While some patients improve early, the risk of developing new-onset depression in the long term is significant at up to 17% at five years.(29) In Saudi Arabia, a study revealed a prevalence of 30% for post-bariatric depression in patients.(30,31) Vitamin D deficiency, which is common following surgery, has been reported to be inversely correlated with depression, suggesting a biochemical correlation.(32,33)

3. Methodology

3.1. Study Design and Population

From March 1 to March 14, 2021, a cross-sectional study was conducted. The study population was Saudi adults who had undergone bariatric surgery. The inclusion criteria were as follows: older than 18 years, both genders, and at least 3 years post-bariatric surgery. 507 participants were initially recruited, but 10 were excluded from the data due to missing values or outliers, leaving 495 participants.

3.2. Tool for Data Collection and Validity

A comprehensive, self-report online survey for this research was designed based on Google Forms in Arabic. The survey was shared only through bariatric surgery support Twitter accounts to prevent any duplication and confirm the validity of the data. The tool had 34 questions spread across two broad sections. The first section gathered sociodemographic data, including gender, age, education level,

employment status, and neighborhood. The second half was a health assessment, including two components: the history of specific diseases and signs, such as depression, anemia, and gallstones, pre-operatively and post-operatively to assess any new conditions; the second component inquired about frequent recurring signs in the past three months, e.g., early satiety and bone pain, to evaluate persistent issues because of micronutrient deficiencies and other complications postoperatively. The validity of the questionnaire was ensured by three independent expert reviews, and reliability through a pilot test with 10 participants. Internal consistency of the instrument was acceptable, with a Cronbach's alpha score of 0.71. The investigation was approved by the King Saud University Subcommittee on Humanities and Social Research Ethics, and informed consent of participants was presumed through their voluntary return of the online survey.

3.3. Statistical Analysis

SPSS version 25 was used to perform the analysis. Continuous variables were presented as means and standard deviation, and categorical variables as frequencies and percentages. Comparisons between continuous variables were made with the independent sample t-test and ANOVA, while categorical variables were compared using Pearson's Chi-Square and Fisher's Exact tests. A p-value of less than 0.05 was statistically significant.

4. Results

4.1. Socio-Demographic Characteristics

The demographic makeup of the 495 patients is presented in Table 1. The sample was predominantly female (63.4%). The age group 25-34 years represented the highest percentage of the sample (42.0%), while the 35-44 years group represented 33.7%. The majority of participants possessed a bachelor's degree or diploma (66.5%). There was a marked gender disparity in employment status, and non-employed females represented 51.3% of the female group (p=0.000). Sleeve gastrectomy was the most common procedure performed (94.9%). Most of the participants (67.9%) underwent surgery 3-4 years prior, and 62.4% reported not carrying out continuous exercise.

Table 1: Socio-demographic Features of Study Sample (N=495)

Variable	Categories	Total N (%)	Male N (%)	Female N (%)	P-Value
Gender	Male	181 (36.6)	-	-	-
	Female	314 (63.4)	-	-	
Age	18-24	59 (11.9)	26 (14.4)	33 (10.5)	0.629
	25-34	208 (42.0)	76 (42.0)	132 (42.0)	
	35-44	167 (33.7)	55 (30.4)	112 (35.7)	
	45-54	43 (8.7)	17 (9.4)	26 (8.3)	
	>55	18 (3.6)	7 (3.9)	11 (3.5)	
Education	< High School	18 (3.6)	5 (2.8)	13 (4.1)	0.577
	High School	110 (22.2)	36 (19.9)	74 (23.6)	
	Bachelor/Diploma	329 (66.5)	127 (70.2)	202 (64.3)	
	Postgraduate	38 (7.7)	13 (7.2)	25 (8.0)	
Employment	Government	153 (30.9)	81 (44.8)	72 (22.9)	**0.000***
	Private	118 (23.8)	63 (34.8)	55 (17.5)	
	Student	42 (8.5)	16 (8.8)	26 (8.3)	
	Other (e.g., non-employed)	182 (36.8)	21 (11.6)	161 (51.3)	
Surgery Type	Sleeve Gastrectomy	470 (94.9)	173 (95.6)	297 (94.6)	0.938
	RYGB	19 (3.8)	6 (3.3)	13 (4.1)	
	Other	6 (1.2)	2 (1.1)	4 (1.3)	
Years Since Surgery	3-4 years	336 (67.9)	120 (66.3)	216 (68.8)	0.798
	4-5 years	78 (15.8)	31 (17.1)	47 (15.0)	
	>5 years	81 (16.4)	30 (16.6)	51 (16.2)	
Physical Activity	Yes	186 (37.6)	77 (42.5)	109 (34.7)	0.083
	No	309 (62.4)	104 (57.5)	205 (65.3)	

***Significant at p < 0.05**

4.2. Development of Negative Effects after Surgery

The investigation of newly developed health conditions following bariatric surgery found several key findings, as described in Table 2. Anemia was observed in 23.4% of the entire cohort, where onset following surgery was responsible for most cases—59.2% of females and 52.6% of males. Gallstones were identified in 19.2% of the participants, and a significant 65% of them developed after surgery. The incidence of post-operative gallstones was significantly more frequent in men (87.5%) than in women (57.1%) (p=0.001). Additionally, as Table 3 illustrates, gallstone development had a significant statistical correlation with a post-operative time lapse exceeding five years (p=0.020). Psychological and neurological symptoms were also prevalent; mood change was observed in half of the sample (50.5%), with a substantially higher proportion of affected men

(85.3%) than women (69.1%) describing its onset following surgery (p=0.002). In a similar manner, unjustified nervousness afflicted 41.2% of participants and manifested with more post-surgery onset among men (84.0%) than women (67.4%) (p=0.002). The most frequent complaint was alopecia, and it impacted 68.5% of the overall sample, with the majority (86.1% of women and 80.7% of men) developing it after surgery.

Table 2: Comparison of Incidence Between Male and Female Post-Surgery Adverse Effects

Variable	Response	Female N (%)	Male N (%)	P-Value
Diagnosed with Anemia	After Surgery	106 (59.2)	10 (52.6)	0.579
	Before/Other	73 (40.8)	9 (47.4)	
Diagnosed with Gallstones	After Surgery	60 (57.1)	35 (87.5)	**0.001***
	Before/Other	45 (42.9)	5 (12.5)	
Mood Swings	After Surgery	163 (69.1)	87 (85.3)	**0.002***
	Before/Other	73 (30.9)	15 (14.7)	
Unexplained Nervousness	After Surgery	130 (67.4)	84 (84.0)	**0.002***
	Before/Other	63 (32.6)	16 (16.0)	
Hair Loss	After Surgery	247 (86.1)	92 (80.7)	0.180
	Before/Other	40 (13.9)	22 (19.3)	
Lethargy & Laziness	After Surgery	141 (60.5)	63 (61.8)	0.829
	Before/Other	92 (39.5)	39 (38.2)	

***Significant at p < 0.05**

Table 3: Correlation Between Gallstone and Number of Years Since Surgery

Gallstone Diagnosis	3-4 Years (N=98)	4-5 Years (N=25)	>5 Years (N=22)	P-Value
After Surgery	57 (58.2%)	19 (76.0%)	19 (86.4%)	**0.020***
Before/Other	41 (41.8%)	6 (24.0%)	3 (13.6%)	

***Significant at p < 0.05**

4.3. Symptoms Returning During the Last Three Months

A review of symptoms in the last three months that were indicative of persistent complications such as dumping syndrome and micronutrient deficiencies, is presented in Table 4. Symptoms in the gastrointestinal tract were very common, with early satiety and postprandial discomfort each affecting more than 72% of the study participants. Gender analysis showed that postprandial discomfort (77.1% vs. 63.5%, p=0.001) and bloating (59.2% vs. 47.0%, p=0.008) were significantly higher among women than among men. Symptoms in muscles and bones were also common, with 43.8% of the whole sample reporting bone pain. This symptom, along with cramps in muscles, was more frequent among females; 52.2% of females had bone pain compared to 29.3% of males (p=0.000), and 40.4% of females had muscle cramps compared to 24.3% of males (p=0.000).

Table 4: Comparison of Symptoms Recurring Over the Past Three Months Between Males and Females

Symptom	Response	Male (N=181)	Female (N=314)	P-Value
Early Satiety	Yes	137 (75.7)	223 (71.0)	0.261
	No	44 (24.3)	91 (29.0)	
Discomfort After Meals	Yes	115 (63.5)	242 (77.1)	**0.001***
	No	66 (36.5)	72 (22.9)	
Bloating	Yes	85 (47.0)	186 (59.2)	**0.008***
	No	96 (53.0)	128 (40.8)	
Muscle Cramps	Yes	44 (24.3)	127 (40.4)	**0.000***
	No	137 (75.7)	187 (59.6)	
Bone Pain	Yes	53 (29.3)	164 (52.2)	**0.000***
	No	128 (70.7)	150 (47.8)	

***Significant at p < 0.05**

4.4. BMI Timeline

The longitudinal trend of change in Body Mass Index (BMI) provided valuable information on the trend of weight loss and regain, as shown in Tables 5 and 6. During surgery, when participants were in the baseline, the mean BMI for males was considerably greater at 48.09 than in females at 43.57 (p=0.000). One year after the surgery, a remarkable and parallel reduction in BMI was seen in both genders, with average values equal to 28.24 for men and 28.42 for women. At the time of the study, however, evidence showed a significant trend toward weight regain since the average BMI was elevated in both groups. One of the highlights was that the participants who underwent surgery more than five years ago had a significantly higher mean BMI in the current time (31.48) compared to their three-year (28.34) and four-year (29.88) post-surgery counterparts (p=0.000), reflecting the challenge of sustaining weight over the long term.

Table 5: Males vs. Females Body Mass Index Comparison at Three Time Points

Timepoint	Male BMI (Mean ±SD)	Female BMI (Mean ±SD)	P-Value
At Surgery	48.09 ± 8.441	43.57 ± 7.543	**0.000***
After One Year	28.24 ± 6.370	28.42 ± 6.740	0.769
Now (at study)	28.54 ± 7.018	29.41 ± 6.324	0.155
***Significant at p < 0.05**			

Table 6: BMI Comparison Against Years Since Surgery

Timepoint	3-4 Years (N=336)	4-5 Years (N=78)	>5 Years (N=81)	P-Value
BMI At Surgery	44.61 ± 7.327	46.45 ± 8.959	46.57 ± 10.289	0.055
BMI After One Year	28.32 ± 6.572	29.04 ± 6.997	27.85 ± 6.355	0.517
BMI Now	**28.34 ± 6.290**	**29.88 ± 6.437**	**31.48 ± 7.351**	**0.000***
***Significant at p < 0.05**				

5. Discussion

This cross-sectional study presents a vivid and bleak image of the wide-ranging long-term disease experienced by Saudi adults in the decades following bariatric surgery. The common prevalence of subjective symptoms together with discrete diagnosed conditions decades after the primary procedure underscores that surgery is merely the initial act of an elaborate clinical process, which clearly requires systematic, lifetime follow-up of the patient and active management.

One of the primary concerns that is explained by the findings is the widespread prevalence of nutritional deficiencies. Such a rate of hair loss, at 68.5% in the research, is a strong clinical indicator, very suggestive of widespread deficiencies of important nutrients such as iron and zinc. This observation is consistent with the increasing evidence linking low ferritin levels with the causation of post-bariatric alopecia.(34) Also, the fact that 23.4% of the cohort presented with anemia, a figure that coincides with previous local(6,27) and worldwide evidence, would imply a systemic iron metabolism and absorption deficit, and that standardized supplementation protocols as they are now may be less than optimal for a significant percentage of the post-surgical population. Beyond hematologic complications, the significant reporting rate of musculoskeletal symptoms—bone pain in 43.8% and cramp of muscle in 40.4% of respondents, with overwhelming predominance in female patients—suggests extensive and chronic disruptions of calcium and vitamin D homeostasis. These findings add strong support to the literature defining the pathophysiology of abnormal calcium absorption and the long-term risk of bone demineralization following bariatric surgery.(23,7,25)

The study also finds evidence of a high incidence of long-term postoperative and metabolic complications. Gallstone development in 19.2% of the sample, with a statistically significant association to a postoperative period of more than five years, confirms the long-understood but still prevalent risk after acute weight loss and metabolic change in cholesterol.(20,21) The higher prevalence unexpectedly recorded for men is due to their far greater pre-operative BMI and consequent greater absolute weight loss, a population factor that needs to be examined further. In parallel, the high frequency of gastrointestinal symptoms such as early satiety, post-prandial pain, and bloating suggests a very important long-term burden of conditions such as dumping syndrome or other functional gastrointestinal disorders, which are established to have a very significant impact on quality of life and nutritional adherence.(30,33)

Perhaps the most significant and considered finding of this research is the clear demonstration of significant weight regain over time. The data indicate that the surgical group, more than five years ago, had a mean BMI that was once more in the obese range (31.48). This trend actually contradicts the common presumption of bariatric surgery as an absolute or permanent solution for obesity. Instead, it highlights the intense and persistent nature of the physiological, metabolic, and behavioral influences underlying the disease, which will result in weight return if not pursued with high-intensity, lifelong lifestyle adjustment and support.(34)

Psychologically, the findings paint a rich picture. Officially reported depression prevalence, as measured by drug use, was 6.4%, lower than in some local studies based on direct psychological interviews.(31) This divergence almost certainly results from methodological differences. However, the very high self-reported rates of mood swings (50.5%) and unexplained nervousness (41.2%) indicate a level of sub-clinical or undiagnosed psychomorbidity that is substantial and ought to be taken seriously in clinical consideration, as it can have direct consequences for adherence to diet and for health.

Finally, the significance of these findings must be interpreted in light of the study's acknowledged limitations. A cross-sectional design provides a snapshot at one point in time and does not enable the causal connection between outcomes reported and surgery to be made. Utilization of self-reporting for diagnoses and symptoms, and omitting objective clinical verification by laboratory tests or medical record review, remains a drawback. Even though the questionnaire was quality-checked by experts, the

lack of formal validation and internet/social media-based sampling method may introduce a range of biases, including selection bias and reporting bias. Moreover, the predominance of the sample of sleeve gastrectomy patients limits the generalizability of the findings to groups who have undergone other bariatric procedures, such as Roux-en-Y gastric bypass.

6. Conclusion

The research offers evidence that bariatric surgery is effective for weight loss in Saudi adults but is associated with numerous long-term complications. It noted high rates of micronutrient deficiencies as demonstrated by hair loss, anemia, bone pain, and cramps, as well as a significantly increased risk of developing gallstones, and experienced weight regain approximately five years after surgery. Furthermore, a concerning gender difference was noted in which female subjects experienced a greater incidence of complications, including musculoskeletal pain. The research calls for a re-examination of bariatric surgery as an independent obesity treatment option and should be recognized as an intervention that requires a lifelong commitment to medical, nutritional, and psychiatric follow-up care. It calls for greater care pathways for patients that include comprehensive education on long-term risks and the importance of adherence to micronutrient supplementation.

There is a need for viable long-term care systems that utilize standardized monitoring protocols for nutrient levels, bone density, and mental health in post-bariatric patients. The result suggests that current micronutrient supplementation advice might be subpar and should be revised for individualized care as soon as possible. Lastly, to mitigate weight regain and improve overall outcomes, it is important to intertwine the surgical process along with healthy nutrition, physical activity, and ongoing behavioral interventions.

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