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Smoking in bariatric surgery: a systematic review

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Abstract

Background The prevalence of smoking among patients undergoing bariatric surgery has been reported to be as high as 40%. The effect of smoking in the perioperative period has been extensively studied for various surgical procedures, but limited data are available for bariatric surgery. The objective of this study is to review the existing literature to assess: (1) the impact of smoking on postoperative morbidity and mortality after bariatric surgery, (2) the relationship between smoking and weight loss after bariatric surgery, and (3) the efficacy of smoking cessation in the perioperative period among bariatric surgery patients.

Methods A comprehensive search of electronic databases including MEDLINE, EMBASE and the Cochrane Library from 1946 to February 2020 was performed to identify relevant articles. Following an initial screen of 940 titles and abstracts, 540 full articles were reviewed.

Results Forty-eight studies met criteria for analysis: five structured interviews, three longitudinal studies, thirty-two retrospective studies and eight prospective studies. Smoking within 1 year prior to bariatric surgery was found to be an independent risk factor for increased 30-day mortality and major postoperative complications, particularly wound and pulmonary complications. Smoking was significantly associated with long-term complications including marginal ulceration and bone fracture. Smoking has little to no effect on weight loss following bariatric surgery, with studies reporting at most a 3% increased percentage excess weight loss. Rates of smoking recidivism are high with studies reporting that up to 17% of patients continue to smoke postoperatively.

Conclusions Although current best practice guidelines recommend only a minimum of 6 weeks of abstinence from smoking prior to bariatric surgery, the findings of this review suggest that smoking within 1 year prior to bariatric surgery is associated with significant postoperative morbidity. More investigation is needed on strategies to improve smoking cessation compliance among bariatric surgery patients in the perioperative period.

Keywords Smoking · Cigarette · Tobacco · Smoking cessation · Bariatric surgery · Weight loss surgery

Bariatric surgery has proven to be the most effective means for achieving weight loss maintenance and remission of obesity-related comorbidities [1]. Over the past decade, the total number of bariatric surgery operations performed worldwide continues to rise, with nearly 580,000 procedures reported in 2014 [2]. Mortality rates associated with bariatric surgery are exceptionally low, especially in the laparoscopic era and with an increasing number of procedures performed annually at high-volume centers. However, rates of major adverse outcomes and overall perioperative complications after bariatric surgery have been reported to be as high as 4% and 20%, respectively [3, 4]. Numerous authors have investigated factors that predict an increased risk for serious complications among patients undergoing bariatric surgery such as gender, age, preoperative body mass index (BMI), obesity-associated comorbidities, operative technique and duration and smoking. Apart from smoking, few of these identifiable risk factors are inherently modifiable or readily amenable to preoperative optimization.

The prevalence of smoking among bariatric surgery candidates is comparable to the general population and has been reported to be as high as 40% [5]. Best practice

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guidelines recommend at least 6 weeks of abstinence from smoking prior to bariatric surgery and avoidance of tobacco use postoperatively [6, 7]. These guidelines have largely been adapted from orthopedic and cardiothoracic surgery literature [8–11]. However, there has been a growing body of research in recent years examining smoking cessation in bariatric surgery patients in the perioperative period and its effects on surgical outcomes. This review summarizes the existing medical literature investigating smoking among patients undergoing bariatric surgery. Three key questions are addressed: (1) What is the effect of smoking on postoperative morbidity and mortality after bariatric surgery? (2) What is the relationship between smoking and weight loss after bariatric surgery? (3) How effective is smoking cessation in the perioperative period among bariatric surgery patients?

Methods

Institutional review board approval and written consent was not required for this systematic review. To ensure transparent and complete reporting of all identified studies, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist was utilized.

Data sources

A comprehensive search of electronic databases including MEDLINE, EMBASE and the Cochrane Library from 1946 to February 2020 was performed to identify relevant articles. Title searching was restricted to include the keywords "smoking" or "cigarette" or "tobacco" or "smoking cessation" in conjunction with the following terms: obesity, bariatric surgery, weight loss surgery, Roux-en-Y, gastric bypass, gastric band, gastric balloon, sleeve gastrectomy, gastroplasty, biliopancreatic diversion, duodenal switch. A manual search of bibliographies was also performed to identify any additional relevant studies. Duplicate records were removed by a library technician. A total of 940 abstracts and articles were identified for review.

Study selection

All randomized controlled trials, non-randomized comparison studies, retrospective and prospective case series, longitudinal studies and structured interviews or surveys published in English were included. Studies were excluded if they were letters, commentary or opinion pieces, review articles that reported data present in other included references or published in abstract form only. Inclusion of studies was limited to the following: human subjects, adult populations (> 18 years of age), primary bariatric operation performed and defined preoperative smoking status. The primary outcomes of interest, as outlined by the three key study questions, were surgical complications and mortality, weight loss after surgery and postoperative smoking status.

Data extraction

After initial screening against the exclusion criteria, full-text articles for all pertinent records were assessed for eligibility by two independent reviewers in an unblinded standardized fashion and discrepancies were resolved by consensus. Risk of bias of included studies was assessed by the pair of reviewers working independently and with adequate reliability by evaluating study design, data sources, sample size and extent of loss to follow-up. Data extraction tables were developed to summarize the key findings of all eligible studies. There was significant heterogeneity among the included studies with respect to study design and reporting of outcomes of interest, making quantitative comparisons and data analysis difficult. As such, a meta-analysis was not performed.

Results

Forty-eight articles met inclusion criteria and were selected from the 540 reviewed: five structured interviews or surveys [12–16], three longitudinal studies [17–19], thirty-two retrospective studies [5, 20–50] and eight prospective studies [51–58] (Fig. 1). No randomized control trials were identified. Articles were organized into three categories based on the key study questions (Tables 1–3), as summarized below.

Effect of smoking on postoperative morbidity and mortality

Twenty-eight studies [5, 16, 19, 20, 22, 27, 28, 30–50] addressed the impact of smoking on postoperative morbidity and mortality after bariatric surgery (Table 1). Twelve of the included studies [5, 20, 27, 28, 32, 37, 41–44, 47, 48] were retrospective reviews that utilized multivariable logistic regression to assess the association between various preoperative risk factors, including smoking, and 30-day adverse outcomes following bariatric surgery. The remainder of the studies examined the relationship between smoking and short and long-term complications following bariatric surgery, such as venous thromboembolism and marginal ulceration.

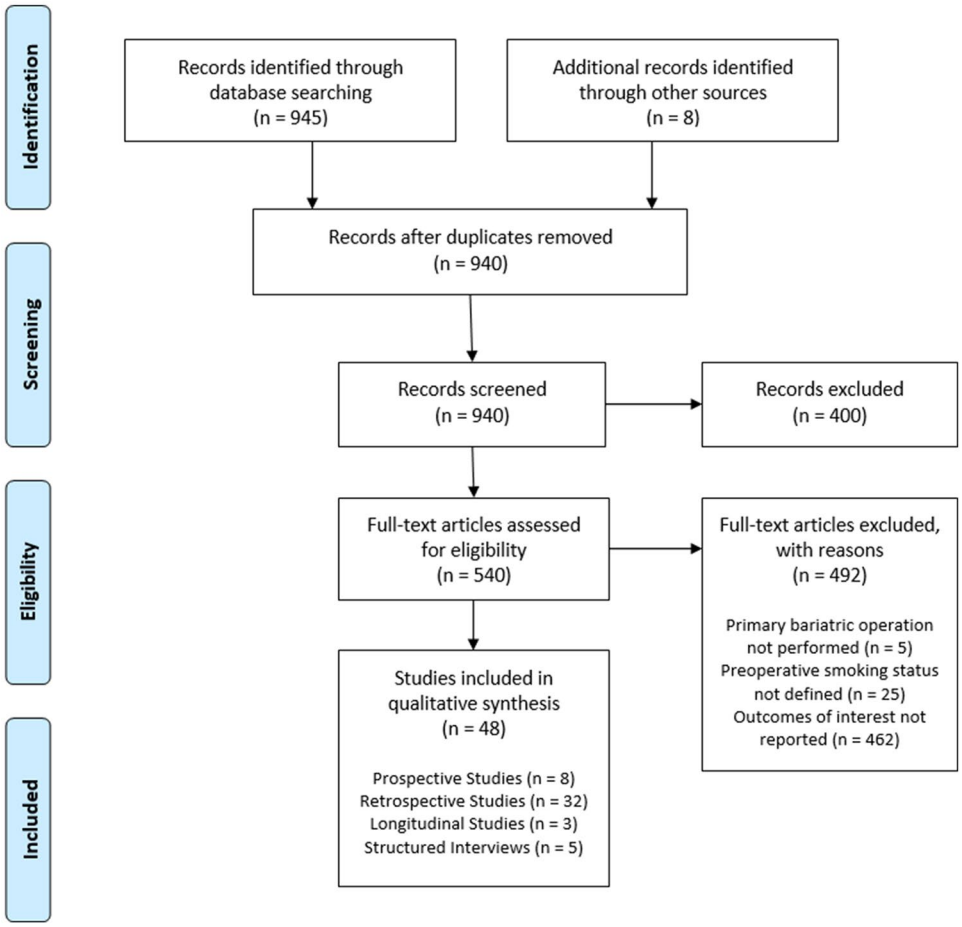

Fig. 1 Summary of literature search

Smoking as a predictor of postoperative complications and death

Early reports by Livingston et al. [42] and Nguyen et al. [47] included smoking in univariate analysis and multistep logistic regression to assess the association between preoperative demographic and clinical variables and 30-day major complications based on prospectively collected data for patients undergoing Roux-en-Y gastric bypass (RYGB) at a single institution. In those studies, smoking history did not correlate with the development of severe postoperative complications. Subsequently, Livingston et al. [43] in 2006 published the first study using 30-day surgical outcome data from the National Surgical Quality Improvement Program (NSQIP) database to perform a similar multivariable logistic regression analysis for a cohort of 575 patients who underwent bariatric procedures at twelve Veterans' Affairs medical centers. The authors reported 30-day mortality and complication rates of 1.4% and 19.7%, respectively. Only a history of smoking in the past 1 year before surgery (OR 1.68, $p = 0.0481$) and super-obesity were identified as statistically significant predictors for postoperative complications after controlling for other variables.

Since that time, multiple authors [5, 20, 27, 28, 32, 37, 41, 48] have undertaken similar retrospective analysis using bariatric surgical outcome data from NSQIP as well as other large databases including the Michigan Bariatric Surgery Collaborative (MBSC), the Bariatric Outcome Longitudinal Database (BOLD) and the International Bariatric Surgery Registry (IBSR) with conflicting results. Finks et al. [5] analyzed data from the MBSC database for 25,469 patients who underwent RYGB, adjustable gastric banding (AGB), sleeve gastrectomy (SG) and biliopancreatic diversion with duodenal switch (BPD-DS) between 2006 and 2010. In that study, RYGB was the most performed procedure, comprising 58% of the study population. The authors reported 30-day mortality and complication rates of 0.1% and 7.4%, respectively. Similar to the findings of Livingston et al. [43], smoking history was identified as a significant patient risk factor for serious postoperative complications on multivariate analysis (OR 1.20, $p = 0.03$). Gupta et al. [37] in 2011 reported on 11,023 patients from the NSQIP dataset who underwent bariatric procedures to identify preoperative risk factors associated with the primary outcome of 30-day major morbidity. Of note, SG was excluded as it did not have a procedure code at the time of data collection. In

Table 1 Summary of studies examining the impact of smoking on postoperative morbidity and mortality after bariatric surgery ($n=28$)

Author	Year	Study Design	Database	Sample size	Procedure	Smoking History	%Smoking	Findings
Altieri et al. [30]	2018	Retrospective observational	SPARCS	35,080	RYGB	Yes vs. no	12.7	Total incidence perforated MU 0.83% Smoking predictive of perforated MU on multivariate analysis (OR 2.216, $p<0.0001$) Smoking predictive of recurrent perforated MU on multivariate analysis (26.71% vs. 12.62%; $p<0.0001$)
Arterburn et al. [20]	2009	Retrospective observational	NSQIP	856	Various	Within 1 year	13.3	30-day, 90-day, and 1-year mortality 1.3%, 2.1%, and 3.4%, respectively Smoking not predictive on multivariate analysis (OR 1.24, $p=0.56$)
Atilla et al. [19]	2017	Cross-sectional study		183	SG	Former vs. current		Total incidence pulmonary complications 15.3% at 3 months of follow-up In current smokers pack-year history predictive of complications ($p=0.02$) but not in former smokers
Azagury et al. [31]	2011	Retrospective chart review		103	RYGB	Yes vs. no		103 patients with MU detected at median 22 months Smoking predictive of MU on univariate analysis (OR 2.5, $p=0.02$) but not on multivariate
Benotti et al. [32]	2014	Retrospective observational	BOLD	81,751	RYGB	Yes vs. no	5	30-day mortality 0.15% Smoking not predictive on univariate analysis ($p=0.705$)
Dittrich et al. [33]	2019	Retrospective chart review		249	RYGB	Former vs. current	51.8	Total incidence MU 10.8% at median 205 days Smoking predictive on multivariate analysis (OR 4.69, $p=0.003$) No difference between current vs. former smokers (OR 1.38, $p=0.685$) or exposure (pack-years) or amount (cigarettes per day)
El-Hayek et al. [34]	2012	Retrospective chart review		328	RYGB	Former vs. current	13.4	328 patients underwent EGD for symptoms and MU detected in 34% at ≥ 12 months 47 patients underwent repeat EGD for persistent symptoms and 51% had persistent/recurrent MU Smoking predictive of MU on univariate analysis (OR 1.6, $p=0.04$) but not on multivariate (OR 1.5, $p=0.07$) Smoking predictive of EGD finding of persistent/recurrent MU on multivariate analysis (OR 14.1, $p=0.003$)
Fashandi et al. [35]	2018	Retrospective observational		3439	RYGB	Yes vs. no	2	Total incidence bone fracture 6.4% at 7.6 years of follow-up Smoking predictive on multivariate analysis (OR 3.124, $p=0.0006$)

Table 1 (continued)

Author	Year	Study Design	Database	Sample size	Procedure	Smoking History	%Smoking	Findings
Finks et al. [5]	2011	Retrospective observational	MBSC	25,469	RYGB, AGB, SG, BPD-DS	Yes vs. no	39	30-day mortality 0.1%, 30-day complications 7.4% Smoking predictive on multivariate analysis (OR 1.20, $p=0.03$)
Gonzalez et al. [36]	2006	Retrospective observational		600	RYGB	Yes vs. no	7.6	Total incidence DVT/PE 3.5% detected at median 5 days Smoking predictive on multivariate analysis (OR 6.7, $p<0.01$)
Gribsholt et al. [16]	2016	Survey		2,238	RYGB	Yes vs. no	22.7	Survey response 63.7% Higher prevalence of symptoms leading to health care contact among smokers (adjusted prevalence ratio 1.07) Symptoms most commonly leading to health care contact after RYGB surgery were abdominal pain (34.2%), fatigue (34.1%) and anemia (27.7%)
Gupta et al. [37]	2011	Retrospective observational	NSQIP	11,023	Various	Within 1 year	12.5	30-day mortality 0.2%, 30-day complications 4.2% Smoking not predictive on univariate analysis ($p>0.05$)
Gupta et al. [38]	2012	Retrospective observational	NSQIP	32,889	Various	Within 1 year	13–18	30-day morbidity 6.4% (pneumonia and respiratory failure comprising 18.7%) Total incidence of 30-day complications: pneumonia 0.6%, respiratory failure 0.6% Smoking predictive of pneumonia on multivariate analysis (OR 1.56, $p<0.05$)
Haskins et al. [39]	2014	Retrospective observational	NSQIP	41,445	Various	Within 1 year		Smoking predictive on multivariate analysis for the following 30-day complications: organ space infection (OR 1.45, $p=0.01$), prolonged intubation (OR 1.82, $p=0.001$), pneumonia (OR 1.90, $p<0.0001$), reintubation (OR 1.62, $p=0.01$), sepsis (OR 1.49, $p=0.01$), shock (OR 1.78, $p=0.01$), lengthy hospital stay > 7 days (OR 1.37, $p=0.003$) Smoking not predictive of 30-day mortality (OR 0.71, $p=0.33$)
Haskins et al. [40]	2017	Retrospective observational	NSQIP	33,714	SG	Within 1 year	9.8	Smoking predictive on multivariate analysis for 30-day mortality (0.2% vs. 0.1%; $p=0.0004$), 30-day composite morbidity outcome (4.3% vs. 3.7%; $p=0.04$), 30-day serious morbidity outcome (0.9% vs. 0.6%; $p=0.003$) Smoking not predictive of length of stay, 30-day readmission

Table 1 (continued)

Author	Year	Study Design	Database	Sample size	Procedure	Smoking History	%Smoking	Findings
Inadomi et al. [22]	2018	Retrospective observational	MBSC	49,772	RYGB, SG	Never vs. former (quit > 1 year) vs. recent (quit within 3–12 months)	9.8	On multivariate analysis among RYGB patients: increased 30-day severe complications for recent smokers compared to never smokers (5.4% vs. 2.9%; $p = 0.04$), less 30-day overall complications for former smokers compared to never smokers (10.5% vs. 11.5%; $p = 0.04$), no statistical comparison between recent smoker and former smoker status was made Complication rates not affected by smoking status among SG patients
Lautz et al. [41]	2007	Retrospective observational	NSQIP	2,438	RYGB	Within 1 year	13–21	30-day mortality 0.25–1.91%, 30-day complications 9.31–22.14% Smoking predictive on multivariate analysis (OR 1.457, $p = 0.02$)
Livingston et al. [42]	2002	Retrospective observational		1,067	RYGB	Yes vs. no	16	30-day mortality 1.3%, 30-day complications 5.8% Smoking not predictive on univariate analysis ($p > 0.05$)
Livingston et al. [43]	2006	Retrospective observational	NSQIP	575	Various	Within 1 year	16.7	30-day mortality 1.4%, 30-day complications 19.7% Smoking predictive on multivariate analysis (OR 1.68, $p = 0.0481$)
Major et al. [44]	2017	Retrospective observational		415	RYGB, SG	Yes vs. no	5	30-day complications 7.3% Smoking not predictive on univariate analysis (OR 0.34, $p = 0.442$) Smoking not predictive on univariate analysis after subgroup analysis of RYGB (OR 0.95, $p = 0.992$) and SG (OR 0.94, $p = 0.966$)
Marchini et al. [45]	2012	Retrospective observational		299	RYGB, AGB	Never vs. former (quit > 1 year) vs. current (quit < 1 year)	32	Smoking predictive of longer hospital stay on multivariate analysis ($p < 0.01$) Current and previous smoker remained 4 and 1 day longer, respectively, compared to never smoker
Moon et al. [46]	2018	Retrospective case–control		5,538	SG	Never vs. former vs. current		Total incidence PMSVT 0.2% at 1 year of follow-up 11 cases (18.2% current smokers, 18.2% former smokers), 33 controls (6.2% current smokers, 24.2% former smokers) In current smokers odds of exposure to smoking for cases were 6.4 times that for controls (OR 6.4, $p = 0.24$) controlling for matched variables such as history of cancer, DM, etc.

Table 1 (continued)

Author	Year	Study Design	Database	Sample size	Procedure	Smoking History	%Smoking	Findings
Nguyen et al. [47]	2003	Retrospective observational		150	RYGB	Yes vs. no	17	30-day complications 14%, lengthy operative time (>240 min) 38%, lengthy hospital stay (>4 days) 11% Smoking not predictive on univariate analysis ($p>0.05$)
Spaniolas et al. [50]	2018	Retrospective observational	SPARCS	35,075	RYGB	Yes vs. no		Total incidence MU 3.2%, 4.7%, 7.9% and 11.4% at 1 year, 2 years, 5 years and 8 years, respectively Smoking predictive on multivariate analysis (OR 1.56, $p<0.001$)
Turner et al. [48]	2011	Retrospective observational	NSQIP	32,426	Various	Within 1 year	12.3	Composite 30-day mortality and complications 3.82% Smoking not predictive on nomogram developed based on multivariate analysis
Wilson et al. [49]	2006	Retrospective chart review		1,001	RYGB		2.8	Total incidence MU 8.1% detected at 1–103 months 226 patients underwent EGD for symptoms and MU detected in 36% Smoking predictive of EGD finding of MU on multivariate analysis (OR 30.6, $p<0.001$)
Yuce et al. [28]	2019	Retrospective observational	NSQIP	133,417	RYGB, SG	Within 1 year	9.3	Smoking predictive on multivariate analysis ($p<0.05$) for 30-day death or serious morbidity (OR 1.13), 30-day readmission (OR 1.21), wound complications (OR 1.44), respiratory complications (OR 1.69) Smoking not predictive of return to OR (OR 1.15) Adjusted OR remained significant on subgroup analysis of SG and RYGB except for death or serious morbidity in SG (OR 1.04)
Zhang et al. [27]	2005	Retrospective observational	IBSR	18,972	Not specified	Yes vs. no	16	Overall mortality 3.45% Smoking predictive on multivariate analysis (OR 2.05, $p<0.0001$)

OR adjusted odds ratio on multivariable logistic regression with 95% confidence interval,*Various* bariatric surgical procedures identified in the NSQIP database using an algorithm of Current Procedural Terminology and ICD-9 codes developed in 1995,*RYGB* Roux-en-Y gastric bypass, *SG* sleeve gastrectomy, *AGB* adjustable gastric banding, *BPD-DS* biliopancreatic diversion with duodenal switch,*NSQIP* National Surgical Quality Improvement Program, *MBSC* Michigan Bariatric Surgery Collaborative, *BOLD* Bariatric Outcome Longitudinal Database, *SPARCS* Statewide Planning and Research Cooperative System, *IBSR* International Bariatric Surgery Registry,*MU* marginal ulceration, *DVT* deep vein thrombosis, *PMSVT* portomesenteric splenic vein thrombosis

contrast to the findings of Livingston et al. [43] and Finks et al. [5], smoking in the past 1 year before surgery was not a statistically significant preoperative variable selected by the stepwise logistic algorithm ($p > 0.05$). In that study, the 30-day mortality and complication rates were 0.2% and 4.2%, respectively.

More recent studies comprising a larger proportion of patients who underwent SG have also demonstrated mixed results. Major et al. [44] in 2017 performed a retrospective analysis of 415 patients who underwent RYGB and SG at a single institution in Poland and found that smoking was not associated with an increased rate of perioperative complications on univariate analysis (OR 0.34, $p = 0.442$). Additionally, no association between smoking and perioperative complications was found on subgroup analysis of RYGB and SG. In that study, LSG comprised 56% of procedures performed. In contrast, Inadomi et al. [22] compiled MBSC data for 49,772 patients who underwent RYGB and SG and demonstrated that in the RYGB cohort, recent smoker status (having quit within 1 year before surgery) was independently associated with an increased rate of 30-day serious complications when compared to never smoker status (5.4 vs. 2.9%; $p = 0.04$). However, complication rates were not affected by smoking status in the SG cohort, which comprised 50.2% of the study population.

Haskins et al. [40] and Yuce et al. [28] investigated the independent effect of smoking on 30-day postoperative morbidity with the largest SG cohorts to date. Haskins et al. [40] in 2017 studied 33,714 patients from the NSQIP registry who underwent SG and found that patients who smoked within 1 year before surgery had higher rates of 30-day composite morbidity (4.3% vs. 3.7%; $p = 0.04$), serious morbidity (0.9% vs. 0.6%; $p = 0.003$) and death (0.2% vs. 0.1%; $p = 0.0004$) when compared to non-smokers. Similarly, Yuce et al. [28] analyzed NSQIP data for 133,417 patients who underwent RYGB and SG from 2012 to 2017 and reported that smoking in the past 1 year before surgery was predictive of 30-day death or serious morbidity (OR 1.13), 30-day readmission (OR 1.21), wound complications (OR 1.44) and respiratory complications (OR 1.69) on multivariate analysis ($p < 0.05$). Except for death or serious morbidity, the adjusted odds ratios remained significant on subgroup analysis of SG, which comprised 61% of procedures performed.

Thromboembolic complications

Thromboembolic events such as pulmonary embolism (PE), deep vein thrombosis (DVT) and portomesenteric and splenic vein thrombosis (PMSVT) are a major contributor to postoperative morbidity and mortality after bariatric surgery. In a retrospective study of 660 patients who underwent RYGB, Gonzalez et al. [36] reported a 3.5% rate of PE/DVT with a median time to presentation of 5 days. On multivariate analysis, a history of smoking was the only modifiable risk factor associated with an increased likelihood of developing postoperative thromboembolic events (OR 6.7, $p < 0.01$). Similarly, in a retrospective case–control study of 5,538 patients who underwent SG conducted by Moon et al. [46], there was a significant relationship between active smoking and PMSVT although this did not reach statistical significance (OR 6.4, $p = 0.24$).

Pulmonary complications

Pulmonary complications such as pneumonia, failure to wean from ventilator and reintubation are the most common postoperative non-wound complications in bariatric surgery and account for 20% of postoperative morbidity [38]. Gupta et al. [38] identified 32,889 patients undergoing bariatric surgery from the NSQIP database and found smoking within 1 year before surgery to be predictive of postoperative pneumonia ($p = 0.02$) and respiratory failure ($p = 0.048$) in univariate analysis. Subsequent multivariate analysis confirmed smoking to be an independent preoperative risk factor associated with greater incidence of postoperative pneumonia (OR 1.56, $p < 0.05$). Haskins et al. [39] reported similar findings of statistically significant increased rates of reintubation (OR 1.62, $p = 0.01$), prolonged intubation (OR 1.82, $p = 0.001$) and postoperative pneumonia (OR 1.90, $p < 0.0001$) among patients who smoked in the past 1 year before bariatric surgery when compared to non-smokers based on a retrospective review of 41,445 patients from the NSQIP registry. Duration of smoking history has also been found to be associated with increased pulmonary complications after bariatric surgery. Atilla et al. [19] conducted a cross-sectional study of 183 patients undergoing SG and demonstrated that among current smokers pack-year history was correlated with higher rates of respiratory complications postoperatively ($p = 0.02$). Livingston et al. [43] in 2006 similarly reported that a greater than 20-pack-year history of smoking was associated with failure to wean from ventilator within 48 h of bariatric surgery (OR 5.16, $p < 0.01$).

Length of stay and postoperative contact with health care providers

Haskins et al. [39] studied 41,445 patients from the NSQIP database and demonstrated that smoking within 1 year prior to bariatric surgery was a significant predictor of length of hospital stay greater than 7 days after controlling for covariates (OR 1.37, $p = 0.003$). This was corroborated by a retrospective study of 299 patients conducted by Marchini et al. [45] that found smoking to be an independent predictor of longer length of stay ($p < 0.01$). In that study, current and previous smokers (quit for at least 1 year) remained admitted

4 days and 1 day longer, respectively, when compared with those who had never smoked.

Gribsholt et al. [16] surveyed 2,238 patients after RYGB investigating the prevalence and predictors of various health-related postoperative symptoms. Symptoms most commonly leading to health care contact after RYGB surgery were abdominal pain (34.2%), fatigue (34.1%) and anemia (27.7%). In that study, smokers had a higher prevalence of symptoms leading to health care contact (prevalence ratio 1.11).

Marginal ulceration

The development of marginal ulceration (MU) is a well-recognized long-term complication after RYGB, usually presenting within 12 months of surgery [34, 49]. Early retrospective studies by Azagury et al. [31] and El-Hayek et al. [34] which reported on small series of patients from single institutions demonstrated that current or previous smoking was significantly associated with MU formation on univariate analysis but not multivariate analysis. More recently, Dittrich et al. [33] in 2019 published a single-center experience of 249 patients who underwent RYGB and found that smoking at the time of surgery was an independent and statistically significant predictor of the development of postoperative MU on multivariable regression (OR 4.69, $p=0.003$). Furthermore, neither the amount of current smoking (cigarettes per day) nor lifetime tobacco exposure (pack-year history) was associated with the rate of development of MU. In that study, the postoperative incidence of MU was 10.8% at a median of 205 days. Similarly, Spaniolas et al. [50] utilized the Statewide Planning and Research Cooperative System (SPARCS) database to identify 35,075 patients who underwent RYGB between 2005 and 2010 and found that a history of tobacco use was significantly associated with development of MU on a multivariable Cox proportion hazard model (OR 1.56, $p<0.001$). In that study, patients were followed for 8 years after surgery and overall cumulative incidence of MU was 3.2%, 4.7%, 7.9% and 11.4% at 1 year, 2 years, 5 years and 8 years of follow-up, respectively. Of note, 17.8% of patients with a history of tobacco use at the time of RYGB developed MU within the study follow-up.

Additionally, El-Hayek et al. [34] retrospectively studied 328 patients who underwent RYGB at a single institution and identified current or previous tobacco use as the sole independent risk factor for persistent or recurrent marginal ulceration on multivariate analysis (OR 14.1, $p=0.003$). Rates of intractable and recurrent marginal ulceration in smokers after appropriate treatment with acid suppression and cytoprotective therapy were reported to be as high as 38% and 27%, respectively. These findings were supported by the 2018 study by Altieri et al. [30] that reported on 35,080 patients from the SPARCS database who underwent RYGB and found that patients who endorsed tobacco use were more likely to develop subsequent perforated MU when compared to their non-smoking counterparts (26.71% vs. 12.62%; $p<0.0001$).

Bone fracture

Tobacco use was identified as an independent predictor of bone fracture after bariatric surgery in multivariate analysis performed by Fashandi et al. [35] of 3,439 patients (OR 3.124, $p=0.0006$). In that study, the total incidence of bone fracture was 6.4% at a mean follow-up of 7.6 years.

Effect of smoking on postoperative weight loss

Fifteen studies [12–14, 18, 21–26, 51–55] fulfilled criteria and were included in the review of the effect of smoking in the perioperative period on weight loss after bariatric surgery (Table 2). Overall, the results of these studies varied from no effect to a modestly beneficial effect of smoking on postoperative weight loss.

The earliest study published by Grace et al. [18] in 1990 analyzed 93 patients undergoing vertical banded gastroplasty and showed greater rates of weight loss among smokers when compared to non-smokers both preoperatively (43.26 kg vs. 34.97 kg; $p<0.05$) and postoperatively (44.47 kg vs. 35.06 kg; $p<0.05$). Subsequently, there have been multiple authors [21, 26, 51–55] who have utilized univariate and multivariate linear regression analysis to assess the impact of various preoperative clinical factors on weight loss after bariatric surgery. The findings with respect to the association of smoking and postoperative weight loss based on these analyses have been varied. In a prospective cohort study of 118 patients undergoing RYGB and SG at a single institution, Parri et al. [54] found no correlation between current smoking and percentage of excess weight loss (%EWL) in follow-up at 1 year ($p=0.118$), 2 years ($p=0.155$), 3 years ($p=0.113$) and 4 years ($p=0.089$) on multivariate analysis. In contrast, Wood et al. [26] performed a retrospective cohort study of 726 patients who underwent RYGB at a single institution between 2001 and 2007 and demonstrated that a history of smoking was associated with greater postoperative weight loss at 7 to 12 years of follow-up based on multivariate regression. The authors reported a 2.8% greater %EWL among patients with a history of smoking compared to non-smokers ($p=0.009$). These findings were supported by two large prospective cohort studies [52, 55] including The Longitudinal Assessment of Bariatric Surgery-2 (LABS-2) study published by Courcoulas et al. [52] in 2015 that identified 2,458 patients undergoing bariatric procedures at ten centers across the United States. In that study, smoking within 1 year before bariatric surgery was

Table 2 Summary of studies examining the impact of smoking on weight loss after bariatric surgery (n = 15)

Author	Year	Study design	Sample size	Follow-up (months)	Procedure	Smoking history	%Smoking	Findings
Adams et al. [12]	2012	Structured interview	61	24	RYGB, AGB	Never vs. former (quit > 1 year) vs recent (quit within 1 year)	18	Smoking predictive of greater %EWL at 6 months ($p = 0.01$) and 12 months ($p = 0.04$) but not at 24 months ($p = 0.14$) on univariate analysis Recent smokers lost more weight than never smokers and former smokers at 6 months and 12 months ($p < 0.03$)
Anderson et al. [51]	2014	Prospective cohort	160	24	SG	Yes vs. no	31	Non-smoking predictive of lower %EWL on multivariate analysis (OR 10.3, $p = 0.029$)
Arterburn et al. [21]	2013	Retrospective observational	516	12	RYGB	Within 1 year	12–14	NSQIP dataset Smoking not predictive of achieving target weight at 1 year on univariate analysis ($p = 0.66$)
Courcoulas et al. [52]	2015	Prospective cohort	2,458	36	RYGB, AGB, other	Within 1 year		LABS-2 dataset Smoking predictive of greater %EWL on multivariate analysis (2.63% more weight loss; $p < 0.001$)
Grace et al. [18]	1990	Longitudinal study	93	23 ± 8	VBG	Never vs. former vs. current	38	Patients who smoked preoperatively lost more weight than non-smokers and former smokers (43.26 kg vs. 34.97 kg and 32. 41 kg, respectively; $p < 0.05$) Patients who smoked postoperatively lost more weight than non-smokers and former smokers (44.47 kg vs. 35.06 kg and 33.07 kg, respectively; $p < 0.05$)
Inadomi et al. [22]	2018	Retrospective observational	49,772	36	RYGB, SG	Never vs. former (quit > 1 year) vs. recent (quit within 3–12 months)	9.8	MBSC dataset On multivariate analysis among RYGB patients, smoking predictive of greater %EWL for recent smokers compared to non-smoker at 2 years (73.4% vs. 69.7%; $p = 0.01$) but not at 1 year (69.3% vs. 67.5%; $p = 0.11$) or 3 years (70% vs. 67.2%; $p = 0.14$) %EWL not affected by smoking status among SG patients

Table 2 (continued)

Author	Year	Study design	Sample size	Follow-up (months)	Procedure	Smoking history	%Smoking	Findings
King et al. [53]	2019	Prospective cohort	1,278	79.2	RYGB	Within 1 year	12.1	LABS-2 dataset Analyzed association between post-surgery behaviors (ie. self-weighing, fast-food meals per week, binge-eating, smoking cigarettes, sedentary time) and weight regain In univariate analysis there was an inverse association between smoking and weight regain ($p < 0.001$) In multivariate analysis there was no inverse association between smoking and weight regain when adjusted for sedentary time ($p = 0.07$)
Kowalewski et al. [23]	2018	Retrospective chart review	131	134.4 ± 14.4	SG, AGB	Never vs. former vs. current	51	%EWL among SG for never, former, and current smokers were 48.9%, 52.5%, and 48.4%, respectively %EWL among AGB for never, former, and current smokers were 31.4%, 21.9%, and 22.5%, respectively In both groups there were no statistically significant differences in %EWL between smokers and non-smokers, or between those who quit postoperatively and did not
Latner et al. [13]	2004	Structured interview	65	16.4	RYGB	Current		Smoking frequency (cigarettes smoked per day) negatively correlated with proximity to goal weight on multivariate analysis ($p = 0.05$)
Lent et al. [14]	2013	Survey	155	35 ± 13	RYGB	Yes vs. no	19.4	Smoking not predictive of greater %EWL before ($p = 0.93$) or after ($p = 0.17$) surgery on multivariate analysis
Moser et al. [24]	2016	Retrospective observational	184	22 ± 7	SG	Never vs. former vs. current	33.7	Subgroup analysis of current smokers using Heavy Smoking Index (HSI) to differentiate heavy (HSI ≥ 4) from non-heavy smokers %EWL among smoking status groups and subgroups (HSI) statistically non-significant at 6 months, 12 months, and 24 months
Parri et al. [54]	2015	Prospective cohort	118	48	RYGB, SG	Current		Smoking not predictive of %EWL at 1 year ($p = 0.118$), 2 years ($p = 0.155$), 3 years ($p = 0.113$), and 4 years ($p = 0.089$) on multivariate analysis

Table 2 (continued)

Author	Year	Study design	Sample size	Follow-up (months)	Procedure	Smoking history	%Smoking	Findings
Signorini et al. [25]	2018	Retrospective observational	102	81 ± 7	SG	Never vs. former vs. current	28.4	Presented 7 year follow-up outcomes for Moser et al. [24] study %EWL among smoking status groups and subgroups (HSI) statistically non-significant at 81 month
Still et al. [55]	2014	Prospective cohort	2,444	≥ 36	RYGB	Yes vs. no		Smoking predictive of greater %EWL at 6 months (OR 2.3, $p = 0.0015$) and ≥ 36 months (OR 4.8, $p = 0.03$) on multivariate analysis
Wood et al. [26]	2016	Retrospective cohort	726	84–144	RYGB	Yes vs. no		Smoking predictive of greater %EWL on multivariate analysis (2.8% more weight loss; $p = 0.009$)

%EWL percentage excess weight loss, *RYGB* Roux-en-Y gastric bypass, *SG* sleeve gastrectomy, *AGB* adjustable gastric banding, *VBG* vertical banded gastroplasty, *NSQIP* National Surgical Quality Improvement Program, *MBSC* Michigan Bariatric Surgery Collaborative, *LABS-2* Longitudinal Assessment of Bariatric Surgery-2

associated with 2.63% greater %EWL compared to the non-smoking cohort ($p < 0.001$). A more recent large prospective cohort study conducted by King et al. [53] in 2019 that also utilized the LABS-2 dataset analyzed the association between various post-surgery behaviors (i.e., self-weighing, fast-food meals per week, binge-eating, smoking cigarettes, sedentary time) and weight regain after RYGB for 1,278 patients. In multivariate analysis, there was no inverse association between smoking within 1 year before bariatric surgery and weight regain when adjusted for sedentary time ($p = 0.07$).

Three studies [12–14] assessed perioperative substance use among patients undergoing bariatric surgery using preoperative psychological clinical evaluations and postoperative structured interviews or surveys. Overall, smoking status and intensity were not shown to be associated with greater postoperative weight loss after bariatric surgery. Lent et al. [14] surveyed 155 patients who underwent RYGB and demonstrated that smoking postoperatively was not related to %EWL after controlling for patient demographic, alcohol use and preoperative BMI ($p = 0.17$). Latner et al. [13] interviewed 150 patients from a single institution who underwent RYGB and found that preoperative smoking frequency (cigarettes per day) was negatively correlated with proximity to goal weight on multivariate analysis ($p = 0.05$).

Only four studies [22–25] have directly examined the relationship between smoking in the perioperative period and weight loss after bariatric surgery. Moser et al. [24] stratified 184 patients undergoing SG into three groups according to their tobacco use status at the time of surgery (smokers, ex-smokers and non-smokers) and also performed a subgroup analysis of active smokers to differentiate heavy smokers from non-heavy smokers. No statistically significant weight loss difference was found among the groups based on either smoking status or severity at 2 years and 7 years of follow-up [25]. Similarly, Kowalewski et al. [23] performed a single-center retrospective study of 131 patients who underwent SG and AGB and demonstrated that in both groups there was no statistically significant difference in %EWL between smokers and non-smokers, or between those who quit postoperatively and those who did not. Inadomi et al. [22] in 2018 analyzed MBSC data for 49,772 patients who underwent RYGB and SG and demonstrated that in the RYGB cohort, recent smoker status (having quit within 1 year before surgery) was not associated with greater postoperative %EWL at 3 years of follow-up when compared to non-smokers on multivariate analysis (70% vs. 67.2%; $p = 0.14$). Similarly, %EWL was not affected by smoking status among the SG cohort.

Smoking cessation in the perioperative period

Based on the selection criteria, we identified thirteen relevant articles [12–15, 17, 18, 23–25, 29, 56–58] describing the prevalence and patterns of smoking before and after bariatric surgery (Table 3). Overall, the prevalence of smoking among patients undergoing bariatric surgery has decreased through the years with earlier studies suggesting rates as high as 40% [5] compared to rates of 10–17% [28, 43] reported in contemporary literature. However, the majority of studies are in agreement that the prevalence and severity of smoking is not significantly altered from pre- to post-surgery [13–15, 17, 29, 56, 57]. Conason et al. [15] administered preoperative and postoperative surveys which assessed the frequency of substance use behaviors including smoking in 155 patients who underwent RYGB and AGB at a single institution. In that study, there was no significant effect of time on the frequency of cigarette smoking at 24 months of follow-up ($p = 0.78$). Similarly, Lent et al. [14] followed 155 patients who underwent RYGB for a mean follow-up period of 35 months and found that smoking status did not differ pre- to post- surgery (19.4% vs. 14.8%; $p = 0.28$). Furthermore, the number of cigarettes smoked per day reported by the preoperative and postoperative cohort did not differ significantly (14 vs. 13; $p = 0.67$).

Small single-center studies have reported that between 30 and 60% of patients who smoke preoperatively quit after bariatric surgery [14, 18, 23–25, 57]. However, those series also found that up to 17% of non-smokers began smoking postoperatively. These findings of significant smoking recidivism are corroborated by a recent prospective cohort study published by King et al. [58] in 2020 that enrolled 1770 patients from the LABS-2 study who underwent RYGB and were followed for 7 years postoperatively to determine their changes in smoking behavior. In that study, the modeled prevalence of current smoking across the follow-up period was statistically significant ($p < 0.001$) with 13.7% of patients smoking within 1 year before surgery, decreasing to 2.2% at the time of surgery, increasing to 9.6% at 1 year postoperative and finally increasing to 14.0% at 7 years. Moreover, the modeled prevalence of continued, relapsed or incidental smoking across the follow-up period with respect to those who quit more than 1 year before surgery compared to those who quit within 1 year before surgery demonstrated that smoking within 1 year before surgery was the strongest predictor of postoperative smoking ($p < 0.001$). Similarly, Adams et al. [12] reported on 61 US veterans who underwent RYGB and AGB at a single institution and found that all of the patients who initiated smoking cessation within 6 months before surgery (15.5% of the study sample) had resumed smoking by 2 years postoperatively.

Discussion

Livingston et al. [43] in 2006 was the first to identify smoking as an independent risk factor for adverse outcomes after bariatric surgery and since that time, there has been increased study into the impact of smoking and perioperative smoking cessation on surgical outcomes. Most of the early studies included smoking in multivariate analysis to determine if smoking was predictive of 30-day major morbidity, but the findings from these studies were conflicting. More recent studies have directly examined the effect of smoking on specific complications after bariatric surgery and suggest that there is a strong association between smoking within 1 year prior to surgery and 30-day postoperative morbidity, particularly wound and pulmonary complications [22, 28, 39, 40]. With respect to the relationship between smoking and long-term postoperative complications specific to RYGB, this review also found postoperative smoking to be an independent predictor of bone fracture and the development of MU. Additionally, smoking is significantly associated with persistent or recurrent MU despite appropriate treatment, further advocating for the continued avoidance of tobacco postoperatively.

Unfortunately, there was significant heterogeneity in the definition of preoperative smoking among the included studies. Many reports only provided dichotomous data as to smoking status before bariatric surgery (i.e., "a history of smoking versus none" or "former versus current smoker") without any details regarding proximity of smoking to surgical intervention or smoking severity (pack-year history). Similarly, most high-powered studies examining the effects of smoking on postoperative morbidity and mortality were based on multivariate analysis of 30-day outcome data collected in national prospective databases such as NSQIP that defined preoperative smoking status as smoking within 1 year prior surgery. It remains unclear if the timing or duration of smoking cessation before bariatric surgery has an impact on postoperative outcomes. A large retrospective study by Inadomi et al. [22] using the MBSC dataset did suggest that among patients who underwent RYGB, those who quit smoking more than 1 year before surgery achieved similar postoperative risk profiles to lifetime non-smokers, while those who quit smoking within 1 year prior to surgery experienced increased rates of 30-day serious complications. Overall, the optimal preoperative duration of smoking cessation to minimize surgical risk after bariatric surgery is unknown. Randomized clinical trials investigating the effects of a smoking intervention program prior to bariatric surgery are required [10].

Another limitation of this review is that many included studies were published prior to the adoption of SG, which has overtaken RYGB as the most common bariatric

Table 3 Summary of studies examining the prevalence and patterns of smoking before and after bariatric surgery (n = 13)

Author	Year	Study design	Sample size	Follow-up (months)	Procedure	Smoking history	Pre-op smoking	Findings
Adams et al. [12]	2012	Structured interview	61	24	RYGB, AGB	Never vs. former (quit > 1 year) vs recent (quit within 1 year)	18	All recent smokers who quit within 6 months of surgery (15.5% of study sample) resumed smoking within the follow-up period No non-smokers or former smokers started smoking post-operatively
Cena et al. [56]	2016	Prospective cohort	100	6	RYGB, SG	Never vs. former vs. current	30	Smoking habit score based on status, duration and severity of smoking Smoking habit score did not differ from baseline to end of follow-up period for both RYGB and SG patients on multivariate analysis ($p > 0.05$)
Conason et al. [15]	2013	Survey	155	24	RYGB, AGB	Current	10.4	No significant effect of time on the frequency of cigarette smoking (F-value 0.49, $p = 0.78$)
Grace et al. [18]	1990	Longitudinal study	93	23 ± 8	VBG	Never vs. former vs. current	38	28.6% of current smokers quit postoperatively 12.1% of non-smokers started smoking postoperatively

Table 3 (continued)

Author	Year	Study design	Sample size	Follow-up (months)	Procedure	Smoking history	Pre-op smoking	Findings
King et al. [58]	2020	Prospective cohort	1,770	168	RYGB	Never vs. former vs. current	13.7	Among those with a history of smoking (45.2% of study sample), 67.9% quit > 1 year before surgery, 26.9% quit within 1 year before surgery and 5.3% were current smokers Modeled prevalence of current smoking across the follow-up period (year 1–7 trend $p < 0.001$): 13.7% (1 year preoperative), 2.2% (time of surgery), 9.6% (1 year postoperative), 14.0% (7 years postoperative) Modeled prevalence of continued, relapsed or incidental smoking across the follow-up period in reference to those who quit > 1 year before surgery vs. within 1 year before surgery (year 1–7 trend $p < 0.001$): 0% vs. 15.8% (time of surgery), 5.2% vs. 55.4% (1 year postoperative), 12.3% vs. 61.7% (7 years postoperative) Smoking within 1 year before surgery was the strongest predictor of postoperative smoking ($p < 0.001$) Among those with no history of smoking incident smoking was 1.0% (1 year postoperative) and 3.8% (7 years postoperative) Mean smoking intensity (packs per day) among smokers was 0.60 (time of surgery), 0.70 (1 year postoperative), 0.77 (7 years postoperative) with year 1–7 trend $p < 0.001$

Table 3 (continued)

Author	Year	Study design	Sample size	Follow-up (months)	Procedure	Smoking history	Pre-op smoking	Findings
Kovacs et al. [29]	2017	Retrospective observational	22,451	48	Not specified	Current		Increased rate of tobaccos misuse in operated patients when compared to non-operated in single-event analysis (OR 1.28, $p<0.05$) when controlling for age and gender but not on multiple-event Cox regression analysis (OR 1.14, $p=0.073$)
Kowalewski et al. [23]	2018	Retrospective chart review	131	134.4 ± 14.4	SG, AGB	Never vs. former vs. current	51	Among SG: 46% of current smokers quit postoperatively, no non-smokers started smoking postoperatively Among AGB: 33% of current smokers quit postoperatively, 17% of non-smokers started smoking postoperatively
Latner et al. [13]	2004	Structured interview	65	16.4	RYGB	Current		Smoking frequency (cigarettes per day) reduced from pre- to postoperative on univariate analysis (3.7 vs. 2.5; $p=0.068$) Smoking postoperatively negatively correlated with satisfaction ($p=0.05$)
Lent et al. [14]	2013	Survey	155	35 ± 13	RYGB	Yes vs. no	19.4	Smoking status did not differ from pre- to postoperative on multivariate analysis (19.4% vs. 14.8%; $p=0.28$) 63.3% of current smokers quit postoperatively 9.6% of non-smokers started smoking postoperatively Smoking frequency (cigarettes per day) unchanged from pre- to postoperative (14 vs. 13; $p=0.67$) Among preoperative factors examined only older age decreased the odds of smoking after surgery ($p=0.002$)

Table 3 (continued)

Author	Year	Study design	Sample size	Follow-up (months)	Procedure	Smoking history	Pre-op smoking	Findings
Maniscalco et al. [57]	2015	Prospective cohort	78	12	RYGB, SG, AGB, IB	Current		Higher rates of smoking cessation for IB compared to AGB and combined RYGB/SG at 3 months (36% vs. 6% and 5%, respectively; $p=0.02$) but not thereafter on univariate analysis Smoking frequency (cigarettes per day) unchanged for persistent smokers on univariate analysis ($p>0.05$)
Moser et al. [24]	2016	Retrospective observational	184	22 ± 7	SG	Never vs. former vs. current	33.7	32% of current smokers quit postoperatively No non-smokers or former smokers started smoking postoperatively
Signorini et al. [25]	2018	Retrospective observational	102	81 ± 7	SG	Never vs. former vs. current	28.4	Presented 7 year follow-up outcomes for Moser et al. [24] study 21% of current smokers quit postoperatively 14.7% of former smokers started smoking postoperatively No non-smokers started smoking postoperatively
Tae et al. [17]	2014	Longitudinal study	23	6–10	Not specified	Current		Smoking status did not differ from pre- to postoperative on univariate analysis (39.1% vs. 17.4%; $p=0.180$)

RYGB Roux-en-Y gastric bypass, *SG* sleeve gastrectomy, *AGB* adjustable gastric banding, *IB* intragastric balloon, *VBG* vertical banded gastroplasty

operation performed worldwide [59, 60]. Patients who undergo SG may have lower rates of 30-day serious morbidity than with RYGB [61] and are not at risk for the same long-term postoperative complications, particularly the development of MU. While more recent studies by Haskins et al. [40] and Yuce et al. [28] have included large proportions of patients who underwent SG and demonstrated that smoking within 1 year prior to surgery was predictive of higher rates of 30-day postoperative morbidity after controlling for covariates, the literature examining the association between smoking and surgical outcomes primarily after SG remains limited.

Smoking cessation has typically been associated with weight gain; previous studies have reported post-cessation weight gain as significant as 28 lb among bariatric surgery candidates who had previously attempted to quit smoking [62]. However, the literature remains divided with respect to the impact of smoking and smoking cessation in the perioperative period on weight loss after bariatric surgery. Overall, the findings of the present study suggest that smoking confers little to no benefit on weight loss after bariatric surgery. In the studies that did demonstrate smoking to be correlated with increased %EWL following bariatric surgery, the increase was modest, with authors reporting between 2 and 3% greater %EWL at a postoperative follow-up of up to 12 years [22, 26, 52]. Unfortunately, few of the available studies investigating the association between smoking and weight loss after bariatric surgery reported postoperative weight loss outcome data such as %EWL or BMI that could be extracted or analyzed on a more quantitative basis.

Finally, this review demonstrates that rates of smoking and severity of smoking are not significantly altered before and after bariatric surgery. The literature suggests that up to 17% of patients continue to smoke after bariatric surgery despite best practice guidelines [12, 14, 17]. Furthermore, while some studies indicate that between 30 and 60% of patients who smoke preoperatively quit after bariatric surgery, significant rates of smoking recidivism are reported [12, 58]. Current best practice guidelines recommend a minimum of 6 weeks of abstinence from smoking prior to bariatric surgery [6, 7] and it is unclear if longer periods of cessation before surgery would be continued long-term. A recent large prospective cohort study published by King et al. [58] using the LABS-2 dataset for RYGB compared patients who quit smoking within 1 year before surgery with those who quit more than 1 year before surgery and found that a shorter duration of cessation was the strongest predictor of postoperative smoking. These study findings suggest that longer periods of smoking cessation prior to bariatric surgery may be beneficial for sustained abstinence and improved postoperative outcomes. Unfortunately, very few studies in the bariatric literature report on postoperative smoking behavior. In studies that did examine smoking before and after bariatric surgery, the types of substance use were not always distinguished (i.e., alcohol, illicit drug and/or tobacco use) [63–66]. In general, the quality of the existing evidence is lacking, with only a few large prospective cohort studies and no randomized clinical trials.

Conclusion

This systematic review suggests that smoking remains prevalent after bariatric surgery and rates of smoking recidivism after bariatric surgery are high. Smokers achieve little to no increased weight loss following bariatric surgery compared to their non-smoking counterparts. However, smoking within 1 year prior to bariatric surgery has been shown to be an independent predictor of significant short-term and long-term postoperative complications. Although best practice guidelines endorse only a minimum of 6 weeks of abstinence from smoking prior to bariatric surgery, the optimal preoperative duration of smoking cessation to minimize surgical risk is unclear. More investigation is needed on strategies to improve smoking cessation compliance among bariatric surgery patients in the perioperative period.

Compliance with ethical standards

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