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PREVALENCE OF CO-MORBIDITIES IN OBESE PATIENTS BEFORE AND AFTER BARIATRIC SURGERY IN MADINAH REGION

Ahmed Alahmari[1]*,Mohamed Abdulnaeem Aly[2], Asim Mukhidheer Almughamsi[3], Muayad Ahmed Alfarsi[4], Ghaidaa Salem Elmehallawy[5], Lujain Abdulaziz Aljohani[5], Raghad Abdulrazaq Makhdhom[5], Reema Ahmed M Alfadhli[5], Rema Mohammed Alhazmi[5], Shaden Mohammed Alhazmi[5]

[1]MBBS, Consultant General, Bariatric and advanced laparoscopic surgeon, UGI&bariatric unit, devision of general surgical departmentKing salman bin Abdulaziz medical city, Madina Al-Munawarah, Saudi Arabia.
[2]MBBS, Taibah University, Madina Al-Munawarah, Saudi Arabia.
[3]MBBS, Department of General Surgery, Taibah University, Medina Al-Munawarah,Saudi Arabia.
[4]MBBS, Consultant Pediatric surgery in Maternity and children's hospital, Medina Al-Munawarah, Saudi Arabia.
[5]MBBS, Taibah University, Medina Al-Munawarah, Saudi Arabia.
*Corresponding author: drmsiyam@gmail.com

Abstract

Background: Obesity is a global public health concern associated with numerous comorbidities and reduced quality of life. Bariatric surgery has emerged as an effective intervention for weight loss. However, there is limited research on the prevalence of comorbidities before and after bariatric surgery in Madinah Region, Saudi Arabia.
Objective: This study aimed to determine the prevalence of co-morbidities in obese patients before and after bariatric surgery in Madinah region.
Methods: A retrospective analysis was conducted on medical records of obese patients who underwent bariatric surgery in Madinah region. Data were collected on co-morbidities, including diabetes mellitus (DM), hypertension (HTN), hypothyroidism, asthma, polycystic ovary syndrome (PCOS), cardiovascular diseases, osteoarthritis, gastrointestinal diseases, sleep apnea, hypercholesterolemia, and hyperprolactinemia. Prevalence rates of these co-morbidities were calculated for the periods before and after surgery.
Results: A total of 170 patients were included in the study. Statistically significant differences were observed in the prevalence of DM, HTN, asthma, hypothyroidism, and PCOS when comparing pre- and post-operative data. The impact of bariatric surgery on DM and HTN according to levels of obesity showed that among cases with a BMI of 40 kg/m^2 or higher, there was a higher rate of clinical improvement and a greater likelihood of reducing medication dosages compared to cases with BMI < 40 kg/m^2.
Conclusion: The findings suggest that bariatric surgery may reduce the prevalence of co-morbidities in this population. These results show the benefits of bariatric surgery and emphasize the importance of considering comorbidities in the management of obesity.

Keywords: Bariatric surgery, BMI, Comorbidity, Obesity, Saudi Arabia

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Introduction

Obesity has become a global epidemic, affecting millions of adults worldwide, including Saudi Arabia. According to the World Health Organization (WHO), there are more than 1.9 billion overweight and obese adults worldwide, and of those over 600 million are morbidly obese [1]. The trend of obesity incidence has increased so rapidly over the last two decades, in developed and developing countries alike [1,2].

In Saudi Arabia, obesity has emerged as a significant public health issue, with a rising trend in its prevalence. Previous studies have indicated a substantial increase in obesity rates, with estimates ranging from 20% to 30.7% among men and women [3]. However, all estimated prevalence from 1995 and beyond showed a high prevalence of obesity in the community, and it was estimated to be 30.7% for men as compared to 28.4% for women [4]. About a quarter (5.5 million) of Saudi citizens are obese, of them 2.7% are morbidly obese [5].

Obesity is associated with a multitude of health consequences and quality of life issues. [6,7]. Obesity increases the risk of several diseases including diabetes [8], cardiovascular disease [8,9], and certain tumors [10]. In addition to the adverse health effects, obesity worsens the quality of life (QOL) of patients while limiting their involvement in productive work. These limitations impose increased demands on the funding required for the treatment of obese patients [11-13].

Bariatric surgery has emerged as an effective intervention for weight loss and the management of obesity-related co-morbidities [7]. Several bariatric procedures are now associated with greatly improved pre-existing diseases such as diabetes (14), and other associated co-morbidities. Moreover, what is known from the previous studies is that in addition to bariatric surgery's effect of reducing weight, Recent research indicated a notable decline in the occurrence of reported comorbidities after the surgery when compared to before the surgery, both in the short-term postoperative period and the long term, leading to a decrease in the need for medications related to significant disease categories [15,16].

Understanding the prevalence of co-morbidities in obese patients before and after bariatric surgery is crucial for healthcare professionals and policymakers to develop effective strategies for obesity management and improve patient outcomes. By examining the changes in co-morbidities after bariatric surgery, healthcare providers can evaluate the effectiveness of this surgical intervention in reducing the burden of obesity-related diseases.

Objectives

Since little is known about comorbidity remission after bariatric surgery in Saudi Arabia's diverse and geographically distributed populations, this retrospective study aimed to address the lack of information regarding this topic and specifically focused on assessing the prevalence of comorbidities among obese patients in the Madinah Region before and after undergoing bariatric surgery. Furthermore, this study will provide valuable insights into the impact of bariatric surgery on the overall health status of obese individuals in the Madinah Region.

Methodology

a. Study design, setting, and duration

This retrospective cohort study took place at the Department of General Surgery, Division of Bariatric and Upper Gastrointestinal Unit, King Salman bin Abdulaziz Medical City (KSAMC), from November 2022 to April 2024. The study utilized existing data from the archives of KSAMC, involving a total of 170 patients. Data was collected retrospectively to analyze the improvements

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in co-morbidities before and after bariatric surgery.

b. Study Population and Sampling

A sample size of 170 patients was determined based on sample size calculations. Previous reports indicated that 300 patients who underwent bariatric surgery and had co-morbidities were available at King Salman bin Abdulaziz Medical City. With an estimated improvement proportion of 50% and a margin of error of 5%, the calculated sample size was determined to be 170 patients. The inclusion criteria consisted of obese patients with confirmed co-morbidities who underwent bariatric surgery at KSAMC, with a one-year follow-up period. Subjects from diverse racial and ethnic backgrounds were included to ensure fair representation. The study excluded obese patients without co-morbidities, children below 18 years of age, and obese patients with and without co-morbidities outside the Madinah region.

c. Measurements

Data were collected by randomly selecting 170 patient samples from the medical records office of KSAMC. These patients had undergone gastric sleeve surgery and had obesity along with one or more chronic diseases such as diabetes or hypertension. The study reviewed the improvement levels of these chronic diseases and recorded any side effects of the gastric sleeve operation from the reports and archives of the hospital records.

d. Data Collection and Analysis

Patient data, including age, sex, BMI, weight, lifestyle, diabetes mellitus, hypertension, and one-year follow-up information, were collected using a data collection sheet. The data gathered was inputted into and assessed utilizing the Statistical Package for the Social Sciences (SPSS). (version 22.0; SPSS Inc., Chicago, IL). Data were presented using frequencies for categorical data and means and standard deviation (SD) for continuous data. The prevalence of comorbidities among the studied cases before and after bariatric surgery, assessed at a one-year follow-up, was compared using the McNemar test. The comparison of the studied cases regarding the improvement of diabetes mellitus, hypertension, and lifestyle profile was conducted using chi-square and Fisher's exact test, as appropriate. These comparisons were made based on the variables of age, sex, and BMI. The statistical significance level was set at $p < 0.05$.

e. Ethical Considerations

The study adhered to the principles of the Helsinki Declaration. Local ethical approval was obtained in accordance with the regulations of Taibah University Medical College for undergraduate student research. Patient privacy and confidentiality were maintained, with human subject names stored in a password-protected database. Patient identifiers were not used. All data was entered into a computer with password protection, and physical copies were stored in a locked office of the investigators.

Results

The study analyzed data from 170 obese patients who underwent elective bariatric surgery at King Salman bin Abdulaziz Medical City (KSAMC), specifically in the Department of General Surgery, Division of Bariatric and Upper Gastrointestinal Unit, and their one year follow up period was between November 2022 and November 2023 in the Madinah Region, Saudi Arabia. The study aimed to assess the effects of surgery on the associated comorbidities in these patients.

I. Table 1. Baseline characteristics of the studied cases (n= 170)

Characteristics	n (%)
Age in years; mean ± SD (Range)	36.9 ± 10.9 (18-64)
Age in years < 40 ≥ 40	 101 (59.4) 69 (41.6)
Sex Male Female	 60 (35.3) 110 (64.7)
Weight in kg	116.1 ± 25.4 (70-192)
Height in cm	162.2 ± 9.6 (140-184)
Body mass index (kg/m²); mean ± SD (Range)	43.7 ± 7.1 (31.1-78.9)
Body mass index (kg/m²) < 40 ≥ 40	 45 (26.5) 125 (73.5)

* Data are presented by n (%) and mean ± SD

Table 1 illustrates the distribution of the examined cases based on their baseline characteristics. The average age of the participants was 36.9 ± 10.9 years, and more than half of them (59.4%) were under the age of 40. Females constituted approximately two-thirds (64.7%) of the study sample. On average, the participants had a weight of 116.1 ± 25.4 kg and a height of 162.2 ± 9.6 cm. The mean body mass index (BMI) was 43.7 ± 7.1 kg/m^2, with 73.5% of the cases having a BMI ≥ 40 kg/m^2.

II. Table 2. Comorbidities profile of the studied cases before surgery (n= 170)

Comorbidity	n (%)
Diabetes mellitus	79 (46.5)
Hypertension	73 (42.9)
Asthma	20 (11.8)
Osteoarthritis	7 (4.1)
Hypothyroidism	35 (20.5)
Polycystic ovary syndrome (PCOS)	23 (13.5)
Sleep apnea	4 (2.4)
Cardiovascular diseases*	9 (5.3)
Gastrointestinal diseases (GIT) **	6 (3.5)
Hypercholesterolemia	10 (5.9)
Hyperprolactinemia	2 (1.2)

*Included 2 cases of unstable angina and 7 cases of ischemic heart diseases
** Included 2 cases of irritable bowel syndrome, 2 cases of GERD, and 2 cases of BA

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Table 2 displays the distribution of the examined cases according to the comorbidities they had prior to surgery. The most prevalent comorbidity was diabetes mellitus, affecting 46.5% of the cases, followed by hypertension at 42.9%. Other associated comorbidities included hypothyroidism (20.5%), asthma (11.8%), polycystic ovary syndrome (13.5%), cardiovascular diseases (5.3%), osteoarthritis (4.1%), gastrointestinal diseases (3.5%), sleep apnea (2.4%), hypercholesterolemia (5.9%), and hyperprolactinemia (1.2%).

III. Table 3. Lifestyle profile of the studied cases before surgery (n= 170)

Lifestyle	n (%)
Active smokers	29 (17.1)
Sedentary life	14 (8.2)
Active smokers and sedentary life	15 (8.8)
Passive smokers and sedentary life	3 (1.8)

Table 3 presents the distribution of the examined cases based on their lifestyle profiles prior to surgery. Among the study participants, 17.1% were identified as active smokers. A sedentary lifestyle was reported by 8.2% of the individuals, while 8.8% reported both a sedentary lifestyle and active smoking. Additionally, 1.8% reported a sedentary lifestyle combined with passive smoking.

IV. Table 4. Comparison of the studied cases by their comorbidities profile before and after surgery

Comorbidities	Before surgery n (%)	After surgery n (%)	P value
Diabetes mellitus	79 (46.5)	12 (7.1)	0.01*
Hypertension	73 (42.9)	16 (9.4)	0.03*
Asthma	20 (11.8)	4 (2.6)	0.01*
Osteoarthritis	7 (4.1)	2 (1.8)	0.10
Hypothyroidism	35 (20.5)	17 (10.0)	0.02*
Polycystic ovary syndrome	23 (13.5)	6 (3.5)	0.002*
Hypercholesterolemia	10 (5.9)	6 (3.5)	0.12
Hyperprolactinemia	2 (1.2)	1 (0.6)	0.15

*Significant

Table 4 presents the comparison of the examined cases based on their comorbidity profiles before and after surgery. Significant differences were observed in the prevalence of certain comorbidities before and after the surgical intervention. Specifically, there were statistically significant differences in the prevalence of diabetes mellitus, hypertension, asthma,

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hypothyroidism, and polycystic ovary syndrome (PCOS) when comparing pre- and post-operative data. Furthermore, although the differences were not statistically significant, there was a reduction in the prevalence of osteoarthritis, hypercholesterolemia, and hyperprolactinemia among the studied cases after surgery.

V. Table 5. Effect of bariatric surgery on diabetes mellitus and hypertension by obesity among the studied cases

	BMI < 40 kg/m²	**BMI ≥ 40 kg/m²**	**P value**
Diabetes mellitus			
Clinical improvement	5 (27.8)	16 (32.7)	
Reduced medication dose	2 (11.1)	9 (18.4)	
Stop medication	11 (61.1)	24 (49.4)	0.64
Total	18	49	
Hypertension			
Clinical improvement	3 (20.0)	8 (19.0)	
Reduced medication dose	4 (26.7)	14 (33.3)	
Stop medication	8 (53.3)	20 (47.6)	0.88
Total	15	42	

*Significant

Table 5 presents the impact of bariatric surgery on diabetes mellitus and hypertension categorized by obesity among the examined cases. Among cases with a BMI of 40 kg/m^2 or higher, there was a higher rate of clinical improvement and a greater likelihood of reducing medication dosages. On the other hand, cases with a BMI below 40 kg/m^2 had a higher rate of medication cessation. These differences, however, were not statistically significant Also, cases with a BMI of 40 kg/m^2 or higher showed a higher frequency of reduced medication usage, while cases with a BMI below 40 kg/m^2 had a higher rate of medication cessation. However, similar to the previous findings, these differences were not statistically significant.

VI. Table 6. Effect of bariatric surgery on lifestyle improvement by obesity, sex, and age among the studied cases

Lifestyle improvement	**Yes**	**No**	**P value**
BMI (kg/m²)			
< 40	22 (48.9)	23 (51.1)	
≥ 40	54 (43.2)	71 (56.8)	0.51
Sex			
Male	23 (38.3)	37 (61.7)	

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Female	53 (48.2)	57 (51.8)	0.21
Age in years < 40 ≥ 40	 45 (44.6) 31 (44.9)	 56 (55.4) 38 (55.1)	 0.96

*Significant

Table 6 illustrates the impact of bariatric surgery on lifestyle improvements categorized by obesity, sex, and age among the examined cases. While no statistically significant differences were found, it is worth noting that cases with a BMI below 40 kg/m2 (48.9% vs. 43.2%) and female cases (48.2% vs. 38.3%) tended to exhibit higher levels of lifestyle improvement.

Discussion

The evaluation of quality of life following bariatric surgery can be approached in two distinct manners. One approach involves assessing improvements in comorbidities, while the other focuses on evaluating the patient's overall quality of life after the surgery. In this retrospective study, the prevalence of comorbidities among obese patients in the Madinah Region before and after undergoing bariatric surgery was assessed.

Among the 170 patients included in the study, the baseline characteristics revealed that the majority of them were categorized as obese (26.5%) or morbidly obese (73.5%). Bariatric surgery is widely recognized as the most effective long-term treatment for weight loss, particularly among morbidly obese patients [17]. This is because lifestyle modifications alone often result in minimal weight loss in this population, and adherence to such modifications is frequently poor [18]. In terms of the gender distribution of the studied patients, females constituted a significant majority, accounting for approximately two-thirds (64.7%) of the study sample. This observation aligns with previous research indicating that women tend to be more likely to undergo bariatric surgery compared to men. In a recent Saudi retrospective study, conducted at King Fahad Specialist Hospital Al-Qassim (Buraydah), on 520 patients who underwent bariatric surgery, 61% were females [18]. Also, in a previous similar study on 794 surgery candidates [19], the sample of individuals seeking gastric bypass surgery was predominantly women (84.8%).

The most prevalent comorbidity observed among the studied patients was diabetes mellitus, which affected 46.5% of the cases. This finding is consistent with the well-established association between obesity and diabetes, given that obesity is a primary contributing factor to the onset of type 2 diabetes [8,20].

Hypertension was the second most common comorbidity, affecting 42.9% of the cases. This finding is also in line with previous research that has demonstrated a strong link between obesity and hypertension [21,22]. Obesity generally decreases parasympathetic tone and increases sympathetic activity. These changes in autonomic activity are associated with increased heart rate (HR), decreased HR variability, and reduced baroreflex sensitivity, as well as hypertension [22].

Other associated comorbidities identified in the study included hypothyroidism (20.5%), asthma (11.8%), polycystic ovary syndrome (13.5%), cardiovascular diseases (5.3%), osteoarthritis (4.1%), gastrointestinal diseases (3.5%), sleep apnea (2.4%), hypercholesterolemia (5.9%), and hyperprolactinemia (1.2%). In the literature, obesity was found as a risk factor for all these diseases [23-26]. These findings highlight the significant burden of comorbidities among individuals seeking bariatric surgery. It reinforces the notion that obesity is often accompanied by multiple coexisting health conditions, which can have a profound impact on the overall health and

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well-being of individuals.

Addressing lifestyle factors, such as smoking behavior and sedentary habits, as part of comprehensive weight management and health improvement strategies for individuals seeking bariatric surgery, the current study revealed 17.1% of the patients were identified as active smokers, a sedentary lifestyle was reported by 8.2% of the individuals, and interestingly, 8.8% of the participants reported both a sedentary lifestyle and active smoking. A sedentary lifestyle is linked to a higher likelihood of obesity, cardiovascular disease, type 2 diabetes, and various other health issues [27].

Moreover, smoking is well-known to have detrimental effects on overall health and is associated with various health conditions, including cardiovascular disease [28], respiratory problems [29], and certain types of cancer, including leukemia [30], and a combination of these factors further exacerbates the health risks associated with each behavior individually. The synergistic effect of sedentary behavior and smoking can contribute to a higher likelihood of developing chronic diseases and experiencing poor health outcomes. In addition, 1.8% of the participants reported a sedentary lifestyle combined with passive smoking. Passive smoking refers to the inhalation of secondhand smoke, typically from individuals who smoke in close proximity to non-smokers. Exposure to secondhand smoke can have detrimental health effects, including an increased risk of respiratory problems, cardiovascular disease, and lung cancer [31].

Significant differences were observed in the prevalence of certain comorbidities before and after the surgical intervention in the present study. Specifically, there were statistically significant differences in the prevalence of diabetes mellitus, hypertension, asthma, hypothyroidism, and polycystic ovary syndrome (PCOS) when comparing pre- and post-operative data. Similar results were reported in a previous study carried out by Pories et al. [32] revealed that, of the studied 141 patients with type 2 diabetes or impaired glucose tolerance, all but two patients became euglycemic within 10 days after bariatric surgery. A longer follow-up period demonstrated that 83% of patients with pre-operative type 2 diabetes and 99% of those with impaired glucose intolerance were able to maintain normal levels of plasma glucose, $HgA1_C$, and insulin [32]. The Swedish Obesity Study demonstrated that 72% of patients had complete resolution of type 2 diabetes compared with 21% of control patients, 2 years after surgery [33], and a decrease in systolic blood pressure by an average of 11.4±19.0 mm Hg and diastolic blood pressure by 7.0±11.0 mm Hg [33].

Additionally, the study findings revealed a significant reduction in the prevalence of PCOS following bariatric surgery. Similarly, previous studies reported a high baseline incidence of hirsutism was found (70.0–95.8%), which decreased to 20.8–50.0% at 12-month follow-up after bariatric surgery [34,35]. These studies have also reported a significant reduction in testosterone levels and significant improvements in the menstrual cycle irregularities conception rate among the studied women after surgery.

A significant reduction in the rate of hypothyroidism was also found in the present study after bariatric surgery. In a recent retrospective study on 215 obese patients in Brazil, with a follow-up of at least 2 years, before the surgery, 9.3% of patients had subclinical hypothyroidism (SCH). After 12 months of Roux-en-Y gastric bypass (RYGB), 89.5% of patients saw an improvement in their SCH. Following bariatric surgery and subsequent weight loss, TSH levels tend to return to normal for the majority of patients, suggesting that regular monitoring of thyroid function post-obesity treatment is a sensible approach.

Furthermore, the present study found a reduction in the prevalence of osteoarthritis, hypercholesterolemia, and hyperprolactinemia among the studied cases after surgery, although

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these results were not significant. However, a meta-analysis study reported that Patients who underwent bariatric surgery showed significant decreases in total cholesterol (TC; -28.5mg/dL), low-density lipoprotein cholesterol (LDL-C; -22.0mg/dL), and triglycerides (-61.6mg/dL), as well as a notable increase in high-density lipoprotein cholesterol (6.9mg/dL) at their one-year follow-up compared to their initial levels [37].

Also, no significant changes in joint pain after bariatric surgery in a previous study on 41 obese females [38]. The authors concluded that bariatric surgery could enhance pain relief, quality of life, and functionality in early-stage knee osteoarthritis. However, this improvement is not necessarily tied to the extent of weight loss.

The impact of bariatric surgery on diabetes mellitus and hypertension in relation to different levels of obesity among the examined cases showed that among cases with a BMI of 40 kg/m^2 or higher, there was a higher rate of clinical improvement and a greater likelihood of reducing medication dosages. This suggests that bariatric surgery is particularly effective in managing diabetes mellitus and hypertension in individuals with severe obesity. These findings were consistent with the International Diabetes Federation (IDF) statement for obese Type 2 diabetes undergoing bariatric surgery [39]. This suggests that bariatric surgery is particularly effective in managing diabetes mellitus and hypertension in individuals with severe obesity.

On the other hand, cases with a BMI below 40 kg/m^2 had a higher rate of medication cessation, indicating that these individuals were able to completely stop taking medications for their diabetes mellitus and hypertension after undergoing bariatric surgery. Although not statistically significant, this finding suggests that even individuals with less severe obesity can benefit from bariatric surgery in terms of medication reduction or cessation. It is worth noting that the lack of statistical significance in these differences indicates that the observed variations may have occurred by chance and are not necessarily attributable to the level of obesity. Other factors such as sample size, variations in patient characteristics, and the specific surgical procedures performed could also contribute to these outcomes.

The impact of age on lifestyle improvements following bariatric surgery was not statistically significant in this study. This implies that age alone may not be a determining factor in the degree of lifestyle improvement experienced after the surgery. However, it is important to consider that age-related factors and individual circumstances may still influence an individual's ability or willingness to make lifestyle changes. This finding was in concordance with the results of a previous study that concluded the improvement in a patient's lifestyle is highly dependent on satisfaction with weight reduction and self-confidence and does not reflect the quality of life in those who are highly impacted by physical symptoms/medical conditions [40]. It is important to note that while lifestyle improvements are an important aspect of post-bariatric surgery outcomes, other factors such as weight loss, comorbidity remission, and psychosocial well-being should also be considered when evaluating the overall effectiveness and benefits of bariatric surgery.

Although no statistically significant differences were observed, cases with a BMI below 40 kg/m^2 showed a slightly higher level of lifestyle improvement compared to cases with a BMI of 40 kg/m^2 or higher (48.9% vs. 43.2%). Furthermore, female cases tended to exhibit higher levels of lifestyle improvement compared to male cases (48.2% vs. 38.3%). These findings highlight the potential variability in lifestyle improvements after bariatric surgery among different subgroups. The trends observed suggest that individuals with a lower BMI and females may be more likely to experience positive changes in their lifestyle behaviors. However, further research is needed to better understand the underlying factors contributing to these differences and to determine the long-term impacts on health outcomes.

This study represents a significant contribution to the existing literature as it is the first to examine the prevalence of comorbidities in obese patients before and after bariatric surgery in the Madinah Region, Saudi Arabia. In addition to assessing the prevalence of comorbidities, the study also evaluated the effect of bariatric surgery on lifestyle improvement among the studied patients based on their age, sex, and BMI category.

However, it is important to acknowledge the limitations of this study. The findings may not be generalizable to the broader population due to the inclusion of patients from a single center, namely the KSAMC. The results may not be representative of other populations or ethnic groups. Additionally, the retrospective nature of the study introduces potential concerns about the accuracy and completeness of the data. The reliance on existing records that were not specifically collected for this study may impact the reliability of the findings.

Conclusion

In patients undergoing bariatric surgery, a significant decrease in the associated comorbidities was observed at the studied analyzed point in time compared to the pre-operative values. Bariatric treatment was associated with a significant reduction in DM, hypertension, polycystic ovary, and hypothyroidism.

The study findings also suggest that bariatric surgery has a positive impact on the management of diabetes mellitus and hypertension, regardless of the level of obesity. Patients with lower BMI and females may be more likely to experience positive changes in their lifestyle behavior. However, further research with larger sample sizes and more rigorous study designs may be needed to determine if there are significant differences in the outcomes based on different levels of obesity.

The findings of this study are expected to contribute to the existing body of knowledge regarding the effectiveness of bariatric surgery in managing comorbidities associated with obesity. The results may have implications for clinical practice, healthcare policy, and patient counseling, facilitating evidence-based decision-making in the management of obesity in the Madinah Region.

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Conflict of interest

The authors declare that they have no competing interests.

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