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# An examination of psychological risk factors for the development of substance abuse among post-bariatric surgery patients

Valentina Ivezaj

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AN EXAMINATION OF PSYCHOLOGICAL RISK FACTORS FOR THE  
DEVELOPMENT OF SUBSTANCE ABUSE AMONG  
POST-BARIATRIC SURGERY PATIENTS

by

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Submitted to the Department of Psychology

Eastern Michigan University

in partial fulfillment of the requirements

for the degree of

DOCTORATE OF PHILOSOPHY

in

Clinical Psychology

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## **Dedication**

I dedicate my dissertation to my mentor, Dr. Karen K. Saules, for her support and encouragement throughout this journey. Her dedication and passion for research in this area serve as a constant inspiration to me. More than a research mentor, she is a lifetime mentor and role model, inspiring me to reach my professional and personal dreams.

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Third, I would like to thank my committee members, Drs. Anne Eshelman, Tamara Loverich, and Ken Rusiniak, for being part of my committee. Their input, insight, and feedback were extremely valuable and helpful. I also appreciated their commitment and energy towards this project.

Fourth, I would like to thank Henry Ford Hospital and St. Vincent Hospital for assistance and support of this project. Specifically, I would like to thank the bariatric team at Henry Ford Hospital in Detroit, Michigan, who encouraged me to complete this project. Dr. Eshelman played an integral role in helping me complete this project. In addition, I would like to thank Renate Eberhart for her assistance with data collection. I would also like to thank Drs. Leslie Schuh and David Creel for their encouragement and assistance with data collection at St. Vincent Hospital, Carmel, Indiana.

Fifth, I would like to thank Dr. Saules' research lab for their support, encouragement, and feedback throughout this process. A special thanks to Bethany Feldman for assistance with creating my survey is warranted.

Finally, I would like to thank all of the bariatric patients who took the time to participate in this project. Without them, this project would not exist. It is my hope that this project will help inform bariatric patients and staff so that those undergoing bariatric surgery may experience a greater quality of life.

## Abstract

Bariatric surgery is a clinically effective tool that commonly results in sustained weight loss changes for the majority of patients. While bariatric surgery is generally associated with a number of positive health outcomes post-operatively, some popular media outlets and clinical anecdotes have presented concerns about the notion of “addiction transfer” and substance abuse post-bariatric surgery. There is a lack of research, however, in this area. The present study examined the rate of substance abuse in a broad sample of post-bariatric surgery patients and examined potential risk factors for the development of substance abuse post-surgery. It was hypothesized that documented risk factors for substance abuse, more generally, would also predict substance abuse among this population. In addition, it was hypothesized that a number of theoretically-driven variables would predict substance abuse among this sample more specifically. For instance, it was hypothesized that those who had high food addiction scores pre-surgery would be more likely to meet criteria for substance abuse post-surgery, thereby supporting the addiction transfer theory. Participants completed a web-based survey assessing retrospective accounts of pre-surgical substance use, eating pathology, family history, and traumatic history, post-surgical substance use, life stressors, and body image, and global trait-like measures such as emotion dysregulation, impulsivity, sensation-seeking, and coping skills. Findings revealed that a subgroup of individuals met criteria for substance abuse post-bariatric surgery; however, the majority of those who met substance abuse criteria post-surgery *did not* have a history of substance abuse. Family history of substance abuse, poor coping skills, and major life stressors were related to substance abuse post-bariatric surgery, particularly for the new-onset substance abuse group. Contrary to expectations, however, the theory of addiction transfer

was not supported. Findings highlight future directions for pre-bariatric assessments and the need for improved follow-up care among post-bariatric surgery patients. Future longitudinal studies with larger sample sizes are needed to better understand both psychological and physiological risk factors for substance abuse development post-bariatric surgery.

WORD COUNT: 319

## TABLE OF CONTENTS

Dedication.....	ii
Acknowledgements.....	iii
Abstract.....	v
List of Tables.....	ix
List of Figures.....	xi
Statement of the Problem.....	1
Literature Review.....	2
Obesity: A National Epidemic.....	2
Non-surgical Treatments.....	7
Bariatric Surgery.....	7
Characteristics of bariatric surgery candidates.....	11
Potentially complicating factors for post-bariatric surgery success.....	16
Depression.....	17
Binge eating disorder (BED).....	17
Sexual abuse.....	21
Substance abuse.....	22
Substance abuse disorders post-bariatric surgery.....	22
Substance Abuse Risk Factors.....	25
Food Addiction.....	26
Preliminary Studies.....	28
Documented and Potential Risk Factors for Substance Abuse Development.....	34
Hypotheses.....	35



Method.....	36
Participants.....	36
Procedures.....	37
Design.....	38
Instruments & Psychometric Properties.....	39
Demographic information and weight-related history.....	39
Assessment of pre-bariatric eating and addictive behaviors.....	39
Assessment of post-bariatric surgery outcomes.....	43
Trait-level measures.....	46
Data Analyses.....	48
Dependent Variables.....	49
Results.....	51
Participants.....	51
Aim 1.....	52
Aim 2.....	56
Discussion.....	69
Aim 1.....	70
Aim 2.....	76
Limitations of the Present Study.....	85
Conclusion.....	86
References.....	88
Appendices.....	115

## LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	BMI classification.....	5
2	Obesity rates of U.S. adults over time based on BMI classification.....	6
3	Selection criteria for bariatric surgery.....	12
4	Lifetime and current rates of axis I disorders among bariatric surgery patients.....	14
5	National lifetime prevalence estimates of axis I disorders in the bariatric population versus a national sample.....	15
6	Diagnostic research criteria for the proposed BED.....	18
7	“Food addiction” symptoms.....	27
8	Themes regarding etiology of substance abuse development and future recommendations.....	31
9	Representative sample (n=14) of trajectories of substance abuse development relative to bariatric surgery.....	32
10	Rates of chronic substance abuse based on the MAST-AD (Score $\geq$ 8).....	49
11	Groups classified by MAST-AD scores.....	50
12	Participant characteristics.....	52
13	Rates of substance abuse and bariatric surgery type by four groups.....	53
14	Descriptive information regarding substance use for post-surgical substance use status categories.....	54
15	Descriptive statistics for engaging in other behavioral excesses at least several days/week.....	55

<u>Table</u>	<u>Page</u>
16 Descriptive statistics for documented risk factors of substance abuse based on substance abuse group.....	56
17 Correlation coefficients for documented risk factors for substance abuse.....	58
18 Independent predictors of SA post-bariatric surgery.....	59
19 Final model for prediction of SA post-bariatric surgery.....	59
20 Descriptive statistics for documented risk factors for substance abuse across four groups.....	61
21 Descriptive statistics for theoretically-driven candidate predictors by substance abuse status.....	63
22 Correlation coefficients for theoretical risk factors for substance abuse.....	64
23 Independent predictors of SA post-bariatric surgery.....	64
24 Final model for prediction of SA post-bariatric surgery.....	65
25 Descriptive statistics for predictor variables for the four group comparison.....	66

## LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Obesity trends among U.S. adults.....	4
2	Normal human anatomy.....	9
3	GBS and ABS images.....	9
4	Substance abuse treatment admissions with a history of bariatric surgery.....	23
5	Gender differences in treatment admissions based on bariatric history status.....	24
6	Food addiction as a function of pre- and post- substance abuse status.....	68
7	Emotional eating as a function of pre- and post- substance abuse status.....	69

AN EXAMINATION OF PSYCHOLOGICAL RISK FACTORS FOR THE  
DEVELOPMENT OF SUBSTANCE ABUSE AMONG  
POST-BARIATRIC SURGERY PATIENTS

**Statement of the Problem**

As obesity rates have soared to epidemic proportions in the United States (US), efforts to reduce obesity through surgical weight loss procedures, or bariatric surgery, have also increased. Relative to non-surgical obesity treatments, bariatric surgery is more effective in producing sustained weight loss changes over time. Thus, the popularity of bariatric surgery has increased dramatically over the last two decades. Although successful weight loss results typically follow bariatric surgery for the majority of patients, a substantial proportion of patients are unsuccessful following bariatric surgery. In light of this, researchers have tried to identify psychological characteristics of bariatric surgery patients that can serve as prognostic indicators. Initially, because certain variables (e.g., depression and binge eating) were found to be related to poor non-surgical obesity treatment outcomes, it was anticipated these same factors would be associated with poor weight loss and/or weight regain following bariatric surgery as well. This hypothesis was unfounded; associations between psychological issues and post-surgical success are inconclusive to date.

Although some psychological conditions have been studied in relation to bariatric surgery, it is important to note that empirical investigations of substance abuse problems post-surgery are lacking, even though current substance use is considered a contraindication to surgery. In addition, patients are generally asked to completely eliminate alcohol use post-surgery. Nonetheless, substance use has rarely been examined post-surgery. Of note, a few studies investigated substance use post-bariatric surgery using distinct methodologies. A worrisome finding emerged indicating that bariatric surgery patients are overrepresented in

substance abuse treatment programs. This finding, in conjunction with popular media and clinical observations of this phenomenon, necessitates further research to better understand the prevalence, nature, and predictors of substance abuse problems among bariatric surgery patients. Thus, the purpose of the present study was to examine the rate of substance abuse post-bariatric surgery by recruiting a broad sample using a cross-sectional design. In addition, risk factors for the development of substance abuse post-bariatric surgery were examined. Said differently, the present study examined variables that potentially differentiate bariatric patients with substance abuse problems from those without substance abuse problems post-bariatric surgery. If risk factors identified in this study can be assessed at the pre-surgical evaluation, follow-up care could be implemented for this subset of individuals at risk for developing substance use disorders following bariatric surgery. In addition, results from this study may be used to provide rationale for measuring specific variables in a longitudinal study examining the development of substance abuse post-bariatric surgery.

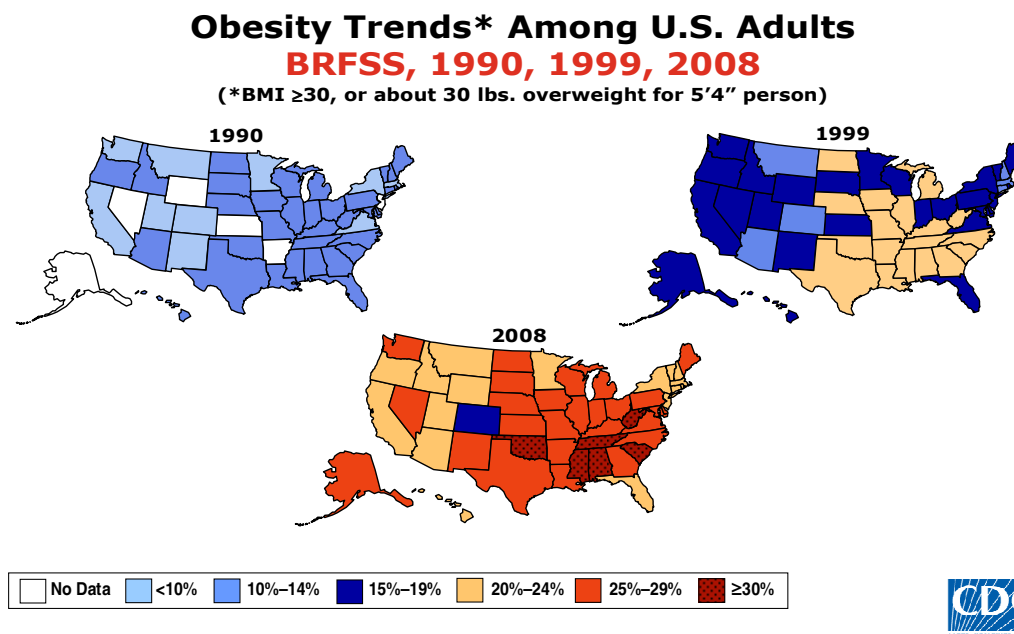
It is extremely important to note that there is a dearth of research on substance use post-surgery. Given that, much of the rationale for the present study stemmed from the addiction literature more broadly, the binge eating literature, and preliminary findings from pilot data that will be presented. Finally, this study was primarily exploratory, and will serve to direct future prospective research in this area.

## **Literature Review**

### **Obesity: A National Epidemic**

Obesity is a serious public health concern in the US (Allison, Fontaine, Manson, Stevens, & VanItallie, 1999) and has been labeled a national epidemic due to the dramatic

increase in obesity rates over the last two decades (Flegal, Carroll, Ogden, & Johnson, 2002; Hedley et al., 2004; Ogden, Flegal, Carroll, & Johnson, 2002). Between 1991 and 2000, a sixty-one percent increase in obesity rates was observed (Smith, 2007). A recent report indicated that 66.3% of American adults are classified as overweight or obese, 32.2% are classified as obese, and 4.8% are classified as extremely obese (Ogden et al., 2006). These rates are alarming given that obesity is linked to a host of negative physical sequelae including coronary heart disease, type 2 diabetes, hypertension, stroke, respiratory problems, some forms of cancer (US Department of Health & Human Services, 2004), and high mortality rates (Allison et al., 1999). In addition to medical comorbidities, obesity is also associated with psychological comorbidities including mood disorders and depressive symptoms (Moreira, Marca, Appolinario, & Coutinho, 2007), binge eating (Grilo, Masheb, Brody, Burke-Martindale, & Rothschild; 2005; Reas, White, & Grilo, 2006; Striegel-Moore, Wilson, Wilfley, Elder, & Brownell, 1998; Womble et al., 2001), and poor quality of life (Kushner & Foster, 2000); however interestingly, it is less likely to be associated with substance use disorders (Pickering et al., 2011). Refer to Figure 1 for a visual depiction of increasing obesity trends in the US from 1990 to 2008 (Centers for Disease Control and Prevention).



*Figure 1.* Obesity trends among U.S. adults

Although there are a number of ways to measure obesity (e.g., waist circumference), obesity is commonly measured through obtaining a Body Mass Index (BMI) score, which is calculated by the following formula:  $\text{weight (lb)} / [\text{height (in)}]^2 \times 703$  (Centers for Disease Control and Prevention). For example, if an individual is 6'5" (77 inches) and weighs 350 pounds, his/her BMI equates to 41.50  $[(350/5929) \times 703]$ , also referred to as morbidly obese. Definitions of BMI and corresponding weight status terms that will be used throughout the remainder of this document are listed in Table 1.



Table 1

*BMI classification*

<b>BMI (kg/m<sup>2</sup>)</b>	<b>Weight Status</b>
Below 18.5	Underweight
Below 16	Severe thinness
16-16.99	Moderate thinness
17-18.49	Mild thinness
18.5-24.9	Normal
25-29.9	Overweight
Over 29.9	Obese
30-34.9	Obese Class I
35-39.9	Obese Class II
Over 40	Obese Class III <sup>a</sup>

*Note.* Adapted from World Health Organization

<sup>a</sup>Obese Class III is also referred to as morbidly obese.

While it is clear that obesity rates have dramatically increased in the US, it is important to note that obesity rates at the higher end of the BMI spectrum, Class III obesity or morbid obesity, are increasing at even more alarming rates than obesity in general (Sturm, 2003; Sturm, 2007). For specific rates, refer to Table 2.

Table 2

*Obesity rates of U.S. adults over time based on BMI classification*

	1986 (Number of Adults)	2000 (Number of Adults)	Obesity Increased by this Factor from 1986- 2000 <sup>a</sup>	Obesity Increased by this Percent from 2000- 2005 <sup>b</sup>
BMI $\geq$ 30	1 in 10	1 in 5	2	24%
BMI $\geq$ 40	1 in 200	1 in 50	4	50%
BMI $\geq$ 50	1 in 2000	1 in 400	5	75%

<sup>a</sup>Sturm, 2003. <sup>b</sup>Sturm, 2007.

As illustrated, Class III obesity is increasing at a higher rate than Class I and Class II obesity, which is even more disquieting, given that higher BMI is related to even poorer health-related quality of life (Fontaine & Barofsky, 2001; Sturm & Wells, 2001), greater depression (Kalarchian et al., 2007), and increased morbidity (Sturm & Wells, 2001), relative to lower BMI classifications of obesity. As such, Sturm (2003) stated that “the most dramatic part of the obesity epidemic has remained hidden” (p. 2147). According to the American Society for Metabolic and Bariatric Surgery, fifteen million Americans are currently morbidly obese, and this number is projected to increase. As the prevalence of morbid obesity continues to rise, efforts to treat these individuals will grow, given the increased health consequences and potential costs to society.

In 2001, obesity-related costs were an estimated 117 billion dollars (US Department of Health and Human Service). Notably, obesity costs outweigh even smoking- and drinking-related costs, both in terms of health problems and health costs (Sturm, 2002). Furthermore, Sturm (2002) projected that the long-term consequences of increasing obesity rates are still unknown.

Given the alarming rates of obesity, particularly in the morbidly obese classification, the negative medical and psychological sequelae, and high costs associated with obesity, it is imperative that efforts to reduce obesity are on the forefront.

### **Non-Surgical Treatments**

A number of pharmacological (e.g., Sibutramine and Orlistat) and psychological (e.g., behavior therapy, very-low-calorie diet) interventions have been developed to treat obesity. Results, however, have yielded poor outcomes, particularly in terms of weight loss maintenance. In terms of initial weight loss, behavioral and drug treatments typically lead to modest success, defined as a seven pound difference between control and treated groups, but often accompanied by health benefits related to weight loss, such as improved hypertension and diabetes (Powell, Calvin, & Calvin Jr., 2007). While non-surgical treatments have been associated with initial weight loss, current non-surgical treatments are highly ineffective for sustained weight loss (Fontaine & Cheskin, 1997), often leading to weight regain. In fact, following weight loss attempts, 33 to 66 percent of dieters regain even more weight than was lost (Mann et al., 2007). Thus, in 1991, the National Institutes of Health developed weight loss surgery guidelines (National Institutes of Health Consensus Development Panel) for the implementation of bariatric surgery.

### **Bariatric Surgery**

Bariatric surgery, also referred to as weight loss surgery, is a term used to categorize a number of weight loss surgery techniques associated with altering an individual's digestive tract. Although there are various forms of bariatric surgery, the two most commonly performed bariatric surgeries in the US are the Roux-en-Y gastric bypass surgery (GBS) and the adjustable banding surgery (ABS). The GBS is the gold standard in the US and leads to

weight loss through two mechanisms, malabsorption and restriction. Malabsorption works through altering the way the body absorbs calories so that fewer calories are absorbed. Specifically, the jejunum (the second part of the small intestine) is attached to the stomach, thereby bypassing the duodenum (the first part of the small intestine), which is the primary region that absorbs calories. Restriction, on the other hand, works by creating a small pouch that restricts the amount of food an individual is able to consume.<sup>1</sup> Thus, through GBS, a small pouch is created through stapling, which is then attached to the jejunum. Upon consumption of food, the nutrients travel through the small pouch straight into the jejunum. Therefore, the nutrients bypass the rest of the stomach and the duodenum, which has not been removed from the body and is still connected to the duodenum. In sum, it is expected that GBS patients will consume less food due to restriction (smaller stomach pouch) and absorb fewer calories given that the duodenum is bypassed (malabsorption), resulting in weight loss. Refer to Figure 2 and Figure 3 for a depiction of normal human anatomy and GBS, respectively.

ABS, on the other hand, works through restriction methods only. A small pouch is again created; however, rather than stapling the stomach, a silicone band is wrapped around the stomach. The idea is that bariatric surgery patients eat less due to this band because the small pouch leads to faster satiety. Figure 3 also illustrates ABS.

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<sup>1</sup> ASMBS reported that the stomach size decreases from the size of a football prior to GBS to the size of a golf ball post-GBS.

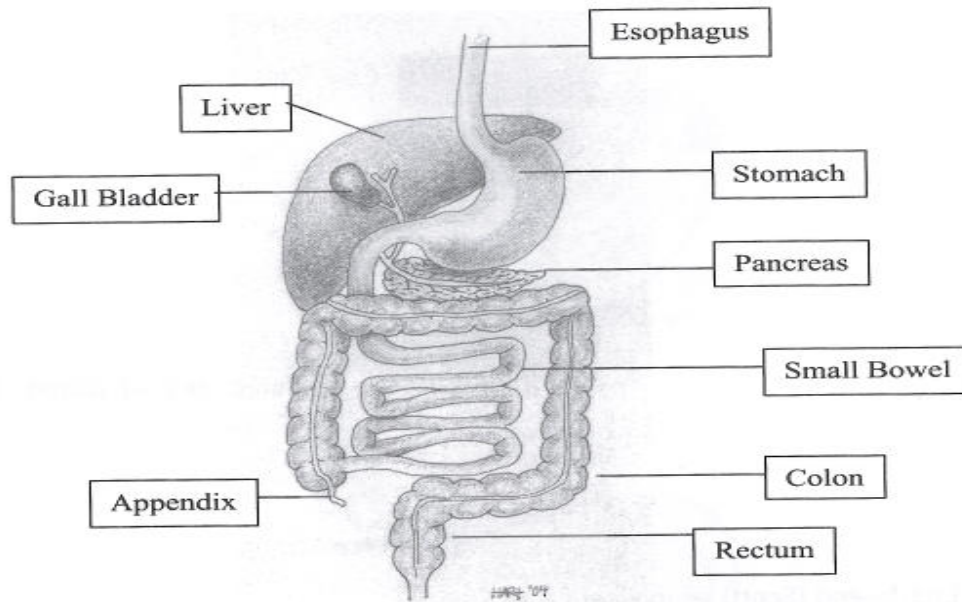


Figure 2. Normal human anatomy. Note. Taken from Mitchell & de Zwaan, 2005, p. 3.

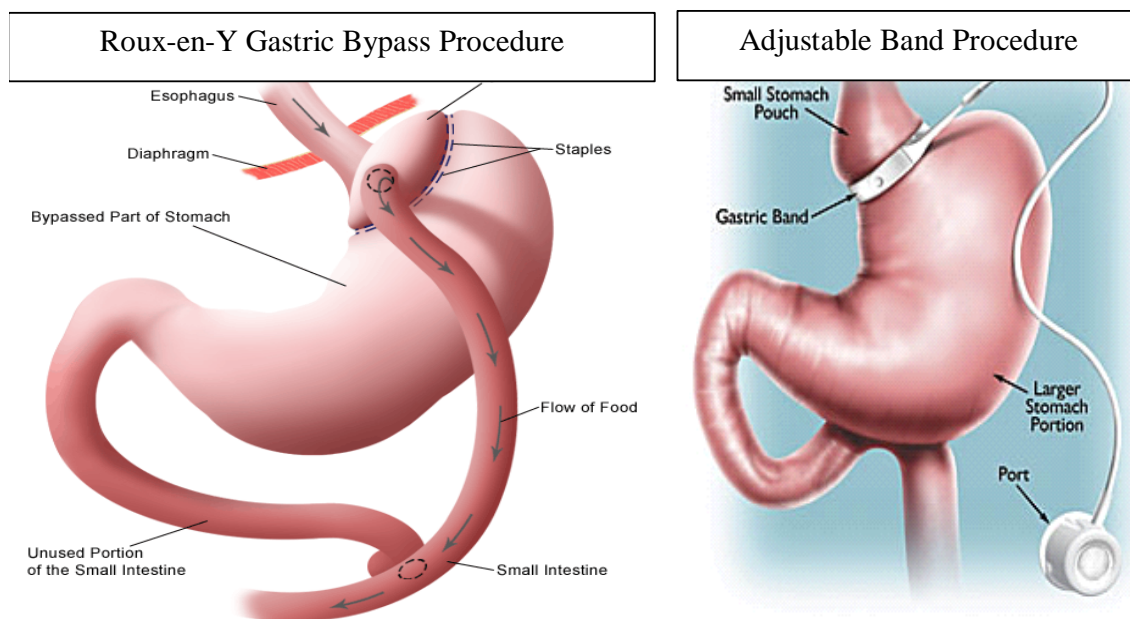


Figure 3. GBS and ABS images

Bariatric surgery is significantly more effective in producing weight loss than non-surgical procedures in the morbidly obese, as was demonstrated in various meta-analyses (Cunneen, 2008; Maggard et al., 2005). Bariatric surgery is also considered to be safe (Cunneen, 2008) and cost-effective (Picot et al., 2009). Weight loss typically occurs within

the first two years following bariatric surgery, with maximum weight loss at eighteen to twenty-four months (ASMBS; O'Brien, Dixon, & Brown, 2004). Specifically, bariatric surgery patients typically lose sixty to eighty percent of their excess weight (Mitchell & de Zwaan, 2005). Despite significant weight loss, weight regain does occur, and significant weight loss does not occur for one fifth of patients (Benotti & Forse, 1995). On the other hand, the majority of bariatric surgery patients benefit from weight loss while also improving their quality of life (Herpertz et al., 2003), increasing life expectancy by eighty-nine percent five years post-surgery (Christou et al., 2004), and reducing mortality rates due to medical conditions associated with obesity (Adams, 2007). For instance, the following medical conditions are either reduced or completely eliminated following bariatric surgery in the short term (Buchwald et al., 2004): type II diabetes, hypertension, hyperlipidemia, and obstructive sleep apnea, and in the long term, ten to fourteen years post-surgery (Pories et al., 1995; Sjostrom et al., 2004). Due to the increased safety of bariatric surgery, significant weight loss, and improved medical conditions and quality of life, many US adults with morbid obesity are selecting this weight loss option.

Bariatric surgery is rapidly gaining popularity in the US (Santry, Gillen, & Lauderdale, 2005; Smoot, Xu, Hilsenrath, Koppersmith, & Singh, 2006). Rates of bariatric surgery per year have exploded in the last two decades, ranging from an estimated 4,925 bariatric surgeries performed in 1990 (Pope, Birkmeyer, & Finlayson, 2002) to approximately 124,838 bariatric surgeries performed in 2008 alone in the US (Nguyen et al., 2011). Refer to Table 3 for selection criteria for bariatric surgery from ASMBS, the American Association of Clinical Endocrinologists (AACE), and the Obesity Society (TOS).

The majority of bariatric surgery candidates undergo GBS in the US (Nguyen et al., 2005; Nguyen et al., 2011; Santry et al., 2005). Notably, according to a review of randomized controlled trials (Picot et al., 2009), GBS may lead to significantly more weight loss than even ABS procedures. This difference is most likely due to the aforementioned malabsorption and restrictive mechanisms involved in GBS. Nonetheless, ABS is also increasing in popularity. As such, a study was conducted to examine psychological differences between those seeking GBS and ABS. The two groups, however, were comparable in terms of psychological characteristics (Walfish, 2010). Understanding psychological and demographic characteristics of bariatric surgery candidates is essential.

**Characteristics of bariatric surgery candidates.** For the purpose of the present study, it is important to understand the characteristics of those seeking bariatric surgery, both demographically and psychologically. In a 2009 press release from ASMBS ([http://www.asmb.org/Newsite07/resources/asmb\\_soc\\_release.pdf](http://www.asmb.org/Newsite07/resources/asmb_soc_release.pdf)), it was reported that a fairly homogenous group of individuals are having bariatric surgery, at least in terms of demographic variables. Of 88,000 bariatric surgeries performed in 2006, the majority were female, White, carried private health insurance, and had higher income than bariatric candidates who did not have surgery. ASMBS stated that, “When the disparities between groups are this large, socioeconomic status is clearly playing a more significant role than medical status in determining who gets bariatric surgery and who does not.” Thus, many minority groups are not being served despite the finding that obesity rates are rising among minority groups (Hrabosky & Grilo, 2007).

Table 3

*Selection criteria for bariatric surgery*

Selection Criteria for Bariatric Surgery <sup>a</sup>	
Factor	Criteria
Weight	
Adults	BMI $\geq$ 40 kg/m <sup>2</sup> with no comorbidities BMI $\geq$ 35 kg/m <sup>2</sup> with obesity-associated comorbidity
Children and adolescents	>95th percentile of weight for age + severe comorbidity
Weight loss history	Failure of previous nonsurgical attempts at weight reduction, including nonprofessional programs (for example, Weight Watchers, Inc)
Commitment	Expectation that patient will adhere to postoperative care Follow-up visits with physician(s) and team members Recommended medical management, including the use of dietary supplements Instructions regarding any recommended procedures or tests
Exclusion	Reversible endocrine or other disorders that can cause obesity Current drug or alcohol abuse Uncontrolled, severe psychiatric illness Lack of comprehension of risks, benefits, expected outcomes, alternatives, and lifestyle changes required with bariatric surgery
<sup>a</sup> BMI = body mass index.	

Note. Taken from AACE/TOS/ASMBS Bariatric Surgery Guidelines, 2008, p. 320.

In addition to understanding the demographics of those having bariatric surgery, it is important to examine their psychological characteristics as well. Franks and Kaiser (2008) conducted a thorough review of rates of psychiatric diagnoses reported by bariatric patients, primarily through the use of semi-structured interviews. As shown in Table 4, a significant proportion of patients reported lifetime rates of major depressive disorders, anxiety disorders, eating disorders, and binge eating. Current rates of psychological disorders are also listed, and they are generally much lower than lifetime rates. Of significance for this paper, substance abuse disorders among bariatric patients ranged from 1.1 – 32.6 percent for lifetime prevalence and 0.6-1.7 percent for current prevalence. It is noteworthy that substance abuse disorders are listed last in this table. The significance of substance abuse



issues being overlooked, neglected, or somewhat minimized in this literature will be explored throughout the proposal. Specific to alcohol dependence and abuse, lifetime prevalence rates have been reported at 17.7 and 13.2 percent, respectively (Kalarchian et al., 2007). To better understand how these rates compare to national samples, refer to Table 5.

One study focusing on health-related quality of life reported alcohol changes pre- and post-surgery in the demographics table (Kolotkin et al., 2003) but did not discuss alcohol use in the discussion section. GBS candidates (n = 339) were compared to a control group of non-treatment seeking individuals (n=87) with similar BMI, age, and gender. GBS candidates were more likely to be current and former smokers and were more likely to use alcohol, 7.4 percent versus 3.4 percent. Therefore, it may be that those seeking GBS are already more likely to consume alcohol than those who do not; however, data are clearly lacking in this area.

Table 4

*Lifetime and current rates of axis I disorders among bariatric surgery patients*

<b>REPORTED PSYCHIATRIC PREVALENCE RATES IN BARIATRIC PATIENTS<sup>24-29</sup></b>			
<i>Disorder</i>	<i>Method of Diagnosis</i>	<i>Reported Prevalence Rates (%)</i>	<i>Lifetime or Current</i>
MDD	SCID	14.9–42.0	Lifetime <sup>24,26</sup>
		3.4–10.4	Current <sup>24,26</sup>
	Clinician-derived diagnosis	31.1	Current <sup>27</sup>
Dysthymia	PDSQ	4.4	Current <sup>28</sup>
		1.1–5.7	Lifetime <sup>25,26</sup>
Eating disorders	SCID	12.8–29.5	Lifetime <sup>24,26</sup>
		7.1–16.3	Current <sup>24,26</sup>
Binge eating	SCID	4.6–27.1	Lifetime <sup>24,26</sup>
		3.4–16.0	Current <sup>24,26</sup>
	Clinician-derived diagnosis	26.7	Current <sup>27</sup>
Bulimia nervosa	QEWP-R	17.3	Current <sup>29</sup>
		1.8–3.5	Lifetime <sup>24,25</sup>
	0.3–0.4	Current <sup>24,25</sup>	
ED-NOS	SCID	9.2	Lifetime <sup>26</sup>
		6.9	Current <sup>26</sup>
Anxiety disorders	SCID	15.5–37.5	Lifetime <sup>24,26</sup>
		11.5–24.0	Current <sup>24,26</sup>
OCD	SCID	2.8–3.8	Lifetime <sup>24,25</sup>
		2.1	Current <sup>24,25</sup>
	PDSQ	13.6	Current
Panic	SCID	8.5–19.4	Lifetime <sup>24,25</sup>
		4.6–5.9	Current <sup>24,25</sup>
	Clinician-derived diagnosis	4.4	Current <sup>27</sup>
Social phobia	PDSQ	4.4	Current <sup>28</sup>
		3.2–9.4	Lifetime <sup>24,25</sup>
	2.8–9.0	Current <sup>24,25</sup>	
Specific phobia	SCID	18.0	Current <sup>28</sup>
		5.3–8.0	Lifetime <sup>24,26</sup>
	5.0–7.3	Current <sup>24,26</sup>	
Generalized anxiety disorder	SCID	1.1	Lifetime <sup>25</sup>
		1.1–6.3	Current <sup>24,25</sup>
	PDSQ	6.8	Current <sup>28</sup>
PTSD	SCID	1.8–11.8	Lifetime <sup>24,25</sup>
		1.1–2.8	Current <sup>24,25</sup>
	Clinician-derived diagnosis	1.1	Current <sup>27</sup>
Substance use disorder	PDSQ	6.8	Current <sup>28</sup>
		1.1–32.6	Lifetime <sup>24,26</sup>
	0.6–1.7	Current <sup>24,26</sup>	
Clinician-derived diagnosis	16.7	Lifetime <sup>27</sup>	

MDD=major depressive disorder; SCID=Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition; PDSQ=Psychiatric Diagnostic Screening Questionnaire; QEWP-R=Questionnaire on Eating and Weight Patterns-Revised; ED-NOS=eating disorder not otherwise specified; OCD=obsessive-compulsive disorder; PTSD=posttraumatic stress disorder.

Note. Taken from Franks and Kaiser, 2008, p. 77.

Table 5

*National lifetime prevalence estimates of axis I disorders in the bariatric population versus a national sample<sup>a</sup>*

	Mood Disorders	Anxiety Disorders	Substance Disorders
National Sample	20.8%	28.8%	14.6%
Bariatric Sample	45.5%	37.5%	32.6%

<sup>a</sup>Kalarchian et al., 2007

Some studies have also compared bariatric surgery candidates to non-bariatric surgery candidates in the community (matched on age and sex) with similar BMI. Bariatric surgery candidates were more likely to have Axis I disorders (anxiety, bulimia, tobacco dependence) and Axis II disorders relative to the community sample. In addition, bariatric surgery candidates were significantly more likely to have comorbid psychological disorders (Black, Goldstein, & Mason, 2003). It may be that societal stigma and discrimination associated with being morbidly obese impacts the development of psychiatric problems among this population (Swan-Kremeier, 2005).

Most research that has examined quality of life issues related to bariatric surgery has focused on bariatric surgery candidates (Andersen et al., 2009; Chang et al., 2008; Kolotkin et al., 2003) or has followed patients up to two-years post-operation (Burgmer et al., 2007; Choban, Onyejekwe, Burge, & Flancbaum, 1999; Isacson, Frederiksen, Nilsson, & Hedenbro, 1997; Van Gemert et al., 1999; Weiner, Datz, Wagner, & Bockhorn, 1999). For instance, Burgmer et al. (2007) found that physical health-related quality of life, depression, and self-esteem improve during the first year post-surgery. Little is known, however, about the quality of life among post-bariatric patients past the two year mark, particularly in terms

of psychological variables including substance use. In fact, substance abuse post-surgery has been generally overlooked in the literature.

**Potentially complicating factors for post-bariatric surgery success.** A substantial proportion of individuals regain weight after bariatric surgery. Initially, researchers hypothesized that certain psychological variables may lead to poor outcomes post-surgery (Busetto et al., 2005). Therefore, psychiatric screenings were uniformly incorporated into the pre-surgical bariatric assessment without any clear empirical support for contraindications to the surgery. As previously mentioned, many bariatric surgery candidates suffer from psychological issues (Clark et al., 2003). Much of the literature is controversial and/or inconsistent in terms of whether or not these psychological issues predict weight regain (Clark et al., 2003). Franks and Kaiser (2008) stated that “Given the state of current knowledge regarding predictive factors for postsurgical outcomes, there is no empirical basis for widely accepted contraindications to bariatric surgery. Except for the psychopathologic states of patients who are clearly unable to be responsible for their health...” (p. 82). That said, researchers have claimed that there is “general agreement” for three variables that serve as contraindications to surgery: current substance use, psychosis, and impairment in cognitive ability to provide consent (Bauchowitz et al., 2005; Walfish, Vance, & Fabricatore, 2007). The most commonly studied psychological variables assumed to impact success have been depression, binge eating, sexual abuse, and substance use. It is very important to note that “success” is typically viewed in terms of weight loss; however, it may be the case that individuals who have lost weight are not doing well in other areas of their lives. Therefore, “success” should encompass psychological variables as well (Ballantyne, 2003), but this more comprehensive form of outcome assessment is noticeably lacking in the literature.

***Depression.*** Depression at the pre-surgical evaluation has not consistently predicted unsuccessful outcomes post-bariatric surgery. For instance, weight loss differences were not detected in a group of GBS patients when comparing those who met criteria for depression prior to surgery and those who did not (Ma et al., 2006). In fact, some studies found that those who were pre-surgically depressed actually lost more weight post-surgery (Odom et al., 2010). In terms of prevalence of depression pre- and post-surgery, in a recent study, 40.5% of the sample had depressive symptoms prior to surgery whereas 16.4% had depressive symptoms two years post-operation (Burgmer et al., 2007). Generally, depression and anxiety are not associated with poor outcomes following bariatric surgery (Franks & Kaiser, 2008).

***Binge Eating Disorder (BED).*** BED is currently a provisional disorder in the diagnostic and statistical manual of mental disorders-text revision; however, it is expected to be included as an official eating disorder in the fifth version of the diagnostic and statistical manual of mental disorders according to the American Psychiatric Association. BED criteria are listed in Table 6.

Table 6

*Diagnostic research criteria for the proposed BED*

<p><b>Diagnostic Criteria:</b></p> <p>A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following:</p> <ol style="list-style-type: none"> <li>(1) eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than most people would eat in a similar period of time and under similar circumstances</li> <li>(2) a sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating)</li> </ol> <p>B. The binge-eating episodes are associated with three (or more) of the following:</p> <ol style="list-style-type: none"> <li>(1) eating much more rapidly than normal</li> <li>(2) eating until feeling uncomfortably full</li> <li>(3) eating large amounts of food when not feeling physically hungry</li> <li>(4) eating alone because of being embarrassed by how much one is eating</li> <li>(5) feeling disgusted with oneself, depressed, or very guilty after overeating</li> </ol> <p>C. Marked distress regarding binge eating is present.</p> <p>D. The binge eating occurs, on average, at least 2 days a week for 6 months.<sup>a</sup>  <b>Note:</b> The method of determining frequency differs from that used for Bulimia Nervosa; future research should address whether the preferred method of setting a frequency threshold is counting the number of days on which binges occur or counting the number of episodes of binge eating.</p> <p>E. The binge eating is not associated with the regular use of inappropriate compensatory behaviors (e.g., purging, fasting, excessive exercise) and does not occur exclusively during the course of Anorexia Nervosa or Bulimia Nervosa.</p>
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*Note.* From the American Psychiatric Association, 2000, p. 787. <sup>a</sup>Criterion D in the DSM-V is expected to differ from the current criterion by changing the frequency to binge eating at least once a week for three months (APA DSM-V Development; <http://www.dsm5.org/proposedrevision/pages/proposedrevision.aspx?rid=372#>).

The body of literature on BED does not always include only those who meet full criteria for BED as delineated in the previous table. Rather, some studies focus solely on criterion A, namely binge eating behavior, or subthreshold levels of BED. The following section will discuss findings from the broader binge eating literature, followed by the literature on BED.

The relationship between obesity and BED is not completely understood; however, some notable findings have emerged. First, among obese women, those who reported binge

eating endorsed greater depression (Wadden, Foster, Letizia, & Wilk, 1993), higher neuroticism, lower self-esteem, greater health dissatisfaction, and greater medical problems (Bulik, Sullivan, & Kendler, 2002) than those who did not report binge eating. In addition, obese women who reported engaging in binge eating were more likely to have lifetime histories of anxiety, phobia, alcohol dependence, and major depression than those who did not engage in binge eating.

Relative to their obese counterparts who do not meet BED criteria, those with BED suffer from a host of problems. Specifically, obese individuals with BED reported higher lifetime prevalence of psychiatric disorders (Yanovski, Nelson, Dubbert, & Spitzer, 1993), greater depression (Clark, Forsyth, Lloyd-Richardson, & King, 2000; Kolotkin et al., 2004; Marcus et al., 1990; Mussell et al., 1996; Specker, de Zwaan, Raymond, & Mitchell, 1994; Yanovski et al., 1993), greater anxiety, more negative thoughts, poorer eating self-efficacy (Clark et al., 2000), lower body satisfaction (Mussell et al., 1996), increased prevalence of impulsive behaviors, greater anger, lower self-esteem (Rieger, Wilfley, Stein, Marino, & Crow, 2005), poorer subjective sleep quality (Vardar, Caliyurt, Arikan, & Tuglu, 2004), poorer physical functioning, greater impairment in work, public distress, and sexual life, and poorer quality of life (Rieger et al., 2005). Histrionic personality disorder (Specker et al., 1994), borderline personality disorder, and avoidant personality disorder (Specker et al., 1994; Yanovski et al., 1993) were also more common among obese individuals diagnosed with BED. In addition, in a laboratory study of eating patterns between obese individuals with and without BED, those with BED ate significantly more food than those without BED (Cooke, Guss, Kissileff, Devlin, & Walsh, 1997; Goldfein, Walsh, LaChaussee, Kissileff, & Devlin, 1993; Guss, Kissileff, Walsh, & Devlin, 1994; Raymond, Neumeyer, Warren, Lee, &

Peterson, 2003; Sysko, Devlin, Walsh, Zimmerli, & Kissileff, 2007; Walsh & Boudreau, 2003). This finding has been replicated via self-report assessments as well (Yanovski & Sebring, 1994). Furthermore, obese individuals with BED were more likely to seek psychological services (Ramacciotti et al., 2008; Yanovski et al., 1992; Yanovski et al., 1993). Finally, researchers found that, except for those who are morbidly obese (Wadden & Stunkard, 1987), obese individuals who do not engage in binge eating do not differ from those in the general population in respect to severe emotional problems (Webber, 1994). Therefore, these findings taken together lend support to the severity of BED and suggest that binge eating, not obesity, may be a major contributor to the aforementioned negative psychological sequelae.

Bariatric surgery was expected to be a “cure” for binge eating and BED (Adami, Gandolfo, Meneghelli, & Scopinaro, 1995; Powers, Perez, Boyd, & Rosemurgy, 1999). Binge eating is “cured” following bariatric surgery, at least in the short term, given that the quantity of food consumed is drastically reduced following surgery. It is unclear how BED in bariatric candidates affects long-term post-surgical outcomes (Mitchell, Devlin, de Zwaan, Crow, & Peterson, 2008); however, some studies have found that binge eating can have negative effects post-surgery (Hsu, Sullivan, & Benotti, 1997). In a literature review of binge eating in a bariatric population, Niego, Kofman, Weiss, and Geliebter (2007) reported that overall, binge eating before surgery was related to less weight loss after surgery and more problematic eating, including a sense of loss of control despite smaller portion sizes. Interestingly, it has been argued that the “sense of loss of control” should probably not be included in the definition of binge eating among post-surgery patients given that quantity consumed is often small due to surgical constraints on dietary intake, rather than due to



deliberate behavioral inhibition of eating. BE defined this way is more strongly associated with weight gain post-surgery (Mitchell et al., 2001). Although binge eating may be considered a poor prognostic indicator for surgery, there is a lack of consensus among researchers and clinicians as far as what steps should be taken with these individuals in terms of bariatric clearance (Mitchell et al., 2008).

When considering the diagnosis of BED rather than the behavior of binge eating (with the latter sometimes simply referred to as overeating), some studies have found no differences between BED and non-BED groups in terms of weight loss post-surgery (Bocchieri-Ricciardi et al., 2006; de Zwaan et al., 2010), while others have found weight regain (Hsu, Betancourt, & Sullivan, 1996). Interestingly, a recent study examined post-GBS patients' eating behaviors, including binge eating, and assessed for eating disorders retrospectively. Binge eating post-surgery was related to lack of weight loss success, whereas pre-surgical eating disorder status was not (de Zwaan et al., 2010). In sum, binge eating as a poor predictor of bariatric surgery success is still controversial (Van Hout et al., 2006).

***Sexual abuse.*** While childhood sexual abuse has been linked to weight loss failure in studies that have used non-surgical treatment options, childhood sexual abuse has not been linked to weight loss failure post-surgery (Kinzl et al., 2006). Few studies, however, have examined this variable in the bariatric population (Dymek-Valentine, Rienecke-Hoste, & Engelberg, 2005). Buser, Dymek-Valentine, Hilburger, and Alverdy (2003) found no weight loss differences among sexually abused and non-sexually abused patients in terms of weight loss one year post bariatric surgery; however, those with a history of sexual abuse reported higher depressive symptoms.

**Substance abuse.** A recent study examined behavioral predictors of weight regain 2-3 years post-surgery (Odom et al., 2010). In terms of alcohol use, more than ninety percent reported that others did not express concern about their use of alcohol; however, 9.1% reported that they increased alcohol use, 19.1% reported that they decreased alcohol use, 30.1% reported that their alcohol use remained stable, while the remainder denied any alcohol use. Unfortunately, these findings do not provide much meaning without baseline data. For example, it is unclear whether or not those who reported no changes were consuming large or small amounts pre-surgery. Similarly, it is unclear how much alcohol any of these participants were actually consuming. Interestingly though, lack of control over food urges *and* concerns over alcohol and drug use (OR = 12.74) independently predicted weight regain.

**Substance abuse disorders post-bariatric surgery.** In 2007, Oprah Winfrey aired a television episode describing the prevalence and problems associated with developing alcohol problems post GBS. Oprah quoted that thirty percent of GBS patients will develop an addiction, which was regarded by many to be an unfounded statement. Based on media portrayals and anecdotal evidence of this “phenomenon,” Sogg (2007) responded emphatically stating that, “To date, no empirical research has been published about alcohol misuse post-surgery...No investigation has been done of how a preoperative history of substance abuse disorders relates to the development of these disorders after surgery” (p. 367). To systematically investigate the possibility of post-surgical emergence of addiction, however, Ertelt et al. (2008) sent questionnaires to GBS patients 6-10 years post-surgery and estimated that a small number increased alcohol use. Only 28 percent of the sample returned the survey, however, leading to the conclusion that “It is clear that additional, empirically

sound examination of the outcomes of bariatric surgery is needed, particularly relating to alcohol abuse and dependence” (p. 650). More recently, Suzuki, Haimovici, & Chang (2010) found that approximately eleven percent of post-bariatric patients met criteria for an alcohol use disorder.

Another study, however, found that bariatric patients were overrepresented in a substance abuse treatment program (Saules et al., 2010). Participants were seeking treatment at a Midwestern drug and alcohol treatment facility. Data were used from the electronic medical records of 7,199 patients with admission dates between April 16, 2006, and May 31, 2009. Results indicated that bariatric surgery patients were overrepresented in this substance abuse program at a rate of approximately 2 percent. Six percent of randomly selected control cases, however, were unexpectedly bariatric surgery patients as well. Therefore, the rate of post-bariatric patients in substance abuse treatment facilities may indeed surpass 2-6 percent. This number far exceeds the estimated number of those who had bariatric surgery in that three-year span, 0.15% of the population (Nguyen et al., 2011). Refer to Figure 4 for a visual depiction of increasing rates of treatment admissions with a history of bariatric surgery. Notably, these patients were more likely to be women than men, as shown in Figure 5.

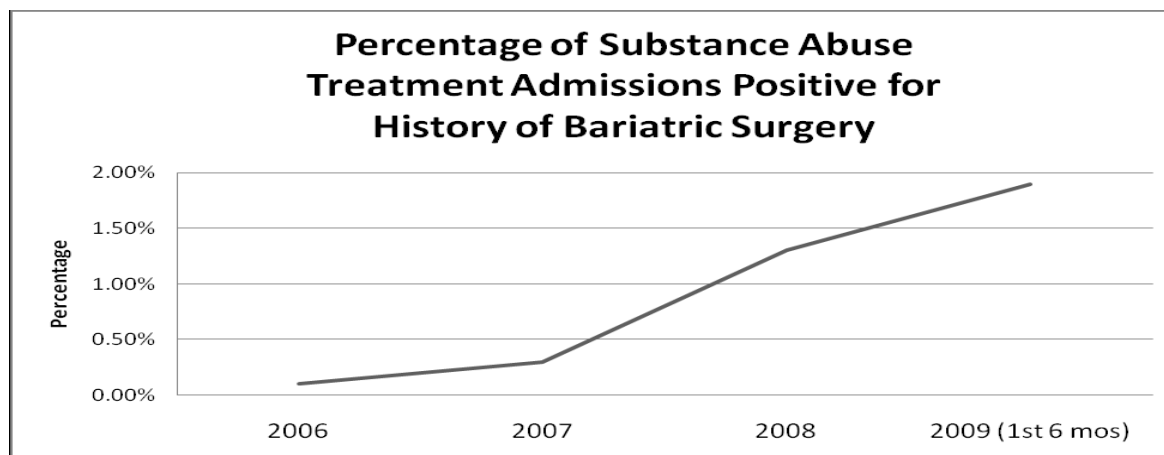


Figure 4. Substance abuse treatment admissions with a history of bariatric surgery.

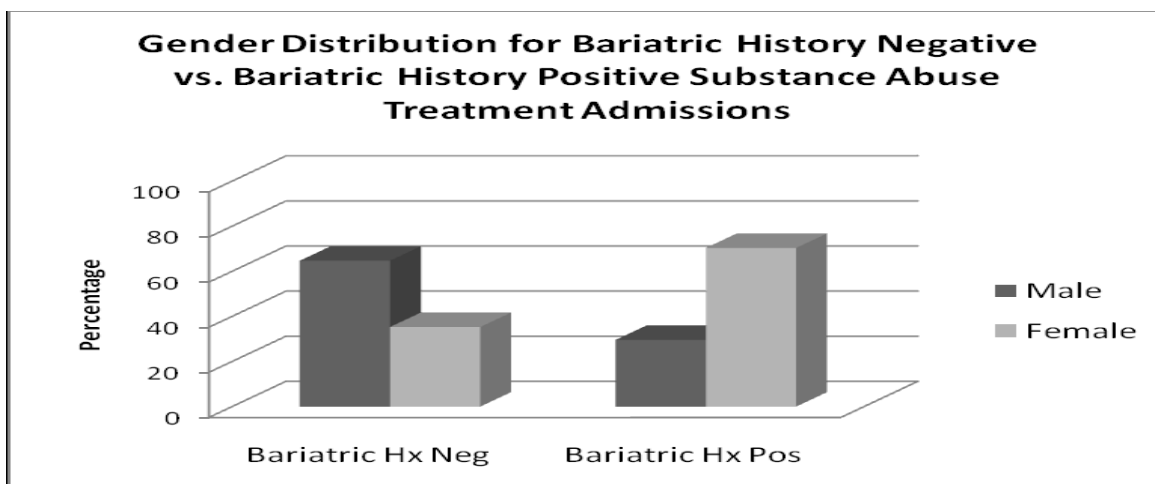


Figure 5. Gender differences in treatment admissions based on bariatric history status.

Although both groups were likely to have an alcohol dependence diagnosis, bariatric patients were more likely to have a diagnosis of alcohol withdrawal.

In addition to these data, chart review data for 54 post-bariatric surgery patients were compared with 54 non-bariatric surgery patients matched on age gender, bariatric surgery year, and admission date into the center. Interestingly, bariatric patients reported consuming greater maximum number of drinks per drinking day.

Clinical observation, popular media, and now empirical support have all corroborated the existence of this problem; however, the full extent of this problem is currently unknown. Although Saules et al. (2010) compared two groups at a substance abuse treatment center, namely those with and without histories of bariatric surgery, these researchers did not compare bariatric surgery patients with substance abuse problems to bariatric patients without substance abuse problems, so it cannot be known which bariatric patients might be at most risk for the development of substance use disorders. Thus, the purpose of the present study was to assess rates of substance abuse among a broad sample of bariatric patients and to identify the behavioral and psychological factors that might confer the most risk for bariatric patients developing such problems. Although this study was primarily exploratory,

hypotheses were derived from three broad categories, namely substance use, eating pathology, and psychological variables that may contribute to the development of substance abuse post-bariatric surgery. The following sections will provide a brief review of the addiction field followed by an explanation of the food addiction controversy. Preliminary pilot data will then be described, which also contributed to hypotheses development. Finally, the rationale for measuring each potential risk factor will be explained.

### **Substance Abuse Risk Factors**

Substance abuse is a major public health problem. In the US, over 510 billion dollars are spent annually (191.6 billion dollars for alcohol specifically) on substance abuse costs (CSAP). In addition, detrimental societal effects are apparent through employee absenteeism, violence, abuse, relationship problems, and trauma (National Institute on Drug Abuse). Substance use disorders are dangerous because they can lead to increased mortality rates due to trauma (accidents or suicide) and substance-related medical conditions (Darke, 2007). Thus, substance abuse prevention is essential.

A number of risk factors for the development of substance use disorders have been documented. Specifically, children of those suffering from alcohol disorders are at an increased risk for developing alcohol problems (Russell, Cooper, & Frone, 1990) and problematic substance use more generally (Sher, Walitzer, Wood, & Brent, 1991). Men are also more likely to develop substance use disorders than are women, particularly when coupled with genetic risk (Ohannessian & Hesselbrock, 1999). Impulsivity (Conrod, Pihl, Stewart, & Dongier, 2000; Loxton & Dawe, 2001) and sensation-seeking (Conrod, Pihl, Stewart, & Maurice, 2000) are also risk factors for the development of substance use disorders. In addition, childhood trauma (Douglas et al., 2010) and depression (Conner,

Pinquart, & Gamble, 2009) have been associated with the development of substance use disorders. Given the consistent findings that impulsivity, sensation seeking, family history, early age of onset, and depression are risk factors for substance use disorders, these variables will be measured in the proposed study as well.

### **Food Addiction**

The concept of food addiction is highly controversial (Rogers & Smit, 2000; Vandereycken, 1990). Binge eating has been viewed as a food addiction (Wilson, 1991) by some (von Ranson & Robinson, 2006) due, in part, to the comorbidity of binge eating and substance use (Holderness, Brooks-Gunn, & Warren, 1994) and the commonalities of features associated with both binge eating and substance dependence such as tolerance, withdrawal, and continued “use” despite maladaptive consequences (Cassin & von Ranson, 2007). In terms of binge eating, consuming more food over time could be regarded as an indicator of “tolerance,” whereas irritability when unable to eat for some period of time might reflect “withdrawal.” In addition, some individuals struggling with binge eating relate to the problem as an addiction and join groups such as Overeaters Anonymous, which follows substance abuse treatment models (Devlin, 2007). Refer to Table 7 for similarities between substance dependence and food as an addiction.

As noted in Table 7, many of the same neurotransmitters are associated with cravings for food and substances (Pelchat, 2002). Reward systems may function similarly among those who engage in binge eating and use substances (Levine, Kotz, & Gosnell, 2003; Mathes, Brownley, Mo, & Bulik, 2009; Small, Zatorre, Dagher, Evens, Jones-Gotman, 2001). Using an animal model, reductions in sugar intake yielded neurochemical changes that are implicated with addictive drugs as well, providing further support for an addiction

model of binge eating (Avena, Rada, & Hoebel, 2008). Although researchers lack a clear understanding of which specific food ingredients may be addictive (Gearhardt, Grilo, DiLeone, Brownell, & Potenza, 2011), it has been suggested that high-fat and high-carbohydrate foods may have addictive properties (Shriner, 2011). One study, however, reported that consuming refined carbohydrates, fat, and salt, may lead to a loss of control over food (Ifland et al., 2009).

Table 7

*“Food addiction” symptoms*

Addiction Symptom	Eating Addiction Corollary
Loss of Control	Binge eating despite consequences Inability to control eating/binge eating
Tolerance	Increased binge sizes
Withdrawal	Headaches Irritability Restlessness Flu-like symptoms for eliminated heavy sugar use.
Cravings and Relapse	Weight cycling
Neurobiology	Similar reinforcing effects from: Dopamine Serotonin
Impulsivity	Obese children who binge eat are more impulsive

*Note.* Adapted from Davis and Carter, 2009 and Cassin & von Ranson, 2007.

In terms of bariatric surgery and the proposed study, the theory of food addiction is relevant primarily due to the concept of addiction transfer, or substituting one form of addiction for another. Specifically, for the purpose of the present study, addiction transfer refers to replacing intake of certain foods or overeating behavior, more generally, with intake of substances more traditionally regarded as being “addictive.” Kalarchian et al. (2007) stated that “it is intriguing to speculate that substance and weight problems may also have a shared diathesis, and that substance abuse remits when eating behavior predominates” (p.

331). Indeed, marijuana and alcohol use decreases with increasing BMI (Kleiner et al., 2004). Given this finding, researchers postulated that obese individuals reduce substance intake if substance use and overeating both serve to the same function in brain reward systems. Additional emerging evidence that may support this “addiction transfer” claim among the bariatric population will be presented in the following section.

### **Preliminary Studies**

Study 1 (Wiedemann et al., 2011). As previously described in Saules et al. (2010), Brighton Hospital’s comprehensive substance abuse treatment facility (Brighton, MI) began observing increasing admissions who reported histories of bariatric surgery. This study investigated whether substance abuse problems developed prior or post-bariatric surgery. Data were obtained from post-bariatric and non-bariatric control patients admitted to Brighton hospital’s rehabilitation, detoxification, and partial hospital programs. Participants were classified based on age of bariatric surgery relative to age of first engaging in heavy drug/alcohol use. Participants were categorized as “Relapsed” if they had a history of heavy drug/alcohol use prior to bariatric surgery and “New Onset Users” if they had no evidence of a prior substance abuse history and spontaneously developed a drug/alcohol problem after surgery. Chi-square and t-test analyses were conducted to explore differences among Relapsed and New Onset Users.

The bariatric sample was predominantly White (88.9%) and female (73.3%), with a mean age of  $45.84 \pm 9.3$ , mean BMI of  $31.68 \pm 7.43$  (obese), and mean post-surgical weight loss of  $159.88 \pm 56.87$  lbs. The average patient underwent bariatric surgery at age  $39.51 \pm 8.86$ . The majority sought treatment primarily for alcohol (52.3%). An additional 13.6%



sought treatment for alcohol plus another drug, 9.1% for dependence on opiates, 4.5% for dependence on benzodiazepines, and 20.5% for dependence on multiple drugs.

Of the total sample, 46% engaged in heavy use of drugs and/or alcohol prior to undergoing bariatric surgery and 54% indicated that they spontaneously developed a drug/alcohol problem subsequent to undergoing surgery. Relapsed patients (of any drug/alcohol) received bariatric surgery at a significantly later age than New Onset Users ( $41.02 \pm 7.74$  vs.  $36.38 \pm 10.82$ ,  $t(72) = 2.12$ ,  $p < .05$ ). Additionally, the New Onset Users regularly used substances, became concerned about their substance use, and entered treatment at significantly later ages than controls.

Study 2 (Ivezaj et al., 2010). The purpose of this investigation was twofold. First, given the aforementioned finding that bariatric surgery patients were overrepresented in a substance abuse treatment center (Saules et al., 2010), Ivezaj et al. (2010) investigated why this phenomenon might be occurring by assessing factors that may be contributing to the development of substance abuse problems post-bariatric surgery. Second, given the findings that two subgroups (Relapsed and New Onset Users) were found in the first pilot study, a second goal was to better understand trajectories of substance abuse development relative to the timing of bariatric surgery. Given the lack of empirical literature in this area to date, we interviewed patients in a substance abuse center for their perceptions of this phenomenon.

Twenty patients in Brighton Hospital's comprehensive substance abuse treatment program participated in the still ongoing study. Participants were asked to complete two phases, namely a semi-structured interview and a questionnaire packet. A qualitative approach developed by Hill, Thompson, and Williams (1997) was used to evaluate

participants' perceptions of the etiology of their substance abuse problems and their recommendations for treatment providers working with bariatric patients.

The sample consisted primarily of Caucasian (88.2%) women (77.8%) with a mean age ( $\pm SD$ ) of 43.83 ( $\pm 10.50$ ), mean BMI ( $\pm SD$ ) of 31.85 ( $\pm 7.20$ ), mean number of years since surgery ( $\pm SD$ ) of 5.06 ( $\pm 2.58$ ) years, and mean post-surgical weight loss ( $\pm SD$ ) of 120.83 ( $\pm 56.25$ ) pounds. Participants were interviewed to assess their perceptions of substance abuse development relative to the timing of bariatric surgery. Qualitative analysis of the interview data yielded four themes regarding substance abuse etiology and three themes regarding future recommendations. Blind coders reviewed each interview transcript for the presence/absence of each theme. Representative quotes of each theme are presented in Table 8. In addition, representative trajectories of substance abuse development relative to bariatric surgery are depicted in Table 9.

Although the findings are preliminary and a larger sample size is needed, results suggest that a subset of patients developed substance abuse problems only after bariatric surgery, and another subset evidenced re-emergence of problems that had been in remission for many years. Substance abuse during the pre-surgical year was very uncommon, but emergence of problematic substance use within a year or two post-surgery was a common pattern.

Table 8

*Themes regarding etiology of substance abuse development and future recommendations*

<b>THEMES REGARDING ETIOLOGY OF SUBSTANCE ABUSE DEVELOPMENT</b>	<b>THEMES REGARDING FUTURE RECOMMENDATIONS</b>
<p>Unresolved Psychological Problems (75%) <i>“After losing weight, I was still left with issues. It was a roller-coaster of emotions...I was a fat person in a skinny person’s body.”</i></p>	<p>Counseling Pre-Post Surgery (55%) <i>“People need to have therapy while they are losing weight because it is such a big transition. Just getting on a scale is stressful, whether you lose weight or not.”</i></p>
<p>Addiction Substitution (85%) <i>“I gave up love for food, and compensated that with going out and drinking.”</i></p>	<p>Increasing Knowledge Regarding Associated Risks of Substance Abuse Post-Surgery (70%) <i>“There should be required readings, or readings on education related to addiction.”</i></p>
<p>Faster Substance Metabolism/Increased Effects (55%) <i>“A slam of wine felt just like a shot of heroin”</i></p>	<p>“Honesty” of Patients and Bariatric Staff (35%) <i>“Get honest without fear of not getting surgery.”</i></p>
<p>Increased Availability of Pain Medications (40%) <i>“Pain pills seemed safe and innocent...I began to act the part of a patient who was in pain in order to get more pills.”</i></p>	

Table 9

*Representative sample (n = 14) of trajectories of substance abuse development relative to bariatric surgery*

	10	15	20	25	30	35	40	45	50	55	60
F			A					P X P			
M			A			X	A				
F					A				X	P	
F			P					X	P	A	
F	A	D							X	A	
F		A					P X A				
F	A	D					X	A	D		
F				X	P						
F										X	P
F									X	P	A
F			X		P						
M								X	A	P	
F								X	A		
F					X	A					

**A = Alcohol**   **D = Drugs**   **P = Pain Medications**  
**X = Bariatric Surgery**   **Red = Problematic Use**

The increased sensitivity to alcohol and increased metabolism theme has been supported in the literature (Buffington, Dalye, Warthen, & Marema, 2006). Researchers have documented that alcohol metabolizes differently among gastric bypass patients (Hagedorn, Encarnacion, Brat, & Morton, 2007). Sogg stated that “it would not be altogether surprising if gastric bypass patients were at an elevated risk of developing problems with alcohol after surgery” (p. 367); however the consequences of developing a substance use disorder following bariatric surgery may be alarming.

Implications from the qualitative study include recommendations for increased psychological treatment for those undergoing bariatric surgery, with a particular focus on navigating identity shifts, and increased education of substance abuse risks post-surgery. Given the increased rates of obesity in the US and the recent explosion of bariatric surgery within the last decade, this area of research is essential to improve pre-surgical screening for bariatric surgery and post-surgical outcomes.

This qualitative approach offered a unique perspective into issues faced by bariatric patients, albeit issues that have not been empirically examined to date. This qualitative approach has also led to the development of hypotheses related to predicting those most likely to develop substance abuse problems post-bariatric surgery, which can be tested quantitatively in future research.

Overall, this is a burgeoning research area that has direct implications for individuals seeking bariatric surgery. In particular, increased awareness of this phenomenon is needed so that substance abuse issues are emphasized throughout the pre-surgical screening process and follow-up care among bariatric surgery patients.

## **Documented and Potential Risk Factors for Substance Abuse Development**

Documented risk factors for the development of substance use disorders were assessed in the present study including impulsivity, sensation seeking, family history of substance abuse, previous substance abuse, and trauma, as previously described. A number of proposed risk factors were also assessed. First, pathological eating behaviors were assessed to try to capture those who struggled with disordered eating prior to having bariatric surgery. Gaining a better understanding of problematic eating prior to surgery may help to elucidate the addiction transfer theory. Specifically, binge eating, emotional eating, and food addiction were measured. Binge eating as a form of an addiction was previously described; however, a recent connection has been made between emotional eating, eating disorders, and substance use (Courbasson, Rizea, & Weiskopf, 2008). It has been hypothesized that emotional eating prior to bariatric surgery may lead to poor outcomes post-surgery (Valley & Grace, 1987).

Second, a number of psychological variables that may be associated with the development of substance abuse among this population were explored, namely depression, fear of negative evaluation, emotional dysregulation, and body image dissatisfaction. Sienko and Saules (2011) recently found an association between fear of negative evaluation and binge eating. In addition, based on the qualitative work previously described, coping skills, emotion dysregulation, and major life stressors post-surgery were assessed. This rationale stemmed primarily from the observation that the majority of patients in the qualitative study reported unresolved psychological problems which were difficult for them to manage. It appeared as though major life stressors after surgery also compounded these issues; however,

empirical evidence to support these observations from the qualitative study is needed. As such, the present study sought to investigate these variables.

Notably, there is research to support body image problems among the bariatric population. Approximately seventy percent of bariatric candidates report some form of body image dissatisfaction. Weight loss does not necessarily correspond with more positive body image (Rosen, Orosan, & Reiter, 1995; Rosen, 1996), which has led researchers to conclude that perceptions of body image are essential when assessing body image dissatisfaction (Foster, Wadden, & Vogt, 1997). This is particularly important among bariatric surgery patients who tend to lose a substantial amount of weight, but may not perceive themselves as such.

Finally, behavioral excesses such as gambling and internet use were measured because research has documented that adults are likely to engage in multiple addictive activities if they engage in one addictive behavior (Miller & Gold, 1990).

In sum, a number of documented and exploratory risk factors for substance abuse development were measured, focusing on substance use, eating pathology, and psychological variables as reviewed earlier.

### **Hypotheses**

1. It was hypothesized that documented risk factors for substance use disorders would also predict substance abuse among the bariatric population, namely previous substance abuse, impulsivity, sensation seeking, previous trauma, and family history of substance abuse.

The following hypotheses were exploratory based on preliminary data and theoretical conceptualizations of this phenomenon (developing substance use disorders post-bariatric surgery).

2. It was hypothesized that unique predictors associated with substance abuse development among the bariatric population would include poor coping skills, major life stressors, fear of negative evaluation, discrepant body image, emotional eating, and emotional dysregulation.
3. It was also expected that those who met criteria for food addiction pre-surgery would be at an increased risk for substance use disorders post-bariatric surgery.
4. It was expected that fear of negative evaluation and emotional dysregulation would moderate the relationship between food addiction and substance abuse post-bariatric surgery.
5. Based on our pilot data, it was expected that two distinct groups would emerge among the post-bariatric patients with substance use disorders, namely those who have relapsed and those who are new-onset users. In total, it was hypothesized that four groups would emerge: 1) those who never engaged in problematic substance use or “non-users,” 2) those who were “recovered” (problematic use prior to surgery, but no problematic use post-surgery), 3) those who “relapsed” (problematic use pre- and post-surgery), and 4) those who developed a new substance abuse problem post-surgery. Specifically, it was expected that those who scored high on the Yale Addiction Food Scale would be at a higher risk for being a new-onset user, suggestive of addiction transfer. Said differently, the “non-users” would have lower or equal Addiction Food scores than the “recovered” group. These two groups would have lower scores than the Relapsed and New-Onset Use group. The following formula helps illustrate how the theory of addiction transfer might be supported:  $(\text{Non-users} \leq \text{Recovered}) < (\text{Relapsed} \leq \text{New Onset Abuse})$  on Food Addiction scores pre-surgery.

## **Method**

### **Participants**

Adults, aged eighteen and older, with a history of bariatric surgery were recruited to



participate in the present study. An effort was made to recruit a broad sample of bariatric patients post-surgery for whom the extent and magnitude of substance use problems was unknown. The severity of addiction was measured by using a commonly used measure (e.g., MAST-AD described below).

### **Procedures**

Prior to data collection, this study was approved by the Eastern Michigan University Human Subjects Review Committee. The sample was recruited through two methods, namely through an online support group that was moderated by a bariatric patient from Henry Ford Hospital and through St. Vincent Hospital (Carmel, IN; with additional IRB approval from the St. Vincent review board). For the online support group, the URL link to the survey was posted so that patients could elect to voluntarily participate. Informed consent was obtained by providing the consent form before the survey; after reading it, participants clicked an “I agree” button to go onto the survey. At the end of the survey, participants had the option of linking to a separate survey URL to provide information about how they would like to receive payment. Participants had the option of listing their email address or their home address to receive compensation. Of note, this identifying information was not linked to any survey responses, but it was only possible to get to the compensation link by completing the survey. All participants were compensated with a \$25 gift card. Funding for the online sample was provided for by the Blue Cross Blue Shield Foundation of Michigan.

In addition to the online recruitment procedure, Drs. Leslie Schuh and David Creel of the St. Vincent Carmel Bariatric Center of Excellence agreed to ask patients participating in their long term outcomes study (R2010-070), or seen at the Bariatric Center for follow-up

visits, about their interest in participating in this study. If participants provided an email address, Dr. Schuh sent them the URL link to the study. If instead, participants preferred to do the survey on paper, Dr. Schuh mailed the questionnaire to them and they returned it to her via a pre-addressed stamped envelope. Upon receipt, Dr. Schuh mailed the de-identified survey to the EMU site for manual data entry. Online payment was dispensed by Dr. Schuh to St. Vincent patients, through an equitable payment option, whereas gift cards were mailed to participants who decided to complete a hard copy of the questionnaire. In sum, questionnaires were emailed or mailed to participants, depending on their requested preferences.

All data were kept strictly confidential. Although there were no anticipated risks in the present study, participants may have experienced minimal psychological or emotional stress as a result of the nature of the questions.

Data from this sample were used to capture the full range of substance use post-bariatric surgery and to identify risk factors for developing substance abuse, with the outcome of interest being problematic substance abuse.

## **Design**

The design of the study was cross-sectional, using a survey that measured demographic variables, retrospective accounts pre-bariatric surgery, and post-bariatric surgery functioning, as well as more global/trait measures. Assessment of the following pre-surgical variables was measured through retrospective recall: pre-surgical substance use, problematic eating (e.g., binge eating, food addiction, and emotional eating), family history of mental illness and chemical dependency, and trauma history. Assessment of post-surgical outcomes included substance use, life stressors, and body image. More global trait-like

measures included emotional dysregulation, impulsivity, sensation-seeking, and coping skills. These measures are each described in more detail below.

### ***Instruments & Psychometric Properties***

**Demographic information and weight-related history.** Demographic information was obtained including age, gender, ethnicity, socioeconomic status, years of education, current marital status, current employment status, economic status of current household, and annual household income. Eight weight-related history items were constructed to capture the timing and associated variables of surgery including date of surgery, type of bariatric surgery, surgical complications, age of bariatric surgery, age of first drug and alcohol use, and age when others were first concerned of drug and alcohol use, and age when first entered treatment. Examples of these items include “What type of weight-loss (bariatric) surgery have you had,” “Were there any surgical complications,” and “How old were you when you had bariatric surgery?” These items are all open-ended response items. Other items assessing weight-related health history include “How old were you when you first began to regularly use alcohol?” and “How old were you the first time you entered alcohol/drug treatment?” There were no reliability and validity coefficients to report on these items. Refer to Appendix A for the demographic variables.

**Assessment of pre-bariatric eating and addictive behaviors.** Participants were asked to retrospectively recall their eating pathology and substance use prior to receiving bariatric surgery. The following measures were considered “pre-bariatric assessment.”

***Eating pathology.*** Eating pathology was assessed using four different questionnaires, namely the Questionnaire on Eating and Weight Patterns-Revised (*QEWP-R*; Spitzer,

Yanovsski, & Marcus, 1994), the Yale Food Addiction Scale (YFAS), and the Emotional Eating Scale (EES). All directions indicated, “BEFORE you had bariatric surgery...”

The QEWP-R is a self-report screening measure for binge eating disorder, subthreshold levels of BED, and bulimia nervosa in accordance with DSM-IV criteria. The QEWP-R measures overeating, binge eating, weight control behaviors such as purging behaviors, and feelings related to eating behaviors (e.g., “In general, during the past six months [to be changed to: during the 6 months prior to your surgery], how upset were you by the feeling that you couldn’t stop eating or control what or how much you were eating?”). The QEWP-R also assesses eating history such as past weight, current weight, dieting, and weight cycling. Psychometric properties of the QEWP-R are based on data from primarily White samples. Nonetheless, Kashubeck-West, Mintz, and Saunders (2001) reported that researchers view the QEWP as a valid measure for identifying binge eating. Moreover, they reported that the QEWP-R correctly distinguished between clinical binge eaters and nonclinical binge eaters, and between those with high and low levels of binge eating. The QEWP-R has demonstrated adequate validity (Nangle, Johnson, Carr-Nangle, & Engler, 1994). Moreover, there was a high level of agreement between self-report on the QEWP and expert-rating through an interview with respect to the presence and absence of BED (Sensitivity = .78; Specificity = .80) (de Zwann et al., 1993). Refer to Appendix B to view the QEWP-R that was used for the present study.

The Yale Food Addiction Scale (YFAS) was recently developed and validated in a college student sample to examine “food addiction” (Gearhardt, Corbin, & Brownell, 2009). The YFAS has demonstrated adequate internal reliability, convergent validity, and discriminant validity. Convergent validity was established by comparing the YFAS to other

predictors of problematic eating, whereas discriminant validity was assessed by comparing the YFAS to alcohol and impulsivity measures. The YFAS consists of 27 items using a likert-type scale ranging from 0 (Never) to 4 (4 or more times or daily). Sample items include: “I find that when I start eating certain foods, I end up eating much more than planned” and “I eat to the point where I feel physically ill.” Scoring for this scale can be found in Appendix C.

The Emotional Eating Scale (EES) was developed to assess the relationship between negative emotions and problematic eating behaviors (Arnold, Kenardy, & Agras, 1995). The measure was developed by using a clinically obese sample. This is considered a psychometrically-sound measure with adequate temporal stability and internal consistency. Three subscales of the measure include Anger/Frustration, Anxiety, and Depression. The measure consists of 25 items that are labeled as emotional states (e.g., resentful, sad, frustrated). Participants are asked to respond by indicating the extent to which the following feelings lead them to feel an urge to eat. Response choices range from “No desire to eat” to “An overwhelming urge to eat,” with a total of five response choices. Refer to Appendix D.

***Mental disorder history.*** Four items were developed to gain a better understanding of whether or not participants sought psychological treatment prior to having bariatric surgery. The four items were: BEFORE you had bariatric surgery, were you ever diagnosed with a mood disorder (e.g., depression, major depression)? BEFORE you had bariatric surgery, did you ever seek treatment for emotional difficulties? BEFORE you had bariatric surgery, did you ever see a psychologist or a psychiatrist for emotional difficulties? BEFORE you had bariatric surgery, were you ever prescribed medication to manage emotional difficulties? Responses are dichotomous, “yes” or “no,” responses for these items. Refer to Appendix E.

*Substance use.* Retrospective recall of substance use pre-surgery was assessed using four instruments, namely Fagerstrom Test of Nicotine Dependence, the CAGE, substance use frequency, and the Michigan Assessment Screening Test for Alcohol and Drugs.

The CAGE is a commonly used alcohol abuse screener developed by Mayfield, McLeod, and Hall (1974). Internal consistency has been measured at 0.69 (Hays, Merz, & Nicholas, 1995). The following four items comprise the CAGE, with its name being an acronym for the main symptom assessed by each item: Have you ever felt you should Cut down on your drinking? Have people Annoyed you by criticizing your drinking? Have you ever felt bad or Guilty about your drinking? Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover (Eye opener)? Refer to Appendix F.

A substance use frequency measure was created for the present study with a focus on alcohol, caffeine, pain medication, anxiety medication, and sleeping medication. Although this has not been validated, the focus was on alcohol and prescription medication because our pilot work indicated that those were the main substances that post-bariatric patients used. Refer to Appendix G.

The Michigan Alcoholism Screening Test (MAST; Selzer, 1971) is a commonly used self-report questionnaire to help identify those struggling with an alcohol disorder (Miller et al., 1995). For the MAST, alpha has ranged from .83 to .95, and test-retest reliability was reported at .97 for one day and .85 for three days (Zung, 1982). For the present study, a modified version of the MAST was used to incorporate drug use as well, namely the Michigan Assessment Screening Test for Alcohol and Drugs (MAST-AD). The MAST-AD has been identified as a severity measure rather than as a screening tool, and it has adequate

reliability (Westermeyer, Yargic, & Thuras, 2004). The MAST-AD is composed of 24 items with a “yes” or “no” response. Scores of eight or more are indicative of chronic substance abuse or dependence whereas scores of five or more are indication of substance abuse. Four points may be a problem, but three points or less is considered “normal.” Refer to Appendix H.

The Fagerstrom Test of Nicotine Dependence (FTND) was used to assess cigarette smoking (Fagerstrom, Heatherton, & Kozlowski, 1991; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). The FTND is widely used and has established psychometrics (Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994). The measure consists of seven items that ask if participants ever smoked, how many days smoked, how many cigarettes smoked, part of day smoked after waking, which cigarette would be difficult to give up, difficulty refraining from smoking in forbidden places, and smoking when ill. Refer to Appendix I.

***Family history.*** Two items were developed to assess family history of substance abuse given that family history is a strong predictor of substance abuse development as previously described. Refer to Appendix J.

**Assessment of post-bariatric surgery outcomes.** Participants were also asked to complete questionnaires focusing on the following variables as they were experienced post-bariatric surgery: substance use, body image discrepancy, depression, life events, and behavioral excesses. The following measures were considered “post-bariatric assessment.”

***Substance use.*** The same measures used to assess substance use pre-surgery (CAGE, smoking, substance use frequency, and MAST-AD) were also used to assess substance use post-bariatric surgery, albeit with different instructions.

**Depression.** The Patient Health Questionnaire (PHQ) is a self-report measure that is used to assess mental disorders in primary care patients (Spitzer, Kroenke, & Williams, 1999). Specifically, the PHQ is a self-report adaptation of the PRIME-MD which assesses Somatoform Disorder, Mood Disorder, Anxiety Disorder, Eating Disorder, and Alcohol Disorder. The survey included the subscale measuring depression. Specifically, the PHQ-9 is a nine-item measure developed to measure depression severity over the past two weeks (e.g., “Feeling down, depressed, or hopeless”; See Appendix C). Respondents indicated agreement with items using a 4-point Likert-type scale. Items are scored as 0 (not at all), 1 (several days), 2 (more than half the days), and 3 (nearly every day; Kroenke, Spitzer, & Williams, 2001). Thus, scores on this measure range from 0 to 27. Depression severity is determined by the following scores: 0-4 (none), 5-9 (mild), 10-14 (moderate), 15 -19 (moderately severe), and 20-27 (severe). The PHQ-9 is reliable with high internal consistency ( $\alpha = .86$ ; Pinto-Meza, Serrano-Blanco, Penarrubia, Blanco, & Haro, 2005) and excellent test-retest reliability, ranging from  $r(\text{ICC}) = .81-.96$  (Lowe, Unutzer, Callahan, Perkins, & Kroenke, 2004). The PHQ-9 has demonstrated good sensitivity and specificity for diagnosing Major Depressive Disorder (Sensitivity =  $.73$ , 95% CI:  $.59-.87$ ; Specificity =  $.98$ , 95% CI:  $.96-.100$ ; Spitzer et al., 1999). It is important to note that although the PHQ-9 was developed for primary care settings, the instrument has also been validated for the assessment of depression and subthreshold depression in the general population (Martin, Rief, Klaiberg, & Braehler, 2006) and in a Nigerian college student population (Adewuya, Ola, & Afolabi, 2006). Although the Beck Depression Inventory (BDI) is the most commonly used measure for depression, correlations between the BDI and the PHQ have ranged from  $.79$  to  $.95$  (Rogers, Adler, Bungay, & Wilson, 2005). Moreover, the PHQ-9 also



assesses for the functional health of individuals based on the severity of the symptoms reported (e.g., “How difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?”). Refer to Appendix K.

***Life events.*** The life events scale was derived from a few life events scales (Cohen, Kamarck, Mermelstein, 1983; Norbeck, 1984; Sarason, Johnson, & Siegel, 1978). The scale consists of 34 items pertaining to life events such as moving, death, divorce, and so on. Respondents use a four point Likert-type scale ranging from 1 (very bad) to 4 (very good). Refer to Appendix L.

***Behavioral excesses.*** One goal of this investigation was to better understand whether certain behavioral tendencies (i.e., gambling, sexual deviance, internet, excessive shopping, and video game addiction) are common among post-bariatric surgery patients who abuse substances. Thus, a five-item measure of “behavioral excess” was created. Examples of these items include “During the past four weeks, how often were you participating in gambling?” and “During the past four weeks, how often were you participating in sexual behavior outside of a committed relationship?” These items are scored on a 4-point scale ranging from 0, indicating “Not at All,” to 4, indicating “Nearly Every Day.” For the purpose of the present study, data was examined by selecting those who engaged in each “behavioral excess” at least several days per week. Since this measure was created for this investigation only, the psychometric properties for this scale have yet to be established. Refer to Appendix M.

***Body image discrepancy.*** Song et al. (2006) modified silhouettes developed by Stunkard, Orenson, and Schulsinger (1983) to assess body image discrepancy. Song et al. created larger body images to be used for bariatric surgery patients. Participants were asked to identify a silhouette that matched their ideal body weight and a silhouette that matched

their current body weight. Silhouettes were numbered from smallest to largest; the discrepancy was calculated by subtracting the two points (e.g., Ideal – Current). This variable was then used to determine body image discrepancy. Note that there are seven male and seven female silhouettes. Refer to Appendix N.

**Trait-level measures.** The following variables were also measured: emotional regulation, impulsivity, sensation-seeking, fear of negative evaluation, and coping.

*Difficulties in Emotion Regulation Scale* (DERS; Gratz & Roemer, 2004). The DERS is a 36-item measure that assesses emotion regulation. It is composed of six subscales, namely Nonacceptance of Emotional Responses (NONACCEPTANCE), Difficulties Engaging in Goal-Directed Behavior (GOALS), Impulse Control Difficulties (IMPULSE), Lack of Emotional Awareness (AWARENESS), Limited Access to Emotion Regulation Strategies (STRATEGIES), and Lack of Emotional Clarity (CLARITY). Overall internal consistency has been reported at .93. Cronbach's alpha for each subscale is as follows: 0.85 for NONACCEPTANCE, 0.89 for GOALS, 0.86 for IMPULSE, 0.80 for AWARENESS, 0.88 for STRATEGIES, and 0.84 for CLARITY. Respondents use a five-point Likert-type scale ranging from 1 (almost never) to 5 (almost always). Refer to Appendix O.

*Barratt Impulsiveness Scale Version 11* (BIS-11; Patton, Stanford, & Barratt, 1995). The BIS-11 consists of thirty items with three impulsivity subscales, namely attentional impulsivity, motor impulsivity, and non-planning impulsivity. The total score, however, was used for the present study. Higher scores are indicative of greater impulsivity. Participants are asked to respond to items using a four point-Likert-type scale. Internal consistency of the BIS-11 has been reported at .82 (Patton et al., 1995). Refer to Appendix P.

**Brief Sensation Seeking Scale** (BSSS; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002). The BSSS is an eight-item measure assessing sensation seeking. Respondents use a five point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). BSSS scores were related to risk factor for substance use. Refer to Appendix Q.

**Brief Fear of Negative Evaluations** (BFNE; Collins, Westra, Dozois, & Stewart, 2005). The BFNE is a twelve item questionnaire that was shortened from the original FNE measure (Watson & Friend, 1969). The measure is composed of a Likert-type scale ranging from 1 (not characteristic of me at all) to 5 (extremely characteristic of me). The BFNE has demonstrated adequate validity, excellent inter-item reliability ( $\alpha = .97$ ) and two-week test-retest reliability ( $r = .94$ ). Refer to Appendix R.

**Brief COPE** (Carver, 1997). The Brief COPE is a 28-item questionnaire that was developed to assess ways that people cope with stress. It consists of fourteen subscales, and was modified from the COPE inventory which consists of sixty items (Carver, Scheier, & Weintraub, 1989). The Brief COPE demonstrated adequate internal reliability among a sample of participants who survived hurricane Andrew (Carver, 1997), with alpha reliabilities of at least .50. Alpha reliabilities for each subscale were as follows: Active Coping (.68), Planning (.73), Positive Reframing (.64), Acceptance (.57), Humor (.73), Religion (.82), Using Emotional Support (.71), Using Instrumental Support (.64), Self-Distraction (.71), Denial (.54), Venting (.50), Substance Use (.90), Behavioral Disengagement (.65), and Self-Blame (.69). Refer to Appendix S.

**Trauma History Questionnaire** (THQ; Green, 1996). The THQ was adapted to assess whether specific traumas occurred prior to or after bariatric surgery. The THQ

contains 24 items focusing on three trauma areas, namely crime-related trauma, general disaster, and unwanted physical and sexual experiences. Test-retest has demonstrated good stability over 2-3 months in a sample of college women (Green, 1996). The THQ asks respondents if they ever experienced these traumas using a “yes/no” response. Rather than using age to determine when the event occurred, the present study will modify the questionnaire to state “before or after bariatric surgery.” Refer to Appendix T.

### **Data Analyses**

Two separate databases were created, one for the online support group and one for St. Vincent Hospital participants. All of the responses from the online support group were completed using the online version of the survey. With the St. Vincent Hospital sample, however, nine participants requested a hard-copy survey. When the hard-copy surveys were returned to the primary investigator, those data were manually entered into Survey Monkey so that all St. Vincent data were grouped together. Next, the two databases from each recruitment site were exported from Survey Monkey and imported into SPSS. Subsequently, the databases were merged and examined for completeness of data. Of note, these databases were combined for all data analyses presented in this report because they did not differ on rates of substance abuse post-bariatric surgery.

Specific items were rescored given that Survey Monkey automatically assigns a score of “1” to the first response choice for each item. This is problematic for certain measures, such as the PHQ-9, which determines cut-off points using a scale from 0 to 3. Thus, these measures were recoded after the data were merged. Next, scale and total scores were calculated to conduct data analyses.

For the present study, data analyses were conducted using SPSS Version 17.0. First, descriptive statistics were computed to examine demographic and psychological variables. Specifically, the prevalence of substance abuse for the full sample was presented, as well as descriptive differences among those who did and did not engage in substance abuse. Substance abuse was determined by using the MAST-AD. Specifically, those who achieved a score of less than 5 on the MAST-AD were compared to those with a score of 5 or above (the cut-off indicating probable substance abuse) on the MAST-AD. Note that a cut-off of 8 on the MAST-AD is indicative of chronic substance abuse or dependence. Given that it was expected that the majority of the sample would not have had time to develop a chronic condition, the cut-off of 5, rather than 8, was used. In addition, sample sizes were too small using the 8-point cut-off. Refer to Table 10 for a breakdown of groups using the MAST-AD score of 8.

Table 10

*Rates of chronic substance abuse based on the MAST-AD (Score  $\geq$  8)*

Post-Problem	No Problematic Use	Recovered	Relapsed	New-Onset Abuse
12(7.8%)	126(81.8%)	16(10.4%)	6(3.9%)	6(3.9%)

*Note.* N(%). Post-problem refers to those who met criterion for substance abuse post-bariatric surgery, regardless of pre-surgical status.

### **Dependent Variables**

All analyses were repeated so as to examine two different groups. First, all analyses were conducted using a two-group comparison, namely comparing those who met criteria for substance abuse post-surgery regardless of their pre-surgical MAST-AD score, and those who did not meet criteria for substance abuse post-surgery. Second, the main analyses were also conducted using a four-group comparison, 1) those who never engaged in problematic

substance use or “non-users,” 2) those who were “Recovered” (lifetime history of problematic use prior to surgery, but no problematic use post-surgery), 3) those who have “relapsed” (problematic use pre- and post-surgery), and 4) those who developed a new substance abuse problem post-surgery. These groups were classified based on MAST-AD scores listed in Table 11.

Table 11

*Groups classified by MAST-AD scores*

No Problematic Use	Recovered	Relapsed	New-Onset Abuse
< 5 pre- and post-surgery	$\geq 5$ pre-surgery and < 5 post-surgery	$\geq 5$ pre- and post-surgery	< 5 pre- and $\geq 5$ post-surgery

Note. MAST-AD scores  $\geq 5$  are indicative of problematic substance abuse as previously described in the Method section.

For hypotheses 1 and 2, correlation matrices were examined to assess the strength of relationships between documented and theoretically-driven risk factors and substance abuse severity in this post-bariatric sample. T-tests and chi-square analyses were used as appropriate to compare groups on variables of interest. When chi-square analyses were used for the four group comparison, separate 2 X 2 chi-square analyses were conducted to further examine group differences, such as the Relapsed group versus the New Onset Use group. Variables which were significantly related to substance abuse were considered candidates for logistic regression models for the two group comparison (substance abuse versus no substance abuse post-surgery). For the four-group comparison, one-way ANOVA was used to compare group differences and Tukey’s test was used for post-hoc differences.

For hypothesis 3, a t-test was used for the two group comparison to determine whether those who had higher food addiction scores pre-surgery were at an increased risk for

developing substance abuse post-surgery, whereas an ANOVA was used for the four group comparison (i.e., No Problem, Recovered, Relapsed, and New Onset Abuse).

Finally, the relationship of food addiction pre-surgery and substance abuse status was evaluated using a 2 (problematic use prior to surgery) X 2 (problematic use post-surgery) ANOVA. Again, the theory of addiction transfer would be supported if the “New-Onset Use” group had higher Food Addiction scores relative to the other groups. Exploratory 2 X 2 ANOVA analyses were also conducted using emotional eating and major life events as dependent variables.

## **Results**

### **Participants**

Participants included female and male post-bariatric surgery patients. A total of 156 patients participated in the present study; however, two participants provided only demographic data. As such, those participants were excluded, leaving data from 154 post-bariatric patients available for data analysis. Of this sample, 59.7% were recruited from an online bariatric support group via Yahoo!, moderated by a former bariatric patient known to the principal investigator, and 40.3% were recruited from St. Vincent Hospital’s bariatric treatment program (Carmel, IN).

The study sample was primarily White (94.2%) and female (88.4%), with a mean age of 48.66 (SD  $\pm$  10.82) and BMI of 32.34 (SD  $\pm$  6.65). The demographic variables are summarized in Table 12.

Table 12

*Participant characteristics<sup>a</sup>*

Demographic variables	Participants (n=154) <sup>b</sup>
Gender (% female)	88.4%
Race (% White)	94.2%
Age	48.66 ± 10.82
Bariatric surgery age	45.96 ± 10.85
Years since surgery	2.70 ± 2.23
Bariatric surgery type	
Roux-en-Y	92.9%
LAGB	5.2%
BPD	0.6%
Gastric sleeve surgery	1.3%
Education (yrs)	15.01 ± 2.82
Marital status (% married)	64.9%
Employment status	
Employed at least part time	67.4%
Economic status	
Barely enough to get by	15.6%
Enough, but no more	29.9%
Solidly middle class	39.0%
Plenty of extras	9.7%
Luxuries	3.2%
Don't know/prefer not to say	2.6%
Annual household income	
>150 thousand	6.5%
100-149 thousand	9.1%
75-99 thousand	22.7%
50-74 thousand	20.1%
25-49 thousand	18.8%
10-24 thousand	9.7%
< 9 thousand	1.9%
Don't know/prefer not to say	11.0%

<sup>a</sup>Values are expressed as n (%) or  $M \pm SD$ . <sup>b</sup>N=154 except for employment (n=153), BMI presurgery (n=150), and BMI current (n=147).

**Aim 1: What is the Prevalence of Substance Abuse (SA) Among a Broad Sample of Post-Bariatric Surgery Patients?**

Using the MAST-AD cutoff score of 5 or higher, 18.8% of the sample met criteria for probable substance abuse following bariatric surgery, while 21.4% of the sample met criteria



for substance abuse at some point in their lives prior to having bariatric surgery. The rate of substance abuse was also assessed across the four groups previously mentioned, namely the No Problematic Use, Recovered, Relapsed, and New-Onset Abuse categories. It is important to note that groups did not differ based on bariatric surgery type, as the majority of the patients reported that they underwent gastric bypass surgery. Refer to Table 13 for a breakdown of percentage of the sample in each group and the percentage within each group that underwent the Roux-en-Y procedures. In addition, frequency of use for various substances is listed in Table 14.

Table 13

*Rates of substance abuse and bariatric surgery type by four groups*

	No Problematic Use	Recovered	Relapsed	New-Onset Abuse
N(%)	102 (66.2%)	23 (14.9%)	10 (6.5%)	19 (12.3%)
Roux-en-Y procedure (% yes)	94 (92.2%)	21 (91.3%)	9 (90.0%)	19 (100.0%)

Note that the four groups did not differ on years since surgery; however, when comparing the groups with presence/absence of substance abuse post-bariatric surgery, those who struggled with substance abuse post-surgery were more likely to have had the surgery longer ago (SA group:  $3.62 \pm 2.58$  years since surgery; Non-SA group:  $2.49 \pm 2.10$  years since surgery;  $t=-2.50$ ,  $p=.01$ ). In addition, when comparing the Recovered group to the SA group (both Relapsed and New-Onset Abuse), the SA group was more likely to have had surgery longer ago than the Recovered group (SA group:  $3.62 \pm 2.58$  years since surgery; Recovery group:  $2.00 \pm 1.81$  years since surgery;  $t=2.55$ ,  $p = .01$ ). Finally, note that current age did not differ by groups.

Table 14

*Descriptive information regarding substance use for post-surgical substance use status categories*

	No Problematic Use (n=102)	Recovered (n=23)	Relapsed (n=10)	New-Onset Abuse (n=19)	Test Statistic
<hr/>					
Alcohol use					
At least twice per week	2(2.1%)	1(4.3%)	4(40%)	4(22.3%)	$\chi^2(3, N = 148) = 25.52, p = .000$
Pain medication use	48(48%)	14(60.9%)	2(20%)	12(63.2%)	$\chi^2(3, N = 152) = 6.16, p = .10$
More than prescribed <sup>a</sup>	2(4.2%)	2(14.3%)	2(100%)	5(41.7%)	
Anxiety medication use	24(24%)	8(36.4%)	2(20%)	10(52.6%)	$\chi^2(3, N = 151) = 7.32, p = .06$
More than prescribed <sup>a</sup>	1(4.0%)	8(100%)	2(100%)	3(30.0%)	
Sleeping medication use	19(19.2%)	7(31.8%)	4(40%)	7(36.8%)	$\chi^2(3, N = 150) = 4.98, p = .17$
More than prescribed <sup>a</sup>	1(5.6%)	2(28.6%)	4(100%)	2(33.3%)	
<hr/>					
Mast pre-surgery score	0-4,	5-28,	6-46,	0-4,	
Range, <i>M</i> ± <i>SD</i>	1.30 ± 1.56	11.30 ± 6.61	16.1 ± 13.46	1.79±1.72	
Mast post-surgery score	0-4,	0-4,	5-53,	5-40,	
Range, <i>M</i> ± <i>SD</i>	0.93 ± 1.43	1.96±1.87	12.8±14.37	9.79±9.10	
<hr/>					
Caffeine use					
Daily moderate-heavy use	26(26.5%)	6(26.1%)	3(33.3%)	11(57.9%)	$\chi^2(3, N = 149) = 7.64, p = .05$
Cigarette use	16(16%)	1(4.3%)	1(10%)	3(15.8%)	$\chi^2(3, N = 152) = 2.32, p = .51$
Cigarette use last 30 days	11(11%)	0	1(10%)	2(10.5%)	$\chi^2(3, N = 151) = 2.65, p = .45$

<sup>a</sup> Percent reflects those who answered the prior screening question.

Follow-up 2 X 2 chi-square analyses were conducted for caffeine, pain medication, anxiety medication, and sleep medication use to identify group differences. For caffeine use, the New-Onset Abuse group had higher rates than the No problematic use and Recovered groups,  $\chi^2(3, N = 117) = 7.24, p = .007$ , and  $\chi^2(3, N = 42) = 4.37, p = .04$ , respectively. Groups did not differ for pain medication or sleeping medication use. For anxiety medication, however, the New-Onset Abuse group was more likely to use anxiety medication than the No Problematic Use group,  $\chi^2(1, N = 119) = 6.4, p = .01$ .

In addition, as an exploratory, descriptive analysis, the four groups were compared on a number of other potentially addictive behaviors, such as gambling and videogame play. The four groups did not differ on the total number of behavioral excesses or by types of behavioral excesses, other than gambling, with the Relapsed group having higher rates than the No Problematic Use group,  $\chi^2(1, N = 110) = 6.97, p = 0.03$ . Refer to Table 15.

Table 15

*Descriptive statistics for engaging in other behavioral excesses at least several days/week*

	No Problematic Use (n=102)	Recovered (n=23)	Relapsed (n=10)	New- Onset Abuse (n=19)	Chi-Square Statistic
Surfing the internet for more than two hours (not work)	67(67.0%)	15(68.1%)	7(70%)	15(79.0%)	1.07
Gambling (any type)	6(6%)	3(13.6%)	3(30%)	1(5.3%)	7.66
Videogame playing	17(17%)	5(22.7%)	2(20%)	0(0%)	4.58
Sexual behavior outside committed relationship	4(4%)	2(9.1%)	0(0%)	1(5.3%)	1.56
Excessive shopping	17(17%)	3(13.6%)	1(10%)	5(26.4%)	1.67
Excessive exercise	11(11%)	2(9.0%)	0(0%)	4(21.1%)	3.20

## Aim 2: What Psychological Variables are Related to Post-Bariatric Substance Abuse?

First, chi-square analyses or T-tests were conducted as appropriate to assess documented risk factors for substance abuse, namely gender, previous substance abuse, family history of substance abuse, impulsivity, sensation seeking, and previous trauma. Two 2 X 2 (Gender X SA Post Surgery Presence/Absence; Family History X SA Post Surgery Presence/Absence) chi-square analyses were conducted. Independent samples T-tests were conducted for prior substance abuse (MAST-AD score before surgery), impulsivity (BIS), sensation seeking (BSSS), and prior trauma (THQ). Refer to Table 16 for a summary of these findings.

Table 16

*Descriptive statistics for documented risk factors of substance abuse based on substance abuse group*

	No SA Post-Surgery (n=125)	SA Post-Surgery (n=29)	Test Statistic	<i>p</i>
Gender (Female)	109(87.2%)	21(72.4%)	$\chi^2(1, N = 154) = 3.91$	0.08
Family History	47(37.6%)	17(58.6%)	$\chi^2(1, N = 154) = 4.28$	0.04
SA History	3.14±4.99	6.72±10.40	$t(31.049) = -1.81$	0.08
Impulsivity	57.29±9.60	61.75±14.43	$t(143) = -1.98$	0.05
Sensation Seeking	19.64±5.07	21.00±7.72	$t(147) = -0.89$	0.38
Trauma	3.56±3.20	3.76±3.88	$t(152) = -0.29$	0.77

*Note.* The following measures were used to tap each variable: SA History (MAST-AD Pre-surgical score), Impulsivity (BIS-11), Sensation Seeking (BSSS), and Trauma (THQ).

Based on the chi-square and t-test analyses, only family history significantly differentiated those who did versus did not evidence substance abuse post-surgery. When a

bivariate correlation matrix was inspected to examine which variables were related to substance abuse post-bariatric surgery, however, prior history of substance abuse, family history of substance abuse, and impulsivity were related to SA post-surgery. Refer to Table 17 for specific correlation coefficients.

Table 17

*Correlation coefficients for documented risk factors for substance abuse*

	SA Post-Surgery	1	2	3	4	5	6
1. Gender <sup>a</sup>	3.91	--					
2. Substance abuse history	0.22**	0.30***	--				
3. Family substance abuse history	0.17*	0.11	0.29***	--			
4. Impulsivity	0.16*	-0.04	0.12	0.13	--		
5. Sensation Seeking	0.09	0.26**	0.09	0.11	0.34***	--	
6. Prior trauma	0.02	0.33***	0.06	0.11	-0.04	0.23**	--

*Note.*  $N = 154$ . \* $p < .05$ , \*\* $p < .01$ . \*\*\*  $p < .001$ . The following measures were used to tap each variable: SA History (MAST-AD Pre-surgical score), Impulsivity (BIS-11), Sensation Seeking (BSSS), and Trauma (THQ).

<sup>a</sup>For gender, the chi-square statistic was used in this table rather than a correlation because both gender and the dependent variable were dichotomous.

All predictors that were significant at the bivariate level, namely substance abuse history, family substance abuse history, and impulsivity, were entered into a logistic regression model. Additionally, although there was not enough power to detect significance in the chi-square analysis previously listed, gender was still worth considering in the regression model because it is well documented that gender plays a role in substance abuse. None of the variables, however, emerged as significant predictors in the final model. When these variables were entered independently, however, family history (OR=2.35) and substance abuse history (OR = 1.07) emerged as significant predictors, while impulsivity and gender did not. Refer to Table 18 for a summary of the results when each variable was entered independently. Refer to Table 19 for a summary of the results for the final model with all expected predictors included.

Table 18

*Independent predictors of SA post-bariatric surgery*

	B	S.E.	Wald	Odds ratio	95% CI	<i>p</i>
Gender	0.95	0.49	3.72	2.60	0.99-6.84	0.05
Substance Abuse History	0.07	0.03	5.62	1.07	1.01-1.13	0.02
Family Substance Abuse History	0.86	0.42	4.15	2.35	1.03-5.35	0.04
Impulsivity	0.04	0.02	3.66	1.04	1.00-1.08	0.06

*Note.* n = 145. The following measures were used to tap each variable: SA History (MAST-AD Pre-surgical score), Impulsivity (BIS-11), Sensation Seeking (BSSS), and Trauma (THQ).

Table 19

*Final model for prediction of SA post-bariatric surgery*

	B	S.E.	Wald	Odds ratio	95% CI	<i>p</i>
Gender	0.75	0.57	1.76	2.12	0.70-6.45	0.18
Substance Abuse History	0.03	0.04	0.75	1.03	0.96-1.11	0.39
Family Substance Abuse History	0.47	0.46	1.07	1.60	0.66-3.92	0.30
Impulsivity	0.03	0.02	3.02	1.03	1.00-1.08	0.08

*Note.* n = 145. The following measures were used to tap each variable: SA History (MAST-AD Pre-surgical score), Impulsivity (BIS-11), Sensation Seeking (BSSS), and Trauma (THQ).

More fine-grained analyses were conducted using the four groups previously mentioned. Documented risk factors were analyzed using either chi-square or ANOVA analyses, as appropriate. Results indicated that the New-Onset Abuse group reported higher rates of impulsivity than the No Problematic Use group. In addition, the New-Onset Abuse and Recovered groups were more likely to have a family history of substance abuse than the No Problematic Use group. Refer to Table 9 for descriptive data of the documented risk factors (e.g., gender, family history, impulsivity, sensation seeking, and trauma) across the four groups. Note that prior history of substance use was not used in these analyses because the four groups were created using that variable. Additionally, because chi-square analyses do not yield primary group differences when four groups are being examined, follow-up 2 X 2 chi-square analyses were conducted for gender and family history to identify group differences. The overall chi-square is presented and the significant between group differences are listed under “post hoc difference” in Table 20.



Table 20

*Descriptive statistics for documented risk factors for substance abuse across four groups*

	No Problematic Use (n=102)	Recovered (n=23)	Relapsed (n=10)	New-Onset Abuse (n=19)	Chi-Square or ANOVA	<i>p</i>	Post hoc difference
Gender (Female)	90.2%	73.9%	60.00%	78.9%	$\chi^2(3, N = 154) = 9.48$	<.05	1 > 3*
Family History	30.4%	69.6%	40.0%	68.4%	$\chi^2(3, N = 154) = 18.32$	<.001	2 > 1*** 4 > 1**
Impulsivity	56.43±9.74	61.00±8.19	58.11±13.06	63.47±15.06	$F(3, 141) = 2.97$	< .05	4 > 1*
Sensation Seeking	19.34±5.08	20.95±4.92	18.33±7.87	22.26±7.53	$F(3, 145) = 1.95$	0.13	
Trauma	3.35±3.12	4.48±3.42	4.70±3.83	3.26±3.91	$F(3, 150) = 1.16$	0.33	

1 = No Problematic Uses, 2 = Recovered, 3 = Relapsed, 4 = New-Onset Abuse. \**p* < .05. \*\**p* < .01. \*\*\**p* < .001. The following measures were used to tap each variable: SA History (MAST-AD Pre-surgical score), Impulsivity (BIS-11), Sensation Seeking (BSSS), and Trauma (THQ).

Follow-up analyses were conducted on total number of family member categories (mother, father, sister, brother, etc.) with a history of substance abuse. When comparing the two groups, substance abuse versus non-substance abuse post-surgery, the substance abuse group had greater total numbers of family members ( $1.45 \pm 1.53$ ) than the non-substance abuse group ( $0.72 \pm 1.13$ ),  $t(35.40) = -2.42, p < .05$ . When comparing the four groups, there was an overall group effect  $F(3, 150) = 5.64, p = .001$ . The post-hoc tests revealed that the only significant group comparison was between the New-Onset Abuse group and the No Problematic Use group. In other words, the New-Onset Abuse group had the greatest total number of categories of family members with a history of substance abuse ( $1.68 \pm 1.29$ ), which was significantly different in this respect from the No Problematic Use group ( $0.60 \pm 1.06$ ).

In addition to examining documented risk factors for substance abuse, other psychological variables that were hypothesized to be related to substance abuse post-bariatric surgery were also examined, namely food addiction, BED, emotional eating, maladaptive coping skills, life stressors, fear of negative evaluation, and emotional dysregulation. As was done for the previous analyses of established substance abuse predictors, these theoretically-relevant variables were examined using both a two group comparison (No SA versus Has SA) and a four group comparison (No Problematic Use, Recovered, Relapsed, and New-Onset Abuse). For descriptive statistics on the theoretically driven predictors, refer to Table 21 for the two group comparison and refer to Table 25 for the four group comparison.

Table 21

*Descriptive statistics for theoretically-driven candidate predictors by Substance Abuse status after surgery*

	Total Sample (N=154)	No SA Post-Surgery (n=125)	SA Post-Surgery (n=29)	Test Statistic	<i>p</i>
Food addiction	4.38±1.86	4.40±1.90	4.28±1.75	<i>t</i> =0.32	0.75
Emotional eating BED <sup>a</sup>	50.55±24.39 47(31.5%)	50.34±25.41 39(32.2%)	51.45±19.75 8(28.6%)	<i>t</i> =-0.22 $\chi^2(1, N = 149) = 0.14$	0.83 0.71
Depression	4.80±4.97	4.52±4.82	6.00±5.52	<i>t</i> =-1.45	0.15
Life events	4.21±3.82	3.76±3.35	6.14±5.05	<i>t</i> =-3.10	< .01
COPE denial	2.65±1.16	2.52±0.96	3.17±1.71	<i>t</i> =-1.97	0.06
COPE substance use	2.44±1.16	2.19±0.61	3.48±2.05	<i>t</i> =-3.36	< .01
Emotional dysregulation total	69.76±22.78	69.41±23.01	71.31±22.09	<i>t</i> =-0.38	0.70
Emotion dysregulation: Nonacceptance	11.42±5.67	11.27±5.59	12.11±6.10	<i>t</i> =-0.70	0.49
Emotion dysregulation: Goals	11.50±4.23	11.52±4.34	11.39±3.82	<i>t</i> =0.14	0.89
Emotion dysregulation: Impulse	9.99±4.21	9.81±4.15	10.72±4.46	<i>t</i> =-1.05	0.30
Emotion dysregulation: Awareness	14.03±5.46	13.98±5.62	14.21±4.84	<i>t</i> =-0.20	0.84
Emotion dysregulation: Strategies	14.20±6.18	14.10±6.31	14.64±5.71	<i>t</i> =-0.42	0.68
Emotion dysregulation: Clarity	9.28±3.50	9.19±3.33	9.68±4.18	<i>t</i> =-0.67	0.51
BMI Current	32.34±6.65	31.92±6.41	34.20±7.49	<i>t</i> =-1.62	0.11
BMI Pre-Surgery	49.68± 8.78	48.87±7.47	53.23±12.61	<i>t</i> =-1.76	0.09

Note. <sup>a</sup>Percent who met full criteria.

The following measures were used to tap each variable: Food addiction (YFAS), emotional eating (EES), BED (QEWP-R), depression (PHQ-9), COPE denial and COPE substance use (Brief COPE), emotion dysregulation total (DERS total score), and the remaining emotion dysregulation labels were subscales of the DERS.

As shown above, number of life events and the COPE substance use score were significantly related to substance abuse post-bariatric surgery. Specifically, those who met criteria for substance abuse post-surgery were more likely to have experienced a greater number of life events post-surgery and were more likely to cope by using substances.

In addition, a bivariate correlation matrix of the previously mentioned variables listed in Table 21 was examined to assess the association of these variables to substance abuse post-bariatric surgery. At the bivariate level, life events, COPE substance use, and COPE denial were related to SA post-surgery. All other relationships were nonsignificant. Refer to Table 22 for specific correlation coefficients.

Table 22

*Correlation coefficients for theoretical risk factors for substance abuse*

	SA Post-Surgery	1	2	3
1. Life events	0.24**	--		
2. COPE denial	0.22**	0.14	--	
3. COPE substance use	0.44***	0.34***	0.40***	--

*Note.*  $N = 154$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

All predictors that were significant at the bivariate level, namely life events, COPE substance use, and COPE denial, were entered into a logistic regression model independently. Results are listed in Table 23.

Table 23

*Independent predictors of SA post-bariatric surgery*

	B	S.E.	Wald statistic	Odds ratio	95% CI	<i>P</i>
Life Events	0.15	0.05	7.63**	1.16	1.04-1.29	<0.01
Cope Denial	0.40	0.16	6.33*	1.49	1.09-2.03	0.01
Cope Substance Use	0.83	0.21	15.97***	2.29	1.53-3.44	<0.001

When entered together, COPE substance use (OR=2.05) emerged as the only significant predictor. Given that two documented risk factors, family history of substance abuse and substance abuse history, were independently related to post-surgical substance abuse, those variables were entered in Step 1 of a regression model, while COPE substance use, COPE denial, and life events were entered into Step 2 of the model. Again, COPE substance use emerged as the only significant predictor. Refer to Table 24 for specific statistics of this model.

Table 24

*Final model for prediction of SA post-bariatric surgery*

	B	S.E.	Wald statistic	Odds ratio	95% CI	<i>p</i>
<b>Step 1</b>						
Family substance abuse history	0.16	0.45	1.89	1.85	0.77-4.45	0.17
Substance abuse History	0.06	0.03	3.70	1.06	1.00-1.13	0.05
<b>Step 2</b>						
Family substance abuse history	0.16	0.52	0.09	1.17	0.42-3.22	0.76
Substance abuse history	0.05	0.04	1.68	1.05	0.98-1.13	0.20
Cope Substance Use	0.69	0.23	8.88	2.00	1.27-3.15	<0.01
Cope Denial	0.20	0.22	0.82	1.22	0.79-1.88	0.37
Life Events	0.05	0.06	0.80	1.06	0.94-1.19	0.37

*Note.* n = 145.

Interestingly, of those who acknowledged using alcohol or drugs at all on the MAST-AD (n=62), those who were classified as meeting criteria for substance abuse had higher scores on using substances as a coping strategy,  $t(16.85)=-3.70$ ,  $p < .01$ .

The theoretically driven predictors were also examined using the four group comparison. Results are presented in Table 25.

Table 25

*Descriptive statistics for predictor variables for the four group comparison*

	No Problematic Use (n=102)	Recovered (n=23)	Relapsed (n=10)	New-Onset Abuse (n=19)	Test Statistic	<i>p</i>	Post hoc difference
Food addiction	4.17±1.92	5.43±1.38	3.30±1.77	4.79±1.55	$F(3, 150) = 4.63$	<.01	2>1* 2>3*
Emotional eating BED <sup>a</sup>	47.19±25.44 26(26.5%)	64.35±20.41 13(56.5%)	45.60±18.56 1(10.0%)	54.53±20.14 7(38.9%)	$F(3, 150) = 3.58$ $\chi^2(3, N = 149) = 10.39$	<.05 <.05	2>1* 2>1** 2>3*
Depression	4.14±4.71	6.22±5.04	6.30±6.04	5.84±5.39	$F(3, 150) = 1.84$	0.14	
Life events	3.54±3.28	4.74±3.56	3.70±2.87	7.42±5.52	$F(3, 150) = 6.32$	<.001	4>1*** 4>3*
COPE denial	2.46±0.95	2.82±0.96	3.10±1.91	3.21±1.65	$F(3, 147) = 3.15$	<.05	4>1*
COPE substance use	2.19±0.64	2.18±0.50	3.70±2.50	3.37±1.83	$F(3, 145) = 11.90$	<.001	3>1*** 4>1*** 3>2** 4>2**
Emotional Dysregulation Total	66.54±21.98	82.14±23.69	67.13±23.66	73.17±21.79	$F(3, 136) = 2.98$	<.05	2>1*
Emotion dysregulation: Nonacceptance	10.71±5.33	13.86±6.13	10.25±4.92	12.89±6.49	$F(3, 142) = 2.41$	0.07	
Emotion dysregulation: Goals	10.89±3.93	14.32±4.50	11.30±4.16	11.44±3.75	$F(3, 143) = 4.20$	<.01	2>1**
Emotion dysregulation: Impulse	9.58±4.15	10.86±4.07	9.70±4.03	11.26±4.68	$F(3, 146) = 1.24$	0.30	
Emotion dysregulation: Awareness	13.55±5.47	15.91±5.96	15.60±5.89	13.47±4.17	$F(3, 150) = 1.53$	0.21	
Emotion dysregulation:	13.56±6.04	16.50±7.05	13.00±5.06	15.56±5.98	$F(3, 144) = 1.81$	0.15	

Strategies						
Emotion dysregulation:	8.86±3.27	10.68±3.27	8.78±3.93	10.11±4.33	$F(3, 146) = 2.12$	0.10
Clarity						
BMI Current	31.89±6.76	32.05±4.52	34.59±9.77	34.01±6.38	$F(3, 143) = 0.88$	0.45
BMI Pre-Surgery	48.39±7.72	51.03±5.85	49.68±10.47	54.92±13.43	$F(3, 146) = 3.30$	<.05 4>1*

*Note.* 1 = No Problematic Uses, 2 = Recovered, 3 = Relapsed, 4 = New-Onset Abuse. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

The following measures were used to tap each variable: Food addiction (YFAS), emotional eating (EES), BED (QEWP-R), depression (PHQ-9), COPE denial and COPE substance use (Brief COPE), emotion dysregulation total (DERS total score), and the remaining emotion dysregulation labels were subscales of the DERS.

Finally, to test the hypothesis related to “addiction transfer,” a 2 (substance abuse pre-surgery) X 2 (substance abuse post-surgery) ANOVA was conducted with food addiction (YFAS) as the dependent variable. Results revealed significance for the full model,  $F(3,150) = 4.43, p < .01$ , with no significant main effects, but a significant interaction effect,  $F(1,150) = 11.37, p = .001, \eta^2 = .07$ . Interestingly, the same pattern emerged when conducting an ANOVA with emotional eating rather than food addiction. For emotional eating, the full model was significant  $F(3, 150) = 3.58, p < .05$ , with no significant main effects, but a significant interaction effect  $F(1,150) = 5.84, p < .05, \eta^2 = 0.04$ . Refer to Figures 6 and 7 for a visual depiction of the interaction patterns with food addiction and emotional eating.

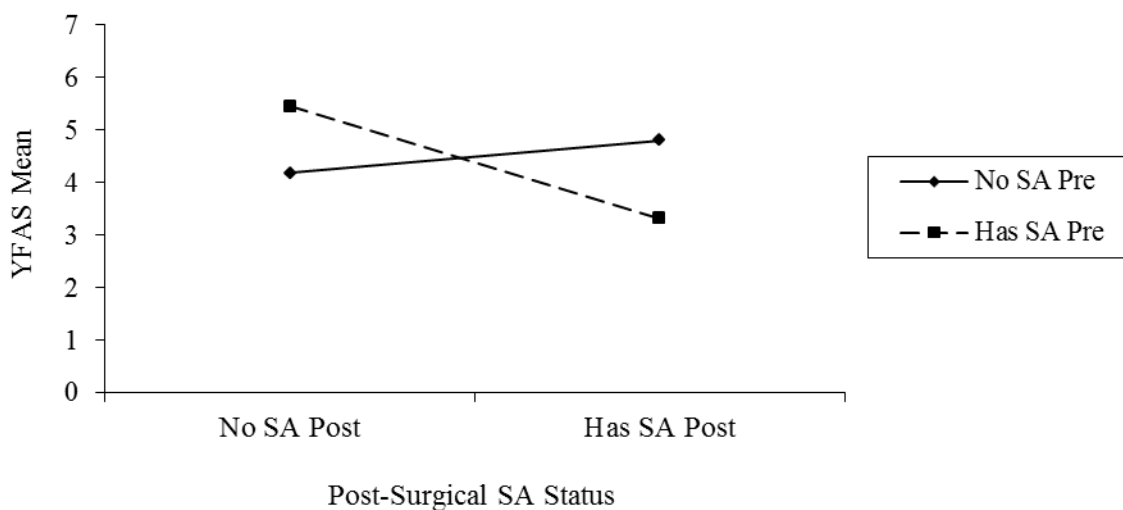
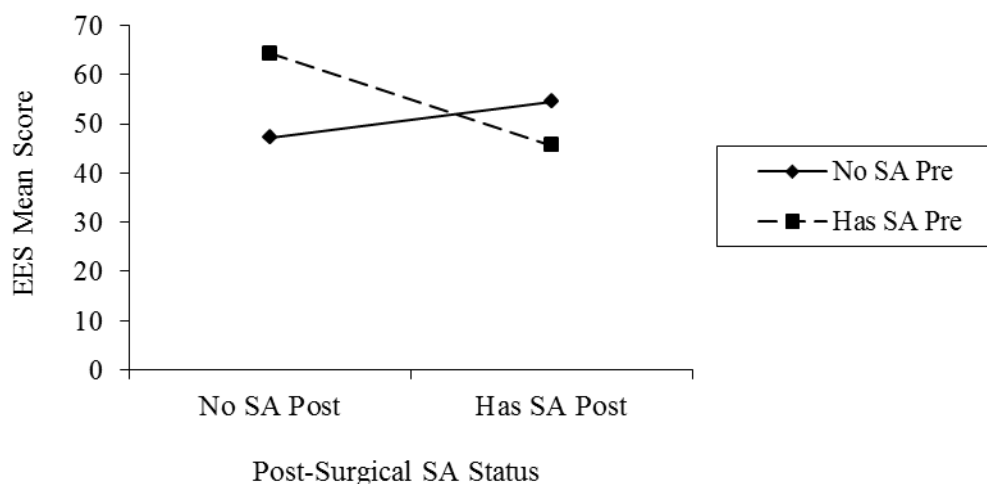


Figure 6. Food addiction as a function of pre- and post- substance abuse status





*Figure 7.* Emotional eating as a function of pre- and post- substance abuse status

Finally, hypothesis 4 was not tested because emotion dysregulation and fear of negative evaluations were not related to substance abuse post-surgery. In addition, body image discrepancy was not pursued because it was not related to substance abuse post-surgery, either.

### Discussion

The present study examined substance abuse rates following bariatric surgery. In order to help identify those at risk for developing substance abuse following bariatric surgery, the present study also sought to investigate psychological predictors of substance abuse among post-bariatric surgery patients. Finally, due to clinical and anecdotal speculation regarding the theory of addiction transfer among bariatric patients, the present study sought to examine this proposed phenomenon.

The present sample was primarily White, female, middle-aged, and had a post-surgical BMI in the obese class I range (BMI 30-34.99). As expected, the majority also underwent gastric bypass surgery, the most common bariatric procedure used in the US

(Nguyen et al., 2011). The demographic variables presented in this sample were very similar to those reported by Suzuki et al. (2010), who examined alcohol use disorders among bariatric patients. Overall, the present sample was representative of the bariatric treatment samples across the literature in terms of age, race, gender, and post-surgical weight (Martin, Beekley, Kjorstad, & Sebesta, 2010; Nguyen et al., 2011; Poulouse et al., 2005; Suzuki et al., 2010; Turner et al., 2011).

**Aim 1: What is the Prevalence of Substance Abuse Among a Broad Sample of Post-Bariatric Surgery Patients?**

The first aim of the present study was to identify the rate of substance abuse in a post-operative sample of bariatric patients. It is important to recall that substance abuse in this study was defined as having a MAST-AD cut-off score that was indicative of probable substance abuse. The following section will report lifetime, pre-surgical, and post-surgical rates of substance abuse and will attempt to compare these rates to the prevalence of substance abuse in the general population. It is imperative to keep in mind, however, that operational definitions of “abuse” vary considerably throughout the literature.

In the present sample, the lifetime substance abuse rate was approximately 34%, which was remarkably similar to that reported by Suzuki et al. (2010; 35.3%) and to that of the general population according to the Substance Abuse and Mental Health Services Administration (SAMHSA, 2002). Interestingly, however, only 21% of the sample met criterion for substance abuse pre-operatively, which is substantially lower than that of the general population. In addition, the rate of post-surgical substance abuse was approximately 19 percent. The literature suggests that the prevalence of pre-surgical, lifetime substance use disorders varies, ranging from approximately 1 percent to 33 percent (Kalarchian et al., 2007;

Mauri et al., 2008; Rosenberger, Henderson, & Grilo, 2006). The rates may differ dramatically due to findings that suggest that bariatric patients were more candid when the researchers were unaffiliated with their surgical team (Muhlhans, Horbach, & de Zwaan, 2009).

Interestingly, of those who met criteria for substance abuse pre-surgically, only 30.3% relapsed after surgery. These numbers are considerably lower than the relapse rates of the general population wherein relapse is the norm rather than the exception (Miller, Walters, & Bennett, 2001; O'Brien & McLellan, 1996), especially among those who have remitted without seeking formal treatment (Moos & Moos, 2006).

When examining only post-surgical substance abuse, two substance abuse groups emerged as expected, namely those who struggled with substance abuse at some point in their lives pre-surgically and thus “relapsed” following bariatric surgery, and those who never struggled with substance abuse prior to surgery and spontaneously developed a new problem following bariatric surgery (referred to as the New-Onset Abuse group). Interestingly, 12.3% of the entire sample fell into the New-Onset Abuse category, while 6.5% fell into the Relapsed category. Thus, while some researchers have noted that those struggling with substance abuse post-bariatric surgery have relapsed (Suzuki et al., 2010), the present findings revealed that approximately two-thirds of those developing substance abuse post-surgery were in fact developing a new problem. In fact, of those who reported substance abuse at any time pre- or post-surgery, approximately 37 percent developed substance abuse only *after* bariatric surgery. These numbers of new substance abuse after bariatric surgery are concerning at first glance; however, it is important to consider, how

these rates of substance abuse relate to substance abuse rates in the general, middle-aged population.

Data from SAMHSA (2002) and the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC; 2002) were used for rates of substance abuse among the general population. Specifically, current or twelve month data were used as the closest approximation of substance abuse rates relative to those who endorsed substance abuse “after bariatric surgery.” According to SAMHSA (2002), 5.2% of those aged 45-49 and 3.2 percent of those aged 50-54, reported alcohol or illicit drug abuse or dependence. More specifically, 5.5 percent of men and 1.70 percent of women aged 45-64 met criteria for DSM-IV alcohol abuse, while 2.67% of men and 1.15 percent of women met criteria for DSM-IV dependence (NESARC, 2002). Furthermore, based on a figure from SAMHSA (2009), it appears that less than ten percent of those aged 40-55 met criteria for “heavy alcohol use,” which was defined as “five or more drinks on the same occasion on each of five or more days in the past thirty days.” The present study, however, combined rates of drugs and alcohol abuse to reach the 19 percent rate, so it is difficult to compare these rates to the reported rates among the general population in this age range. Although the rate of substance abuse in the present sample is comparable to that of the general population as a whole, the comparison becomes less clear when examining the data among the middle-aged population.

Substance abuse research has focused heavily on adolescence and young adulthood, primarily because age of onset for substance dependence is highest at age eighteen and declines after mid-twenties (Chen & Kandel, 1995). Substance abuse research on middle-aged adults, however, is lacking, especially when examining new-onset use during middle-age. An emerging literature, however, has examined substance abuse among the elderly,

namely those over the age of 65. According to SAMHSA (2002), approximately 17% of older adults struggle with alcohol and/or prescription drug abuse. Of the elderly who struggle with alcohol abuse, two-thirds are considered to have relapsed and are referred to as early-onset users in the literature, whereas one-third are considered to be late-onset users, developing an alcohol problem later in life. Menninger (2002) reported that late-onset alcohol abuse is often associated with a stressful life event and with the first alcohol problem occurring at age forty or fifty. As such, one could speculate that perhaps the New-Onset Abuse bariatric patients are experiencing their first alcohol problem currently, given that the mean age of the present sample is forty-eight; as such, they may be on the path to developing a substance use disorder later in life. On the other hand, the New-Onset Abuse group may be a unique group with special needs post-bariatric surgery, rather than in the early stages of late-onset alcohol abuse that is typically seen among the elderly population.

When examining illicit drug use, rates of illicit drug use (primarily marijuana and prescription misuse) are increasing in adults aged 50 and older (SAMHSA, 2009). Specifically, for those aged 50 to 59, illicit drug use increased to 6.2 % in 2009 from 2.7% in 2002. In addition, as the baby boomer generation (1946-1964) ages, it is expected that substance use disorders treatment will more than double for ages 50 and older by 2020 (Gfroerer, Penne, Pemberton, & Folsom, 2003).

It is also important to note that the majority of the present sample was female and research suggests that age of onset for alcohol-related problems is later for women than it is for men (Diehl et al., 2007). Nonetheless, the literature is scant with respect to women developing substance abuse during their forties and fifties.

Finally, it is important to consider the rates of substance abuse among the obese population. Using the NESARC data, results indicated that there was not a relationship between alcohol or drug abuse and alcohol or nicotine dependence for those who were overweight, obese, or extremely obese (Pickering, Grant, Chou, & Compton, 2007). Another study reported that obesity decreased the risk of developing a substance use disorder, even when controlling for age, sex, smoking, or comorbid psychiatric disorders (Simon et al., 2006). Specific lifetime and current prevalence for alcohol use disorders for the extremely obese (BMI >40) were 13.20 percent and 3.09 percent, respectively, while the lifetime and current prevalence for alcohol use disorders for the obese population (BMI 30-30.99) was 13.57 and 3.03 (Petry, Barry, Pietrzak, & Wagner, 2008). Interestingly, one study reported that there is an inverse relationship between BMI and alcohol use disorders for women, but not for men (Barry & Petry, 2009). For females with a BMI greater than thirty, lifetime prevalence of substance use disorders was 8.1% (Simon et al., 2006), which is remarkably lower than that of the general population and of that observed in the present sample, where the mean BMI was in the obese range.

Taken together, it is difficult to determine if substance abuse rates from the present sample are comparable to those of the general population due to varying operational definitions of “abuse,” different age ranges studied, the projection of increases in substance use disorders in the next decade due to the baby boomer generation, and differential (typically lower) prevalence of substance use disorders in the obese population. Consequently, it is unknown if the rates of substance abuse post-bariatric surgery are similar to rates of this specific age group in the general population, or whether the substance abuse is, in part, a byproduct or a function of having bariatric surgery. Suzuki et al. (2010) reported

that the current rate of alcohol use disorders among post-bariatric surgery patients was 11.8% in their sample, which they reported was comparable to the prevalence of current alcohol use disorders in the general population, 8.5%. Nonetheless, it may be premature to conclude that the development of these problems post-bariatric surgery is not associated with the life-changing experience, both physiologically and psychologically, that may follow bariatric surgery, especially because there is a lack of literature on middle-aged substance abuse and new-onset substance abuse among the middle-aged. In addition, research suggests that obese women are less likely to struggle with substance abuse. Future research is warranted to better understand the etiology of substance abuse among post-bariatric surgery patients.

For descriptive purposes, the frequency of specific substances used was examined. As can be seen in Table 14, the quantity and frequency of substance use among the sample appeared to be quite low, yet some participants still experienced negative consequences associated with their use (as measured by the MAST-AD). Frequency was not used as an indicator of abuse in the present study; rather, negative consequences were used to better capture problematic use, which is common in the literature because of the low correspondence between reports of frequency of use and adverse consequences (Dowdall & Wechsler, 2002).

Finally, it is important to note that those in the substance abuse group were more likely to have had bariatric surgery longer ago (approximately three years prior), on average, than the non-substance abuse group. This is relevant because a recent study found that of those who committed suicide after bariatric surgery, 68% committed suicide 2-3 years after bariatric surgery. It is even more alarming that over half of the “suicides” were considered drug overdoses, and it is unclear whether the drug overdoses were deliberate or not (Tindle et

al., 2010). As such, a better understanding of substance abuse post-bariatric surgery is needed. If predictors of substance abuse among this population can be identified, improved follow-up care and education can be provided for those at risk.

### **Aim 2: What Psychological Variables are Related to Post-Bariatric Substance Abuse?**

Given that a group of post-bariatric patients struggle with substance abuse, the second aim of the study was to examine psychological variables that may be related to substance abuse in order to gain a better understanding of those who may be at risk for developing such problems after surgery. In addition, because there appear to be two different substance abuse groups, namely the Relapsed and New-Onset Abuse groups, findings were highlighted in two different ways: a) comparing the substance abuse group versus the non-substance abuse group, and b) comparing all four groups, namely those who never abused substances (No Problematic Use), those who only abused substances pre-surgically (Recovered), those who abused pre- and post-surgery (Relapsed), and those who abused only post-surgery (New-Onset Abuse).

First, documented risk factors for substance abuse for the two groups (substance abuse versus non-substance abuse) were examined among post-bariatric surgery patients. It was expected that documented risk factors for substance abuse, namely gender (male), prior substance abuse history, family history of substance abuse, impulsivity, sensation seeking, and previous trauma, would also predict substance abuse among the post-bariatric population. Partial support for this hypothesis was found.

Substance abuse history was predictive of substance abuse post-surgery. In fact, individuals with a substance abuse history were seven percent more likely to develop a problem post-surgery (OR=1.07). Family substance abuse history was also predictive;



individuals with a family history of substance abuse were at more than a two-fold (OR=2.35) greater risk of developing a problem post-surgery. When the four group analysis was conducted, results revealed that both the New-Onset Abuse and Recovered groups were more likely to have a family history of substance abuse than the No Problematic Use group. Interestingly, follow-up analyses revealed that post-surgical substance abuse was related to greater number of categories of family members with a history of substance abuse. More specifically, the New-Onset Abuse group had significantly more types of family members with a substance abuse history than the No Problematic Use group. That is, the New-Onset Abuse group may have a greater predisposition to develop substance abuse because of vulnerability conferred by their family history; however, whether it is more of a genetic or environmental risk is unknown. Given that family history was a strong predictor of substance abuse post-surgery, especially for the New-Onset Abuse group, it may be important to assess for family history of substance abuse during the pre-surgical evaluation for bariatric surgery. It may be less threatening to ask about a family history rather than personal substance abuse history. Bariatric candidates may be more likely to minimize their own symptoms, but may feel more comfortable describing family history. Future research is needed to test this hypothesis.

Second, when the four groups were analyzed, impulsivity scores were higher among the New-Onset Abuse group than the No Problematic Use group. Generally, impulsivity scores range from 30 (low on impulsivity) to 120 (high on impulsivity). The scores from the present study appear to be somewhat higher than those reported in a study examining impulsivity among patients seeking bariatric surgery. Respective mean scores for the bariatric candidates relative to the New-Onset Abuse and No Problematic Use groups were

49, 63, and 56. An older version of the questionnaire was used in the previous study and the samples slightly differ in that there may be important differences between bariatric candidates and those who follow through with surgery. Overall, it is not surprising that impulsivity was predictive of substance abuse because the link between obesity and impulsivity (Chalmers, Bowyer, & Olenick, 1990; Nederkoorn, Smulders, Havermans, Roefs, & Jansen, 2006) and substance abuse and impulsivity (Conrod, Pihl, Stewart, & Dongier, 2000; Loxton & Dawe, 2001; Perry & Carroll, 2008), has been well documented.

It is also important to note that gender (male) emerged as a trend for predicting substance abuse ( $p=.05$ ). The sample size of men in the present study may have been too small to detect significant differences. Although the majority of those in the substance abuse group were female, of the men in the sample, one-third fell into the substance abuse group, whereas only 16.2% of the women fell into the substance abuse group. In light of this, future research should oversample men to gain a better understanding of sex differences in substance abuse among this population, because the majority of those seeking bariatric surgery are female.

In sum, with respect to documented risk factors for substance abuse, impulsivity and family history seem to be the most important variables for the New-Onset Abuse group, while family history and substance abuse history capture differences between the post-surgical substance abuse and non-substance abuse groups.

In addition to examining documented risk factors for substance abuse, exploratory analyses were conducted on a host of psychological variables that were hypothesized to predict substance abuse post-surgery. As previously mentioned, the notion of addiction transfer, that is, replacing a “food addiction” pre-surgery with a substance use addiction post-

surgery, has been speculated throughout the literature (Hagedorn et al., 2007; Volkow & Wise, 2005; Wendling & Wudyka, 2010; Woodard, Downey, Hernandez-Boussard, & Morton, 2011). Contrary to expectations, however, pre-surgical food addiction scores, emotional eating scores, and BED status were not related to substance abuse post-surgery (i.e., the two group comparison). Even more striking is that when comparing the four groups, significant differences emerged; however, the Recovered group had the highest food addiction scores, BED scores, and emotional eating scores. The same pattern emerged for all eating patterns with the Recovered group having higher scores than either of the active substance abuse groups. If the food addiction theory was supported, the New-Onset Abuse group should have had the highest scores on food addiction; yet scores from the New-Onset Abuse group were comparable to the scores of the No Problematic Use group. The main finding is that those who met criterion for substance abuse pre-surgery but did NOT relapse post-surgery were the ones who had the highest food addiction scores. This interaction had a moderate effect size and findings were consistent across multiple indicators (food addiction, emotional eating, binge eating) suggesting that, while it is certainly a curious and unexpected finding, it is a robust one that merits further exploration. As such, future research should investigate what factors may have protected this Recovered group from relapse, an outcome that would not be predicted based on their combination of high food addiction scores and history of substance abuse. Research shows that the relationship between obesity and alcohol use disorders is complex, especially when considering gender. Specifically, obese men may be at an increased risk for developing alcohol use disorders (Barry & Petry, 2009); however, those in the present sample, including the Recovered group, were primarily female.

Of note, lack of support for addiction transfer mirrors that of Suzuki et al. (2010) who did not find a relationship between BED pre-surgery and alcohol use disorders post-surgery in a sample of post-bariatric patients. In sum, converging lines of research indicate that the theory of addiction transfer among bariatric patients is not supported.

Thus far, the findings from two quantitative studies have not supported the notion of addiction transfer even with strong theoretical underpinnings for this phenomenon. Future research is needed to disentangle the discrepancies that have been reported in qualitative research on addiction transfer versus quantitative methods. To help illustrate the differences, a quote is listed from a post-bariatric patient describing his personal experience with “addiction transfer.”

I continued to obsess in other areas because food wasn't my obsession anymore and I could not eat....Bulimia came into effect because I felt fat all the time so anytime I put food into my mouth I knew to take that extra bite to make sure I threw up. And naturally my stomach could not handle it. I was making sure I could vomit or I ended up bingeing or purging, some points intentionally at other points not intentionally.... Then came, well drug abuse....I started with cocaine and slowly but surely ended up with crack cocaine. I ended up in detox. I went to a treatment center and I stayed there almost four months and I got through a lot of issues that needed to come out. Today I feel a lot better but I still think about it every day. (LePage, 2010, p. 61)

It is clear that whether or not the theory of addiction transfer is supported empirically, a subgroup of individuals need help adjusting to life after bariatric surgery, and some of them turn to drugs and alcohol to cope. Therefore, there are clinical implications for working with post-bariatric patients struggling with substance abuse that will be addressed later in this paper.

Another theorized predictor of substance abuse among this population was major life stressors. The literature on late-onset alcohol abuse postulates that these problems may stem from stressful life events such as changing roles, loss, or retirement (O'Connell, Chin,

Cunningham, & Lawlor, 2003). Similarly, among post-bariatric patients seeking inpatient treatment for substance use disorders, those in the New-Onset Abuse and Relapsed group were equally likely to have experienced the same categories of life events pre-surgery, but those in the New-Onset Abuse group were more likely to have experienced a major personal life adjustment after surgery (e.g., becoming a caretaker, moving) than those in the Relapsed group (Feldman et al., 2011). In light of this, it was expected that major life events would predict substance abuse more generally, but particularly among the New-Onset Abuse group. As expected, major life events conferred risk for post-surgical substance abuse. Specifically, each increment on the life events scale conferred a 16% increase in risk for post-surgical substance abuse. Similar to previous findings, the New-Onset Abuse group in the present sample was also more likely to have reported major life events than both the Relapsed and No Problematic Use group. Accordingly, interventions to promote more adaptive coping skills may help bariatric patients manage potential major life events post-surgery, which could in turn serve an important protective function in the success of bariatric patients post-surgery. In light of this finding, it was imperative to compare specific coping skills within the present sample.

Two coping skills were related to substance abuse post-surgery, namely COPE Denial and COPE Substance Use. COPE Denial consisted of two items: “I’ve been saying to myself ‘This isn’t real’ and ‘I’ve been refusing to believe that it has happened.’” COPE Substance Use items consisted of the following two items: “I’ve been using alcohol or other drugs to make myself feel better” and “I’ve been using alcohol or other drugs to help me get through it.” The post-surgical substance abuse group had greater COPE Denial and COPE Substance Use scores than the non-substance abuse group. Specifically, each one point

increment on COPE Denial scores conferred a 49% increased risk for meeting criteria for substance abuse; those with higher COPE Substance Use scores were also at increased risk for substance abuse, with each increment on that scale conferring over a two-fold (2.29) risk of having substance abuse post-surgery. Interestingly, when all variables that were related to substance abuse were entered into a logistic regression model, COPE Substance Use emerged as the strongest predictor of substance abuse. This finding mirrors that of Cooper, Russell, and George (1988), who found that drinking to cope was the most powerful predictor in a model for alcohol abuse. In addition, both cross-sectional (Carpenter & Hasin, 1999) and prospective studies (Holahan, Moos, Holahan, Cronkite, & Randall, 2001) have found an association between drinking to cope and risk for developing an alcohol use disorder. In fact, in a prospective, Holahan et al. (2001) found that initial drinking to cope was predictive of alcohol abuse over ten years, and that “within a 1-year interval, drinking to cope operates prospectively as a risk factor for increased alcohol use and abuse” (p. 196). These findings are also consistent with the present findings in that among all who endorsed having a drink or drugs now and again, only the substance abuse group had higher scores on COPE Substance Use, implying that the substance abuse group may be using substances to cope and the non-substance abuse group may be using substances for other purposes, such as for social facilitation. Given that COPE Substance Use appears to be a major risk factor for developing substance use even with only two items, it may be important to add these two items to pre-surgical psychological bariatric evaluations. It is easy to assess and respondents may be more likely to answer these questions than to admit a current or past problem.

Finally, given the literature on emotion regulation and substance abuse (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996; Lang et al., 1999) it was expected that difficulty

regulating emotions would be associated with substance abuse post-surgery. Contrary to expectations, however, emotion dysregulation was not associated with substance abuse in this sample. In fact, total mean scores on the DERS were comparatively lower for the present sample (69.76) than for the normed sample of college women (77.99) and men (80.66; Gratz & Roemer, 2004). Emotion regulation research suggests that younger adults have greater difficulty regulating emotions than older adults (Orgeta, 2009), which may account for the lower scores among the bariatric patients in this sample.

Interestingly, despite the group differences in substance abuse, groups did not differ on severity of depressive symptoms. In fact, the sample ranged from not having depressive symptoms to endorsing mildly depressive symptoms. Therefore, the sample seems to be doing relatively well in terms of mood.

In sum, a host of psychological variables were assessed and the main predictor of post-surgical substance abuse was coping by using substances. Other predictors included impulsivity and family history for the New-Onset Abuse group. When comparing the two groups, substance abuse history was also related.

Despite these findings, it is important to note that there may be other predictors that are not psychological in nature, which may put an individual at risk for developing a substance abuse problem post-bariatric surgery. For example, physiological factors may confer greater risk for developing substance abuse after bariatric surgery. It is known that alcohol is metabolized differently following bariatric surgery (Hagedorn et al., 2007; Klockhoff et al., 2002; Woodard et al., 2011). Increased peak blood alcohol levels occur when comparing gastric bypass surgery patients to non-surgical patients (Hagedorn et al., 2007; Klockhoff et al., 2002), and the gastric bypass patients take longer to return to baseline

(Hagedorn et al., 2007). One study even matched pre-surgical and post-surgical gastric bypass patients to better understand the differences in alcohol metabolism following bariatric surgery. Researchers concluded that, “Patients feel different effects of alcohol intoxication postoperative, and this can lead to overindulgence to achieve the same symptoms of intoxication that they experienced before surgery” (Woodard et al., 2011, p. 212). Results are worrisome because heightened reinforcement from the altered metabolism is speculated to lead to an alcohol problem (Hagedorn et al., 2007).

There are a few important reasons why alcohol may impact gastric bypass patients differently. First, Hagedorn et al. (2007) explained that the majority of bariatric patients are women and alcohol impacts women differently than men (Frezza, di Padova, Pozzato, Terpin, Baraona, & Lieber, 1990). Nonetheless, Hagedorn’s study on alcohol absorption post-surgery included men as well. Second, the alcohol is emptied in the jejunum quickly. Last, but not least, alcohol dehydrogenase, an enzyme that begins to break down alcohol in the stomach, is ineffective in the small gastric pouch (Shikora, 2007).

Although there have been consistent findings that alcohol is metabolized differently after gastric bypass surgery, little is known about how other bariatric surgeries impact metabolism. A recent study, however, found that alcohol was absorbed differently following laparoscopic sleeve gastrectomy as well (Maluenda et al., 2010). Specifically, researchers measured the levels of alcohol in twelve participants pre- and post-surgery, using each participant as his/her control. Results indicated that blood alcohol values were higher post-surgery and took longer to reach baseline after surgery. Does having gastric bypass surgery, however, increase an individual’s risk of developing substance abuse relative to other bariatric procedures? Although this is unknown, it is noteworthy that *all* of those in the



New-Onset Abuse group had gastric bypass surgery and all of those who met criteria for alcohol dependence in Suzuki's study also had gastric bypass surgery. As the adjustable lap-band procedure gains popularity (Nguyen et al., 2011), future research should examine alcohol metabolic changes with that procedure and if that relates to the development of substance abuse.

In addition, while the literature has focused on alcohol metabolism, there is a dearth of research examining how *other* substances metabolize after surgery, such as pain medications. As previously mentioned, the majority of suicides among post-bariatric patients were drug overdoses, although it is unknown if these drug overdoses were deliberate (Tindle et al., 2010). With the metabolic and physiological changes after surgery, it would be tragic if the suicides were in fact accidental due to a lack of understanding of such changes.

Overall, more follow-up care is needed post-bariatric surgery. Whether or not the prevalence of substance abuse in the general population mirrors that of the rates in the present sample, bariatric patients in the New-Onset Abuse group may have unique treatment needs. Liberto and Oslin (1995) argued that specific substance use treatment should be tailored to meet the needs of older individuals struggling with substance abuse. Similarly, tailored substance abuse treatment for bariatric patients may be needed. Future research should investigate treatment outcomes of post-bariatric patients versus non-bariatric patients in substance use disorder treatment settings in order to help determine whether or not this group has unique needs that need to be addressed in treatment.

### **Limitations of the Present Study**

The present study had a number of limitations. First, due to the small cell sizes of some of the groups, namely the Relapsed and New-Onset Abuse groups, further research is

necessary to replicate these findings. Second, for those struggling with substance abuse, it is unknown when the substance abuse began and what specific substances were used. Third, patients were asked to retrospectively recall eating and substance abuse patterns. A prospective, long-term longitudinal study is needed to help elucidate these findings. Finally, substance abuse rates may be an underestimate due to the possibility that some of those in the Recovered group did not relapse yet, while some of those in the No Problematic Use group could go on to develop new onset use. In addition, those struggling with substance abuse at the most severe end of the spectrum may not have completed the study online. Future research should compare treatment seeking post-bariatric patients and non-treatment seeking post-bariatric patients to capture psychological differences.

### **Conclusion**

Overall, findings highlight the development of substance abuse post-bariatric surgery among a subgroup of individuals without a history of substance abuse. Results suggest that developing adaptive coping skills to manage life stressors during middle age may help prevent the development of substance abuse among this group. In addition, findings suggest that assessing for family history and coping during the pre-surgical assessment may help identify those at risk for developing a problem post-surgery. Furthermore, the physiological changes that occur after surgery may play a role in increasing risk of developing a substance use disorder; however, all patients experience these same metabolic changes due to the surgery, but all do not develop a substance use problem after bariatric surgery. Therefore, the aforementioned psychological variables may tip the scale for the New-Onset Abuse group. Future research is needed to better understand physiological changes that may occur after surgery that may confer risk for developing a substance abuse problem after surgery.

Finally, despite the clinical anecdotes, popular media, and speculation from the literature, the theory of addiction transfer was not supported in the present sample. Given that this was a retrospective study, future research should prospectively test this theory.

To my knowledge, this was the first study to examine psychological predictors of substance abuse among a post-bariatric surgery sample. Future longitudinal studies with larger sample sizes may serve to replicate and extend these findings.

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## Appendix A

### Background Information

1. How old are you? \_\_\_\_\_ years
  
2. Are you...
  - Female
  - Male
  - Transgender
  
3. Please check the box(es) below which correspond to the racial/ethnic groups you belong to:
  - Black or African-American
  - White or Caucasian
  - Hispanic or Latino/a
  - Native American
  - Asian or Asian American
  - Middle Eastern
  - Other (Please Specify: \_\_\_\_\_)
  
4. How many years of education have you completed? \_\_\_\_\_ years  
(NOTE: Completing High School or its equivalent = 12 years)
  
5. What is your current relationship status?
  - Married
  - Living with partner (same sex)
  - Living with partner (opposite sex)
  - Single (never married, not living with partner)
  - Divorced
  - Remarried
  - Widowed
  - Separated
  - Other (Please Specify: \_\_\_\_\_)
  
6. What is your current employment status?
  - Working full time (>35 hours/week)
  - Working part-time, regular hours
  - Working part-time, irregular hours
  - Unemployed - student
  - Unemployed - homemaker

- Unemployed – other
- Retired
- Disability
- Military

7. What is the economic status of your current household?

- We have barely enough to get by
- We have enough to get by, but no more
- We are solidly middle class
- We have plenty of “extras”
- We have plenty of “luxuries”
- Don't know/unsure/prefer not to say

8. What is your annual household income?

- >\$150,000
- \$100,000-\$149,000
- \$75,000-\$99,000
- \$50,000-\$74,000
- \$25,000-\$49,000
- \$10,000-\$24,000
- <\$9,000
- Don't know/unsure/prefer not to say

### **Weight-related Health History**

1. What type of weight-loss (bariatric) surgery have you had?

- LAP-BAND adjustable gastric banding (LAGB)
- Roux-en-Y gastric bypass
- Vertical banded gastroplasty (“stomach stapling”)
- Biliopancreatic diversion with duodenal switch (BPD)
- Gastric sleeve surgery
- Don't know, not sure

If you are not sure, please provide some details about what you can recall about the procedure that you had:



2a. Were there any surgical complications? No  Yes

2b. If you experienced any complications, please describe what happened:

**Actual or approximate  
DATE**

3a. What was the date of your bariatric surgery? \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

3b. How old were you when you had bariatric surgery?.....\_\_\_\_\_years old

3b. How old were you when you first begin to regularly  
**use alcohol?**.....\_\_\_\_\_years old

*NOTE: Regular use = 2 or more times per week*

Check here if not applicable

3c. How old were you when you first begin to regularly  
**use drugs?** .....\_\_\_\_\_years old

*NOTE: Regular use = 2 or more times per week*

Check here if not applicable

3d. When did you or others first become concerned  
about your alcohol/drug use? .....\_\_\_\_\_years old

3e. How old were you the first time you entered  
**alcohol/drug treatment?** .....\_\_\_\_\_years old

Check here if not applicable

4. How tall are you? \_\_\_\_\_ feet and \_\_\_\_\_ inches

5. What is/was your highest adult weight (not including pregnancy)? \_\_\_\_\_ pounds  
What year were you at your highest weight? \_\_\_\_\_

7. What did you weigh just before your weight loss surgery? \_\_\_\_\_ pounds

8. What is your weight now? \_\_\_\_\_ pounds

9. What do you consider to be your ideal weight? \_\_\_\_\_ pounds

## Appendix B

### QEWPR

1. How many times (approximately) have you lost 20 pounds or more (when you weren't sick) and then gained it back?

- Never  
 Once or twice  
 Three or four times  
 Five times or more

2. **BEFORE you had bariatric surgery**, did you often eat within any 2 hour period what most people would regard as an unusually large amount of food? Sometimes people refer to this as "binge eating". Did you tend to do that often?

No  Yes

IF NO: SKIP TO QUESTION 8

3. During the times when you ate this way, did you often feel you couldn't stop eating or couldn't control what or how much you were eating?

No  Yes

IF NO: SKIP TO QUESTION 8

4. How old were you when you first had times when you ate large amounts of food and felt that your eating was out of control? If you are not sure, what is your best guess? \_\_\_\_ years old.

5. **BEFORE you had bariatric surgery**, how often, on average, did you have times when you ate this way – that is, large amounts of food **plus** the feeling that your eating was out of control? (There may have been some weeks when it was not present – just average those in.)

- Less than one day a week  
 One day a week  
 Two or three days a week  
 Four or five days a week  
 Nearly every day

6. Did you **usually** have any of the following experiences during those occasions?

- a. Eating much more rapidly than usual?.....No  Yes   
b. Eating until you felt uncomfortably full?.....No  Yes   
c. Eating large amounts of food when you didn't  
feel physically hungry?.....No  Yes

- d. Eating alone because you were embarrassed  
by how much you were eating?.....No  Yes
- e. Feeling disgusted with yourself, depressed,  
or very guilty after overeating?.....No  Yes

7. Think about a typical time when you ate this way – that is, large amounts of food **plus** the feeling that your eating was out of control.

a. What time of day did the episode start?

- Morning (8am- 12 Noon)  
 Early afternoon (12 Noon – 4pm)  
 Late afternoon (4pm – 7pm)  
 Evening (7pm-10pm)  
 Night (After 10pm)

b. About how long did a typical episode of eating like this last, from the time you started to eat until when you stopped and didn't eat again for at least two hours?

\_\_\_\_\_ hours \_\_\_\_\_ minutes

c. At the time an episode like this would have started, how long would it probably have been since you had previously finished eating a meal or snack?

\_\_\_\_\_ hours \_\_\_\_\_ minutes

8. In general, **BEFORE you had bariatric surgery**, how upset were you by overeating (eating more than you think is best for you)?

- Not at all  
 Slightly  
 Moderately  
 Greatly  
 Extremely

9. In general, **BEFORE you had bariatric surgery**, how upset were you by the feeling that you couldn't stop eating or control what or how much you were eating?

- Not at all  
 Slightly  
 Moderately  
 Greatly  
 Extremely

10. **BEFORE you had bariatric surgery**, how important to you was your weight or shape in terms of how you felt about or evaluated yourself as a person – as compared to other

aspects of your life, such as how you were doing at work/school, as a parent/partner/friend, or how you got along with people?

- Weight and shape were **not very important**
- Weight and shape **played a part** in how you felt about yourself
- Weight and shape **were among the main things** that affected how you felt about yourself
- Weight and shape **were the most important things** that affected how you felt about yourself

11. **BEFORE you had bariatric surgery**, how important to you has your weight or shape been in terms of how you have been feeling about or evaluating yourself as a person – as compared to other aspects of your life, such as how you are doing at work/school, as a parent/partner/friend, or how you got along with people?

- Weight and shape are **not very important**
- Weight and shape **play a part** in how you felt about yourself
- Weight and shape **are among the main things** that affect how you feel about yourself
- Weight and shape **are the most important things** that affect how you feel about yourself

12. **BEFORE you had bariatric surgery**, did you go to any meetings of an organized weight control program? (like Weight Watchers, Optifast, Nutrisystem, Curves) or a self-help group (like TOPS, Overeaters Anonymous, etc.)?

No  Yes

**IF YES:** Name of program: \_\_\_\_\_

13. **BEFORE you had bariatric surgery**, have you gone to any meetings of an organized weight control program? (like Weight Watchers, Optifast, Nutrisystem, Curves) or a self-help group (like TOPS, Overeaters Anonymous, etc.)?

No  Yes

**IF YES:** Name of program: \_\_\_\_\_

14. Since you have been an adult – 18 years old – how much of the time have you been on a diet, been trying to follow a diet, or in some way been limiting how much you were eating to lose weight or to keep from regaining weight you had lost?

- None or hardly any of the time
- About a quarter of the time
- About half the time
- About three-quarters of the time
- Nearly all of the time

15. I think I am: \_\_\_\_\_

1. Very Underweight
2. Somewhat Underweight
3. Normal Weight

4. Somewhat Overweight
5. Very Overweight

## Appendix C

### YFAS

This survey asks about your eating habits before you had bariatric surgery. People sometimes have difficulty controlling their intake of certain foods such as:

- Sweets like ice cream, chocolate, doughnuts, cookies, cake, candy, ice cream
- Starches like white bread, rolls, pasta, and rice
- Salty snacks like chips, pretzels, and crackers
- Fatty foods like steak, bacon, hamburgers, cheeseburgers, pizza, and French fries
- Sugary drinks like soda pop

When the following questions ask about “CERTAIN FOODS” please think of ANY food similar to those listed in the food group or ANY OTHER foods you have had a problem with before you had bariatric surgery.

<b>BEFORE YOU HAD BARIATRIC SURGERY:</b>	Never	Once a month	2-4 times a month	2-3 times a week	4 or more times or daily
1. I found that when I started eating certain foods, I ended up eating much more than planned	0	1	2	3	4
2. I found myself continuing to consume certain foods even though I was no longer hungry	0	1	2	3	4
3. I ate to the point where I felt physically ill	0	1	2	3	4
4. Not eating certain types of food or cutting down on certain types of food was something I worried about	0	1	2	3	4
5. I spent a lot of time feeling sluggish or fatigued from overeating	0	1	2	3	4
6. I found myself constantly eating certain foods throughout the day	0	1	2	3	4
7. I found that when certain foods were not available, I would go out of my way to obtain them. For example, I would drive to the store to purchase certain foods even though I had other options available to me at home.	0	1	2	3	4
8. There were times when I consumed certain foods so often or in such large quantities that I started to eat food instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoyed.	0	1	2	3	4
9. There were times when I consumed certain foods so often or in such large quantities that I spent time dealing with negative feelings from overeating instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoyed.	0	1	2	3	4
10. There were times when I avoided professional or social situations where certain foods were	0	1	2	3	4

	available, because I was afraid I would overeat.					
11.	There were times when I avoided professional or social situations because I was not able to consume certain foods there.	0	1	2	3	4
12.	I had withdrawal symptoms such as agitation, anxiety, or other physical symptoms when I cut down or stopped eating certain foods. (Please do NOT include withdrawal symptoms caused by cutting down on caffeinated beverages such as soda pop, coffee, tea, energy drinks, etc.)	0	1	2	3	4
13.	I consumed certain foods to prevent feelings of anxiety, agitation, or other physical symptoms that were developing. (Please do NOT include consumption of caffeinated beverages such as soda pop, coffee, tea, energy drinks, etc.)	0	1	2	3	4
14.	I found that I had elevated desire for or urges to consume certain foods when I cut down or stopped eating them.	0	1	2	3	4
15.	My behavior with respect to food and eating caused significant distress.	0	1	2	3	4
16.	I experienced significant problems in my ability to function effectively (daily routine, job/school, social activities, family activities, health difficulty because of food and eating.	0	1	2	3	4

<b>BEFORE YOU HAD BARIATRIC SURGERY:</b>		NO	YES			
17.	My food consumption caused significant psychological problems such as depression, anxiety, self-loathing, or guilt.	0	1			
18.	My food consumption caused significant physical problems or made a physical problem worse.	0	1			
19.	I kept consuming the same types of food or the same amount of food even though I was having emotional and/or physical problems.	0	1			
20.	Over time, I have found that I needed to eat more and more to get the feeling I wanted, such as reduced negative emotions or increased pleasure.	0	1			
21.	I found that eating the same amount of food did not reduce my negative emotions or increase pleasurable feelings the way it used to.	0	1			
22.	I wanted to cut down or stop eating certain kinds of food.	0	1			
23.	I tried to cut down or stop eating certain kinds of food.	0	1			
24.	I was successful at cutting down or not eating these kinds of food.	0	1			
25.	How many times in one year would you try to cut down or stop eating certain foods altogether?	1 time	2 times	3 times	4 times	5 or more times

26. Please circle ALL of the following foods you had problems with:

<b>Ice cream</b>	<b>Chocolate</b>	<b>Apples</b>	<b>Doughnuts</b>	<b>Broccoli</b>	<b>Cookies</b>	<b>Cake</b>	<b>Candy</b>
<b>White Bread</b>	<b>Rolls</b>	<b>Lettuce</b>	<b>Pasta</b>	<b>Strawberries</b>	<b>Rice</b>	<b>Crackers</b>	<b>Chips</b>
<b>Pretzels</b>	<b>French Fries</b>	<b>Carrots</b>	<b>Steak</b>	<b>Bananas</b>	<b>Bacon</b>	<b>Hamburgers</b>	<b>Cheese burgers</b>
<b>Pizza</b>	<b>Soda Pop</b>	<b>None of the above</b>					

27. Please list any other foods that you had problems with that were not previously listed:



## Appendix D

### EES

We all respond to different emotions in different ways. Some types of feelings lead people to experience an urge to eat. Please indicate the extent to which the following feelings led you to feel an urge to eat **BEFORE YOU HAD BARIATRIC SURGERY** by checking the appropriate box.

	No Desire to Eat	A Small Desire to Eat	A Moderate Desire to Eat	A Strong Urge to Eat	An Overwhelming Urge to Eat
Resentful					
Discouraged					
Shaky					
Worn Out					
Inadequate					
Excited					
Rebellious					
Blue					
Jittery					
Sad					
Uneasy					
Irritated					
Jealous					
Worried					
Frustrated					
Lonely					
Furious					
On Edge					
Confused					
Nervous					
Angry					
Guilty					
Bored					
Helpless					
Upset					

**Appendix E**

## Mental Disorder History

1. BEFORE you had bariatric surgery, were you ever diagnosed with a mood disorder (e.g., depression, major depression).

No             Yes

2. BEFORE you had bariatric surgery, did you ever seek treatment for emotional difficulties?

No             Yes

3. BEFORE you had bariatric surgery, did you ever see a psychologist or a psychiatrist for emotional difficulties?

No             Yes

4. BEFORE you had bariatric surgery, were you ever prescribed medication to manage emotional difficulties?

No             Yes

**Appendix F****CAGE****BEFORE you had bariatric surgery...**

1. Did you ever feel you should cut down on your drinking?

No                       Yes

2. Did people annoy you by criticizing your drinking?

No                       Yes

3. Did you ever feel bad or guilty about your drinking?

No                       Yes

4. Did you ever have a drink first thing in the morning to steady your nerves or to get rid of a hangover (eye opener)?

No                       Yes

## Appendix G

### Substance Use

1. BEFORE you had bariatric surgery, how often did you have any of the following:

	Not At All	Monthly	Weekly	2-3 times/week	4-6 times/week	Daily Moderate Use	Daily Heavy Use
Alcohol							
Caffeine							

2. BEFORE you had bariatric surgery, did you use any prescription pain medications (e.g. Vicodin, OxyContin, Tylenol 3 with Codeine, Percocet, Darvocet, Morphine, Hydrocodone, Oxycodone)

No  Yes

2a. If yes: Did you use prescription pain medications only as prescribed by your doctor.

No  Yes

2b. If yes: Did you use prescription pain medications more than prescribed by your doctor?

No  Yes

2c. If yes: Did you use prescription pain medications, none of which were prescribed by your doctor?

No  Yes

3. BEFORE you had bariatric surgery, did you use any sedative/anxiety medication (e.g. Ativan, Xanax, Valium, Klonopin, Diazepam, Lorazepam)?

No  Yes

3a. If yes: Did you use sedative/anxiety medications only as prescribed by your doctor?

No  Yes

3b. If yes: Did you use sedative/anxiety medications more than prescribed by your doctor?

No  Yes

3c. If yes: Did you use sedative/anxiety medications, none of which were prescribed by your doctor?

No

Yes

4. BEFORE you had bariatric surgery, did you use any sleeping medication (e.g. Ambien, Halcion, Restoril, Temazepam, Triazolam)?

No

Yes

4a. If yes: Did you use sleeping medications only as prescribed by your doctor?

No

Yes

4b. If yes: Did you use sleeping medications more than prescribed by your doctor?

No

Yes

4c. If yes: Did you use sleeping medications, none of which were prescribed by your doctor?

No

Yes

## Appendix H

### MAST-AD

Note that directions and items will be reworded to either reflect “BEFORE you had bariatric surgery, or currently, for the pre-bariatric and post-bariatric assessment, respectively.

	Score	
	No	Yes
0. Do you enjoy a drink or drug use now and then?	0	0
1. Do you feel you are a normal drinker or drug user? (By normal we mean you drink or use drugs less than or as much as most other people.)	0	2
2. Have you ever awakened the morning after some drinking or drug use and found that you could not remember a part of the evening?	2	0
3. Does your wife, husband, a parent, or other near relative ever worry or complain about your drinking or drug use?	0	1
4. Can you stop drinking or using drugs without a struggle after one or two drinks or drug doses?	0	2
5. Do you feel guilt about your drinking or drug use?	1	0
6. Do friends or relatives think you are a normal drinker or drug user?	0	2
7. Are you able to stop drinking or drug use when you want to?	0	2
8. Have you ever attended a meeting of Alcoholics Anonymous, Narcotics Anonymous or other self-help group for drug use?	5	0
9. Have you gotten into physical fights when drinking or drug use?	1	0
10. Has your drinking or drug use ever created problems between you and your wife, husband, a parent, or other relatives?	2	0
11. Has your wife, husband (or other family members) ever gone to anyone for help about your drinking or drug use?	2	0
12. Have you ever lost friends because of your drinking or drug use?	2	0
13. Have you ever gotten into trouble at work because of your drinking or drug use?	2	0
14. Have you ever lost a job because of drinking or drug use?	2	0
15. Have you ever neglected your obligations, your family, or your work for two or more days in a row because you were drinking or using drugs?	2	0
16. Do you drink or use drugs before noon fairly often?	1	0
17. Have you ever been told you have liver trouble? Cirrhosis?	2	0

18. After heavy drinking or drug use have you ever had Delirium Tremens (D.T.'s) or severe shaking, or heard voices or seen things that really weren't there? How many times? _ 0	2	
19. Have you ever gone to anyone for help about your drinking or drug use?	5	0
20. Have you ever been in a hospital because of drinking or drug use?	5	0
21. Have you ever been a patient in a psychiatric hospital or on a psychiatric ward of a general hospital where drinking or drug use was apart of the problem that resulted in hospitalization?	2	0
22. Have you ever been seen at a psychiatric or mental health clinic or gone to any doctor, social worker, or clergyman for help because of any emotional problem, where drinking or drug use was part of the problem?	2	0
23. Have you ever been arrested for drunk driving, driving while intoxicated, or driving under the influence of alcoholic beverages or drugs? How many times?	2	0
24. Have you ever been arrested, or taken into custody, even for a few hours, because of other drunk or drug-related behavior? How many times?	2	0

## Appendix I

### FTND

Note. Items and directions will be reworded to assess current smoking in addition to smoking prior to having bariatric surgery.

#### **BEFORE you had bariatric surgery....**

1. Did you ever smoke a cigarette?

No       Yes

If you have ever smoked cigarettes...

(Check here if not applicable  )

2a. If yes, how many days per week were you smoking? \_\_\_\_\_ days

(Check here if not applicable  )

2b. And, on average, on days when you smoked at all, about  
How many cigarettes per day would you smoke? \_\_\_\_\_ cigarettes

(Check here if not applicable  )

3. Did you smoke more frequently during the first hours after waking than during the rest of the day?

No       Yes

4. How soon after you wake did you smoke your first cigarette?

- ≤ 5 minutes  
 6 - 30 minutes  
 31 - 60 minutes  
 > 60 minutes = 0

5. Which cigarette of the day would you most hate to give up?

- The first one in the morning  
 After a meal  
 Some other cigarette of the day

6. Did you find it difficult to refrain from smoking in places where it was forbidden (e.g. in church, at the library, at the movies, etc.)?

No       Yes

7. Did you smoke when you were so ill you were in bed most of the day?



No       Yes

## Appendix J

### Family History

1. Do you have a family history of substance abuse (drugs or alcohol)?

No       Yes

2. If yes: What family members suffered from substance abuse problems? Check all that apply:

Mother	<input type="checkbox"/>
Father	<input type="checkbox"/>
Sibling	<input type="checkbox"/>
Aunt	<input type="checkbox"/>
Uncle	<input type="checkbox"/>
Grandmother	<input type="checkbox"/>
Grandfather	<input type="checkbox"/>

## Appendix K

### PHQ-9

Over the <b>last 2 weeks</b> , how often have you been bothered by the following problems?	Not At all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Feeling down, depressed, or hopeless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Trouble falling or staying asleep, or sleeping too much	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Feeling tired or having little energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Poor appetite or overeating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Trouble concentrating on things, such as reading the newspaper or watching television	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Thoughts that you would be better off dead or of hurting yourself in some way	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**If you checked off any problems above, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?**

**Not difficult  
at all**

**Somewhat  
difficult**

**Very  
difficult**

**Extremely  
difficult**

From the Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PRIME-MD PHQ). The PHQ was developed by Drs. Robert L. Spitzer, Janet B.W. Williams, Kurt Kroenke and colleagues. For research information, contact Dr. Spitzer at [rls8@columbia.edu](mailto:rls8@columbia.edu). PRIME-MD® is a trademark of Pfizer Inc. Copyright© 1999 Pfizer Inc. All rights reserved. Reproduced with permission.

## Appendix L

### Life Events

If an event happened to you **after you had bariatric surgery**, please tell me if the event had a *very bad*, *somewhat bad*, *somewhat good*, or *very good* effect. If an event had both bad and good effects, please indicate the one that came first. Remember to indicate only things that happened **after you had bariatric surgery**.

If an event did not happen **after you had bariatric surgery**, circle “8” for N/A/

	Very Bad	Somewhat Bad	Somewhat Good	Very Good	N/A
1. You moved into a new home	1	2	3	4	8
2. You divorced or separated from your partner	1	2	3	4	8
3. The number of arguments with your partner increased	1	2	3	4	8
4. The number of arguments with your children increased	1	2	3	4	8
5. You lost your job	1	2	3	4	8
6. A family member died	1	2	3	4	8
7. Your child(ren) had trouble in school	1	2	3	4	8
8. Your child(ren) left home	1	2	3	4	8
9. Your child(ren) got in trouble with the law	1	2	3	4	8
10. You got a new job	1	2	3	4	8
11. Your child(ren) went to jail	1	2	3	4	8
12. Your financial status changed	1	2	3	4	8
13. There was increased trouble with your child(ren) at home	1	2	3	4	8
14. A family member had a serious illness or injury	1	2	3	4	8
15. The number of arguments with other family members increased	1	2	3	4	8
16. You changed your residence more than twice	1	2	3	4	8
17. Your child(ren) had a drug problem	1	2	3	4	8
18. You had a major illness or injury	1	2	3	4	8
19. A close friend died	1	2	3	4	8
20. A close friend had a serious illness or injury	1	2	3	4	8
21. You lost a close friend (other than by death)	1	2	3	4	8

22. You got a new lover	1	2	3	4	8
23. You broke up with your lover	1	2	3	4	8
24. You were physically assaulted	1	2	3	4	8
25. You were raped/sexually assaulted	1	2	3	4	8
26. You were robbed or burglarized	1	2	3	4	8
27. You witnessed a fight in which a weapon was used	1	2	3	4	8
28. You saw or heard violent arguments between your neighbors	1	2	3	4	8
29. People in your neighborhood were hit by the police	1	2	3	4	8
30. Someone in your neighborhood was murdered	1	2	3	4	8
31. You heard gunshots on your block	1	2	3	4	8
32. You saw drug deals on your block	1	2	3	4	8
33. You had medical problems associated with surgery	1	2	3	4	8
34. You had other medical complications	1	2	3	4	8

## Appendix M

### Behavioral Excesses

During **the past four weeks**, how often were you participating in each of the following activities:

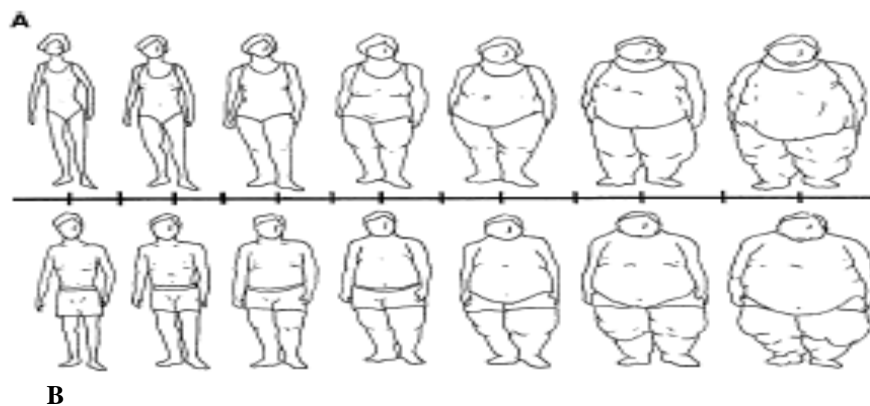
	<b>Not at all</b>	<b>Several days a week</b>	<b>More than half the days</b>	<b>Nearly every day</b>
Surfing the internet for more than two hours (not for work purposes)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gambling (any type)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Videogame playing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sexual behavior outside of a committed relationship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Excessive Shopping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Appendix N

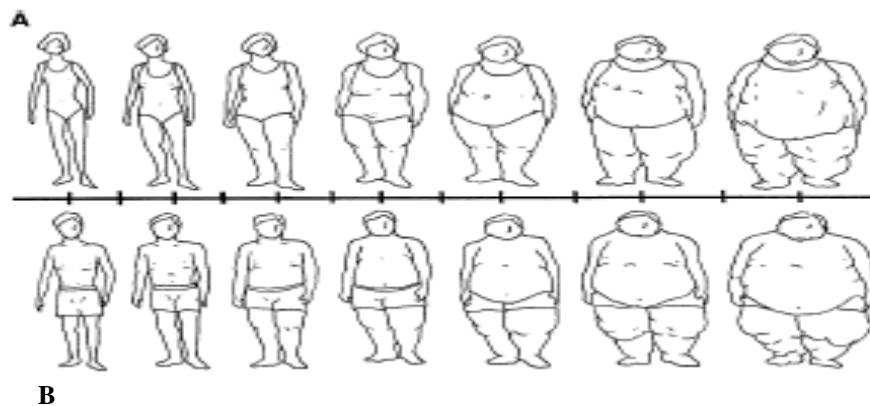
### Body Image Discrepancy

If you are female, please refer to the silhouettes on line A. If you are male, please refer to the silhouettes on line B.

Please circle the silhouette that most closely resembles your **CURRENT** body weight.



Please circle the silhouette that most closely resembles your **IDEAL** body weight.



## Appendix O

### DERS

Please respond to the following items.

- |   |                              |
|---|------------------------------|
| 1 | Almost never (0-10%)         |
| 2 | Sometimes (11-35%)           |
| 3 | About half the time (36-65%) |
| 4 | Most of the time (66 – 90%)  |
| 5 | Almost always (91-100%)      |
- 
1. I am clear about my feelings.
  2. I pay attention to how I feel.
  3. I experience my emotions as overwhelming and out of control.
  4. I have no idea how I am feeling.
  5. I have difficulty making sense out of my feelings.
  6. I am attentive to my feelings.
  7. I know exactly how I am feeling.
  8. I care about what I am feeling.
  9. I am confused about how I feel.
  10. When I'm upset, I acknowledge my emotions.
  11. When I'm upset, I become angry with myself for feeling that way.
  12. When I'm upset, I become embarrassed for feeling that way.
  13. When I'm upset, I have difficulty getting work done.
  14. When I'm upset, I become out of control.
  15. When I'm upset, I believe that I will remain that way for a long time.
  16. When I'm upset, I believe that I'll end up feeling very depressed.
  17. When I'm upset, I believe that my feelings are valid and important.

18. When I'm upset, I have difficulty focusing on other things.
19. When I'm upset, I feel out of control.
20. When I'm upset, I can still get things done.
21. When I'm upset, I feel ashamed with myself for feeling that way.
22. When I'm upset, I know that I can find a way to eventually feel better.
23. When I'm upset, I feel like I am weak.
24. When I'm upset, I feel like I can remain in control of my behaviors.
25. When I'm upset, I feel guilty for feeling that way.
26. When I'm upset, I have difficulty concentrating.
27. When I'm upset, I have difficulty controlling my behaviors.
28. When I'm upset, I believe there is nothing I can do to make myself feel better.
29. When I'm upset, I become irritated with myself for feeling that way.
30. When I'm upset, I start to feel very bad about myself.
31. When I'm upset, I believe that wallowing in it is all I can do.
32. When I'm upset, I lose control over my behaviors.
33. When I'm upset, I have difficulty thinking about anything else.
34. When I'm upset, I take time to figure out what I'm really feeling.
35. When I'm upset, it takes me a long time to feel better.
36. When I'm upset, my emotions feel overwhelming.



## Appendix P

### BIS-11

	Rarely/ Never	Occasionally	Often	Almost always/ Always
1) I plan tasks carefully	1	2	3	4
2) I do things without thinking	1	2	3	4
3) I make up my mind quickly	1	2	3	4
4) I am happy-go-lucky	1	2	3	4
5) I don't "pay attention"	1	2	3	4
6) I have "racing" thoughts	1	2	3	4
7) I plan trips well ahead of time	1	2	3	4
8) I am self-controlled	1	2	3	4
9) I concentrate easily	1	2	3	4
10) I save regularly	1	2	3	4
11) I "squirm" at plays or lectures	1	2	3	4
12) I am a careful thinker	1	2	3	4
13) I plan for job security	1	2	3	4
14) I say things without thinking	1	2	3	4
15) I like to think about complex problems	1	2	3	4
16) I change jobs	1	2	3	4
17) I act "on impulse"	1	2	3	4
18) I get bored easily when solving thought problems	1	2	3	4
19) I act on the spur of the moment	1	2	3	4
20) I am a steady thinker	1	2	3	4
21) I change residences	1	2	3	4
22) I buy things on impulse	1	2	3	4
23) I can only think about one problem at a time	1	2	3	4
24) I change hobbies	1	2	3	4
25) I spend or charge more than I earn	1	2	3	4
26) I often have extraneous thoughts when thinking	1	2	3	4
27) I am more interested in the present than the future	1	2	3	4
28) I am restless at the theater or lectures	1	2	3	4
29) I like puzzles	1	2	3	4
30) I am future oriented	1	2	3	4

## Appendix Q

### BSSS

	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
1) I would like to explore strange places.	1	2	3	4	5
2) I get restless when I spend too much time at home.	1	2	3	4	5
3) I like to do frightening things.	1	2	3	4	5
4) I like wild parties.	1	2	3	4	5
5) I would like to take off on a trip with no pre-planned routes or timetables.	1	2	3	4	5
6) I prefer friends who are excitingly unpredictable.	1	2	3		5
7) I would like to try bungee jumping.	1	2	3	4	5
8) I would love to have new and exciting experiences, even if they are illegal.	1	2	3	4	5

## Appendix R

### BFNE

Read each of the following statements carefully and indicate how characteristic it is of you according to the following scale:

Not at all characteristic of me = 1

Slightly characteristic of me = 2

Moderately characteristic of me = 3

Very characteristic of me = 4

Extremely characteristic of me = 5

	Not at all characteristic of me	Slightly characteristic of me	Moderately characteristic of me	Very characteristic of me	Extremely characteristic of me
1. I worry about what other people will think of me even when I know it doesn't make any difference.	1	2	3	4	5
2. I am unconcerned even if I know people are forming an unfavorable impression of me.	1	2	3	4	5
3. I am frequently afraid of other people noticing my shortcomings.	1	2	3	4	5
4. I rarely worry about what kind of impression I am making on someone.	1	2	3	4	5
5. I am afraid others will not approve of me.	1	2	3	4	5

6. I am afraid that people will find fault with me.	1	2	3	4	5
7. Other people's opinions of me do not bother me.	1	2	3	4	5
8. When I am talking to someone, I worry about what they may be thinking about me.	1	2	3	4	5
9. I am usually worried about what kind of impression I make.	1	2	3	4	5
10. If I know someone is judging me, it has little effect on me.	1	2	3	4	5
11. Sometimes I think I am too concerned with what other people think of me.	1	2	3	4	5
12. I often worry that I will say or do the wrong things.	1	2	3	4	5

## Appendix S

### Brief COPE

We are interested in how people respond when they confront difficult or stressful events in their lives. There are lots of ways to try to deal with stress. This questionnaire asks you to indicate what you generally do and feel, when you experience stressful events. Obviously, different events bring out somewhat different responses, but think about what you usually do when you are under a lot of stress.

Then respond to each of the following items by circling one number on your answer sheet for each, using the response choices listed just below. Please try to respond to each item separately in your mind from each other item. Choose your answers thoughtfully, and make your answers as true FOR YOU as you can. Please answer every item. There are no "right" or "wrong" answers, so choose the most accurate answer for YOU--not what you think "most people" would say or do. Indicate what YOU usually do when YOU experience a stressful event.

- 1 = I haven't been doing this at all
- 2 = I've been doing this a little bit
- 3 = I've been doing this a medium amount
- 4 = I've been doing this a lot

1. I turn to work or other activities to take my mind off things.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

2. I concentrate my efforts on doing something about the situation I'm in.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

3. I say to myself "this isn't real."

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

4. I use alcohol or other drugs to make myself feel better.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

5. I get emotional support from others.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

6. I give up trying to deal with it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

7. I take action to try to make the situation better.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

8. I refuse to believe that it has happened.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

9. I say things to let my unpleasant feelings escape.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

10. I get help and advice from other people.

I haven't been	I've been doing this a	I've been doing this a	I've been doing this
----------------	------------------------	------------------------	----------------------

doing this at all	little bit	medium amount	a lot
1	2	3	4

11. I use alcohol or other drugs to help me get through it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

12. I try to see it in a different light, to make it seem more positive.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

13. I criticize myself.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

14. I try to come up with a strategy about what to do.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

15. I get comfort and understanding from someone.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

16. I give up the attempt to cope.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

17. I look for something good in what is happening.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

18. I make jokes about it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

19. I do something to think about it less, such as going to movies, watching TV, reading, daydreaming, sleeping, or shopping.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

20. I accept the reality of the fact that it has happened.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

21. I express my negative feelings.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

22. I try to find comfort in my religion or spiritual beliefs.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

23. I try to get advice or help from other people about what to do.



I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

24. I learn to live with it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

25. I think hard about what steps to take.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

26. I blame myself for things that happened.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

27. I pray or meditate.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

28. I make fun of the situation.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

## Appendix T

THQ (Adapted)

### TRAUMA HISTORY QUESTIONNAIRE

The following is a series of questions about serious or traumatic life events. These types of events actually occur with some regularity, although we would like to believe they are rare, and they affect how people feel about, react to, and/or think about things subsequently. Knowing about the occurrence of such events, and reactions to them, will help us to develop programs for prevention, education, and other services. The questionnaire is divided into questions covering crime experiences, general disaster and trauma questions, and questions about physical and sexual experiences.

For each event, please indicate (circle) whether it happened **BEFORE YOU HAD BARIATRIC SURGERY, AFTER YOU HAD BARIATRIC SURGERY, or NEVER.**

#### Crime-Related Events

1. Has anyone ever tried to take something directly from you by using force or the threat of force, such as a stick-up or mugging?  
 BEFORE bariatric surgery       AFTER bariatric surgery       Never
  
2. Has anyone ever attempted to rob you or actually robbed you (i.e. stolen your personal belongings)?  
 BEFORE bariatric surgery       AFTER bariatric surgery       Never
  
3. Has anyone ever attempted to or succeeded in breaking into your home when you weren't there?  
 BEFORE bariatric surgery       AFTER bariatric surgery       Never
  
4. Has anyone ever tried to or succeeded in breaking into your home while you were there?  
 BEFORE bariatric surgery       AFTER bariatric surgery       Never

#### General Disaster and Trauma

5. Have you ever had a serious accident at work, in a car or somewhere else?  
 BEFORE bariatric surgery       AFTER bariatric surgery       Never

6. Have you ever experienced a natural disaster such as a tornado, hurricane, flood, major earthquake, etc., where you felt you or your loved ones were in danger of death or injury?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
7. Have you ever experienced a "man-made" disaster such as a train crash, building collapse, bank robbery, fire, etc., where you felt you or your loved ones were in danger of death or injury?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
8. Have you ever been exposed to dangerous chemicals or radioactivity that might threaten your health?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
9. Have you ever been in any other situation in which you were seriously injured?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
10. Have you ever been in any other situation in which you feared you might be killed or seriously injured?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
11. Have you ever seen someone seriously injured or killed?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
12. Have you ever seen dead bodies (other than at a funeral) or had to handle dead bodies for any reason?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
13. Have you ever had a close friend or family member murdered, or killed by a drunk driver?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
14. Have you ever had a spouse, romantic partner, or child die?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never

15. Have you ever had a serious or life-threatening illness?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
16. Have you ever received news of a serious injury, life-threatening illness or unexpected death of someone close to you?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
17. Have you ever had to engage in combat while in military service in an official or unofficial war zone?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never

### **Physical Experiences**

18. Has anyone, including family members or friends, ever attacked you with a gun, knife or some other weapon?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
19. Has anyone, including family members or friends, ever attacked you without a weapon and seriously injured you?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never
19. Has anyone in your family ever beaten, "spanked" or pushed you hard enough to Cause injury?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never

### **Other Events**

21. Have you experienced any other extraordinarily stressful situation or event that is not covered above?
- BEFORE bariatric surgery       AFTER bariatric surgery       Never

If yes, please specify.

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