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Alcohol and drug use among post-operative bariatric patients: A systematic review of the emerging research and its implications

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Abstract

Background—Emerging research suggests that some bariatric surgery patients are at a heightened risk for developing substance use problems, especially alcohol use problems.

Methods—An exhaustive literature review was conducted in January 2015 to investigate all articles published that included data on post-operative alcohol use, alcohol use disorders, and illicit drug use among bariatric surgery patients.

Results—Twenty-three studies reported on alcohol and/or substance use among bariatric patients. Six studies longitudinally assessed alcohol use behaviors; three of these studies found an increase in alcohol use following surgery. Six studies were cross-sectional, and two studies assessed medical records. Five studies investigated the prevalence of admissions to substance abuse treatment, and three studies combined alcohol and drug use data in a single index. Six studies reported on illicit drug use and reported low-post-operative use. The studies' samples were primarily non-Hispanic white females in their upper 40s, and only 11 of the 23 studies utilized validated assessment instruments.

Conclusions—Studies employing longitudinal designs and large sample sizes indicate that bariatric patients who had the gastric bypass procedure are at an elevated risk for alcohol use problems post-operatively. Research also indicates that bariatric surgery patients might be over-represented in substance abuse treatment facilities. Risk factors for problematic post-operative alcohol use include regular or problematic alcohol use pre-surgery, male gender, younger age, tobacco use, and symptoms of attention deficient and hyperactivity disorder. As a whole, however, studies indicate bariatric surgery patients demonstrate a low prevalence of problematic alcohol use, and studies about gastric bypass patients are not entirely conclusive. Prospective, longitudinal studies are needed, utilizing standardized and validated alcohol assessment instruments that follow post-operative bariatric patients well beyond 2 years, and account for types of bariatric procedure. Finally, study samples with greater racial/ethnic diversity and wider age ranges are needed.

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Keywords

Bariatric surgery; alcohol; substance use; drug use; addiction

Background

The high prevalence of obesity and severe obesity poses both public health and clinical challenges in the United States (Flegal et al., 2012). As a result of this epidemic, a burgeoning number of patients are undergoing bariatric, or weight loss (WLS), surgery (Buchwald et al., 2004; Nguyen et al., 2011). Despite the potential health benefits of WLS, including the reversal of type 2 diabetes and other cardiometabolic disease risk factors (Abbatini et al., 2013; Buchwald et al., 2004; De La Cruz-Munoz, et al., 2013; Heneghan, et al., 2013) reports of post-surgical substance use problems, and alcohol use problems in particular (Conason, et al., 2012; King et al., 2012; Svennson et al., 2013) have recently emerged.

Current alcohol or illicit drug use disorder is among the exclusion criterion for undergoing WLS in the United States (Mechanick et al., 2013). Furthermore, many WLS facilities recommend that *all* patients avoid alcohol for several months after surgery to promote post-surgical healing and prevent macronutrient deficiencies (Mechanick et al., 2013). Recent studies suggest that certain subsets of WLS patients may be vulnerable to developing post-surgical substance use disorders, specifically alcohol use disorders (AUD; King et al., 2012, Suzuki et al., 2012; Svensson et al., 2013).

The two most common types of WLS procedures in the United States are the Roux-en-Y gastric bypass (RYGB) and the laparoscopic adjustable gastric band (LAGB) procedure. The RYGB procedure involves the creation of a small stomach pouch and re-routing of the digestive tract with food bypassing most of the stomach and part of the small intestine, resulting in the malabsorption and restriction of calories. The adjustable band procedure (AGB) on the other hand, is much less invasive, and involves an adjustable band placed around the upper stomach, restricting the amount of food the patient can consume (de la Cruz-Muñoz et al., 2011).

Psychological and physiological factors have been suggested to explain the heightened vulnerability for post-operative problematic alcohol use. The nervous system has a remarkably similar response to the consumption of (1) drugs of abuse and (2) overeating (Kenny, 2011 Volkow et al., 2013; Wang et al., 2003). As such, an “addiction transfer” model has been suggested, meaning that one may trade an “addiction” for food to an “addiction” to drugs or alcohol post-surgery (McFadden, 2010). Second, as will be discussed further, certain WLS procedures (i.e. the RYGB procedure) can cause a heightened sensitivity to alcohol post-operatively (Hagerdorn, Encarnacion, Brat, & Morton, 2007; Klockhoff, Näslund, & Jones, 2002; Woodard, Downey, Hernandez-Boussard, & Morton, 2011).

To date, there has not been a review of the literature to assess: (a) types and rates of alcohol and illicit drug use in post-WLS populations; (b) correlates of post-surgical alcohol and

illicit drug use disorders; and (c) implications for future research. The current paper is the first systematic, comprehensive, and critical review of the literature; we examine published articles reporting on alcohol use, problematic alcohol use, and illicit drug use among post-operative WLS patients, and provide recommendations for future research.

Method

A systematic review of the literature was conducted in January 2015 using the following electronic databases: Medline, Psych INFO, and Social Work Abstracts. Keyword searches were conducted using Boolean operators “AND” and “OR” to specify or broaden the search. The term “bariatric surgery,” was included with all keywords. Separate searches were conducted using specific keywords including: “alcohol*,” “psychosocial,” and “substance,” The wildcard character “*” was used to truncate words to include all forms of the root word.

Articles were included in the review if they were published in a peer-reviewed journal (online and/or print format) and addressed: (a) alcohol use and/or (b) illicit drug use among people who had WLS. There was no restriction on publication date or language. Case studies were not included in the review as they are not generalizable to a broader population. Data were abstracted independently by two of the authors to ensure reliability. Figure 1 details the study selection process.

Review

A total of 23 studies met the search criteria. Nineteen studies reported on alcohol use, and six on illicit drug use (five of these studies also reported on alcohol use). Three studies combined alcohol and drug use into one variable. Overall, study samples were comprised of mainly non-Hispanic white females with mean ages ranging from 40 to 57. Data, including sample demographics and findings regarding alcohol and illicit drug use, were extracted (see Tables 1 and 2).

Alcohol

Nineteen studies reported on alcohol use in post-operative WLS patients (Table 1 and 2). Six of these studies used a longitudinal design and assessed patient alcohol use both pre- and post-operatively. Six studies were cross-sectional; pre-surgical alcohol use data (if applicable) was determined through retrospective report or medical charts. Two studies reviewed medical records for alcohol use data. Finally, five studies investigated the prevalence of WLS patients admitted to in-patient treatment for problematic alcohol use.

Longitudinal Studies—Svensson and colleagues (2013) and King and colleagues (2012) conducted the two most rigorous studies to date, using large sample sizes and prospective, longitudinal designs. Svensson and colleagues (2013) conducted the largest investigation of alcohol use among WLS patients and utilized a non-surgical control group. The authors examined long-term changes in alcohol use risk behaviors and alcohol use disorders at baseline, six months and then 1, 2, 3, 4, 6, 8, 10, 15, and 20 years post-WLS, among Swedish women (2,010 WLS patients and 2,037 non-surgical control patients; see Table 1). Overall, the vast majority of respondents (93.1% of the WLS group and 96% of the non-

surgical group) demonstrated a low prevalence of problematic alcohol use behaviors at all assessment time points.

However, compared to the non-surgical control group, patients who underwent the RYGB procedure were nearly three times as likely to report alcohol use at the medium risk level (defined by the World Health Organization as over 1.5 drinks per day for women), almost five times more likely to have an alcohol abuse diagnosis (as obtained from medical records), and almost six times more likely to report "problems with alcohol" (Table 2; Svensson et al., 2013). Patients who underwent the less-invasive AGB procedure did not demonstrate higher alcohol risk behaviors when compared to the control group. Data concerning alcohol use frequency was collected using a dietary questionnaire. Data concerning problems with alcohol was determined from the question "Do you think you have alcohol problems?" The prevalence of alcohol abuse diagnoses were obtained from medical records (Table 1).

King and colleagues (2012) investigated alcohol use frequency and AUDs at one and two years post-WLS among 1,945 WLS patients; this is the largest investigation of AUDs among WLS patients conducted in the United States. Self-report data collected with the Alcohol Use Disorders Identification Test (AUDIT), an empirically validated and widely used assessment (Allen et al., 1997), revealed no increase in alcohol use frequency or AUD symptoms within one post-surgical year (Table 2). However, there was a significant increase in AUDs in the second post-surgical year from 7.6% to 9.6% [$p \leq 0.01$])(King et al., 2012). Equally important, RYGB patients were most at risk for AUDs two years post-WLS compared to respondents who underwent the AGB or other surgical procedures (Table 2). Participants were predominantly non-Hispanic white females with a median age of 47.

Conason and colleagues (2012) collected alcohol use frequency data among 155 patients using a questionnaire developed by the study authors (Table 1). While the study had a high attrition rate (i.e., 75% loss to follow up by 24 months) which may have led to biased findings due to differential dropout, RYGB patients demonstrated a significant increase in alcohol use from pre-WLS to 24 months post-WLS ($p = 0.011$). When examining both RYGB and AGB patients, no significant increase in the frequency of alcohol use was found from pre-WLS to 24 months post-WLS; however, significant increases in alcohol use were found from one month post-WLS to 24 months post-WLS ($p < 0.001$; Conason et al., 2012). Thus, these data could potentially account for patients adhering to instructions to avoid alcohol use for several months following WLS, suggesting increased alcohol use over time.

Conversely, other studies have reported post-surgical decreases in high-risk alcohol use and overall alcohol consumption, (Table 2; Wee et al., 2014; Lent et al., 2013). Specifically, Wee and colleagues (2014) collected alcohol use data for 541 WLS patients using a shorter, modified version of the AUDIT (AUDIT-C; Dawson et al., 2005; Reinert & Allen, 2007) (Table 1). Half of RYGB patients and 57% of AGB patients who reported high-risk alcohol use at baseline no longer reported high-risk alcohol use at one and two years post-WLS (Table 2). However, it is also important to note that a subset of respondents who did not report high-risk alcohol use before surgery did report high-risk alcohol use at follow-up, representing "new" post-surgical cases of high-risk alcohol use. This sample was

predominantly female (76%) and non-Hispanic white (69%) with a mean age of 44 (Wee et al., 2014).

Similarly, Lent and colleagues (2013) prospectively examined alcohol use frequency among 155 RYGB patients and found a significant decrease in frequency of alcohol use post-surgery; 72.3% (n=112) of participants endorsed *any* alcohol use during the year prior to surgery, which shrank to 63.2% post-surgery (p=.026). Alcohol use data were collected using a non-validated, mailed questionnaire developed by the study authors that was not anonymous. Alcohol use questions are detailed in Table 1, and included: "how often did you have a drink containing alcohol in the past year?" While this study presents important findings regarding a reduction in alcohol use frequency after WLS, due to a lack of methodological rigor (i.e. use of non-validated, identifiable, mailed assessments), and the fact that problematic alcohol use was not assessed, implications are limited. The sample was a mean age of 50.1 years (SD=11.3), and primarily white (98.1%), and female (80.6%).

Alfonsson and colleagues (2014) examined pre- and post-operative problematic alcohol use (as determined by an AUDIT score >8 for men and >6 for women) among 129 Swedish RYGB patients (Table 1). Compared to pre-WLS, post-operative patients had a lower prevalence of alcohol problems (14% vs. 5.4%)(Table 2). Interestingly, however, after surgery three patients met criteria for "alcohol disturbance" (as determined by an AUDIT score over 16), representing new-onset cases. Symptoms of adult ADHD were a risk factor for post-surgical problematic alcohol use. Respondents were an average of 43 years old and 78% female.

Cross-Sectional Studies—Six cross-sectional studies assessed problematic alcohol use, alcohol use disorders, alcohol sensitivity and/or alcohol use frequency in post-operative WLS patients (Table 1). Overall, while the studies report a low prevalence of problematic alcohol use post-surgery, patients with a history of pre-operative AUDs and those who undergo the RYGB bariatric procedure might be at risk for problematic alcohol use post-WLS. However, many of the cross-sectional studies relied on retrospective report of pre-surgical alcohol use and failed to use validated alcohol use assessment instruments; thus findings must be interpreted within these limitations.

Buffington (2007) conducted an online survey of 318 post-WLS patients (predominantly RYGB) using non-standardized assessments; nearly 30% reported difficulty controlling their alcohol intake post-surgery compared to only 4.5% who (retrospectively) reported difficulty pre-surgery (Table 2). Furthermore, 84% of respondents who drank one or more alcoholic beverages weekly indicated that they were more sensitive to alcohol after surgery than before surgery. Nearly half of the sample was between the ages of 36 and 50, and sample was mostly female (93.7%). Race/ethnicity was not reported, but the sample included respondents of various nationalities.

Ertelt and colleagues (2008) investigated alcohol abuse and dependence diagnoses among 70 RYGB patients via a mailed, non-standardized survey based on DSM-IV-TR criteria (Table 1). Prior to surgery, 6 patients (8.6%) retrospectively met criteria for alcohol abuse or dependence. Post-surgery, the prevalence rate was the same, however 2 patients (2.9%)

newly met the alcohol use disorders criteria post-surgery (Table 2). Moreover, 54.3% of patients reported responding differently to alcohol post-operatively; 34.3% (n=24) reported quicker intoxication and 20% (n=13) reported feeling intoxicated after drinking lower quantities of alcohol. The sample predominantly consisted of non-Hispanic white females and had a mean age of 49 (SD=9.2) (Table 1).

Mitchell and colleagues (2001) examined AUDs among a sample of 78 RYGB patients via a telephone interview using sections of the SCID (Table 1). Overall, only six patients (7.7%) met criteria for alcohol abuse or dependence post-surgery, which was assessed 13-15 years after surgery (Mitchell et al., 2001). This sample was predominantly female (83%), with a mean age of 57 (range 31-77; SD not reported). Race/ethnicity data were not reported.

Macias and Leal (2003) interviewed 140 WLS patients (post-WLS) and analyzed psychosocial differences among patients meeting DSM-IV criteria for Binge Eating Disorder (BED) prior to surgery. The pre-operative BED group (n=25) was more likely to have symptoms of alcohol dependence post-operatively, based on the Millon Clinical Multiaxial Inventory-II (39.28, SD=22.7 vs. 12.46, SD=18.71; p=.001; Table 2). The sample was primarily female, with the BED group mean age 36.46 (SD=11.72), and non BED group 44.61 (SD=9.92). Race/ethnicity data was not reported, but the study was conducted in Spain.

In a sample of 51 WLS patients, Suzuki and colleagues (2012) collected pre-operative data via medical chart reviews of psychiatric assessments, and post-operative data through telephone interviews using the SCID (Table 1). Thirty-five percent had a history of a lifetime, pre-surgical AUD, and 12% met criteria for current AUD post-WLS. No patients met criteria for an AUD at time of surgery. Post-surgical AUDs were associated with the RYGB procedure (compared to other surgical procedures) and having a lifetime history of a pre-surgical AUD (Table 2). This sample was predominantly female (86.3%) with a mean age of 51 (SD=8.7). Race/ethnicity data were not reported.

Finally, Odom and colleagues (2010) investigated alcohol use frequency and “concern” with alcohol use through mailed, non-standardized surveys to 203 RYGB patients who had WLS over one year ago. Nearly 42% reported never using alcohol before or after WLS, 20.1% identified a decrease in post-surgical alcohol use, and 9.1% reported increased alcohol use post-WLS. Approximately 10% of respondents reported that someone expressed concern about their alcohol or drug use post-operatively, suggesting problematic alcohol use. Of note, only 24.8% of the surveys were returned, making the representativeness of the study questionable. In addition, it is not completely clear if the respondents who reported never using alcohol were referring to lifetime use as the response choice was simply “I never drank alcohol before or after [surgery]” (Odom et al., 2010). The sample was mainly non-Hispanic white (71.9%) and female (85%), with a mean age of 50.6 (SD=9.8).

Medical Record Reviews—Through a review of medical records two studies investigated AUDs among military veterans who had WLS; both studies found a low prevalence of post-operative AUDs. Adams and colleagues (2012) conducted a chart review of 61 predominantly AGB patients (Table 1) and found that 5 patients (8.2%) had a pre-

surgical history of alcohol abuse. No patients demonstrated post-surgical AUDs as determined by the AUDIT-C. Tedesco and colleagues (2013) revealed a high prevalence of a pre-surgical DSM-IV-TR-defined alcohol abuse (21.5%) among a sample of 205 veterans. More than half of this sample was RYGB patients. Six patients demonstrated problematic alcohol use at their follow-up assessment. While patients with a history of alcohol abuse seemed more likely to develop an AUD post-surgery, this did not reach statistical significance. Males in their upper 40s to lower 50s were predominantly represented in both studies. Adams et al. (2012) reported a 70% non-Hispanic white sample, and Tedesco and colleagues (2013) did not report race/ethnicity data.

The Prevalence of Bariatric Surgery among Patients in Substance Abuse Treatment—Five studies examined medical records of patients in substance abuse treatment facilities to determine the prevalence of WLS. Because all of these studies reported on treatment admissions for problematic alcohol use, they are reported here. Saules and colleagues (2010) reviewed 7,199 electronic medical records (EMRs) and hard copies of medical charts from admissions to a substance abuse treatment facility in Michigan over the course of 3 years. Based on EMR data, 2% were WLS patients; based on hand searching medical charts, 6% were WLS patients. Well over half (62.3%) of the WLS patients were seeking treatment for alcohol use, and 9.4% were seeking treatment for alcohol as well as an illicit drug. Findings revealed that 43.4% of patients did not engage in heavy alcohol or illicit drug use until after surgery, representing new onset cases. Admission to substance abuse treatment occurred an average of 5.4 (S.D.=3.2) years post-surgery.

Wiedemann and colleagues (2013) conducted a follow up to Saules et al. (2010), and reviewed EMRs of inpatient substance abuse admissions from July 2009 to April 2011 (Table 1). Nearly 3% of 4,658 patients were determined to be WLS patients; the WLS subset was older and more likely to be female and have an alcohol (vs. drug) diagnosis (Table 2). Of this sample, 56 patients participated in a qualitative interview, and the majority of the qualitative interview participants (60%) developed a “new onset” AUD/SUD post-surgery (Wiedemann et al., 2013; Table 2). Respondents who participated in the qualitative interview portion of the study were on average 44.8 years old, primarily non-Hispanic white, and predominantly female (Table 2).

Cuellar-Barboza and colleagues (2014) reported that 4.9% (n=41) of 823 patients in a treatment program for alcohol use problems had undergone the RYGB WLS procedure. Self-reported alcohol consumption patterns as well as clinical impressions and diagnoses, based on DSM-5 criteria, were extracted from EMRs. Nearly 40% (n=16) of the 41 RYGB patients also met criteria for an AUD prior to WLS, and 17% (n=7) did not consume any alcohol prior to WLS. Study authors were contacted to elucidate about the remaining 18 patients; this subset reported drinking alcohol prior to WLS, but did not report a prior AUD diagnosis. Thus, 73% (n= 25) of this sample represents “new onset” cases of AUDs that first appeared after WLS. Patients met criteria for an AUD approximately three years post-WLS, and sought treatment an average of 5.4 years post WLS (Table 2). WLS patients were admitted to treatment had a mean age of 46, and were primarily non-Hispanic white and female (Table 2).

Ostlund and colleagues (2013) conducted largest medical record review to date about the putative association between WLS and substance abuse treatment, using a nationwide patient registry in Sweden from 1980 to 2006. Findings reveal that 11,115 patients underwent WLS, and patients who had the RYGB procedure were more likely to be hospitalized for an AUD than WLS patients who had the AGB or VGB procedures (hazard ratio, 2.3; 95% CI, 1.7-3.2). The prevalence of treatment admissions for alcohol use was not provided. Participants were on average 40 years old and predominantly female (Table 2). No race/ethnicity data were provided.

Finally, Fogger and colleagues (2012) present a sub-analysis of nurses participating in a monitoring program for nurses with problematic alcohol or illicit drug use. Of 173 respondents, 25 (14%) were WLS patients. The majority of participants (68%) indicated that their problem with substances began after they underwent WLS (Fogger, 2012). While frequency statistics of substances used were not reported, the nurses who had WLS were more likely to report problems with alcohol versus illicit drugs (24% versus 19%).

Illicit Drug Use

Six studies that met review criteria reported on illicit drug use data among post-operative WLS populations (Table 1 and 2). Five of these studies also reported on alcohol use among WLS patients; findings regarding alcohol use were previously described.

Longitudinal Studies—Conason and colleagues (2012) represent the only prospective assessment of pre- and post-surgical illicit drug use among post-WLS populations to date. There were no statistically significant differences in illicit drug use before and after WLS (Table 2). However, as described earlier, implications of this study are limited due to high-attrition experienced at follow-up (Table 2).

Cross-Sectional Studies—Two cross-sectional studies also reported a low prevalence of post-operative substance use disorders (SUDs) in post-operative WLS patients. These findings are summarized in Table 2.

Medical Record Reviews—Adams and colleagues (Adams et al., 2012) extracted illicit drug use information from medical charts that was prospectively collected pre- and post-WLS at a U.S. Department of Veterans Affairs (VA) facility. Three of 61 patients had a lifetime, pre-surgical history of cocaine abuse. Post-WLS, one of those 3 patients was using cocaine again, as revealed by urine toxicology screen. Tedesco and colleagues (Tedesco et al., 2013) also reviewed medical records at a VA facility and found that 48 of 205 patients had a history of a pre-operative SUD. Post-WLS, two patients had a SUD, specifically methamphetamine use.

Finally, Omalu and colleagues (2007) reported on death rates and causes of death after WLS in the state of Pennsylvania over nine years. Among the 440 deaths, 14 (3%) were listed as being attributed to a non-suicidal drug-overdose, most of which occurred at least one year after surgery. While no other details are provided, this suggests an elevated rate of drug overdose deaths compared to the general population (Omalu, et al., 2007).

Substance use (alcohol and illicit drug use combined)

Three studies investigated post-surgical substance use disorders. Because the types of substances were never distinguished (i.e., alcohol, illicit drug, and/or tobacco use), alcohol use and illicit drug use were not separable. Reslan and colleagues (2014) examined 141 RYGB patients (Table 1) for pre- and post-operative "probable substance misuse." It is important to note that the authors included tobacco, in addition to alcohol and illicit drugs, in their substance use index. The majority of the sample (80%) reported no substance misuse both before and after WLS. However, of the twenty patients (14%) who indicated post-surgical substance misuse, 70 % (n=14) did not report pre-operative substance misuse, representing new-onset post-WLS cases. Tobacco, alcohol, and sedatives were the most commonly reported "misused" substances (Reslan et al., 2014). Frequency statistics for each separate substance (i.e., tobacco, alcohol, and illicit drugs) were not indicated.

Ivezaj and colleagues (2014) reported on a similar patient sample, and found nearly identical rates of probable substance use disorders. The authors used the MAST-AD to assess for SUDs and never differentiated between alcohol and illicit drug use (Table 2). Correlates of post-operative SUDs included more years since WLS, more stressful events post-WLS, and more family members with SUD histories (Table 2; Ivezaj et al., 2014). Fowler and colleagues (2014) performed a secondary data analysis on Ivezaj et al.'s (2014) data (Table 1), and found that patients who reported having pre-surgical problems with foods that were a combination of high in sugar and low in fat, as well as high glycemic index foods (i.e., refined carbohydrates) were at greater risk for developing a "new" onset SUD after surgery (Table 2).

Conclusions

The most rigorous studies—those that were prospective, were longitudinal, and involved large samples of WLS patients—reveal that WLS patients who undergo the RYGB procedure are at a heightened risk for post-operative problematic alcohol use compared to (a) non-surgical controls (Svensson et al., 2013), and (b) patients undergoing other WLS procedures (King et al., 2012). In addition, a large-scale medical chart review of 11,115 WLS patients found that RYGB patients were more likely to seek in-patient treatment for AUDs than WLS patients who underwent other types of procedures (hazard ratio, 2.3; 95% CI, 1.7-3.2; Ostlund et al. 2013). Findings from two cross-sectional studies (Conason et al., 2012; Suzuki et al., 2012) also found elevated rates of alcohol use problems among RYGB patients. However, the existing literature is far from unequivocal. For example, Wee and colleagues (2014) found that over 70% of RYGB patients reported amelioration in high risk drinking behaviors one year after surgery, compared to only 48% of AGB patients.

As discussed earlier, physiologic changes that result from the RYGB procedure may offer a putative explanation for an increased vulnerability for post-surgical AUDs (Hagerdorn, et al., 2007; Klockhoff et al., 2002;Woodard et al., 2011). Common theories about the causes of these changes reflect anatomy after the gastric bypass, which allows for rapid absorption of alcohol into the blood stream. In fact, RYGB patients have demonstrated blood alcohol content over .08% after only one drink (Steffen et al., 2013). To date, this has not been found to be true for AGB patients.

Patient reports of increased alcohol sensitivity following the RYGB procedure are also documented in two of the studies reviewed here (Buffington, 2007; Ertelt et al., 2008). Increased alcohol sensitivity could potentially increase vulnerability for addiction or problematic use (Woodard et al., 2011). Pre-clinical research has also documented increased alcohol consumption in rats that underwent the RYGB procedure (Davis et al., 2012; Hajnal et al., 2012; Thanos et al., 2012).

For WLS patients overall, and not just RYGB patients, risk factors for post-surgical problematic alcohol use (i.e. high-risk drinking and/or AUDs) include a history of preoperative AUDs (Suzuki et al., 2012; King et al., 2012), male gender (King et al., 2012 & Svensson et al., 2013) younger age, (King et al. 2012), any pre-operative alcohol use (Svensson et al. 2013), regular (≥ 2 drinks per week) pre-operative alcohol use, (King et al. 2012), pre-operative tobacco use (King et al., 2012; Svensson, et al. 2013), pre-operative illicit drug use (King et al., 2012), and symptoms of ADHD (Alfonsson et al., 2014). Three studies also documented that WLS patients might be over-represented in substance use treatment facilities (Saules et al., 2010; Wiedemann et al., 2013; Cuellar-Barboza), with WLS patients more likely to seek treatment for alcohol use as opposed to illicit drug use (Saules et al., 2010; Wiedemann et al., 2013).

New onset cases of problematic alcohol use

Perhaps some of the most compelling findings from the previously cited studies include the documentation of “new” post-operative AUDs, meaning that WLS patients did not develop symptoms of AUDs until *after* surgery (Buffington, 2007; Cuellar-Barboza et al., 2014; Ertelt et al., 2008; Fowler et al., 2014; Mitchell et al. 2001; Reslan et al., 2014; Saules et al., 2010; Wee, et al. 2014; Wiedemann et al., 2013). While intriguing, the aforementioned finding comes from studies limited by small sample sizes, failure to use validated assessment instruments, and absence of a control comparison group. Also notable is that females over the age of 45 represent the prototypic participant across these studies, a demographic not commonly associated with problematic alcohol or drug use. The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) found that less than 2% of women from ages 45-60 met criteria for an AUD (Grant et al., 2004), and less than 1.6% of adults aged 45-59 met criteria for an AUD in the past 12 months according to the National Comorbidity Study (NCS-R; Kessler et al., 2005). Thus, It appears that the pro-typical post-WLS patient is remarkably at-risk for AOD problems during a remarkably low risk period in the lifespan.

Alcohol and Illicit Drug Use Disorder Trajectories

Several studies found that post-WLS patients who will have problems with alcohol/substances start experiencing problems a year or more post-surgery. Cuellar-Barboza et al., 2014; Saules et al., 2010; and Wiedemann et al., 2013 documented the significance of one-year post-WLS for symptoms of AUDs/SUDs; while, King and colleagues (2012) found the same two years post-WLS (Table 2).

Research Implications

The literature would benefit from the inclusion of younger and racially/ethnically diverse WLS patients in relation to substance use outcomes. While currently, non-Hispanic white females in their mid forties represent the majority of WLS patients (Sudan et al., 2014), younger and racially/ethnically diverse and male bariatric patients warrant inclusion in future research. Improved health outcomes and weight loss have been documented in younger populations (Messiah et al., 2013) and increases in weight loss have been associated with having WLS at a younger age (Contreras et al. 2013). Equally important, in the general population, younger adults (ages 18 to 35) are at an increased risk for demonstrating problematic alcohol use (Brown et al., 2008), and thus may be at elevated post-surgery risk for substance use problems. Thus, WLS patients in this age range could represent both an emerging population undergoing WLS, and an especially at-risk population for post-surgical alcohol use disorders.

Studies including ethnic/racial minority populations are also warranted. Non-Hispanic blacks, Hispanics, and Native Americans/American Indians are disproportionately affected by obesity in the United States (Flegal et al., 2012; Schiller et al. 2012). These ethnic/racial populations have an over-representation of candidates for WLS and will likely represent an increasing demographic (Pickett-Blakely et al., 2012). Other than Conason et al. (2012), none of the studies attended to minority populations (Table 1). Furthermore, almost 40% of the studies reviewed did not include race/ethnicity information (Alfonsson et al., 2014; Buffington, 2007; Fogger et al., 2012; Macias & Leal, 2003; Mitchell et al., 2001; Ostlund et al., 2013; Svensson et al., 2013; Suzuki et al., 2012; Tedesco et al., 2013).

The literature also would benefit from longitudinal investigations of post-operative alcohol and illicit drug using reliable and validated measures. Moreover, many studies relied on retrospective report, which is only so accurate. Prospective studies assessing alcohol and illicit drug use at multiple points post-surgery also would make important contributions to the literature; such studies would help elucidate which and when WLS patients may be at highest risk for AUDs.

It would also be helpful for researchers to routinely obtain specific and separate alcohol and drug use data. Too many studies to date have collected and reported alcohol and drug use data in a single, combined variable. Physiological and psychological responses to alcohol and illicit drugs certainly vary, as do implications of using alcohol compared to illicit drugs. In addition, with the increasing legalization and decriminalization of medical marijuana, the implications of post-operative marijuana use should also be explored (Rummel & Heinberg, 2014).

The use of validated alcohol use disorder assessments is also warranted. Of the studies reviewed here, only 11 employed validated assessments, most commonly the AUDIT (Table 1). Illicit drug and alcohol use information should also be collected separately from clinical practices and not by treating clinicians to limit responses driven by social desirability (Ambwani et al., 2013). As a final note, many of the studies reviewed here relied on now outdated diagnostic criterion to assess alcohol abuse and dependence.

In conclusion, most of the research reviewed in this systematic review, including the best designed studies, suggests patients undergoing the RYGB procedure are at risk for post-operative AUDs. Additional research involving longitudinal designs, validated assessment instruments, investigation of large and diverse samples, and follow up after the two-year post-operative point, is warranted. Comparisons of post-operative AUDs across surgery groups is also needed to further elucidate the relationship between type of WLS and post-operative AUDs.

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References

Abbatini F, Capoccia D, Casella G, Soricelli E, Leonetti F, Basso N. Long-Term Remission Of Type 2 Diabetes In Morbidly Obese Patients After Sleeve Gastrectomy. Surgery For Obesity And Related Diseases. 2013; 9:498–502. [PubMed: 23290187]

Adams CE, Gabriele JM, Baillie LE, Dubbert PM. Tobacco Use And Substance Use Disorders As Predictors Of Postoperative Weight Loss 2 Years After Bariatric Surgery. The Journal Of Behavioral Health Services & Research. 2012; 39:462–71. [PubMed: 22374227]

Allen JP, Litten RZ, Fertig JB, Babor T. A Review Of Research On The Alcohol Use Disorders Identification Test (Audit). Alcoholism: Clinical And Experimental Research. 1997; 21:613–619.

Ambwani S, Boeka AG, Brown JD, Byrne TK, Budak AR, Sarwer DB, Fabricatore AN, Morey LC, O'Neil PM. Socially Desirable Responding By Bariatric Surgery Candidates During Psychological Assessment. Surg Obes Relat Dis. 2013; 9(2):300–5. [PubMed: 21924688]

Brown SA, Mcgue M, Maggs J, Schulenberg J, Hingson R, Swartzwelder S, Martin C, Chung T, Tapert SF, Sher K, Winters KE, Lowman C, Murphy S. A Developmental Perspective On Alcohol And Youths 16 To 20 Years Of Age. Pediatrics. 2008; 121:S290–S310. [PubMed: 18381495]

Buchwald H, Avidor Y, Braunwald E, Jensen Md, Pories W, Fahrbach K, Schoelles K. Bariatric Surgery: A Systematic Review And Meta-Analysis. JAMA, The Journal Of The American Medical Association. 2004; 292:1724. [PubMed: 15479938]

Buffington C. Alcohol Use And Health Risks: Survey Results. Bariatric Times. 2007; 4:21.

Centers For Disease Control And Prevention, U.S. Department Of Health And Human Services. Vital Signs: Binge Drinking Among Women And High School Girls-United States. Morbidity And Mortality Weekly Report. 2013; 62:1. [PubMed: 23302815]

Chitwood DD, Sanchez J, Comerford M, Mccoy CB. Primary Preventative Health Care Among Injection Drug Users, Other Sustained Drug Users, And Non-Users. Substance Use & Misuse. 2001; 36:807–824. [PubMed: 11697612]

Conason A, Teixeira J, Hsu CH, Puma L, Kanfo D, Geliebeter A. Substance Use Following Bariatric Weight Loss Surgery. Archives Of Surgery. 2012; 148:145–50.

Contreras JE, Santander C, Court I, Bravo J. Correlation Between Age And Weight Loss After Bariatric Surgery. Obesity Surg. 2013; 23:1286.

Dawson DA, Grant BF, Stinson FS, Zhou Y. Effectiveness of the Derived Alcohol Use Disorders Indentification Test (AUDIT-C) in Screening for Alcohol Use Disorders and Risk Drinking in the US General Population. Alcoholism: Clinical and Experimental Research. 2005; 29(5):844–854.

Davis JF, Schurdak JD, Magriss IJ, Mul JD, Grayson BE, Pfluger PT, Tschöp MH, Seeley RJ, Benoit SC. Gastric Bypass Surgery Attenuates Ethanol Consumption In Ethanol-Preferring Rats. Biological Psychiatry. 2012; 72:354–360. [PubMed: 22444202]

De La Cruz-Munoz N, Lopez-Mitnik G, Arheart KL, Miller TL, Lipshultz SE, Messiah SE. Effectiveness Of Bariatric Surgery In Reducing Weight And Body Mass Index Among Hispanic Adolescents. Obesity Surgery. 2013; 23(2):150–156. [PubMed: 22918552]

Ertelt TW, Mitchell JE, Lancaster K, Crosby RD, Steffen KJ, Marino JM. Alcohol Abuse And Dependence Before And After Bariatric Surgery: A Review Of The Literature And Report Of A New Data Set. Surg for Obesity And Related Disease. 2008; 4(5):647–650.

Fogger SA. The Relationship Between Addictions And Bariatric Surgery For Nurses In Recovery. Perspectives In Psychiatric Care. 2012; 48:10–15. [PubMed: 22188042]

Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence Of Obesity And Trends In The Distribution Of Body Mass Index Among Us Adults, 1999-2010(Report). JAMA The Journal Of The American Medical Association. 2012; 307(5):491. [PubMed: 22253363]

Hagerdorn JC, Encarnacion B, Brat GA, Morton JM. Does Gastric Bypass Alter Alcohol Metabolism? Surgery For Obesity And Related Diseases. 2007; 3:543. [PubMed: 17903777]

Hajnal A, Zharikov A, Polston JE, Fields MR, Tomasko J, Rogers AM, Volkow ND, Thanos PK. Alcohol Reward Is Increased After Roux-En-Y Gastric Bypass In Dietary Obese Rats With Differential Effects Following Ghrelin Antagonism. Plos One. 2012; 7(11):E49121. [PubMed: 23145091]

Heneghan HM, Cetin D, Navaneethan SD, Orzech N, Brethauer SA, Schauer PR. Effects Of Bariatric Surgery On Diabetic Nephropathy After 5 Years Of Follow-Up. Surgery For Obesity And Related Diseases. 2013; 9(1):7–14. [PubMed: 23211651]

Kenny PJ. Common cellular and molecular mechanisms in obesity and drug addiction. Nat Rev Neurosci. 2011; 12(11):638–51.10.1038/nrn3105 [PubMed: 22011680]

Kessler RC, Chiu WT, Demler O, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. Archives of general psychiatry. 2005; 62(6):617–627. [PubMed: 15939839]

King WC, Chen J, Mitchell JE, Kalarchian MA, Steffen KJ, Engel SG, Courcoulas AP, Pories WJ, Yanovski SZ. Prevalence Of Alcohol Use Disorders Before And After Bariatric Surgery. JAMA : The Journal Of The American Medical Association. 2012; 307(23):2516–2525. [PubMed: 22710289]

Klockhoff H, Näslund I, Jones AW. Faster Absorption Of Ethanol And Higher Peak Concentration In Women After Gastric Bypass Surgery. British Journal Of Clinical Pharmacology. 2002; 54(6): 587–591. [PubMed: 12492605]

Lent MR, Hayes SM, Wood GC, Napolitano MA, Argyropoulos G, Gerhard GS, Foster GD, Still CD. Smoking And Alcohol Use In Gastric Bypass Patients. Eating Behaviors. 2013; 14(4):460–463. [PubMed: 24183136]

Mechanick JI, Kushner RF, Sugerman HJ, Gonzalez-Campoy JM, Collazo-Clavell ML, Spitz AF, Apovian CM, Livingston EH, Brolin R, Sarwer DB, Anderson WA, Dixon J. American Association Of Clinical Endocrinologists, The Obesity Society, And American Society For Metabolic & Bariatric Surgery Medical Guidelines For Clinical Practice For The Perioperative Nutritional, Metabolic, And Nonsurgical Support Of The Bariatric Surgery Patient. Obesity. 2009; 17(S1):S3–S72. [PubMed: 19927143]

Messiah SE, Lopez-Mitnik G, Winegar D, Sherif B, Arheart KL, Reichard KW, Michalsky MP, Lipshultz SE, Miller TL, Livingstone AS, De La Cruz Muñoz N. Changes In Weight And Co-Morbidities Among Adolescents Undergoing Bariatric Surgery: 1-Year Results From The Bariatric Outcomes Longitudinal Database. Surgery For Obesity And Related Diseases. 2013; 9(4):503–513. [PubMed: 22542199]

Mitchell JE, Lancaster KL, Burgard MA, Howell M, Krahn DD, Crosby RD, Wonderlich SA, Gosnell BA. Long-Term Follow-Up Of Patients' Status After Gastric Bypass. Obesity Surg. 2001; 11(4): 464.

Moher D, Liberati A, Tetzlaff J, Altman DG. The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med. 2009; 6(6):e1000097. [PubMed: 19621072]

Nguyen NT, Masoomi H, Magno CP, Nguyen XT, Laugenour K, Lane J. Trends In Use Of Bariatric Surgery, 2003–2008. Journal Of The American College Of Surgeons. 2011; 213(2):261–266. [PubMed: 21624841]

Odom J, Zalesin KC, Washington TL, Miller WW, Hakmeh B, Zaremba DL, Altattan M, Balasubramaniam M, Gibbs DS, Krause KR, Chengelis DL, Franklin BA, Mccullough PA. Behavioral Predictors Of Weight Regain After Bariatric Surgery. Obesity Surgery. 2010; 20(3): 349–356. [PubMed: 19554382]

Omalu BI, Ives DG, Buhar AM, Lindner JL, Schauer PR, Wecht CH, Kuller LH. Death Rates And Causes Of Death After Bariatric Surgery For Pennsylvania Residents, 1995 To 2004. Archives Of Surgery. 2007; 142(10):923. [PubMed: 17938303]

Ostlund MP, Backman O, Marsk R, Stockeld D, Lagergren J, Rasmussen F, Näslund E. Increased Admission For Alcohol Dependence After Gastric Bypass Surgery Compared With Restrictive Bariatric Surgery. JAMA Surgery. 2013; 148(4):374–377. [PubMed: 23716012]

Pickett-Blakely OE, Huizinga MM, Clark JM. Sociodemographic Trends In Bariatric Surgery Utilization In The USA. Obesity Surgery. 2012; 22:838. [PubMed: 22399326]

Raebel MA, Newcomer SR, Reifler LM, Bourdreau D, Elliott TE, Debar L, Ahmed A, Pawloski PA, Fisher D, Donahoo WT, Bayliss EA. Chronic Use Of Opioid Medications Before And After Bariatric Surgery. JAMA. 2013; 310(13):1369. [PubMed: 24084922]

Reslan S, Saules KK, Greenwald MK, Scuh LM. Substance Misuse Following Roux-En-Y-Gastric Bypass Surgery Substance Use And Misuse. 2014; 49:405–417.

Rummel CM, Heinberg LJ. Assessing Marijuana Use In Bariatric Surgery Candidates: Should It Be A Contradiction? Obesity Surgery. 2014; 10:1764–70.

Saules KK, Wiedemann A, Ivezah V, Hopper JA, Foster-Hartsfield J, Schwartz D. Bariatric Surgery History among Substance Abuse Treatment Patients: Prevalence and Associated Features. Surgery for Obesity and Related Diseases. 2010; 6:615–621. [PubMed: 20207591]

Substance Abuse and Mental Health Services Administration. NSDUH Series H-48. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014. Results from the 2013 National Survey on Drug Use and Health: Summary of National Findings. HHS Publication No. (SMA) 14-4863

Sudan R, Winegar D, Thomas S, Morton J. Influence of ethnicity on the efficacy and utilization of bariatric surgery in the USA. Journal of Gastrointestinal Surgery. 2014; 18(1):130–136. [PubMed: 24101449]

Schiller J, Lucas J, Peregoy J. Summary Of Health Statistics Of U.S. Adults: National Health Interview Survey, 2011. National Center for Health Statistics. Vital Health Stat. 2012; 10:256.

Steffen KJ, Engel SG, Pollert GA, Li C, Mitchell JE. Blood Alcohol Concentrations Rise Rapidly And Dramatically After Roux-En-Y Gastric Bypass. Surgery For Obesity And Related Diseases. 9:470–473.

Suzuki J, Haimovici F, Chang G. Alcohol Use Disorders After Bariatric Surgery. Obesity Surgery. 2012; 22(2):201–207. [PubMed: 21188544]

Svensson P, Anveden Å, Romeo S, Peltonen M, Ahlin S, Burza MA, Carlsson B, Jacobson P, Lindroos A, Lönroth H, Maglio C, Näslund I, Sjöholm K, Wedel H, Söderpalm B, Sjöström L, Carlsson LMS. Alcohol Consumption And Alcohol Problems After Bariatric Surgery In The Swedish Obese Subjects Study. Obesity. 2013; 21(12):2444–2451. [PubMed: 23520203]

Tedesco M, Hua WQ, Lohnberg JA, Bellatorre N, Eisenberg D. A Prior History Of Substance Abuse In Veterans Undergoing Bariatric Surgery. Journal Of Obesity. 2013; 2013:740312. [PubMed: 23840947]

Thanos PK, Subrize M, Delis F, Cooney RN, Culnan D, Sun M, Wang G, Volkow ND, Hajnal A. Gastric Bypass Increases Ethanol And Water Consumption In Diet-Induced Obese Rats. Obesity Surgery. 2012; 22(12):1884–1892. [PubMed: 22976430]

Wee CC, Mukamal KJ, Huskey KW, Davis RB, Colten ME, Bolcic-Jankovic D, Apovian CM, Jones DB, Blackburn GL. High Risk Alcohol Use After Weight Loss Surgery. Surg Obes and Relat Dis. 2014; 10(3):508–13. [PubMed: 24680762]

Woodard GA, Downey J, Hernandez-Boussard T, Morton JM. Impaired Alcohol Metabolism After Gastric Bypass Surgery: A Case-Crossover Trial. Journal Of The American College Of Surgeons. 2011; 212(2):209–214. [PubMed: 21183366]

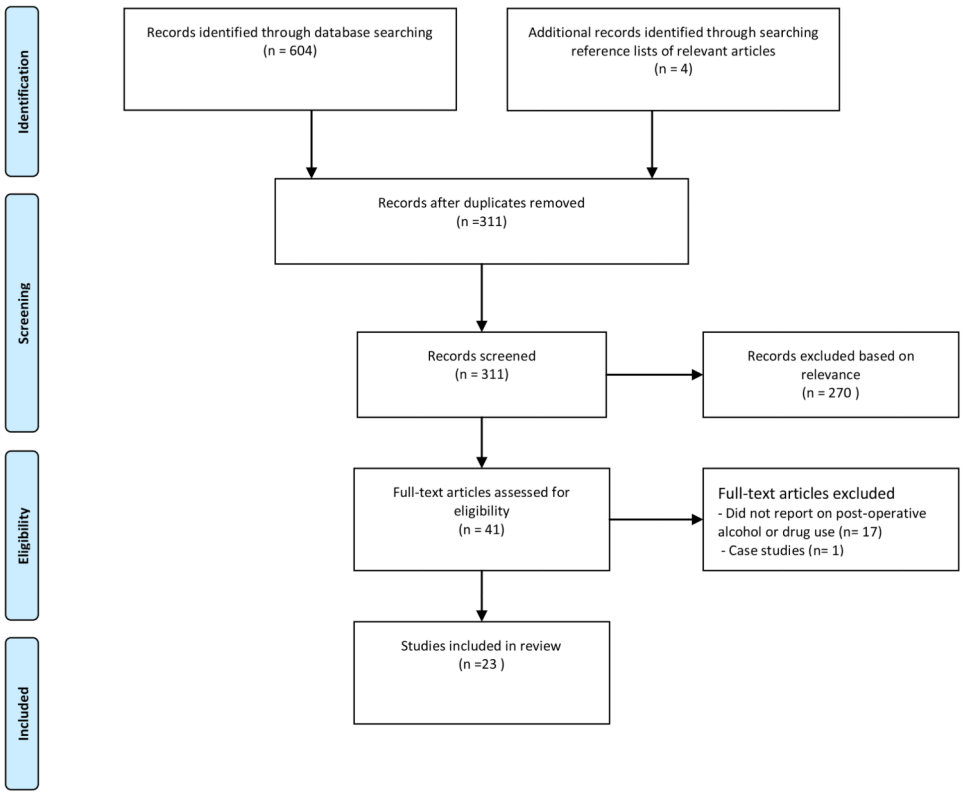

Figure 1.

Table 1

Characteristics of published studies examining alcohol and illicit drug use in post-bariatric populations

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
Svensson et al., 2013	a. Prospective; longitudinal b. Baseline (4 months prior to surgery for surgery group) .5, 1, 2, 3, 4, 6, 8, 10, 15, and 20 years follow-up	a. Surgery group =2,010; non-surgical control group = 2,037 b. Sample derived from Swedish Obese Subjects (SOS) trial; recruited from media campaigns and health care centers c. Identical inclusion/ exclusion criteria for both surgery and control groups: eligible for bariatric surgery, between 37 and 60 years; BMI ≥ 34 men and ≥ 38 for women d. n.d. e. n.d. .5 yrs., n.d. 1 yr., 87% 2 yrs., 71% 10 yrs., 52% 15 yrs., 50% 20 yrs. f. GBP = 265; 376=AGB; VBG =1,369 g. Mean age (S.D.): GBP= 47 (6.0); AGB=47.6 (6.0);	a. SOS dietary questionnaire (assessed intake of food and beverages in past 3 months); self-reported alcohol use problems were assessed with an affirmative response to “Do you think you have alcohol problems?”; alcohol abuse diagnosis obtained from medical records b. Self-reported data (alcohol use frequency and problems with alcohol) and chart review (alcohol abuse diagnosis) N.D. provided if assessments were self-administered or interviewer/ clinician administered	1 Post-surgical problematic alcohol use/ alcohol use disorder 2 Post-surgical alcohol use/ frequency of alcohol use 3 Quantity of alcohol intake

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		VBG=47.1 (5.9) h. Males: GBP=28.7 %, AGB=30.9 %, VBG=29.1 % i. N.D. (conducted in Sweden)		
King et al., 2012	a. Prospective; longitudinal b. Baseline (pre-surgery), 1, and 2 years post-surgery	a. n=1945 b. Sample recruited from participating surgeons at 10 centers across the U.S. c. Patients > 18 years old, seeking bariatric surgery d. 79% completed baseline and first and/or 2nd year post-operative assessment e. See above f. 69.6%=RYGB, 25.2% = AGB 4.9% = other g. Median age (range)=47 (38-55) h. 78.8%=female; 21.2%=male i. 87% white; 9.4% black; 4.9% Hispanic	a. Alcohol Use Disorders Identification Test (AUDIT); scored an 8 or higher on AUDIT, or at least 1 symptom of alcohol related harm or alcohol dependence b. Self-reported; in-person interview	1 Pre-surgical history of problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic alcohol use/ alcohol use disorder 3 Post-surgical alcohol use/ frequency of alcohol use 4 Quantity of alcohol intake
Conason et al., 2012	a. Prospective; longitudinal	a. n=155 b. Recruited from a pre-operation	a. “Compulsive Behaviors Questionnaire”	1 Post-surgical problematic alcohol use/

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
	b. Baseline (pre-surgery) and 1, 3, 6, 12, and 24 months post-surgery	information center at one participating bariatric surgery center c. N.D. d. N.D. e. 61% 1 mo., 41% 3 mo., 43% 6 mo., 49% 12 mo., 25% 24 mo. f. n=100 RYGB; n=55 AGB g. Mean age = 40 (SD=11) h. 85% female, 15% male i. 47% Hispanic, 32% non-Hispanic black, 17% non-Hispanic white 1% Asian; 3% other	(developed by study authors) b. Self-administered questionnaire	alcohol use disorder 2 Any alcohol use/frequency of alcohol use 3 Post-surgical illicit drug use
Wee et al., 2014	a. Prospective; longitudinal b. Baseline (pre-surgery), 1, and 2 years post-surgery	a. n= 541 b. Sample derived from Assessment of Bariatric Surgery Study (ABS); recruited from 2 WLS centers in Boston, MA. c. 18-65, English speaking, permission of physician d. 70% e. 69 % 1 year, 63% 2 year	a. Alcohol Use Disorders Identification Test – C (AUDIT-C); high-risk alcohol use defined as cut off score≥4 in men ≥3 in women, or affirmative response to follow up items of alcohol dependency (i.e., impaired control over drinking, morning drinking, etc.), or harmful drinking (i.e., others concerned about	1 Post-surgical problematic alcohol use/ alcohol use disorder 2 Any alcohol use/frequency of alcohol use 3 Quantity of alcohol intake

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		f. RYBG = 55%, AGB = 44%; ASG/other = 1% g. Mean age = 43.9 h. Male = 24 %; Female = 76% i. 69% non-Hispanic white; 17% African American; 11% Hispanic; 4% Other	drinking, guilt after drinking, etc.). b. Self-reported; Telephone interviews	
Lent et al., 2013	a. Prospective; longitudinal b. Baseline (6-12 months before surgery) & 1 time post-surgery (mean 34.9 months post-surgery; +/12.8 months)	a. n=155 b. RYGB patients recruited from rural integrated health system c. Respondents who returned a post-operative (mailed)survey and answered at least one question on recent alcohol and smoking use, d. 899 patients recruited, 155 (17.2%) answered at least one question on alcohol and smoking use at both pre- and post-operative assessments. e. 345 (38%) of 899 completed post-operative survey; of these 155 answered a question on recent smoking	a. Substance use questionnaire created by study researchers (not validated). Questions included: “How often did you have a drink containing alcohol in the past year?” “How many drinks did you have on a typical day when you were drinking in the past year?” and “How often did you have 6 or more drinks on [one] occasion in the past year?” Alcohol use on typical drinking occasions categorized as 1) none, 2) low consumption (1-4 drinks), and 3) high consumption (≥5).	1 Any alcohol use/frequency of alcohol use

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		and alcohol use and were included in analysis f. 100% RYGB g. Mean age = 50.1(S.D=11.3 years) h. 80.6% female i. 98.1% white	b. Mailed, self-administered questionnaire	
Alfonsson et al., 2014	a. Prospective; longitudinal b. 5 months prior to surgery (*m-153* days, SD=10.52) and 12 months post-surgery (*m*=370, SD=77.3)post-surgery	a. n=129 b. Patients were recruited from a University hospital in Sweden who were eligible for RYGB c. N.D. d. N.D e. 100% (only complete data used in analyses). f. 100% RYGB g. Mean age =42.8 (SD=10.52) h. 78% female i. N.D. (conducted in Sweden)	a. Alcohol Use Disorders Identification Test (AUDIT); scored an 8 (men) or 6 (women) or higher on AUDIT to indicate AUD or at least 1 symptom of alcohol related harm or alcohol dependence; Adult ADHD Self-Rating Scale (ASRS) for ADHD symptomatology b. Self-reported data; N.D. if assessments were self-administered or interviewer/ clinician administered	1 History of problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic alcohol use/ alcohol use disorder
Buffington, 2007	a. Cross-sectional b. One time post-surgery; 84% ≥ one year post-surgery	a. n=318 b. Online survey c. Open to all readers of an online bariatric surgery journal, who had bariatric surgery	a. No standardized assessments; “questions pertaining to alcohol sensitivity, postoperative changes in alcohol use and clearance.”	1 Problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic alcohol use/ alcohol use disorder

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		d. N/A e. N/A f. 97.4% RYGB g. 49.4% between 36 and 50 h. 93.7% female (n=298) i. N.D.; respondents from U.S., northern Europe, & Israel	b. Online survey	3 Any alcohol use/frequency of alcohol use 4 Quantity of alcohol intake 5 Subjective sensitivity to alcohol
Ertelt et al., 2008	a. Cross-sectional b. One time; 6-10 years post-bariatric surgery	a. n=70; b. Surveys mailed to patients who underwent the RYGB procedure, 6-10 years ago, at one bariatric surgery center c. N.D. d. 28% (70 of 250 mailed surveys) e. N/A f. 100%= RYGB g. Mean age=49.9 (SD=9.2) h. 85.5% female i. 90% white	a. Post-Bariatric Surgery Appearance Questionnaire (developed by study authors, contains questions on alcohol abuse and dependence based on DSM-IV criteria; not validated) b. Self-administered questionnaires mailed to participants	1 History of problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic alcohol use/ alcohol use disorder 3 Any alcohol use/frequency of alcohol use 4 Quantity of alcohol intake 5 Subjective sensitivity to alcohol
Mitchell et al., 2001	a. Cross-sectional b. One time; 13-15 years post-surgery	a. n=78 b. Post-operative patients from one facility, contacted via postal mail and telephone c. N.D.	a. MFED – instrument which uses sections of Structured Clinical Interview for DSM-IV Disorders (SCID)	1 History of problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic alcohol use/

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		d. 78% (100 post-operative patients attempted to be contacted) e. N/A f. 100% RYGB g. Mean age = 56.8 (31-77) h. 83% (n=65) female i. N.D.	b. Telephone interview	alcohol use disorder 3 Pre-surgical History of illicit drug use 4 Post-surgical/ Post-Surgical illicit drug use
Macias & Leal, 2003	a. Cross-sectional b. One time; 18 months post-surgery	a. n=140 b. Post-operative patients from a University hospital in Spain c. N.D. d. N.D. e. N/A f. 100% VBG g. Binge eating group 36.46 (SD=11.72); non binge eating eating group 44.61 (SD=9.92) h. 78.6% female i. N.D. (conducted in Spain)	a. Millon Clinical Multiaxial Inventory-II to assess alcohol dependence b. N.D.	1 Post-surgical problematic alcohol use/ alcohol use disorder
Suzuki et al., 2012	a. Cross-sectional b. Retrospective chart review (pre-surgical data) & telephone interview (post-surgical data)	a. n= b. Patients were recruited who completed pre-operative psychological evaluation at	a. Structured Clinical Interview for DSM-IV (administered post-surgery only)	1 History of problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		Bringham and Women's Hospital and underwent bariatric surgery between 2004 and 2007 c. ≥ 2 years post-surgery; ≥ 18 years old d. 460 surveys mailed to patients; 51 agreed to participate (11.1%) e. N/A f. RYGB 54.9%, LAGB 45.1% g. mean age= 51 (SD=8.7; 33-68) h. 86.3% female i. N.D.	b. Chart review of pre-surgical psychiatric assessments & telephone interview post-surgery	alcohol use/ alcohol use disorder 3 Pre-surgical history of illicit drug use 4 Post-surgical illicit drug use
Odom et al., 2010	a. Cross-sectional; retrospective b. Mailed surveys administered one time, over 1 year post-surgery	a. n=203 b. Surveys mailed to bariatric surgery patients identified through patient database from one hospital. c. N.D. d. 1,117 surveys mailed, 24.8% returned (n=278), 203 included in final analysis e. 100% RYGB	a. No standardized assessment. “Has your alcohol consumption increased/ decreased since bariatric surgery” and “Has anyone ever expressed concern about your use of alcohol or drugs?” b. Retrospective chart review (pre-surgical data) & self-administered surveys sent via postal mail (post-surgical data)	1 Post-surgical problematic alcohol use/ alcohol use disorder 2 Subjective change in alcohol use after surgery

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		f. Mean age = 50.6 (+/9.8 years) g. 85% female h. 71.9% white i. N.D.		
Adams et al., 2012	a. Medical record review b. Review of medical records collected pre-surgery, 6, 12, and 24 months post-surgery	a. n=61 b. Chart review of veterans who underwent bariatric surgery from one VA facility between 2003 and 2008. c. Met national VA requirements for bariatric surgery d. N/A e. N/A f. 59% AGB, 41% RYGB g. Mean age = 48 +/-7.3; 35-60) h. 67%=male i. 70%=white; 28.3% African American	a. AUDIT-C for alcohol use diagnoses; DSM-IV based diagnosis made by licensed clinical psychologist or healthcare provider for drug use disorder(pre-surgery), and urine screen (post-surgery) b. Medical chart review	1 History of problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic alcohol use/ alcohol use disorder 3 Pre-surgical illicit drug use 4 Post-surgical illicit drug use
Tedesco et al., 2013	a. Medical record review b. Review of medical records collected pre-surgery and 2 weeks, 2 months, 6 months, and 12 months post-surgery	a. n=205; n= 74 with a pre-surgical history of substance abuse (alcohol and drugs; SA group), n= 131 with no substance abuse history (NA group)	a. Diagnosis made by mental health professional based on DSM-IV-TR criteria b. Medical chart review; participants were screened for alcohol and substance abuse	1 Pre-surgical problematic alcohol use/ alcohol use disorder 2 Post-surgical problematic alcohol use/ alcohol use disorder

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		b. Veterans who had undergone bariatric surgery at the Palo Alto VA from 2002 and 2011 at one Veterans Affairs hospital; identified through database review c. N/A d. N/A e. N/A f. 11.2% AGB (n= 23); 35% ASG (n=72); 53.7% RYGB (n=110) g. Mean age = 51.5 h. SA group =86.5% male; NA group =73.3% male i. N.D.	as a part of their regular post-op visits	3 Pre-surgical illicit drug use 4 Post-Surgical illicit drug use
Saules et al., 2010	a. Medical record review b. Retrospective review of electronic medical records	a. Review of 7,199 medical records b. Review of medical records of patients admitted to a drug and alcohol treatment program c. Admitted to drug and alcohol treatment program from April 16, 2006 to May 31,	a. N.D. b. Chart Review of substance abuse and alcohol abuse diagnoses among WLS patients	1 Prevalence of patients admitted to a substance use treatment facility that have a history of WLS 2 History of problematic alcohol use/ alcohol use disorder 3 Post-surgical problematic alcohol use/

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		2009 and have a history of WLS. d. N/A e. N/A f. N.D. g. Mean age =44.7(SD=9.2) h. 70.4% female i. 81.5% white		alcohol use disorder
Wiedemann et al., 2013	a. Medical record review and semi-structured interview b. Retrospective review of electronic medical records, and interview one time after surgery with identified patients.	a. Review of 4,658 medical records, and interview of 56 identified WLS patients. b. Review of medical records of patients admitted to a drug and alcohol treatment program, and recruitment to participate in an interview. c. Admitted to drug and alcohol treatment program from July 2009 to April 2011, have a history of WLS, and agreed to an interview. d. 91.07% (51 out of 56 patients) e. N/A f. 90.6% RYGB	a. AUDIT-R for alcohol use, questions developed by investigators to assess illicit drug use/alcohol use trajectories (i.e. “Do you feel like your problems with alcohol/ drugs began after you had bariatric surgery? If yes, please describe how you began or increased your use of alcohol/ drugs, and how you become concerned that it might be a problem for you”), chart review, self-reported questionnaire, and semi-structured interview b. Self-reported questionnaire (N.D. if self-administered or interviewer administered) and interviewer	1 Prevalence of patients admitted to a substance use treatment facility that have a history of WLS 2 History of problematic alcohol use/ alcohol use disorder 3 Post-surgical problematic alcohol use/ alcohol use disorder 4 Pre-surgical substance use disorder 5 Post-surgical substance use disorder

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		g. Mean age =44.8 (SD=7.11) h. 71.4% female i. 91.1% white,	administered semi-structured questionnaire.	
Cuellar-Barboza et al., 2014	a. Medical record review b. Retrospective review of electronic medical records	a. Review of 823 electronic medical records (EMR) b. Data extracted from EMRs of patients treated at the Mayo Clinic Addiction Treatment Program, between June 2004 and July 2012 c. Patients aged 30-60 with a primary treatment diagnosis of AUD, and had the RYGB procedure c. N/A d. N/A E. N/A f. 100 %RYGB g. Mean age of admission=46 (1.3) h. 89.6% female i. 92.7% white	a. Clinical interview	1 Prevalence of patients admitted to a substance use treatment facility that have a history of WLS 2 History of problematic alcohol use/ alcohol use disorder 3 Post-surgical problematic alcohol use/ alcohol use disorder
Ostlund et al., 2013	a. Medical record review b. Review of all patients in Sweden who had bariatric surgery procedure from January 1, 1980 to December 31, 2006 via the Swedish Patient Registrar	a. n= 11,115 b. Review of the nationwide dataset, the Swedish Patient Registrar, from January 1, 1980 to December 31, 2006 for all patients who had bariatric surgery.	a. Clinical diagnosis for substance abuse or alcohol abuse (no other information given) b. Chart Review of substance abuse and alcohol abuse diagnoses as documented in	1 Prevalence of patients admitted to a substance use treatment facility that have a history of WLS

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		c. Bariatric surgery patients d. Patients who had more than 1 bariatric procedure e. N/A f. 37% RYGB; 63% AGB & VBG g. RYGB cohort = 40.2 (10.1) AGB&VBG cohort =40.0 (10.4) h. RYGB cohort, female = 75%; AGB &VBG cohort, female =78% i. N.D. (study conducted in Sweden)	the Swedish Patient Register	
Omalu et al., 2007	a. Retrospective record review b. Chart review of Pennsylvania State health care database and death records to examine death rate and causes of death for all Pennsylvania residents who had bariatric surgery from 1995-2005	a. n=16,683 total surgeries; 440 deaths b. investigation of death rates and causes of death for all Pennsylvania residents who had bariatric surgery from 1995-2005 c. N/A d. N/A e. N/A f. N.D. g. 48=Mean age at time of surgery	a. Review of death records b. Chart review of death records obtained from the Division of Vital Records, Pennsylvania State Department of Health investigating drug overdose as cause of death	1 Post-surgical illicit drug use

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		h. 82.3% female (n=13,734) i. 81% white (n=13,504)		
Reslan, Saules, Greenwald, & Schuh, 2014	a. Cross-sectional; retrospective b. One time	a. n=141 b. Participants who previously participated in prior bariatric research or bariatric support groups were recruited. c. RYGB patients, at least 24 months post-operative; not currently pregnant d. N.D. e. N/A f. 100% RYGB g. mean age =53 (SD=10.33) h. 79% female (n=112) i. 93% white (=130)	a. Michigan assessment-screening test for alcohol and drugs (MAST/AD) and the Alcohol, Smoking and Substance Involvement Screening Test(ASSIST) b. Self-reported; web-based survey or mailed survey	1 Pre-surgical history of substance use disorders (alcohol and illicit drug use not distinguished). 2 Post-surgical substance use disorders (alcohol and illicit drug use not distinguished).
Ivezaj, Saules, & Schuh, 2014	a. Cross-sectional; retrospective b. One time	a. n=143 b. Participants recruited through St. Vincent Caramel Hospital's Bariatric Center of Excellence and through an online support group c. Post-surgical RYGB patients	a. Michigan assessment-screening test for alcohol and drugs (MAST/AD) b. Self-reported; web-based survey	1 Pre-surgical history of substance use disorders (alcohol and illicit drug use not distinguished). 2 Post-surgical substance misuse (alcohol and illicit drug use

Study	Research Design a. Study Design b. Assessment Time Points	Sample a. N b. Recruitment Design c. Inclusion Criteria d. Baseline Response Rate e. Retention Rate f. Surgery Type g. Age h. Sex i. Race/Ethnicity	Methods a. Assessment instrument(s) b. Assessment method(s)	Substance Use Outcomes Measured
		d. N.D. e. N/A f. 100% RYGB g. mean age= 48.97(SD=10.5) h. 83.9% female (n=120) i. 94.4% white (n=135)		not distinguished).
Fowler et al., 2014	a. Cross-sectional; retrospective b. One time	a. n=154 b. N/A Secondary data analysis of a bariatric surgery patient database c. N/A d. N/A e. N/A f. 92.9% RYGB g. Mean age = 48.7 (SD=10.8) h. 88.4% female i. 94.2% white	a. Michigan assessment-screening test for alcohol and drugs (MAST/AD) and Yale Food Addiction Scale (YFAS) b. N.D.	1 Pre-surgical substance use disorders (alcohol and illicit drug use not distinguished) as related to pre-surgical endorsement of problematic intake of certain foods.
Fogger et al., 2012	a. Cross-sectional b. One-time; post-surgery	a. Total = 173; bariatric surgery patients =25 b. Analysis of a sub-group of bariatric surgery patients among a study investigating the efficacy of a state-monitoring program for nurses with addictions i	a. Three qualitative questions regarding bariatric surgery: (1) Have you ever had bariatric surgery, (2) Did your problem with substances begin after surgery? (3) If you had a substance problem prior to surgery did it change after bariatric surgery?	1 Prevalence of nurses who underwent bariatric surgery participating in a state monitoring program for nurses with addiction

Study	**Research Design** **a. Study Design** **b. Assessment Time Points**	**Sample** **a. N** **b. Recruitment Design** **c. Inclusion Criteria** **d. Baseline Response Rate** **e. Retention Rate** **f. Surgery Type** **g. Age** **h. Sex** **i. Race/Ethnicity**	**Methods** **a. Assessment instrument(s)** **b. Assessment method(s)**	**Substance Use Outcomes Measured**
		c. N/A **d.** 382 surveys mailed; 173 returned **e.** N/A **f.** N.D. **g.** N.D. **h.** Bariatric surgery subgroup: women=24 **i.** N.D.	**b.** Mailed survey	

Key: N.D. = no data; N/A= not applicable; RYGB = Roux en y gastric bypass; ASG = sleeve gastrectomy; AGB= Adjustable Gastric Band; VBG = vertical banded gastroplasty (stomach stapling); SD=standard deviation

Table 2

Summary of results among studies examining alcohol and illicit drug use in post-bariatric populations

Outcome Measured	Reference	Results
Post-surgical problematic alcohol use/alcohol use disorders (AUDs) **A.** Main Finding(s) **B.** Data stratified by surgery type **C.** Predictors/ Risk Factors	Svensson et al., 2013	**A.** 93.1% of the surgery group and 96% of the non-surgical control group reported low risk alcohol consumption at all follow up points [risk defined by World Health Organization (WHO), less than 3 drinks per day for men and 1.5 drinks per day for women] **B.** Compared to non-surgical control group: • RYGB patients were at an increased risk for demonstrating at least medium risk alcohol intake behaviors (adjusted hazard ratio [adjHR] =2.69), an increased risk of alcohol abuse diagnosis (adjHR=4.97), and self-reported alcohol problems (adjHR=5.91) • VBG patients also demonstrated increased risk for alcohol consumption at least at the WHO medium risk level (adjHR=1.52), an increased risk of alcohol abuse diagnoses (adjHR = 2.23), and self-reported alcohol problems (adjHR=2.30). • AGB patients did not demonstrate higher alcohol risk behavior compared to controls. Within the surgical group: • RYGB patients were at a higher risk for risky alcohol consumption, an alcohol abuse diagnosis, and self-reported alcohol problems compared to the VBG (adjHRs =1.91, 2.27, and 3.21) and AGB patients (adjHRs=2.28, 4.45, and 4.34). **C.** Male gender (HR=1.86, 95% CI= 1.14-3.05, P=.013), pre-operative tobacco use (HR=2.76, 95% CI 1.84-4.12; P<.001), pre-operative alcohol use (HR=1.80, 95% CI 1.52-2.12; P<.001), in addition to the RYGB and VBG procedure, were among predictors of post-operative alcohol abuse
	King et al., 2012	**A.** No significant difference between AUD prevalence 1 year before surgery vs. 1 year after surgery (7.6% vs. 7.3%; P=.98), but AUD prevalence higher in the 2nd year post-surgery vs. 1 year prior to surgery (7.6% vs. 9.6% P=.01) **B.** RYGB patients demonstrated to be most at risk for post-operative AUDs in the 2nd year post-surgery compared to AGB and SG surgical procedures (9.1% vs. 5.6% and 6.5% respectively, p <.001) **C.** RYGB procedure (adjusted odds ratio [AOR], 2.07, [95% CI, 1.04-1.15]; p=. 01) male gender (AOR, 2.14; [95% CI, 1.51-3.01], p <.001), younger age (AOR, 1.31 [95% CI,1.03-1.68], P=.03), smoking (AOR, 2.58 [95% CI, 1.19-5.58], P=.02), consuming at least 2 drinks per week pre-surgery (AOR, 6.37 [95% CI, 4.17-9.72]; P <.001), history of a AUD, (AOR 11.14 [95% CI, 7.71-16.10]; P<.001), drug use (AOR 2.38 [95% CI, 1.37-4.14]; P=.01), and a lower sense of belonging as indicated on Interpersonal Support Evaluation assessment (AOR, 1.09; [95% CI, 1.04-1.15] were associated with an increased risk of AUDs post-WLS.
	Wee et al., 2014	**A.** Among patients completing the one year follow up interview (n=375), high risk drinking was 17% (95% CI, 13-21%) pre-surgery and 13% (95%CI,10-17%) at 1-year post-surgery (p=.10). Among those completing the 2 year follow up interview (n=328), high risk drinking was 15% (95% CI,11-19%) pre-surgery compared to 13% at 2 years post-surgery. 7% who didn't report high risk drinking at baseline reported high risk drinking at 1 year post-surgery and 6% at 2 years post-surgery ("new" cases). **B.** 71% of RYGB patients reported amelioration in high risk drinking compared to only 48% of AGB patients at the year one assessment (n.s.). There was no difference in surgical procedure and amelioration of high risk drinking at year 2 (50 % RYGB and 57% AGB) **C.** N/A (no risk factors identified for new cases of high risk drinking post-surgery)
	Alfonsson et al., 2014	**A.** 18 RGYB patients (1 man, 17 women; 14% of sample) met the criteria for high-risk alcohol use post- WLS (AUDIT score of 8 for men 6 for women) and 7

Outcome Measured	Reference	Results
		patients (3 men, 4 women 5.4% of sample) met criteria for high-risk alcohol use post-WLS. Pre-surgery, no patients met criteria for "alcohol disturbance" (AUDIT score ≥ 16), but 3 patients (1 man, 2 women 2.3% of the sample) met the criteria for alcohol disturbance post-WLS. Post-WLS, the sample as a whole had decreased mean audit scores (from 3.31 (SD=2.89) to 2.42 (SD=2.94). **B.** N/A **C.** Symptoms of adult ADHD associated with increased scores on the AUDIT post-operatively.
	Suzuki et al., 2012	**A.** 18 (35.3%) participants had a lifetime history of an AUD, and 6 (11.8%) had a current, post-surgical AUD. No patients met criteria for an AUD at time of surgery. **B.** Patients who underwent RYGB compared to AGB were significantly more likely to demonstrate current (post-operative) AUDs (21.4% vs. 0%; p<.05) **C.** Patients with a history of AUDS and who underwent the RYGB procedure were more likely to report a current, post-operative AUD (p<.05)
	Ertelt et al., 2008	**A.** 6 patients (8.6%) met criteria for alcohol abuse or dependence pre-surgery; this remained unchanged post-operatively. 2 patients (2.9%) developed alcohol dependence post-surgery that didn't report symptoms pre-surgery. **B.** N.D. **C.** N.D.
	Buffington, 2007	**A.** 4.5% of 318 respondents of an online survey reported difficulty controlling their alcohol intake pre-surgery, versus 28.4% who reported difficulty in controlling alcohol intake post-surgery **B.** N.D. **C.** N.D.
	Saules et al., 2010	**A.** Between 2-6% of past 3 year admissions at a drug treatment facility were bariatric surgery patients, based on medical chart review. 62.3% of these patients sought treatment for alcohol use, and 9.4% sought treatment for alcohol use plus illicit drug use. The remainder sought treatment for illicit drug use. 61.9% of alcohol users reported engaging in heavy use before their surgery, and 43.4% of patients did not engage in heavy alcohol or illicit drug use until after surgery, representing new onset cases **B.** N.D. **C.** N.D.
	Wiedemann et al., 2013	**A.** 2.8% of 4,658 patients in a substance use treatment facility were WLS patients, based on review of electronic records. WLS patients were more likely to have an AUD diagnosis compared to non-WLS controls (x^2 (1, *n*=4658) = 7.41, P <0.01). Of the WLS patient subset 56 were recruited to undergo a qualitative interview, 60% were classified as developing a SUD post-surgery, and 40% had a pre-operative history of a SUD. WLS patients took 1.6 years (1.62) to become concerned with SUD. **B.** N.D. **C.** N.D.
	Cuellar-Barboza, et al., 2014	**A.** 4.9% (n=41) of 823 patients admitted to an AUD treatment program previously had the RYGB procedure. Of the WLS subset 61% (n=25) met criteria for an AUD after surgery, and 39% met criteria for an AUD prior t.o surgery. 17% reported not consuming alcohol until after surgery (n=7). RYGB patients met criteria for an AUD 3.1 years (S.D.=.5) post-operatively and sought treatment 5.4 (S.D.=.3) years post-operatively. **B.** Sample 100% RYGB patients **C.** N.D.

Outcome Measured	Reference	Results
	Ostlund et al., 2013	**A.** A review of a nationwide registry in Sweden revealed that 11,115 patients, over age 18, underwent bariatric surgery from 1980 to 2006. Patients who had RYGB were more likely to seek inpatient treatment for alcohol use disorders than bariatric patients who had the AGB or VGB procedures (hazard ratio, 2.3; 95% CI, 1.7-3.2). **B.** RYGB patients were more at risk for inpatient hospitalization for alcohol abuse than patients who had the AGB and VGB procedures (malabsorptive versus restrictive procedures). **C.** RYGB procedure associated with increased risk of seeking inpatient care for AUDs following bariatric surgery compared to AGB and VGB procedures
	Adams et al., 2012	**A.** 5 patients (8.2%) had a pre-surgical history of alcohol abuse, based on chart review. Zero patients demonstrated post-operative alcohol use disorders as determined by AUDIT-C screen. **B.** N.D. **C.** N.D.
	Mitchell et al., 2001	**A.** 2 (2.6%) patients reported alcohol abuse prior to surgery and 4 (5.1%) reported alcohol abuse after surgery.10.3% (n=8) reported alcohol dependence before surgery and 2.6% (n=2) reported alcohol dependence after surgery. Recruitment revealed 8 deaths. One death was due to GI bleeding associated with severe alcoholism (cirrhosis). **B.** Sample 100% RYGB patients **C.** N.D.
	Macias & Leal, 2003	**A.** Among 25 patients meeting DSM-IV criteria for Binge Eat Disorder (BED) and 115 patients not meeting criteria for BED prior to surgery, patients diagnosed with pre-operative BED had higher mean scores for symptoms of alcohol dependence based on the Millon Clinical Multiaxial Inventory-II. (39.28, SD=22.7 vs. 12.46, SD=18.71; p=.001). **B.** N/A 100% VBG patients **C.** Patients with pre-operative BED 10 times more likely to have higher scores for alcohol dependence than non-BED patients (OR=1.06, 1.00-1.12; p=.0002)
	Odom et al., 2010	**A.** Less than 20 patients (10%) reported that someone expressed concern about their alcohol or drug use. **B.** N.D. **C.** N.D.
	Tedesco et al., 2013	**A.** 44 of 205 veterans had a pre-surgical history of alcohol abuse and 48 had a pre-surgical history of illicit drug abuse, with 18 respondents having a history of both AUDs and SUDs. Post-surgery, 8 patients developed SUDs, 6 were abusing alcohol and 2 were using methamphetamine. 6 of these 8 had a prior history of alcohol/drug abuse. It is not known if the 6 with the pre-and postsurgical SUD/AUD were formerly using alcohol, illicit drugs, or both. **B.** Patients with a pre-surgical history of AUD/SUDs were more likely to demonstrate post-operative SUDs/AUDS, however not enough to warrant statistical significance. **C.** N.D.
	Fogger et al., 2012	**A.** Of 173 nurses participating in a state-monitoring program for nurses with substance use disorders, 25 (14%) were bariatric surgery patients. 17 (68%) stated they developed their substance use disorder after surgery. **B.** N.D. **C.** N.D.

Outcome Measured	Reference	Results
Post-surgical alcohol use/frequency of alcohol use **A.** Main Finding(s) **B.** Data stratified by surgery type **C.** Predictors/ Risk Factors	Conason et al., 2012	**A.** Significant decrease in alcohol use found from baseline (pre-surgery) to 1 month (p<.001) and 3 months (p=.009) post-surgery. Significant increase in frequency of alcohol use post-surgery was found: from 1 month to 12 months (p<.001), 1 month to 24 months (p <.001), 3 months to 12 months (p=.016), and from 3 to 24 months (p<.001), and 6 months to 24 months (p=.001). **B.** RYGB patients reported significant increase in frequency of alcohol use from baseline to 24 months (p=.011). No significant increases found in LAGB patients **C.** N.D.
	Lent et al., 2013	**A.** Significant decrease among patients reporting alcohol use from before surgery (n=112; 72.3%) to after surgery (n=98; 63.2%; p=.026). 24 (21.4%) of the 112 respondents who used alcohol before surgery reported no alcohol use post-surgery.10 (23.2%) of the 43 participants who reported no alcohol use in the year prior to surgery reported alcohol use after surgery. Post-surgery, 54.8% (n=85) classified themselves as consuming 1-4 drinks on a typical drinking occasion, and 3.2% (n=5) classified themselves as drinking over 5 drinks on a typical occasion. The majority of post-operative patients reported drinking monthly or less (n=60; 38.7%), followed by 2-4 times per month (n=27; 17.4%), 2-3 times per week (n=5, 3.2%), 4-5 times per week (n=5, 3.2%), a over 5 times per week (n=1, 0.6%). **B.** Sample 100% RYGB patients **C.** Quantity of alcohol use prior to surgery was the strongest predictor of post-surgical alcohol use (EXP [B] = 6.36, 95% CI [3.09-13.08], *p* <.001). Older age decreased the likelihood of post-surgical alcohol use (EXP [B]=.954, 95% CI [. 919-.990], *p*=.013). High post-surgical alcohol consumption was associated with higher pre-operative BMI (EXP[B] = 1.23, 95% CI[1.05-1.44], *p*=.01).
	Odom et al., 2010	**A.** 25 (9.1%) patients identified an increase in alcohol use since their surgery; 53(19.1%) reported a decrease in alcohol use,83 (30.1%) reported no change in alcohol use pre-surgery and; 115 (41.7%) never used alcohol. **B.** Sample 100% RYGB patients **C.** N.D.
Post-surgical change in sensitivity to alcohol (subjective account) **A.** Main Finding(s) **B.** Surgery Type	Ertelt et al., 2008	**A.** 38 patients (54.3%) indicated a change in response to alcohol post-surgery; of these 24 (34.3%) patients reported quicker intoxication, and 14 (20%) reported feeling intoxicated after drinking lower quantities of alcohol compared to before surgery. No one indicated that it took them longer to reach intoxication post-surgery or took more quantities of alcohol post-surgery to become intoxicated. **B.** Sample 100% RYGB patients
	Buffington, 2007	**A.** 83% of 318 respondents reported consuming alcohol after surgery. 84% of the sample who reported having one or more beverages weekly, reported increased sensitivity to alcohol post-surgery. 44% said they felt a physical response after only a few sips, and 45% felt the effects after one drink. 29% felt the effects of alcohol for a longer period of time compared to before surgery. **B.** 100% RYGB
Post-surgical illicit drug use	Conason et al., 2012	**A.** 4.5% (n=155) of respondents reported illicit drug use pre-surgery, 5.3% (n=94) at 1 month post-surgery, 1.6% (n=64) at 3 months post-surgery, 3% (n=67) at 6 months post-surgery, 2.6% (n=76) at 12 months post-surgery, and 13.2% (n=38) at 24 months post-surgery. There were no statistically significant differences or significant effects when comparing pre- and post-surgical illicit drug use.
	Mitchell et al., 2001	**A.** 3.8% (n=3) reported drug abuse pre-surgery, and 1.3% (n=1) reported drug abuse after surgery (n.s.).

Outcome Measured	Reference	Results
	Suzuki et al., 2012	**A.** 13.7% (n=7) of participants demonstrated a lifetime history for a drug use disorder, no participants (n=0) demonstrated to have a current, post-surgical drug use disorder.
	Adams et al., 2012	**A.** 3 (5%) of patients reported a pre-surgical history of a drug use (cocaine) disorder diagnosis, but were not active drug users at the time of their surgery. One (1.6%) of these patients demonstrated to be an active drug user post-surgery as revealed by a positive urine drug screen test, indicating a relapse.
	Tedesco et al., 2013	**A.** Of 205 patients, 44 (23.4%) had a pre-surgical history of illicit drug use, but were not believed to be active drug users at the time of their surgery. Post-operatively 2 patients used methamphetamine, indicating a drug use relapse post-surgery.
	Omalu et al., 2007	**A.** Of 440 deaths, 14 (3%) were attributed to drug overdoses, as indicated on the patient's death certificate. 12 of these deaths occurred in women.
Post-surgical "substance" abuse (combined alcohol and illicit drug use) **A.** Main Finding(s) **B.** Data stratified by surgery type **C.** Predictors/ Risk Factors	Reslan et al., 2014	**A.** 20 participants (14%; n=141) reported probable post-operative substance misuse, which was defined as a score of 5 or higher on the MAST/AD. Tobacco, alcohol, and illicit drug use were not distinguished. Of the subset reporting probable post-operative substance misuse, 14 (70%) did not report probable misuse prior to surgery, suggesting new onset of probable substance misuse post-surgery; 6 of the 20 reported both pre and post-operative probable substance misuse, suggesting continued use post-surgery; and 6% (n=8) reported pre-operative probable substance misuse but not post-operative substance misuse, suggesting recovery from substance misuse post-surgery. 80% did not meet criteria for both pre-and post-operative probable substance misuse **B.** N/A, sample entirely RYGB patients. **C.** Current (post-operative) probable substance misuse was associated with younger age (M=46.70 SD=9.91 vs. M=54.5, SD=10.15, *p*=.001) and younger age at time of surgery (M=40.05, SD=8.34 vs M=48.09, SD=9.79, *p*=.001).
	Ivezaj et al., 2014	**A.** 94 participants (65.7%) did not meet criteria for a probable substance use disorder both pre- and post- operatively. 28 participants (19.6%; n=143) met criteria for a probable post-operative substance use disorder, which was defined as a score of 5 or higher on the MAST/AD. Alcohol and illicit drug use were not distinguished. Of the subset reporting a probable post-operative substance use disorder, 19 (68%) did not meet criteria for a probable substance use disorder prior to surgery. **B.** N/A, sample entirely RYGB patients. **C.** Current (post-operative) probable substance use disorder was associated with greater time since surgery (3.68 ±2.61 vs. 2.45±2.09; p <.01)) having a greater number of immediate family numbers with a history of a substance use disorder (p<05), and reporting a greater number of life stressors post surgery (p<05).
	Fowler et al., 2014	**A.** Patients who reported pre-surgical problems with foods high in sugar and low in fat (F(3,150) = 3.257, *p=.023, n2 =0.061*) as well as foods high on the glycemic index (F(3, 150) =4,8880, p=.003, n2=0.089)were more likely to report a "new"/post-surgical substance use disorder. These findings remained significant even after controlling for family history of SUDs and pre-surgical BMI. **B.** N.D. **C.** Endorsement of problems with foods high in sugar and low in fat (in combination) and high glycemic index foods (i.e. sweets, refined carbohydrates)

Key: N.D. = no data; RYGB = Roux en y gastric bypass; ASG = sleeve gastrectomy; AGB= Adjustable Gastric Band; VBG = vertical banded gastroplasty (stomach stapling);