

# Sleeve Gastrectomy and Beyond: Chronic Postoperative Symptoms and Patient Experiences in Saudi Arabia: A Systematic Review

Waleed M. Alhuzaim, MD\*, Raghad Mohammed Alajlan\*\*, Rahaf Abdulkhaliq Alshehri\*\*, Razan Mohammed Alanazi\*\*, Leen Khalid Alsarhan\*\*, Hala Khalid Alamri\*\*

## ABSTRACT

Sleeve gastrectomy (SG) is a popular bariatric surgical option employed in Saudi Arabia; however, long-term patient experiences and chronic postoperative systems remain largely understudied. This systematic review seeks to assess the prevalence, severity, and impact of chronic postoperative symptoms on the quality of life and patient satisfaction. This systematic literature review adhered to PRISMA guidelines, with the selection of 27 studies published between 2016 and 2025 aligning with a rigorous inclusion criterion. Academic Databases like PubMed, Google Scholar, Scopus, Semantic Scholar, and Saudi Digital Library were used to retrieve literature using keywords like “sleeve gastrectomy,” “GERD,” and “patient satisfaction”. The most common chronic symptom reported is GERD (23-58%), followed by nutritional deficiencies (e.g., Vitamin D, iron) and psychological issues such as depression (15-23%). Quality of life was negatively impacted due to chronic symptoms, specifically dietary restrictions and body image concerns were the key concerns. Notable weight loss and comorbidity remission rates were reported; however, satisfaction was variable (62-92%) which was majorly influenced by cultural and lifestyle factors. Long-term significant challenges are persistent in SG patients within Saudi Arabia which requires increased preoperative screening, multidimensional postoperative management, and culturally sensitive interventions. Mitigating these challenges will help improve outcomes and elevate patient satisfaction attributing to the procedure’s long-standing efficacy.

**Keywords:** Patient Satisfaction, Quality of Life, Saudi Arabia, Gastroesophageal Reflux, Gastrectomy, Weight Loss

## INTRODUCTION

Obesity is one of the most critical global health challenges of the 21<sup>st</sup> century, with obesity prevalence multiplied threefold between 1975 and 2016 with a continuous increase of 2 percent with each passing decade. Recent data highlights concerning obesity trends show 2 billion adults being overweight, and 650 million obese globally, the continuation at this rate will project by 2025 to 2.7 billion overweight and over 1 million obese global population. Gender prevalence of Obesity is also crucial as the rates have exceeded in men from 3.2% to 12.2% and women from 6% to 15.7% between 1980 and 2019<sup>1</sup>. According to the World Obesity Atlas 2025, 3 billion adults are estimated to be overweight which is 50% of the global adult population by 2030, exacerbating obesity-related complications<sup>2</sup>. The global rise in obesity has also exacerbated the epidemic of metabolic disorders such as Type 2 Diabetes Mellitus (T2DM), hypertension, and metabolic syndrome, with 43.8 and 1.2 billion cases worldwide of T2DM and metabolic disorders respectively in 2019. The prevalence of metabolic syndrome impacts 25-43% of US adults along with the European/Latin American population at the same rate. Furthermore, hypertension and diabetes rates are exacerbated in African/Middle Eastern populations with women being most affected. Socio-economic factors are responsible for driving these rates in low-income countries in particular<sup>3</sup>.

The consistently high prevalence of obesity in Saudi Arabia also exacerbates the associated metabolic disorder burdens which are evident in the recent studies. A study examining 92,137 Saudi adults reported alarmingly high but stable obesity prevalence rates (22.2%

to 21.4%) with higher rates of associated medical conditions such as hypertension, diabetes, and cardiovascular disease, in addition, depression and anxiety were also reported significantly<sup>4</sup>. Similarly, historical trends also underscored an increased obesity progression from the 1970s to a 60% increase in 2016 where women had the highest burden with a very narrow gender gap<sup>5</sup>. Furthermore, the adolescent obesity burden has also significantly increased from 14.1% (2004) to 18.9% (2015), particularly in boys reflecting fast-food consumption and relatively poor body image attitudes<sup>6</sup>. The obesity-related health risks in Saudi Arabia are exacerbated mostly due to lifestyle factors such as lack of physical activity in 80% of adult individuals, concerning increased use of e-cigarettes. Additionally, shifting of diet-related patterns toward more processed foods and sugars, and reduced low fruit/vegetable intake are also contributing to increased metabolic and cardiovascular risks<sup>4,5</sup>. Saudi Arabia is on the verge of a severe obesity crisis where obesity strongly correlates with hypertension (67.6%), T2DM (60.7%), and hypercholesterolemia (51.3%)<sup>7</sup>, also noted in the PURE study which highlights 49.6% higher obesity and CVD risks<sup>8</sup>. Furthermore, Obesity also adds to 27% of NCD mortality and multiple chronic conditions<sup>10</sup> emphasizing the ever-growing health burden. Given the health burden, economic costs related to obesity-related are massive with estimates starting from \$6.4 billion<sup>7</sup> to \$116.85 billion annually, disease contributing to 88% of costs including CVD (37%), gastrointestinal disorders (26%), and diabetes (25%) which involves 3.4-95% of the GDP<sup>11</sup>. The direct diabetes costs in particular span 24% of cases with a staggering \$3.8 billion in healthcare expenses<sup>10</sup>.

\* Canadian Board and Fellowship of the Royal College of Surgeon of Canada  
Principal Investigator, Department of Medicine, College of Medicine  
Al-Imam Mohammad Ibn Saud Islamic University, Riyadh, KSA  
Email: waleedalhuzaim@outlook.com

\*\* Student, College of Medicine, Al-Imam Mohammad Ibn  
Saud Islamic University, Riyadh, KSA

The consistently growing high obesity rates and related metabolic complications have led bariatric surgery to become a popular intervention. These procedures are often safe with lower mortality, and performed within specialized centers, however, they require long-term nutritional maintenance<sup>12,13</sup>. It demonstrates sustained results, with patients losing up to 50-70% of excess fat within the span of 1 year<sup>13,14</sup>. Interestingly, these surgeries also influence increased metabolic functions such as diabetes remission among 80% of gastric bypass cases while also proven beneficial in cases of hypertension and sleep apnea<sup>13,15,16</sup>. Additionally, they also demonstrate the potential to lower CVD risks and mortality in comparison to non-surgical management<sup>16</sup>. There are three common procedures: Roux-en-Y Gastric Bypass (RYGB) which involves stomach reduction and intestinal rerouting, being surgically complex it gives enhanced metabolic benefits<sup>13</sup>. One of the common procedures is the Sleeve Gastrectomy (SG) which provides a balanced efficacy and safety while removing 80% of the stomach which limits intake and suppresses hunger hormones<sup>17</sup>. A less invasive option namely Adjustable Gastric Banding (AGB) with modest outcomes<sup>14,16</sup>.

Among the common bariatric surgery procedures, the least invasively performed procedure is Laparoscopic Sleeve Gastrectomy (LSG) involving five small abdominal stitches given under general anesthesia, while surgeons remove 70-80% of the stomach and fundus, which creates a narrow tube-shaped stomach, yet the pylorus is preserved for the normal functioning of gastric function. The procedure typically takes 2 hours and a 2-day postoperative hospital stay. The mechanism through which LSG works involves three steps, early satiety is increased due to the removal of stomach volume, hunger is decreased with induced hormonal changes due to the removal of ghrelin-producing fundus tissue and it speeds up the gastric emptying which improves metabolic benefits resulting in GLP-1/PYY secretion, beneficial for insulin sensitivity<sup>18-20</sup>. LSG progress was demonstrated in a study which underscored that 67% excess weight loss (EWL) and 31% total weight loss as attributed to LSG, being sustained for 13 years, while the maximum effects were evident in the first 18 months<sup>21</sup>. Associated medical conditions were also seen to improve after LSG, for T2DM, within one-year HbA1c levels were lowered from 8.38% to 6.43%. However, 10-year follow-up remission rates highlighted lower values (26%) than RYGB<sup>22,23</sup>. While Obstructive Sleep Apnea had comparative remission rates among RYGB (31%) and LSG (16%), RYGB outperformed in hypertension remission while both procedures were beneficial for the improvement of dyslipidemia<sup>23</sup>. This evidence is suggestive of LSG's efficacy in weight loss promotion and comorbidity enhancement<sup>21</sup>.

There are several postoperative LSG complications frequently reported such as Gastroesophageal Reflux Disease (GERD) being one of the main concerns with increased severity of symptoms by 5 years<sup>24</sup>. Surgical techniques (complete fundus removal, avoiding stenosis, hiatal hernia repair) may help lower the likelihood of GERD appearance, however, long-term sustainability remains a gap<sup>25,26</sup>. Additionally, nutritional deficiencies which are less severe in comparison to bypass procedures still demand life-long monitoring<sup>27-29</sup>. Patients mostly report satisfaction with the procedure outcomes, while 36.4% in a study also reported experiencing weight regain. GERD appearance may significantly impact the quality of life due to worsened symptoms or new onset of GERD<sup>24</sup>.

There is consistently growing evidence related to SG outcomes globally, however, there is a significant gap in the comprehensive understanding of long-term patient experiences, particularly in the Saudi context. The majority of the existing studies are reliant on short-term weight loss outcomes or surgical complications, while limited to no research

is dedicated to chronic symptoms and quality-of-life influences after the postoperative period<sup>30,31</sup>. There is a critical research gap persistent in Saudi Arabia where the manifestation and management of chronic postoperative symptoms are influenced by elements such as cultural practices, dietary habits, and health seeking behaviors.

Given the research gap, this systematic literature review aims to comprehensively synthesize the current literature available regarding SG patients in Saudi Arabia with chronic postoperative symptoms. This review also seeks to explore the common chronic postoperative symptoms, their prevalence and severity reported by SG patients in Saudi Arabia. The study also aims to evaluate the impact of SG experiences within Saudi populations on the quality of life along with the patient satisfaction and efficiency of the procedure.

## METHODOLOGY

**Study Design:** This study employed a systematic literature review study design for the synthesis of current literature on sleeve gastrectomy patients in Saudi Arabia with their associated chronic postoperative symptoms and patient experiences. Aligning with the PRISMA guidelines, this literature review ensured methodological accuracy and evidence transparency during the synthesis. Additionally, this review explored the patterns of prevalence and characterization of the chronic symptoms and their impact on the quality of life of patients who had experienced SG while aligning their satisfaction levels in accordance with cultural and clinical aspect of Saudi population.

**Search Strategy:** Several academic databases such as Google Scholar, PubMed, Semantic Scholar, Scopus and Saudi Digital Library were accessed to retrieve relevant literature. Peer-reviewed publications published between 2016 to 2025 were searched using different keyword combinations including "Sleeve Gastrectomy," "GERD after SG," "Nutritional Deficiencies," "Patient Satisfaction," "Quality of Life," and "Saudi Arabia" (Table 1). The search results were further refined using Boolean operators (AND, OR) while maintaining precision.

**Inclusion Criteria:** Selection of studies were carried out using a strict inclusion criterion while ensuring their alignment with the research aims and objectives. Studies were included if published between 2016-2025 with a special focus on Saudi population who had experienced sleeve gastrectomy procedures and their correlating postoperative chronic symptoms, nutritional deficiencies, patient satisfaction and their quality of life. Included studies comprised of clinical trials, observational studies, cross-sectional surveys, and academy theses. Full-text availability of the selected studies was also ensured along with their language medium being English or Arabic. Translation of Arabic studies was carried out wherever necessary. This criterion ensured comprehensive data assessment and selection.

**Exclusion Criteria:** Studies published before 2016 were excluded to maintain temporal relevance and their alignment with the focus and methodological rigor of the review. Studies focusing on other types of bariatric procedures like Roux-en-Y gastric bypass or adjustable gastric banding were also excluded unless they provided specific insights and data related to SG. Furthermore, populations other than Saudi Arabia or limited to no data reported on chronic symptoms or patient-centered outcomes were also not part of the study. Non-reviewed publications like opinion pieces, editorials, commentaries, and studies demonstrating low or poor methodological quality were also excluded to strengthen the academic integrity of the literature synthesis (Table 2).

**Study Selection:** The study Selection process was conducted in adherence to the PRISMA framework. An initial academic database search retrieved 500 studies. Removing the duplicates, 300 articles

**Table 1.** Defined Search Strategy

Database	Search terms	Boolean Operators
PubMed	("Sleeve Gastrectomy" OR "Laparoscopic Sleeve Gastrectomy" OR "LSG" OR "Hypolactasia") AND ("Saudi Arabi" OR "Middle East" OR "KSA") ("Postoperative Complications" OR "Quality of Life" OR "Patient Satisfaction") AND ("Bariatric Surgery" OR "Obesity Surgery") ("Saudi population" OR "Arab Descent")	AND, OR
Google Scholar	("Long-term LSG Outcomes" OR "Weight Regain After SG") AND ("Saudi Arabia" OR "GCC") ("patient Experiences" OR "Cultural Factors") AND ("Sleeve Gastrectomy" OR "Bariatric Surgery")	AND, OR
Saudi Digital Libraries	("LSG Complications" OR "GERD after Sleeve") AND ("Saudi Hospitals" OR "Jeddah" OR "Riyadh") ("Vitamin D Deficiency" OR "Iron Deficiency") AND ("Post-SG Complications" OR "Bariatric Patients")	AND, OR
Semantic Scholar	("Sleeve Gastrectomy Saudi Arabia" OR "LSG Long-term Outcomes") AND ("GERD" OR "Nutritional Deficiencies" OR "Patient-Reported Outcomes") ("Bariatric Surgery Quality of Life" OR "Post-SG Complications") AND ("Saudi Culture" OR "Middle East")	AND, OR
Scopus	("Laparoscopic Sleeve Gastrectomy" OR "LSG") AND ("Chronic Postoperative Symptoms" OR "Weight Regain") AND ("Saudi Arabia" OR "Arab Patients") ("Patient Satisfaction" OR "Dietary Adherence") AND ("LSG Complications" OR "Metabolic Outcomes")	AND, OR

**Table 2.** Protocol for Study Selection

Criteria	Inclusion	Exclusion
Population	Saudi patients who underwent SG	Non-Saudi population or other bariatric procedures (e.g., RYGB, AGB)
Phenomenon	Chronic symptoms (GERD, nutritional deficiencies), quality of life, patient satisfaction	Acute complications or unrelated outcomes (e.g., surgical technique)
Publication Type	Peer-reviewed articles, Clinical studies, theses	Editorials, Opinion pieces, or non-academic content
Time Frame	2016–2025	Publications before 2016 unless seminal works
Language	English and Arabic (translated if needed)	Non-translatable content

were further analyzed for title and abstracts ensuring their relevance. Studies not aligning with the review objectives were excluded which resulted in 50 studies. These studies were further screened for full-text availability and eligibility. After these rigorous screening cycles, 27 studies were included in the review that adhered to the inclusion criteria for study selection. Figure 1 illustrates the detailed study selection process using a PRISMA flowchart.

**Quality Assessment:** Design-specific appraisal tools were employed to assess the selected studies to ensure the reliability and validity of the synthesis, The Newcastle-Ottawa Scale (NOS) was utilized for the assessment of cohort studies with a distinctive focus on selection criteria, comparability of groups, and outcome certainty (Table 3). AHRQ Tool helped evaluate Cross-sectional studies for sampling methods, measurement validity, and confounding adjustment. JBI Critical Appraisal Checklist ensured clinical details, diagnostic clarity, and follow-up durations within Case reports. Finally, Systematic reviews were also assessed for methodological rigor such as search comprehensiveness and risk of bias using AMSTAR-2. Collectively, studies were ranked as high ( $\geq 8/10$  NOS, full AMSTAR-2/JBI compliance), moderate (5-7/10), or low quality ( $< 5/10$ ).

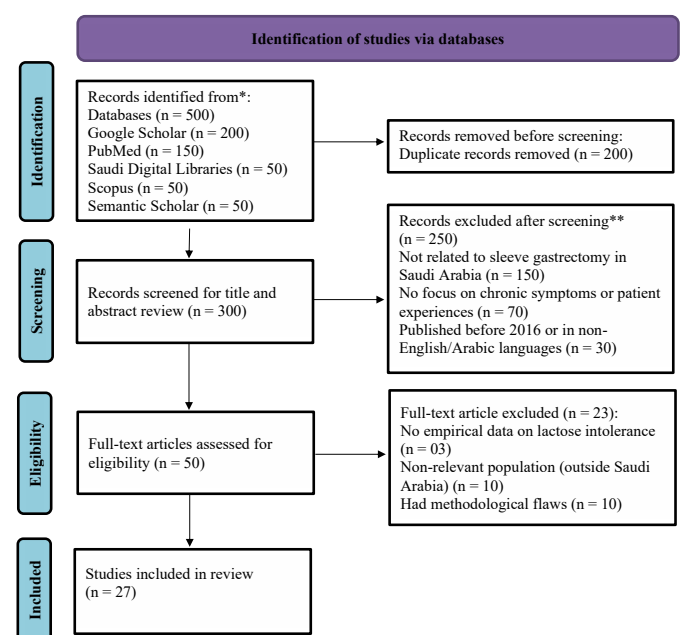
**Data Analysis:** The thematic analysis approach was employed for the final analysis of studies while identifying recurring themes and patterns. Data collected from the studies were systematically analyzed and evaluated to reflect trends, gaps, and implications for clinical practice and future studies.

## RESULTS

### Study Characteristics

The final study selection yielded 28 studies underscoring chronic postoperative symptoms along with patient experiences and outcomes in the Saudi Arabian population of sleeve gastrectomy (SG) (Table 4).

Included studies were published between 2016 and 2025 with diverse ranges of methodologies such as cohort studies (n=10), cross-sectional studies (n=11), case reports (n=2) systematic reviews (n=1), literature reviews (n=2), and longitudinal study (n=1). Sample sizes varied across the studies with single-case reports to larger cohorts, while populations resided in several geographical settings such as tertiary hospitals (e.g., King Fahad General Hospital) along with regional centers (e.g., Asir). Frequently reported complications (35.7% of studies) within studies were predominantly GERD with varying prevalence rates influenced by surgical technique or follow-up durations. Cohorts with >2-year-



**Figure 1.** Illustrates the detailed study selection process using a PRISMA flowchart

**Table 3.** Quality Assessment of Included Studies

Study (Year)	Design	Tool Used	Key Criteria Assessed	Strength	Limitation	Overall Rating
Mahfouz et al. 2016	Cohort	NOS	Comorbidity resolution, QoL	Multi-domain outcome	Small sample (n=50)	Moderate
Makki et al. (2016)	Cross-sectional	AHRQ Tool	Histopathological confirmation of gastritis	Objective data (endoscopy)	Small sample size	Low-Moderate
Althuwaini et al. (2018)	Cohort	NOS	Selection, comparability, follow-up	Long-term follow-up, adjusted for confounders	Retrospective design	High
Alghanim et al. (2018)	Case Report	JBIChecklist	Surgical complication details	Comprehensive literature review	Isolated case	High
Alharbi et al. (2018)	Cross-sectional	AHRQ Tool	QoL post-SG	Region-specific data	Non-validated QoL tool	Moderate
Alolyyan et al. (2020)	Review	Narrative Synthesis	GERD mechanism	Pathophysiology focus	Non-systematic	Low
Alghamdi (2020)	Cross-sectional	GRADE	Satisfaction surveys, body contouring desire	Patient-centered outcomes	Non-validated survey tool	Moderate
Aljarboo et al. (2020)	Case Report	JBIChecklist	Clinical details, diagnostic clarity	Rare complication documented	Single case	High
Alsaif et al. (2020)	Cohort	NOS	Eight loss tracking, cholelithiasis diagnosis	Longitudinal design, ultrasound-confirmed outcomes	Attrition bias	Moderate
Alfadeel et al. (2021)	Cross-sectional	AHRQ Tool	Satisfaction, complication rates	Large sample (n = 1956)	Recall bias	Moderate
Alrshood (2021)	Review	AMSTAR-2	Nutrition challenges, interventions	Broad scope, practical recommendations	Non-systematic methods	Low-Moderate
Altawil et al. (2021)	Cohort	NOS	Hyperparathyroidism, lab metrics	Metabolic focus, adjusted analysis	Limited follow-up	Moderate
Dalboh et al. (2021)	Cohort	NOS	GERD impact, QoL metrics	Prospective, validated tools	Attrition bias	Moderate
Dalboh et al. (2022)	Cohorts	AHRQ Tool	Depression assessment, sample diversity	Regional representation (Asir)	Lack of pre-op data	Moderate
Alhuzaim et al. (2023)	Cross-sectional	AHRQ Tool	Selection bias, measurement validity	Large sample size, clear objectives	Single-center, recall bias	Moderate
Aljohani et al. (2023)	Cross-sectional	AHRQ Tool	Participant selection, depression screening tools	Validated scales (PHQ-9)	Convenience sampling	Moderate
Alhussaini et al. (2023)	Cross-sectional	AHRQ Tool	Deficiency prevalence, lab tests	Objective biomarkers	Single hospital data	Moderate
Alharbi et al. (2023)	Cohort	AHRQ Tool	Knee pain correlation, confounders adjusted	Novel focus (orthopedic impact)	Cross-sectional limitations	Moderate
Qadhi et al. (2023)	Cross-sectional	NOS	Dietary behavior, micronutrient tracking	Pre- and post-op comparisons	Self-reported diet	Moderate
Suliman et al. (2024)	Cohort	NOS	Depression prevalence, post-op follow-up	Multi-center, validated tools	Short follow-up period	Moderate
Dalboh et al. (2024)	Cohort	NOS	GERD symptoms, hiatal hernia repair	Prospective design, QoL metrics	Small subgroup analysis	Moderate
Alrasheed et al. (2024)	Systematic Review	AMSTAR-2	QoL, satisfaction post-surgery	PRISMA adherence, risk of bias assessment	No meta-analysis	Moderate
Alshehri et al. (2024)	Cross-sectional	AHRQ Tool	Confounding adjustment, outcome definition	Tertiary hospital data, robust statistical analysis	Limited generalizability	Moderate
Alzaben et al. (2024)	Cross-sectional	GRADE	Appetite-QoL correlation	Validated questionnaires (SF-36)	Single timepoint	High
Khan et al. (2024)	Cohort	NOS	Barret's esophagus, GERD	Long-term (5-year) data	Lo-risk population bias	Moderate
Suliman et al. (2025)	Cross-sectional	AHRQ Tool	Sampling method, outcome measurement	Multi-center, standardized diagnostics	Self-reported symptoms	Moderate
Alhajri (2025)	Cohort	NOS	Physical activity, weight loss	2-year follow-up, objective measures	Female-only sample	High

**Table 4.** Summarized Study Characteristics

Study (Year)	Study Design	Sample Size	Population	Key Findings	Limitation
Mahfouz et al. 2016	Cohort	425	Saudi patients undergoing sleeve gastrectomy	Significant weight loss, improved comorbidities, and enhanced QoL post-surgery	Limited follow-up duration; self-reported data.
Makki et al. (2016)	Cross-sectional	106	Morbidly obese patients with sleeve gastrectomy in Saudi Arabia	High prevalence of chronic gastritis post-surgery	Small sample size; lack of generalizability.
Althuwaini et al. (2018)	Retrospective Cohort	213	Patients post-laparoscopic sleeve gastrectomy in Saudi Arabia	High prevalence of GRED post-surgery; predictors included pre-existing GERD and hiatal hernia.	Retrospective design; potential recall bias.
Alghanim et al. (2018)	Case Report	01	Saudi patient with gastro pleural fistula post-sleeve gastrectomy	Rare complication reported; highlights need for surgical vigilance.	Case report; limited generalizability.
Alharbi et al. (2018)	Cross-sectional	298	SG patients in the Alqassim Region	Improved QoL post-surgery	Self-reported data; regional bias
Alolyyan et al. (2020)	Literature Review	Not Applicable	Patients with GERD post-SG in Saudi Arabia	Reviewed GERD as a common complication post-surgery.	Review article; no new data
Alghamdi (2020)	Cross-sectional	108	Post-SG patients in Taif City in Saudi Arabia	High patient satisfaction but a strong desire for body contouring surgery.	Small sample; self-reported satisfaction
Aljarboo et al. (2020)	Case Report	1	Saudi Patients with gastroesophageal cancer post-sleeve gastrectomy	Rare case of cancer post-surgery; underscores the need for long-term monitoring	Case report; cannot infer causality
Alsaif et al. (2020)	Retrospective Cohort	711	Patient post-laparoscopic sleeve gastrectomy in Saudi Arabia	Rapid weight loss linked to underscores need for long-term monitoring	Single-center study; limited follow-up.
Alfadeel et al. (2021)	Cross-sectional	279	SG patients in Saudi Arabia	High satisfaction rates; common complications included GERD and nutritional deficiencies.	Self-reported data; potential bias
Alrshood (2021)	Literature Review	Not Applicable	Bariatric surgery patients in Saudi Arabia.	Identified nutrition-related challenges and emphasized postoperative care interventions.	The review's article; lacks primary data
Altawil et al. (2021)	Cross-sectional	143	Obese patients post-SG in KSA.	Secondary hyperparathyroidism was prevalent due to Vitamin D deficiency.	Single-center; limited demographic diversity
Dalboh et al. (2021)	Prospective Cohort	326	Patients post LSG gastrectomy in KSA.	LSG improved GERD symptoms in some but worsened in others; identified risk factors.	Self-reported GERD symptoms; no objective measures
Dalboh et al. (2022)	Cross-sectional	209	SG patients in the Asir Region	High prevalence of depression; associated with poor weight loss outcomes.	Self-reported data; no control group.
Alhuzaim et al. (2023)	Cross-sectional	117	Post-SG patients in KSA	Chronic symptoms like GERD and nausea are prevalent; need for long-term management.	Cross-sectional; cannot establish causality.
Aljohani et al. (2023)	Cross-sectional	408	Bariatric surgery patient in KSA	High prevalence of depression post-surgery; linked to psychosocial factors.	Self-reported depression; no clinical diagnosis
Alhussaini et al. (2023)	Retrospective Cohort	101	Post-bariatric surgery patients in King Fahad Hospital, Jeddah	High rates of postoperative deficiencies; emphasized need for supplementation.	Single-center; retrospective design
Alharbi et al. (2023)	Cross-sectional	313	SG patients in KSA	Knee pain correlated with weight loss; influenced by activity levels.	Cross-sectional; cannot infer causation.
Qadhi et al. (2023)	Prospective Cohort	160	Patients' one-year post-bariatric surgery in KSA	Improved dietary behavior but persistent micronutrient deficiencies.	Short follow-up; reliance on self-reports
Suliman et al. (2024)	Cross-sectional	377	Adults post-bariatric surgery in KSA	Depression prevalent post-surgery; negatively impacted QoL.	Cross-sectional; self-reported depression
Dalboh et al. (2024)	Prospective Cohort	253	LSG patients with fatal hernia repair in KSA	Hiatal hernia repair reduced de novo GERD symptoms post-LSG.	Small sample; short follow-up

Alrasheed et al. (2024)	Systematic Review	Not Applicable	Bariatric surgery patients in KSA	High patient satisfaction and QoL post-surgery.	Heterogeneity in included studies
Alshehri et al. (2024)	Retrospective Cohort	343	Morbidly obese patients post-LSG in Makkah, KSA	High prevalence of gastritis post-surgery; linked to <i>H.pylori</i> infection.	Single-center; limited sample diversity
Alzaben et al. (2024)	Cross-sectional	140	Adults with obesity post-SG in KSA	Appetite changes post-surgery significantly impacted QoL.	Cross-sectional; self-reported appetite.
Khan et al. (2024)	Retrospective Cohort	560	Low-risk Saudi patients 5-years post LSG	Lo incidence of Barrett's esophagus and GERD post-surgery	Single-center; limited generalizability
Suliman et al. (2025)	Retrospective Cohort	380	GS patients in KSA	High prevalence of gallstones post-surgery; associated with rapid weight loss.	Single center; retrospective design
Alhajri (2025)	Longitudinal	352	Women post-SG in KSA (2-year follo-up)	Positive weight loss outcomes; improved physical activity and eating habits.	Limited to women; self-reported habits.

follow-up in particular underscored nutritional deficiencies (28.6% of studies) namely iron and Vitamin D inadequacy. 25% of the studies evaluated the quality of life (QoL) and patient satisfaction which retrieved mixed results highlighting the efficacy of weight loss in the improvement of QoL whereas GERD and depression were negatively impacting outcomes. Furthermore, 14.3% of the studies also reported depression post-SG being associated with hormonal changes and body image concerns.

The selected studies also face some limitations such as heterogeneities within data while reporting inconsistent definitions of chronic symptoms (e.g., GERD symptoms) or diverse follow-up time. Reliance on self-reported data in cross-sectional studies and single-center designs highlights potential limitations in the generalizability of the findings. Long-term data was scarce with only 5 studies opting for follow-up beyond 5 years.

### Thematic Analysis

Thematic analysis was carried out of the synthesis of literature findings focusing on chronic postoperative symptoms after sleeve gastrectomy, particularly in the context of Saudi Arabia. The findings were characterized into four main themes that underscore long-term patient experiences while focusing on both clinical and psychosocial dynamics of recovery. The emerging themes are common chronic postoperative symptoms, prevalence and severity of symptoms, impact on quality of life, and Efficacy and patient satisfaction in the Saudi Population. All of the themes individually encompass specific challenges and insights related to postoperative care which highlights unique aspects of the SG journey that extend beyond the mere weight loss outcomes.

#### Theme 1: Common Chronic Postoperative Symptoms

SG is widely recognized in Saudi Arabia not just for being an effective surgical intervention for the treatment of obesity and associated comorbidities but the burden it exerts due to chronic postoperative symptoms experienced within the Saudi population. These involve gastrointestinal complications, nutritional deficiencies, psychological disturbances, and unique musculoskeletal complaints. One of the most frequently experienced post-SG symptoms is Gastroesophageal reflux disease (GERD) which is also a relatively common chronic symptom. Studies in Saudi Arabia highlight an increased prevalence of GERD from 23% to 58% along with symptoms like heartburn, acid reflux, and regurgitation which are collectively adding to the discomfort of the patient<sup>32,33</sup>. This high prevalence rate is reflective of the surgical modifications being carried out on the stomach which exacerbated intragastric pressure and challenged the angle His resulting in reflux<sup>34</sup>.

Similarly, another gastric complication reported in the studies was gastritis which impacts 70.3% of SG patients<sup>35</sup>. In this regard, the role of Helicobacter pylori infection is also an important complication where patients often test positive for H. pylori with a 17.12-fold increased risk leading to the onset of chronic gastritis. Furthermore, rapid postoperative weight loss manifests into gallstone formation or symptomatic cholelithiasis emerging in 3.5% to 51.6% of SG patients<sup>36,37</sup>. The differences in the incidence of these complications are indicative of the need for postoperative counselling and in more severe cases prophylactic cholecystectomy.

A very common and weakening long-term consequence of SG is the nutritional complexities which are highlighted in multiple studies, underscoring the increased rate of micronutrient deficiencies particularly Vitamin D (70.1%), Vitamin b12 (65%), and iron (70.9%)<sup>28</sup>. Lowered gastric volume and modifications induced in nutrient absorption pathways are exacerbated by these nutritional deficiencies which are further jeopardized by poor dietary adherence and impaired supplement use. A worrisome medical condition regarding these deficiencies is secondary hyperparathyroidism (SHPT) which affects 36.4% of patients<sup>38</sup>. SHPT further adds to the long-term risks involving osteomalacia, metabolic bone disease, and increased susceptibility to bone fractures especially in the case of postmenopausal women.

Given the long-term consequences on physical health, SG tends to influence psychosocial well-being negatively. Studies reported a wider prevalence of postoperative depression and anxiety with its values ranging from 15.2% to 23.5%. It has also highlighted that younger patients along with females were more inclined to vulnerability following the consistent body image dissatisfaction and unmet expectations regarding ideal weight or social involvement<sup>39,40</sup>. Interestingly, findings also highlight a very rarely discussed yet clinically important symptom is the aggravating musculoskeletal pain specifically knee pain even after weight loss. This increased knee discomfort is reported by 12.1% of patients who experience them, however, these symptoms exist due to altered biomechanics or already existing degenerative joint conditions<sup>41</sup>.

#### Theme 2: Prevalence and Severity of Symptoms

It is imperative to develop a comprehensive understanding of the extent and intensity of these chronic symptoms for better development of management strategies. There is a wide spectrum of variability in the prevalence and severity of symptoms reported in the studies which are heavily influenced by factors such as demographic conditions, surgical technique, postoperative follow-up, and lifestyle modifications. 32.2% to 47.6% of patients in the studies reported the

new onset of GERD followed by an SG procedure which highlights a critical clinical burden<sup>42,43</sup>. Most of the patients experienced mild to moderate symptoms, however, 13.8% of patients reported developing severe GERD which either requires ongoing medications or a surgical intervention. Whereas, a smaller population subset (3%) also demonstrated progression to Barrett's esophagus which is a precancerous stage requiring endoscopic surveillance<sup>33</sup>. Additionally, a close association between *H. pylori* infection along with nonsteroidal anti-inflammatory drug (NSAID) use and gastritis was established. This chronic inflammation results in decreased dietary tolerance, frequent vomiting, and iron malabsorption which collectively further complicates nutritional challenges. Studies also reported an escalation of micronutrient deficiencies up to the symptomatic level such as Iron-deficiency anemia (44.6% and folic acid deficiency (70.4%) were reported to be the most severe resulting in fatigue, impaired cognition, and lowered immune defense<sup>44</sup>. Given the effect of these deficiencies on physical health, they also tend to influence work productivity and daily functioning. If the deficiencies escalate, patients were also reported to develop metabolic bone disease which often requires high-dose supplementation, endocrinology referrals, and even hospitalization in a few cases amid fractures or osteomalacia.

Varying psychological complications were also reported which ranged from moderate mood disruptions to more severe depressive episodes, 26.5% of the patients were impacted due to moderate-to-severe depression which is exacerbated by the reporting of suicidal ideation in 3.8% of the patients<sup>45</sup>. This highlights the urgent need for structured mental health support during postoperative patient management. Another critical yet rare and life-threatening postoperative symptom reported was Gastropleural fistula (GPF) which requires long-term follow up and emergency surgical intervention<sup>46</sup>.

### Theme 3: Impact on Quality of Life (QoL)

Chronic symptom manifestation impacts across broader factors of patients' quality of life such as physical functionality, psychological stability, social engagement and life satisfaction. Persistent gastrointestinal symptoms are the reason for the physical QoL of patients to be impacted. Studies reported GERD and gastritis often resulting in sleep disturbances (15.96%), chronic nausea, and strict dietary limitations (27.3%)<sup>42</sup>. These conditions not only restrict patients' participation in social meals or cultural gatherings which are very important dimensions of the daily social fabric of Saudi society. Furthermore, problems with excess skin as a result of rapid weight loss emerged causing dual physical and psychological complications for patients. Similarly, it further complicates irritation and hygiene challenges, and mobility issues exacerbated due to loose skin which is particular to women and older adults, ultimately leading to lower physical activity levels and weight regain<sup>47</sup>. The complexity of chronic physical discomfort leads to challenging pre-existing or new-onset depression or anxiety. Female patients in particular were seen to be more dissatisfied and concerned regarding body image issues and social stigma<sup>40</sup>. This psychosocial pressure is increased due to unmet expectations, particularly in instances where expected SG benefits do not reflect real-life results. 19.6% of patients reported these psychological realities to result in social withdrawal which not only impacts patients' interpersonal relationships but also promotes a decline in overall psychosocial functioning<sup>45</sup>. While it is already established that SG improves associated comorbidities, patients still report facing challenges in social and professional environments. 56.8% of the patients reported enhanced work productivity, however, there was still a significant minority representing consistent fatigue, pain or emotional distress due to the psychosocial impacts<sup>48</sup>. This underlines a crucial gap in the understanding related to clinical manifestations of success long with real-world functioning.

### Theme 4: Efficacy and Patient Satisfaction in the Saudi Population

SG has demonstrated striking results regarding weight loss and metabolic improvement, but long-term satisfaction is increasingly interlinked with symptom burden, lifestyle modifications, and cultural contexts. Studies consistently demonstrated striking BMI reductions from 44-52 kg/m<sup>2</sup> preoperatively to 29-38 kg/m<sup>2</sup> postoperatively<sup>49,50</sup>. There was predominant comorbidity resolution demonstrated in studies, for instance, diabetes remission rates were reported between 15.7% to 61.6% whereas hypertension remission rates were reported ranging from 13% to 52.8% of SG patients<sup>47,51</sup>. These results highlight SG's efficacy in managing obesity while also justifying its popularity across Saudi Arabia. Given the positive results of the procedure, levels of patient satisfaction were not consistent in the literature, where 62% to 92.4% of patients declared being postoperatively satisfied, chronic GERD (23-30%), visible excess skin particularly in women (70.4%), and continuous nutrient inadequacy (49%) led to exacerbate patients dissatisfaction<sup>47,52</sup>. Women were also seen raising cosmetic concerns reflecting the need for body contouring services or alternate pathways for plastic surgery which are either underutilized or not cost-effective. Furthermore, cultural values and healthcare practices majorly influence the desired results. There was an evident gender-specific dissatisfaction where females were subjected to more crucially analyzed and reported emotional and social dissatisfaction mainly due to appearance, cultural pressures, or inadequate support infrastructure for postoperative complications<sup>47</sup>. Moreover, another aspect found in the findings was the non-adherence to supplement regimens where only 37.5% of patients stick to the prescribed vitamin intake protocols, this non-adherence multiplies the complications and jeopardizing long-term consequences of this surgical procedure<sup>44</sup>.

## DISCUSSION

The findings of this systematic review highlight a distinct effect of sleeve gastrectomy (SG) on chronic postoperative symptoms and patient experiences in Saudi Arabia. SG had tremendous potential in lowering the burden of obesity management, however, the procedure correlates with a wider range of challenges in the long-term effects such as patients' physical health, impacting psychological well-being, and influencing overall quality of life. Findings underscored Gastroesophageal reflux disease (GERD) to be the most recurring post-SG chronic symptom in Saudi studies with a consistently increasing prevalence rate. These findings are in agreement with the global data which confirms GERD to be a well-established postoperative complication associated with SG due to the anatomic modifications of the stomach which causes increased intragastric pressure and also disrupts the angle of His<sup>53,54</sup>. Recent studies highlight that 30-50% of SG patients are likely to experience GERD symptoms globally, particularly in populations where reflux conditions are already prevalent<sup>55</sup>. Given the alignment with global data, the severity of GERD in Saudi patients in addition to the likelihood of developing Barrett's esophagus in 3% of cases, underscores the urgency and need for postoperative monitoring and preoperative screening.

Findings also revealed nutritional deficiencies to be of significant concern due to the higher incidence of deficiencies reported such as vitamin D, vitamin B12, and iron. These findings reflect global trends that emphasize micronutrient deficiencies to be a constant universal post-SG complication which is worsened due to lowered gastric volume and inadequate dietary compliance<sup>56,57</sup>. Additionally, the increased prevalence of secondary hyperparathyroidism (SHPT) in Saudi SG patients further strengthens the need for lifelong supplementation and surveillance specifically in populations such as postmenopausal women which are considered high-risk groups. Along with nutritional deficiencies, findings also demonstrated psychological disruptions

particularly depression and anxiety to be highly prevalent among the Saudi SG population. Recent studies align with these findings demonstrating comparable depression prevalence rates in post-SG patients while reporting it at 37.7%<sup>58</sup>. Psychological challenges in Saudi Arabia are exacerbated due to the cultural landscape that shapes body image and social stigma to be of critical importance, especially in women and younger demographics.

The reported psychological and physical symptoms often lead to reduced quality of life for patients, while the findings demonstrate weight loss and comorbidity remission to favor physical functionality, associated chronic symptoms like GERD, nausea, and excess skin in particular diminish the collective satisfaction. These findings also mirror the studies that establish the mixed QoL outcomes, where SG seems to improve mobility and self-esteem, it also leads to decreased gastrointestinal-related QoL<sup>59,60</sup>. In the context of Saudi Arabia, various cultural factors are direct contributors to complicate QoL for patients particularly with dietary restrictions, especially due to the cultural importance of communal dining. Furthermore, the challenge of excess skin after SG-induced weight loss emerged as a critical concern in the findings. Studies underscore the challenges excess skin poses such as hygiene issues, mobility restrictions, and emotional distress which is further complex leading to patients considering body contouring surgeries<sup>61,62</sup>. These procedures might prove to be limited or costly in Saudi Arabia which leads to these concerns being unresolved.

Contradictory to the postoperative challenges of SG, findings highlight a strong efficacy of this procedure in weight loss with enhanced comorbidity remission values in Saudi Arabia with significant BMI reductions from 44-52 kg/m<sup>2</sup> to 29-38 kg/m<sup>2</sup> while diabetes remission values were 15.7-61.6%. These findings are comparable with wider data that underlines excess weight loss levels achieved within 18 months post-SG was reported to be 50-70%. In Saudi Arabia however, patient satisfaction is driven by cultural expectations and symptom burden alike. A study conducted for cultural-specific influences regarding bariatric surgery within the MENA region highlighted initial satisfaction of Saudi patients which was attributed to the evident weight loss, however, it was constrained afterwards due to the risk of chronic symptoms and unmet cosmetic goals<sup>63</sup>. Saudi healthcare system and cultural influences further complicate these postoperative experiences with recurring issues like non-adherence to supplement prescription poses a serious threat to patients lack of awareness or poorly guided postoperative management. These findings emphasize the urgency of culturally sensitive interventions targeted to care for postoperative SG patients. In addition to these factors, gender-specific particularly women reported dissatisfaction across studies which is a reflection of underrepresented dimensions within provided support strategies such as body image issue or dealing with social stigmas.

The present review underscores some crucial clinical and policy implications important for mitigating the increasing burden of chronic postoperative symptoms in SG patients in Saudi Arabia. Tackling the postoperative complication challenge requires comprehensive preoperative evaluations for nutritional status and GERD assessment. Curating educational programs specifically tailored for long management and adherence to supplementation and dietary requirements. Furthermore, it is of high importance to ensure regular follow-ups, monitoring of GERD manifestation symptom through endoscopy or biochemical profiling of nutritional deficiencies. Psychological support is also critically required in the postoperative care which mitigates psychological symptoms stemming from body image issues such as depression. Healthcare providers must also consider cultural factor while prescribing postoperative care strategies which involve dietary patterns and social stigma. Moreover, for increasing patient satisfaction and compliance with supplementation routines

counselling services and support groups may prove to be a beneficial tool. With the ever-increasing demands of cosmetic procedures after SG particularly in women of Saudi Arabia, policymakers are urged to create more patient centered, cost-effective and accessible option to cater this demand.

**Study Limitations:** The reliance on self-reported may introduce potential bias which limits the generalizability of the findings. Variability in defining chronic symptoms throughout studies demonstrate heterogeneity within the data and most of the studies did not follow-up beyond 5 years.

**Future Limitations:** Longitudinal studies should be conducted for the assessing outcomes of SG over longer time durations to evaluate far-reaching impacts. Standardized protocols are required for effective diagnosis and management within SG patients for postoperative chronic symptoms. Region like Saudi Arabia that thrive on their cultural values, culturally sensitive interventions might address treatment regimen compliance.

## CONCLUSION

**This systematic literature review focuses on the impacts of sleeve gastrectomy (SG) on patient experiences of chronic postoperative symptom experiences in Saudi population. There is a large body of evidence supporting SG's efficiency in the reduction of eight loss and associated comorbidities, however, it poses serious long-term complications like GERD, nutritional deficiencies and psychological burden. Patients' quality of life is heavily impacted by these factors collectively with additional cultural and lifestyle elements jeopardizing the already complex postoperative challenges. Findings underscore the need for thorough preoperative evaluations, culturally sensitive curated patient education and streamlined postoperative management to resolve these persistent issues. A multidimensional approach is required to address these challenges which involves nutritional support, mental health services and culturally specific interventions. Healthcare providers are emphasized to formulate patient-centered care strategy in Saudi Arabia which ensures patient satisfaction along with long-term efficiency in SG patients.**

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Raghad Mohammed Alajlan, Rahaf Abdulkhalik Alshehri, Razan Mohammed Alanazi, Leen Khalid Alsarhan, Hala Khalid Alamri contributed to study design, data collection, analysis, manuscript drafting, critical revision, and final approval. All authors fulfilled ICMJE criteria for authorship.

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