Predictors of Bariatric Surgery Outcomes

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Table of Contents

List of Tables

Chapter 1: Literature Review

Chapter 2: Empirical Paper

List of Figures

List of Appendices.....

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Introductory Chapter: Thesis Overview

Obesity is a chronic and costly health concern and global rates continue to increase (Jones, Hardman, Lawrence & Field, 2018). Current estimates suggest that up to 1.9 billion adults are overweight and around 600 million are obese (World Health Organization, WHO, 2016). Bariatric surgery is considered to be an effective treatment in cases of severe obesity (National Institute for Health and Care Excellence, (NICE) 2014) with results showing substantial weight loss for some patients, as well as improvement or resolution in obesity-related comorbidities (Brandao et al., 2015). Despite these benefits however, surgical outcomes (even between those receiving the same procedure) can vary considerably. Figures suggest up to 20% of patients report sub-optimal weight loss or weight re-gain (Beck, Mehlsen & Stoving, 2012). Irrespective of weight loss results, variation is also found in measures of post-operative wellbeing and quality of life (Pataky, Carrard & Golay, 2011; Weineland, Lillie & Dahl, 2012).

More research is therefore currently needed to identify who will benefit most from bariatric surgery (Wimmelman, Dela & Mortensen, 2013). The existing literature suggests that the cause of unsatisfactory results is likely to be multi-factorial and includes a number of surgery related variables and individual level characteristics which cannot be modified, such as age and gender (Adams, Salheb, Hussain, Miller & Leveson, 2013; Livhits et al., 2012). The role of psychosocial factors increasingly represents an area of research interest which could not only improve patient selection, but also inform pre and post- surgical interventions to support meaningful and sustainable outcomes (Holgerson et al., 2018).

Levels of comorbidity in those seeking bariatric surgery is often high (British Obesity and Metabolic Surgery Society, 2017). Alongside a number of possible obesity-related health conditions, estimates suggest that around 40% of patients may also have a mental health diagnosis (Kalarchian et

al, 2017). Bariatric patients can therefore represent a complex population with a broad range of needs, motivations and expectations for surgery (Aarts, Hinnen, Gerdes, Acherman & Brandjes, 2013). The level of adjustment and adaptation required post-operatively can also bring a significant number of challenges (Parretti, Hughes & Jones, 2019). A better understanding of the psychological mechanisms that may influence outcomes and determine how people might cope after surgery is therefore needed, in order to ensure appropriate and effective, pre and post-operative support.

To date, literature on the psychological and social predictors of bariatric surgery outcome has largely focussed on the first 12 months after surgery (Dawes et al., 2016; Livhits et al., 2012) Studies indicate however that there may be something of a 'honeymoon period' in the first year (de zwaan et al., 2011), in which weight loss outcomes are often greatest and patients may be most likely to adhere to post-operative guidelines (Parretti, Hughes & Jones, 2019). Currently the NICE recommendation is that bariatric patients receive up to 2 years specialist support following surgery (NICE, 2014). Increasingly however the literature suggests that a number of outcomes may be more likely to emerge at least 2 years after surgery (King et al., 2012, Mistry et al., 2018).

The focus of this thesis was therefore to investigate psychosocial predictors of bariatric surgery outcome beyond 24 months post-operatively. The systematic review (chapter 1) aims to synthesise the literature on the pre-operative psychological factors associated with weight changes at least 2 years after surgery. Previous reviews in this area have largely focussed on shorter term outcomes with inconclusive and often contradictory results (Dawes et al., 2016; Livhits et al., 2012). A systematic approach to identifying and screening empirical research enabled a comprehensive coverage of the topic area. The findings suggested limited evidence for the impact of psychological factors on weight loss outcomes more than 2 years after surgery. Substantial heterogeneity across studies was found in the definitions of psychological factors and how these were measured and concerns around the potential under-reporting of psychological difficulties at pre-surgery assessments were also highlighted. This review suggests more prospective studies are needed,

possibly on a broader range of factors, in order to investigate the impact of psychological variables on longer term weight outcomes.

The empirical paper (chapter 2) focused on predictors of psychosocial outcome 24 months after surgery. More specifically it aimed to investigate which factors were most predictive of problematic alcohol use, which has been shown to occur in a small but significant number of bariatric surgery patients (Conason et al., 2013; Svensson et al., 2013). Existing research in this area has largely focussed on demographic- and surgery-related predictor variables. Much of this has supported biological theories of problematic alcohol use, explained by increased alcohol effects and metabolic changes after surgery (Bak, Siebold-Simpson & Darling, 2016). Less is currently understood about the possible psychological mechanisms underlying problematic alcohol use after bariatric surgery and why, if caused by anatomical changes, alcohol may only be an issue in a small number of patients. One growing theory is the idea of drinking in order to cope (Reaves, Dickson, Halford, Christiansen & Hardman, 2019). Although studies have begun to emerge which provide some support for this model (Yoder, Macdeela, Conway, Heary, 2017), the question of what individuals may struggle to cope with and what might predict this particular coping response remains. This study therefore sought to explore further a possible model of drinking to cope by considering possible associations between problematic alcohol use and the experience of childhood adversity and difficult life events. The decision to focus on these areas in particular was initially prompted by a gap in the research base which, to the best of the authors knowledge has not to date extended to possible links between childhood adversity and problematic alcohol use in order to cope after surgery. Motivation to focus on this area was also derived from my own clinical interest in the psychological impact of developmental trauma, which was further re-enforced by anecdotal feedback from a number of bariatric patients who had highlighted the significance of their early life experiences and care-giver attachments in their individual coping responses. The role of shame and negative body image as a possible factor in problematic alcohol use after surgery has been

highlighted (Reaves et al, 2019) and this study also therefore aimed to build on existing work by considering the role of attachment style and the possible impact of self-compassion as a potential protective factor.

Results from an online questionnaire were analysed using a multiple regression and found that both drinking to cope and time since surgery were significant predictors of problematic alcohol use at least 24 months after surgery. Clinical implications including the importance of more individualised and timely interventions pre and post-surgery are discussed, as well as the need for more longitudinal literature exploring the impact of surgery related factors and preoperative drinking behaviours and expectations.

The target journal for both papers is the Journal of Eating Behaviours. (See Appendix A for author guidelines).

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Chapter 1: Literature Review

Psychological Factors Associated with Weight Changes 24 Months After Bariatric Surgery: A Systematic Review

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Abstract

Background: Bariatric surgery is increasingly used as an effective treatment for severe obesity. However, studies have shown that between 20-30% of patients do not achieve satisfactory long-term weight loss results. Existing literature on the psychological factors that might predict weight loss outcomes has been inconclusive and largely limited to 12 months after surgery. This systematic review therefore aimed to provide a synthesis of the available literature on the pre-operative psychological factors associated with weight change at least 24 months after bariatric surgery. **Method:** Articles were identified by searching Medline, PsycINFO, Web of Science, CINAHL plus and Scopus using predefined search terms. A risk of bias assessment was also completed. Eligible studies used validated measures for pre-operative psychological factors and weight loss. A narrative synthesis of results was undertaken. **Results**: Of the 16 studies identified, 9 found an association with at least one pre-operative psychological factor and weight loss at 24 months after surgery and beyond. However, a number of the findings were contradictory and there was also substantial heterogeneity in the way that psychological factors were conceptualised and assessed across studies. **Conclusions**: The literature indicates limited longitudinal evidence that pre-operative psychological factors impact weight loss results by 24 months after bariatric surgery. This could have clinical implications for thinking about eligibility criteria for surgery and the timing of interventions to best support long-term outcomes. Clinicians may wish to consider the use of more individualised pre and post-operative assessments focussed on the impact of possible psychological factors, avoiding over reliance on diagnoses or psychometrics. The possibility of under-reporting of mental health difficulties at pre-surgery assessment is also discussed as well as the need for more research on predictors of longer-term bariatric surgery outcomes.

Keywords: systematic review, bariatric surgery, psychological factors, weight-loss, adults

Introduction

Obesity is increasingly considered an 'escalating, global epidemic' (World Health Organisation, (WHO), 2014). Often classified using Body Mass Index (BMI) cut-offs, obesity is typically defined as a Body Mass Index (BMI) ≥ 30kg/m^2 and severe obesity as a BMI ≥40kg/m^2. It is estimated that 26% percent of adults in the UK were classified as obese in 2016 (National Health Service, (NHS), 2018). Obesity is a significant risk factor for chronic diseases such as type-2 diabetes, cardiovascular disease and a number of cancers (Bordignon, Aparicio, Bertoletti & Trentini, 2017). It also carries substantial social and economic costs with an estimated 617,000 obesity-related, hospital admissions in the UK between 2016-17 (NHS, 2018).

The use of bariatric surgery in cases of severe obesity is increasing (Buchwald & Oien, 2011; Ruffault et al., 2018). According to the UK National Bariatric Surgery Register (NBSR, 2017), there were 21,436 operations conducted in the UK between 2015-2017, of which 76.2% were funded by the NHS (Welbourn, Sareela, Small & Summers, 2014). Over 75% of weight loss surgery patients were female, with Roux-en-Y Gastric Bypass surgery (RYGB) the most commonly used procedure, followed by sleeve gastrectomy and gastric band (NBSR, 2017). Considered an effective treatment for severe obesity (Freid et al., 2013), success in bariatric surgery is typically defined as >50% of Excess Weight Loss (EWL). The benefits of surgery can also include a reduction in obesity-related comorbidities and longer-term healthcare cost savings (Adams, Salhab, Hussain, Miller & Leveson, 2013; O'Brien, McPhail, Chaston & Dixon`, 2006). Bariatric surgery has been indicated as particularly effective in patients with type 2 diabetes and a BMI >35kg/m^2 (NHS Commissioning Board, 2018). Current eligibility criteria for surgery in the UK includes a BMI over 40 or a BMI over 35 with an obesity related condition. Prospective patients must also have first attempted weight loss using non-surgical approaches (NHS, 2017).

Despite its efficacy, studies have shown there can be considerable variation in the level of weight change achieved, even between patients receiving the same procedure (Beck, Mehlsen & Stoving, 2012). Indeed, it is estimated that up to 15-20% of bariatric patients fail to achieve satisfactory results, either in terms of suboptimal weight loss, or substantial regain of initial weight (Maggard et al., 2005). Surgical outcomes are difficult to predict (Sarwer, Dilks & West-Smith, 2011), however poor results are associated in some patients with an increase in depression-related symptoms, anxiety and poor eating behaviours (Marek, Lavery, Heinberg, Merrel-Rish & Ashton, 2016). Dissatisfaction with surgery has also been shown to have a negative impact on patient quality of life, body image and self-efficacy (Nickel et al., 2017).

There is a growing need therefore, to identify predictors of weight loss after bariatric surgery, not only to improve overall patient outcomes, but to inform processes of patient selection and preparation, as well as effective follow-up and post-surgery support (Marek et al., 2016). Existing research demonstrates that surgical weight loss outcomes are largely multifactorial, influenced by a number of variables including individual and surgery-specific factors (Livhits et al., 2012). Pre-operative weight loss, surgery type and pre-surgery BMI, have all been shown to have a significant impact on bariatric outcomes (Pournaras & Le Roux 2009). There is also some evidence for the importance of demographic factors such as gender, age and ethnicity (Adams et al., 2012). However, the role of individual pre-operative psychological characteristics and behaviours, has increasingly been emphasised as a much-needed area of research (Livhits et al., 2012). These variables may be of particular interest in representing potentially modifiable factors which could be targeted as part of pre and post surgery interventions.

Psychological factors associated with weight loss outcomes following bariatric surgery

Studies of personality traits in bariatric candidates present this patient group as very heterogeneous (Claes, Vandereycken, Vandeputte, & Braet, 2013). The prevalence of mental health diagnoses and comorbidity in this patient group compared to the general population is high, with rates estimated at around 40% (Kalarchian et al., 2017). Amongst these, mood disorders (predominantly depression), anxiety and eating disorders are the most common (Bordingnon, Aparicio, Bertoletti & Trentini, 2017). A number of studies have investigated links between pre-operative psychological factors and poor weight outcomes. These have included studies on personality traits such as high neuroticism (Canetti, Berry & Elizur, 2009) and lack of motivation (de Zwaan et al., 2011), as well as anxiety, depression and other psychiatric diagnoses (Kinzl et al., 2006). However, published findings to date have been contradictory. Studies of the relationship between eating disorders and weight loss outcomes demonstrate mixed results (Niego, Kofman,Weiss & Geliebter, 2007) with the evidence for the association between weight loss and depression also seemingly varied (van Hout, Verschure & van Heck, 2005).

A systematic review on predictors of post-operative weight outcomes (Livhits et al., 2012), considered the role of pre-operative psychiatric diagnoses and maladaptive eating behaviours as well as BMI, marital status and previous weight loss. According to Livhits et al., (2012), personality disorder was the only diagnosis associated with weight loss outcomes. However, out of 102 papers reviewed, only a small proportion of these (14%), reported on results from greater than 1-year post surgery. A further review by Dawes et al., (2016) on the prevalence of mental health conditions in bariatric surgery samples found no association between weight loss after surgery and mental health diagnoses. This study looked exclusively at studies with large sample sizes (>500), results again varied significantly in length of follow

up and due to inclusion criteria around very specific clinical cut offs, did not include any studies on maladaptive eating habits.

Limitations of existing literature

Numerous methodological limitations have been identified in previous literature on psychosocial predictors of bariatric weight outcomes (Adams et al., 2013). Most notable is the wide variety of measures used to assess both weight loss and psychological variables (Livhits et al., 2012). Discrepancies also exist in the timing of assessments prior to surgery, with great variation in clinical cut-offs for diagnoses, and the use of current versus lifetime mental health status. Changes to diagnostic criteria also pose another challenge. For example, Binge Eating Disorder (BED) was only added to The Diagnostic and Statistical Manual of Mental Disorders (DSM-V) in 2013 (5th Edition; American Psychiatric Association, 2013). The growing literature around obesity has led to increased interest in sub-categories of eating behaviours such as objective and subjective binge eating (Meany, Conceição & Mitchell, 2014) and the relationship between emotional regulation and eating to cope (Micanti et al., 2017). Other studies have highlighted the limitations of an evidence base that draws predominantly on diagnostic categories to assess psychological variables, arguing that this does not always best account for individual presentations, comorbidity, severity of symptoms and impact on functioning (Marek, Ben-Porath, Ashton & Heinberg, 2015)

Finally, results so far have been largely limited to short term follow up. Research indicates that weight loss variability often occurs at least 18-24 months post-surgery (Sjöström et al., 2004). Bariatric patients are often required to follow strict post-surgery guidelines in the first year after surgery and adherence is often greatest in this period as patients remain under specialist services for the first 2 years (Mechanick et al., 2013). Issues that may impact weight loss such as emotional eating and increased grazing are also most

likely to re-emerge after at least the first 12 months (Courcoulas et al., 2015). To date however studies have largely focused on short-term outcomes of up to 12 months or less.

Current context and clinical implications

The National Institute for Health and Care Excellence (NICE) obesity guidelines recommend all patients seeking bariatric surgery receive a pre-surgery, psychological assessment, as well as up to 2-years post-surgery follow-up support services (NICE, 2014). The scope and format of this provision however is not currently standardised across service providers (Mahony, 2011). Eligibility requirements for surgery have been found to vary across the UK (Ogden, Hollywood & Pring, 2015) with exclusion criteria in regard to psychological variables, often determined by an individual service, surgeon or commissioner (Flores, 2014).

A better understanding of the impact of psychological factors on weight loss outcomes at least 24 months after bariatric surgery is therefore urgently needed. Improved understanding of their significance could not only reduce unnecessary exclusions but improve the psychological support available both before and after surgery. This could help to inform interventions that are sufficiently individualised and timely, to effectively support positive outcomes.

Aims

This review aims to provide a comprehensive overview of the literature on the pre-operative psychological factors associated with weight change at least 24 months after bariatric surgery. In so doing, it will draw on techniques similar to those used by Livhits et al., (2012) which looked at both psychiatric diagnoses and maladaptive eating behaviours while also broadening the definition of psychological predictors to include non-diagnostic

variables. More specifically it will aim to build on the work of previous reviews by investigating the impact of psychological factors on medium term weight outcomes, at least 2 years following surgery.

Method

Pre-registration of review protocol

The review protocol was pre-registered with the International Prospective Register of Systematic Reviews (PROSPERO) with the registration number CRD42019127305.

Search strategy

The electronic databases PsycINFO, Medline, CINAHL Plus, SCOPUS and Web of Science were searched for journal articles by the primary reviewer (SC) from the date of inception to January 2019. The search terms combined with Boolean operators are shown in Table 1.

A three-stage screening process was used to review identified articles. Titles were initially screened and those that were evidently unsuitable were excluded at this stage. This included the identification and removal of duplicates. The remaining abstracts were then reviewed and excluded where appropriate. A sample of the results were screened by an independent reviewer to ensure consistency in selection and discrepancies were resolved through discussion. A full text screen of all selected articles was then conducted by the primary reviewer to confirm eligibility (a sample of full text articles was again independently reviewed to ensure consistency). The references of eligible articles and relevant review papers were manually searched for papers that might have been missed. This yielded a further 4 articles, two of which were included in the final review. Any unresolved disagreements around

eligibility were arbitrated by the review team until consensus was reached. Searches were repeated in May 2019 to check for any further published articles.

Table 1 Search Terms

Bariatric surgery search terms	**S1 =** bariatric surgery OR bariatric* OR gastric* OR gastric surgery OR weight loss surgery OR weight reduction OR obesity surgery OR biliopancreatic diversion OR laparoscopic band OR lap band OR gastric band OR gastric sleeve OR gastric bypass OR gastroplasty OR sleeve gastrectomy OR duodenal switch
Psychological predictors search terms	**S1 AND S2** = psychological predictors OR psychol* OR psychiat* OR eating disorder OR eating behaviours OR eat* OR bulimia nervosa OR anorexia OR maladaptive eating OR binge eating OR anxiety OR depression OR mood OR interpersonal OR relationships OR depressive disorder OR anxiety disorder OR low self -esteem OR self-efficacy OR responsibility OR motivation
Weight change search terms	**S1 AND S2 AND S3**= Body Mass Index OR weight loss OR excess weight loss OR weight gain OR weight change

Inclusion and exclusion criteria

Given the high variability in how psychological factors are defined in the literature, a broad definition was used for the purposes of this review in order to capture all relevant studies. ‘Psychological factors’ were therefore taken to include studies which examined the association of clinical diagnoses with weight change, as well as sub-clinical personality and behavioral traits. This review focused predominantly on pre-operative psychological factors

assessed at the point of surgery. However, some studies also provided data on historical or lifetime psychological factors identified prior to surgery and therefore when available this was also included. Studies using data obtained from health records were considered eligible if information was provided on the validity of measures/criteria used to assess/diagnose. Studies and data on alcohol and/or substance abuse however were not included. The reasons for this were that individuals presenting with current substance misuse are usually either excluded from surgery or are required to attend treatment and demonstrate 12 months of abstinence. Data is therefore often restricted to historical use and retrospective account (Mechanik et al., 2013). Furthermore, the impact of alcohol and substance use pre- and post-operatively on weight loss outcomes is debated in the literature and complicated by metabolic changes brought about by surgery along with the calorific content of alcohol which can complicate weight results (Wee et al., 2014). Finally there continues to be debate across the addictions literature as to whether alcohol and substance misuse should be defined exclusively as a psychological variable with many theories emphasising biological underpinnings and the complex interaction of social, psychological and physical factors impacting a wide variety of addiction behaviours and how they are defined (Munafo & Albany, 2006). Although all databases were initially searched from inception it was later agreed amongst the review team that only studies published after 2010 would be included to avoid duplication with the results found in Livhits et al's., (2012) comprehensive review. A summary of inclusion and exclusion criteria is shown in Table 2.

Final study selection

The systematic study selection led to 16 studies deemed eligible for review. The search flow diagram is outlined in Figure 1. The PRISMA guidelines (Moher, Liberati,

Tetzlaff & Altman, 2009) for reporting items in a systematic review were drawn upon throughout (See Appendix B).

Data extraction

Relevant information was extracted from the selected studies and compiled into customised tables designed by the author (Tables 3 and 5). Only data relevant to the aims and scope of this review were included.

Table 2 Inclusion and Exclusion criteria

Inclusion criteria	• an adult sample (>18 years) of participants who had undergone weight loss surgery • studies measuring weight change using validated and established measures • studies measuring psychological predictors using validated measures • quantitative studies using a prospective or retrospective design with a follow up period of at least 24 months
Exclusion Criteria	• Studies with follow up periods of less than 24 months • cross sectional studies, case reports, reviews, interviews, opinion pieces or newspaper articles, unpublished articles • qualitative research • studies with children (<18 years), animal studies or a non-weight loss surgery sample • studies on the impact of alcohol and drug use

Risk of bias

Included studies were assessed using The Agency for Research and Healthcare Quality Assessment tool (AHRQ) (Williams, Plassman, Burke, Holsinger & Benjamin, 2010); Appendix C) and elsewhere (Forrester, Slater, Jomar, Mitzman, & Taylor, 2017; Manning et al., 2017). This assessment can be adapted to a specific context and thus items relevant to this review were selected. The tool provided a quality rating of specific elements within each included paper. Quality assessment of extracted data and analyses was initially completed by the primary reviewer and then combined with the results obtained by a second reviewer. Discrepancies in quality appraisal were resolved through a discussion with the research team.

Analysis

Due to the wide variety of measures and psychological variables measured, aggregation of effect sizes would be limited by high heterogeneity and low precision (Manning, Dickson, Palmier-Claus, Cunliffe & Taylor, 2016). Meta-analysis was therefore not considered appropriate. The results were synthesised narratively and grouped according to psychological predictor investigated. Where available, multivariate statistics were given precedence over bivariate results.

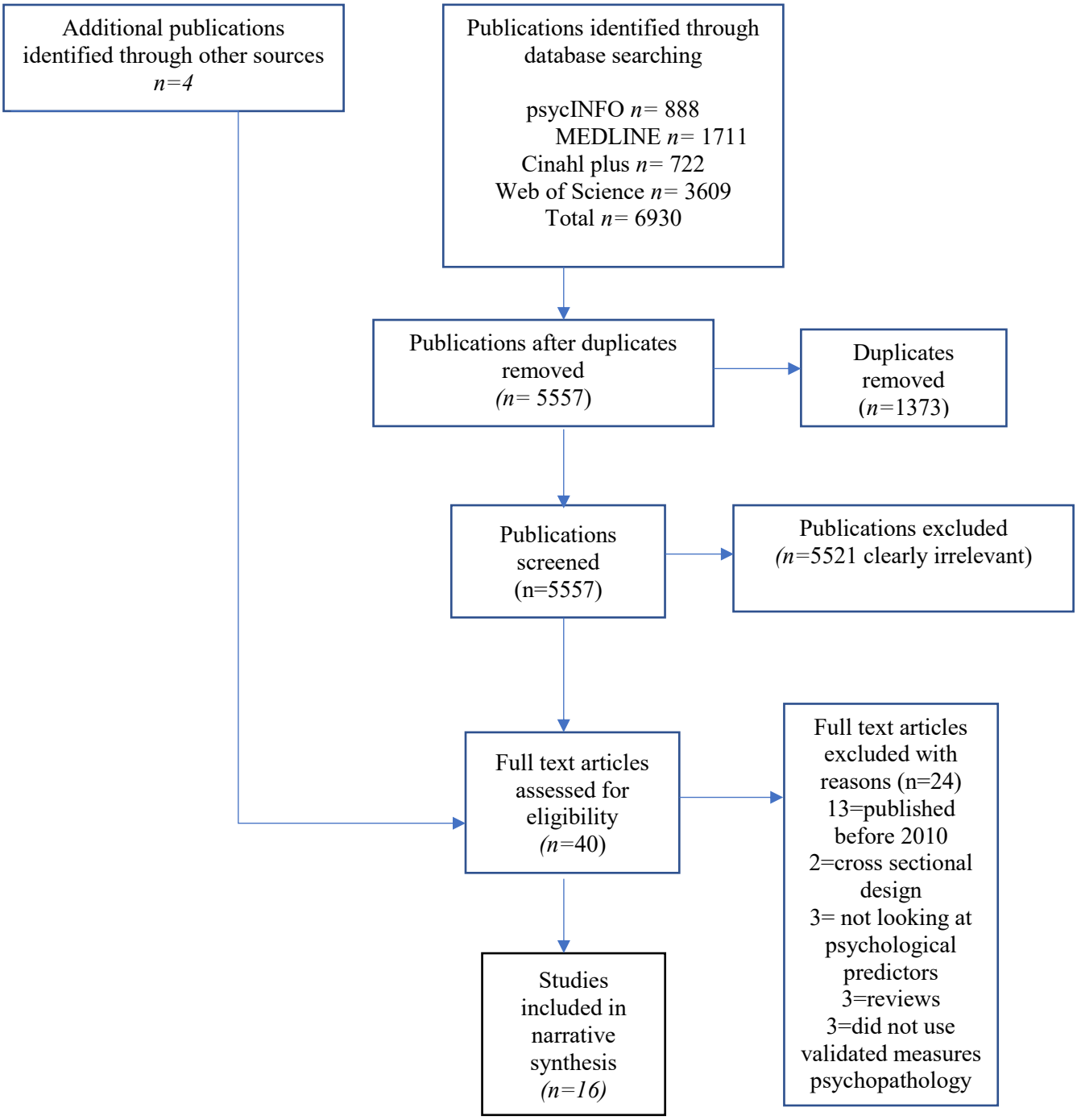

Figure 1 Flow diagram of study selection based on the PRISMA guidelines

Results

Description of the selected studies

An overview of study characteristics and relevant extracted data can be found in Table 3. The 16 included studies were published between 2011-2017 with sample sizes ranging from 60-446 (N = 3331). Samples were derived from 10 different countries (USA, Norway, Sweden, Netherlands, Australia, Germany, Spain, Portugal, Canada and Switzerland). Fourteen of these were prospective in design and 2 were retrospective. The majority of articles reported on Roux-en-Y gastric bypass (RYGB), vertical sleeve gastrectomy (VSG) and laparoscopic adjustable gastric band (LAGB). Mean age ranged from 36 – 48 years and all studies were made up of ≥ 70% female participants with one exception (Ames et al., 2017). Mean baseline BMI was between 36.2 kg/m^{2}and 55 kg/m^2.

The majority of studies reported on more than one pre-operative psychological predictor. Thirteen of the studies reported on eating disorders and maladaptive eating habits. Nine studies reported on both depression and anxiety and 3 further studies reported only on depression. Three studies included other mental health diagnoses and 4 studies reported on other psychological factors. Three studies included historical and lifetime diagnoses but the remainder (n=13) looked at the presence of current psychological predictors at the point of assessment for surgery.

Measures of weight change

Weight changes were measured across the studies using 4 different metrics. The main measures used were percentage total weight loss (%TWL) (7 studies) and percentage excess weight loss (%EWL) (6 studies). The latter describes the percentage of weight loss relative to an ‘ideal’ which is defined by the weight corresponding to a BMI of 25 (American Society for Metabolic and Bariatric Surgery, (ASMBS), 2015). One study looked at percentage

excess BMI loss (%EBMIL) as well as %TWL(de Zwaan et al., 2011). Another reported on change in BMI (de Man Lapidoth, Ghaderi, & Norring, 2011)and a final study looked at both change in BMI and %TWL (Morseth et al., 2016). Three studies accepted self-reported weight measurements (de Man Lapidoth et al., 2011; Devlin et al., 2016; Kalarchian, Levine, & Marcus, 2013) .

Risk of bias assessment

The risk of bias assessment for each study is presented in Table 4. Many of the studies included had small samples (5 studies had a participant sample below 100). This increases the likelihood that studies were underpowered and therefore the probability of a type-II error. Over half the studies had attrition rates of over 30% at follow up. The majority used convenience or consecutive sampling and only one study justified their sample with a power calculation (Devlin et al., 2016). Two studies provided only limited information on results found(Chao et al., 2017; Morseth et al., 2016).

Table 3 Characteristics of Included Studies

Author (Year) Country	**Design**	**Type of surgery**	**Study N at recruitment**	**Mean age years (SD)**	**% female**	**Follow up (mo)**	**Weight loss measure/Pre-surgery BMI (SD)**	**Psychological predictors reported**
Aguera et al., (2015) Spain	Prospective	GBP BPD/DS VSG LGP	139 (information on rates of attrition not given)	40.6 (10.3)	78% females	6 12 18 24	Mean %EWL (Successful weight loss defined as at least 50% of excess body weight) 46.3 (6.4)	Clinical Psychopathological and personality predictors
Ames et al., (2017) USA	Retrospective (looking back through database)	RYGB VSG	422 72 lost to follow up and excluded	RYGB n= 305 48 years Range 22-75 VSG N= 117 48 years 23-70	100 % males	12 24	%TWL 45.3 (5.3)	Mood/depression Anxiety Binge eating disorder Night eating syndrome Food addiction
Chao et al., (2016) USA	Prospective observational	RYGB LAGB	48 recruited with BED and 56.3% (27) completed measures at 24 months 80 recruited without BED and 62.5% (50) completed measures at 24 months	Surgery non-BED 43.8 Surgery BED 46.9	83% females 73% females	24	% TWL Non - BED 49.5 (BED)49.3	BED
Conceição et al., (2017) Portugal	Prospective Longitudinal	LAGB RYGB	100 39 lost to follow up/no longer eligible at 24 months	44.66 (9.92) 37.06 (7.43)	85.2% females	Mean 25.57 months Mean 26.08 months	%TWL 44.95 (6.8) 47.24 (3.53)	Problematic eating behaviours (Loss of control eating, picking/nibbling, grazing)
Devlin et al., (2016) USA	Prospective	RYGAB LAGB Large band LAGB small band	183 14 lost to follow up	46	83% female	12 24 36	%TWL (Self-reported weight accepted) 45.1	Eating pathology/maladaptive eating

de Lapidoth et al., (2011) Sweden	Prospective	GBP GB VNG BPD/DS	173 recruited Data was only available for 130	40.6 (9.2)	78% female	36	Change in BMI Included some self-reported weight 45.8	Binge Eating
de Zwaan et al., (2011) Germany	Prospective	GB GBP	107	37.5 (9.7)	70% female	6-12 months 24-36 months	%TWL %EBMIL 49.4	Current and lifetime anxiety and depressive disorders
Hayden et al., (2014) Australia	Prospective Observational	LAP-BAND AP®	271 invited 228 took part 200 had surgery 74% completed all measures at follow up 12.5% (25) partially completed measures 12.5% (25) lost to follow up	45.18	Baseline: 82.4% female Follow up 81.3% female	24 months	% EWL 42.7	Axis I Disorders (SCID)
Kalarchian et al., (2016) USA	Prospective	RYGB LAGB	199 recruited (34 lost to follow up) Follow up 165	Median age 46	81.1% female	24 36	% TWL (Included self - reported weight) 44.8	Axis I Disorders
Lanza et al., (2013) Switzerland	Retrospective (Records of questionnaires completed)	LRYGB	98 and then 58 at follow up	38.5 (9)	100% female	Approx. 36 months	%EWL 46.9	Anxiety Depression Eating Disorders
Marek et al., (2016) USA	Prospective	RYGB	451 records available 446 available for analysis	46.75 (11.63)	74.2% female	60	% EWL 49.14 (9.5)	Depression Panic Generalised Anxiety Disorder Anxiety disorders BED
Morseth et al., (2016) Norway	Prospective Longitudinal Randomised Controlled Study	RYGB BPD/DS	60 3 participants had missing data	35.6 (6.2)	70% female	6 12 24 60	Reduction in BMI units kg/m^2 Total weight loss (kg)	Eating Disorders

							Percentage of body weight loss 55.0 (3.3)	
Sockalingham et al., (2017) Canada	Prospective cohort study	SG LYRGB	277 recruited 56.3% (156) completed 2 year follow up	45.23 (9.30)	81% female	12 24	% TWL 50.43 (8.77)	Past history of psychiatric illness Anxiety Depression
Weineland et al., (2015) Sweden	Prospective Longitudinal Observational Study	GBP SG	186 patients invited 35 analyses	42.2 (9.3)	92% female	6 24	% EBMIL 36.2 (3.6)	Emotional over-eating Experiential avoidance Depression Anxiety
Wezenbeck et al., (2016) Netherlands	Prospective	VBG	98 invited 71.4% (70) followed up	39.4 39.3	85.5% female 94% female	6 12 24	% EWL Failed patients (<50% EWL) 46.4 Successful patients (>50%) 44.3	Eating Disorder Personality
White et al., (2015) USA	Prospective	GBP	357 85% completed 6-month follow up (303) 80% completed 12-month (n=285) 47% completed 24 months follow up (n= 167)	43.7 (10)	86% female	6 12 24	% TWL 51.2 (8.3)	Depressive symptoms Eating Disorder psychopathology

BMI= Body Mass Index, %EBMIL = percentage excess BMI Loss, %EWL = percentage excess weight loss, %TWL= percentage total weight loss
Type of surgery: BPD/DS= Biliary Pancreatic Diversion with Duodenal Switch, GB= Gastric Banding, GBP= Gastric Bypass, LAGB= Laparoscopic Adjustable Gastric Banding LGP = Laparoscopic gastric plication, LRYGB= Laparoscopic Roux-en-Y gastric bypass, RYGB= Roux-en-Y gastric bypass, SG= Sleeve Gastrectomy, VBG= Vertical Banded Gastroplasty, VSG= Vertical Sleeve Gastrectomy
Psychological Predictor: BED= Binge Eating Disorder

Fourteen studies recruited from either a single hospital site or 2/3 sites in one geographical area with only 2 using multi-site cohorts (Ames., 2017; Sockalingam., 2017). This may have introduced both sampling and selection bias as well as cohort effects around ethnicity or socio-economic status. Apart from one study (which had 100% male sample) (Ames et al., 2017), all studies had more than 70% female participants. This however is common across research in this area and is representative of the bariatric surgery population (NBSR, 2017).

Both surgery type and pre-operative BMI are known predictors of weight loss post-surgery (Clark et al., 2013). Ten studies controlled for pre-operative BMI and 7 for bariatric surgery type. Fourteen of the studies used a prospective design and had completed appropriate analysis including accounting for missing data.

Studies used a mixture of self-report measures and semi-structured interviews to assess psychological variables. Three studies used a combination of both (Conceicao, et al., 2017; de Lapidoth et al., 2011; Marek et al., 2017). The literature is mixed in terms of which is considered most reliable in this area for this population. Although interviews may introduce researcher related bias, self-report measures are also impacted by social desirability (Herbert, Clemow, Pbert, Ockene & Ockene, 1995). Only one study gave a clinical cut off for a measure used (White et al., 2015).

One concern raised in the literature regards the reliability of data due to the possibility of under-reporting in pre-surgery screening assessments. Only two studies made it explicit that their psychological assessment had been conducted separately from their pre-surgery evaluation and kept confidential (Devlin et al., 2016; White et al., 2015)

Author (year)	Unbiased selection of the cohort	Sample Size calculated	Adequate Description of the cohort	Validated method for recording weight loss	Validated method for ascertaining psychological predictors	Psychological assessment independent and confidential	Missing Data	Analysis controls for confounding	Analytic methods appropriate
Aguera et al., (2015)	Partially	No	Yes	Yes	Yes	N/A	Cannot tell	Partially	Yes
Ames et al., (2017)	Partially	No	Yes	Yes	Yes	N/A	Partially	Yes	Yes
Chao et al., (2016)	Yes	No	Yes	Partially	Yes	N/A	No	Yes	Yes
Conceição et al., (2017)	Yes	No	Yes	Yes	Yes	No	Yes	Yes	yes
Devlin et al., (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
de Lapidoth et al., (2011)	Yes	No	Yes	Partially	Partially	No	Partially	Partially	Partially
de Zwaan et al., (2011)	Partially	No	Partially	Yes	Yes	Cannot tell	Partially	Yes	yes

Hayden et al., (2014)	Yes	No	Yes	Yes	Yes	Partially	Partially	Yes	Yes
Kalarchian et al., (2016)	Yes	No	Yes	Yes	Yes	Partially	Yes	Yes	Yes
Lanza et al., (2013)	Partially	No	No	Yes	Partially	N/A	No	Yes	Yes
Marek et al., (2016)	Yes	No	Yes	Partially	Partially	Cannot tell	Yes	Yes	Yes
Morseth et al., (2016)	Partially	No	Yes	Yes	Partially	Cannot tell	Cannot tell	Partially	Partially
Sockalingham et al., (2017)	Yes	No	Yes	Yes	Yes	No	Cannot tell	N/A	Yes
Weineland et al., (2015)	Partially	No	Partially	Yes	Yes	Cannot tell	Partially	Cannot tell	Yes
Wezenbeck et al., (2016)	Partially	No	Partially	Partially	Partially	N/A	Partially	Cannot tell	Partially
White et al., (2015)	Yes	No	Yes	Partially	Yes	Yes	Partially	Partially	Yes

Two further studies had offered a separate assessment but did not indicate whether this was shared with the surgery team (Hayden et al., 2014; Kalarchian et al., 2016). One study accounted for this using the MMPI-2-RF and found an underreporting response in 38.1% of the sample (Marek et al., 2017).

Psychological factors associated with of weight change 24 months after surgery

The results of the selected studies are presented in Table 5. The measures used for each predictor are also included.

Mood and Anxiety Disorders

A range of measures and methods were used to assess mood and anxiety across the included studies. Eight studies used self-report questionnaires. Two (Aguera et al., 2015; van Wezenbeek, van Hout, & Nienhuijs, 2016) used the Symptom-Checklist 90 Items-Revised (SCL-90-R) to measure psychological distress and psychopathology. One study used the Depression, Anxiety and Stress Scale (DASS-21)(Weineland, Brogie, & Dahl, 2015) and another used the Hospital Anxiety and Depression scale (Lanza et al., 2013). Two studies used the Patient Health Questionnaire-9 (PHQ-9) for depression and the Generalized Anxiety Disorder-7 (GAD-7) to measure anxiety (Ames et al., 2017; Sockalingam et al., 2017). Two studies used the Beck Depression Inventory (BDI; Revised edition) (Conceicao et al., 2017; White et al., 2015).

Five out of the 11 studies used interviews conducted by clinical psychologists/psychiatrists to assess mental health status. This included the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) Axis I Disorders (SCID) (Hayden et al., 2014; Kalarchian et al., 2016). This interview differentiated between different anxiety and mood diagnoses including post-natal

depression and Post Traumatic Stress Disorder (PTSD). A fourth study used a semi-structured interview looking at past and present diagnoses based on Diagnostic and Statistical Manual _ Fourth Edition _ Text Revision (DSM-IV-TR). A final study (Sockalingam et al., 2017) also used the Mini International Neuropsychiatric Interview (MINI).

Summary of findings

Nine studies reported on potential associations between pre-operative mood and anxiety disorders and weight changes after bariatric surgery. Two further studies looked exclusively at depression/depressive features without anxiety (Conceição et al., 2017; White et al., 2015). Of these 9, only 3 found associations with weight loss outcomes. One found that a history of a mood disorder (but not current depressive symptoms) was a significant predictor of greater weight loss after 24 months (β = -5.06, p= 0.047) (Sockalingham et al., 2017). This was the only study to find a positive association. In a second study mixed models analyses found that a lifetime anxiety disorder was associated with poorer weight loss (point estimate -8.45, 95% CI-16.87,-0.03, p = 0.049) at 24 months (de Zwaan et al., 2011). This was also the case for a comorbid diagnosis of anxiety and mood disorder when gender, age, surgery type and pre-operative BMI was controlled for (lifetime - point estimate = -10.61, 95% CI, -19.42, -1.79, p= 0.018,) and (current, point estimate = -12.64, , 95%CI, -22.83, -1.45, p = 0.03,). Current depressive disorders in this study were significantly associated with a lower degree of weight loss at 24-36 months (p = 0.001) for %TWL and p = 0.002 for %EBMIL) despite this not being evident at 6-12 months.

Table 5 Results from included studies

Author, (Year)	Overall Study Aim(s)	Psychological variables investigated (measures used)	Analyses	Control variables	Summary of main findings	Results
Aguera et al., (2015)	(1) To assess the weight loss and the comorbidities remission in severely obese patients following BS and (2) To assess and identify clinical, psychopathological and personality predictors of short-term treatment outcome (regarding %EWL and metabolic conditions), after controlling for relevant variables, such as type of BS.	Eating Disorders (EDI-2) Psychological distress and psychopathology (SCL-90) Temperament and character dimensions (TCI-R) Impulsiveness (BIS-11)	Generalized estimated equations were used to estimate the best predictive models for the course of %EWL levels	Type of surgery	Good outcome (%EWL>50%) after surgery associated with: higher TCI-R: cooperativeness scores	$\beta = 0.049$ $X^2 = 4.628$ P = 0.022 Odds Ratio: 1.05 Confidence interval (1.00, 1.10)
Ames et al., (2017)	This study sought to determine psychological correlates that may influence weight loss outcome differentially by surgery type.	Depression (PHQ-9) Anxiety (GAD-7) Binge Eating (QEWP-R) Night eating (LABS-2) Food addiction (YFAS)	Multivariate linear regression models (conducted separately for RYGB and VSG patients Multivariable models were adjusted for the clinic site as well as any variable that was associated	Demographic variables Type of surgery	No psychological correlates were significantly associated with weight loss outcomes	Not significant

			with the given outcome with a p value of 0.05 or lower in single-variable (i.e., unadjusted) analysis. For the linear regression analyses (primary study analysis), a Bonferroni correction for multiple testing was used separately for each surgery type, after which p values of 0.0031 or lower were considered statistically significant. p values of 0.05 or lower were considered as statistically significant in all remaining analyses.		
Chao et al., 2016	A previous study reported that pre-operative binge-eating disorder (BED) did not attenuate weight loss at 12 months after bariatric surgery. This report extends the authors' prior study by examining weight loss at 24 months.	Binge Eating Disorder (EDE-Q) abbreviated version to diagnose BED Binge eating EDE	Changes in weight measured using Linear mixed effects models One-way analyses of variance and Fisher's exact tests to examine 24 -month differences between groups in categorical weight loss and BED Two tailed p value of <0.05	Initial BMI, type of surgery, age, gender, ethnicity, and presence of type 2 diabetes	At month 24 participants diagnosed with BED lost a mean of 18.6% (+/- standard error 2.3%) of baseline weight which was significantly smaller (p = 0.049) than the 23.9% (+/- standard error 1.6%) lost by surgery patients without BED A significantly greater percentage of the non-BED than BED surgery patients lost >20% of initial There were no significant differences between groups in the percentage of participants who lost >5% or >10%

			Exploratory analysis using linear mixed effects			
Conceição et al (2017)	How stable are LOC and picking and/or nibbling from the pre- to post-operative periods? Do patients with pre-operative LOC develop picking and/ or nibbling postoperatively? Are pre- or post-operative PEBs and associated psychological variables predictors of weight loss and weight regain? Are pre- or post-operative PEBs predictors of different weight loss trajectories after surgery?	Problematic Eating Behaviours (PEBs) (Threshold = at least once a week in previous 3 months) (EDE) Diagnostic items of EDE used (EDE-Q) Total score used in analysis Depression BDI (items 18 & 19 removed to account for somatic symptoms)	Generalized linear models Predictors of weight loss (likelihood ration *x^2=28.8, P<.000)* Predictors of weight regain Chi Square was calculated to test differences between the proportion of patients presenting with problematic eating behaviours and regain Generalized estimating equations with growth curve analyses were used to investigate changes over time in % TWL	Type of surgery Time elapsed since surgery Age Pre-operative BMI Type of surgery Age Pre-operative BMI	Pre-operative PEBs were significant predictors of weight loss Pre-operative PEBS not significant predictors of weight gain Nonsignificant interaction effects with pre-operative PEBs suggesting that patients with and without PEBs preoperatively have similar weight loss trajectories over time	β= 6.301 Wald X^2 = 5.823 P=0.016 Not significant
Devlin et al., (2016)	To examine eating pathology and experiences and their associations with pre- to post-surgery weight loss in a cohort evaluated prior to undergoing bariatric surgery	Eating Disorders (EDE- BSV)	Linear mixed models With a sample size of 183, there was 80% power to detect an association with	Age Ethnicity Rates of diabetes, co-morbidity, ischemic heart disease	There was no statistically significant association between pre-surgery eating pathology or experience and post- surgery weight at years 1, 2 or 3	Not significant

	and followed prospectively for 3 years		independent variables that accounted for at least 2% of the variance in weight loss, controlling for covariates with an R^2 of 0.40. Nonsignificant eating pathology and experience variables were eliminated via backwards elimination Statistical significance set at p<0.05			
de Zwaan et al., (2011)	To examine -if prevalence of current anxiety and depressive disorders as assessed with Structured Clinical Interviews (SCID-I) decreased 6–12 months (T1) and 24–36 months (T2) after bariatric surgery -if pre-operative current and lifetime anxiety and depressive disorders would predict post-operative anxiety and depressive disorders -if weight loss would be a function of pre-operative and post-operative anxiety and depressive disorders.	Current and lifetime anxiety and depressive disorders (German version of the (SCID))	Point prevalence rates of depressive and anxiety disorders between different time points were compared using McNemar test for paired samples. Series of linear regression analyses conducted to test hypothesis that wight loss at T1 and T2 could be predicted by baseline anxiety and depression	Gender Age Type of Surgery Initial BMI	In linear regression pre-operative lifetime and current anxiety and depressive disorders did not significantly predict weight outcomes at any follow-up assessment point However mixed models analyses showed that: patients with lifetime anxiety disorders and patients who exhibited both depressive and anxiety disorders (current and lifetime) at baseline lost significantly less weight after surgery	Not significant Lifetime anxiety disorder Point estimate = -8.45 CI (-16.87, -0.03) P= 0.049 Anxiety and Depressive Disorders Lifetime Point estimate = -10.61 CI (-19.42, -1.79) P = 0.018 Current Point estimate = -12.64

						CI = (-22.85, -1.45) P=0.026
					The presence of an anxiety disorder was not associated with the degree of weight loss at either time point	Not significant
Hayden et al., (2014)	To measure the rates of psychopathology in a bariatric surgery population prior to surgery and 2 years post-operatively, to examine if pre-operative psychopathology predicts weight loss at 2 years and to measure the change in psychopathology at 2-years of follow-up.	Axis I disorders (SCID)	ANOVA and repeated measures ANOVA Mann-Whitney test *U* test and Fisher's exact test (non-normal data)	BMI Age Gender Marital status Education	No significant differences in % EWL at 2 years between those with and without a preoperative axis I disorder	Not significant
Kalarchian et al., (2016)	To document changes in psychiatric disorders at 2 and 3 years after surgery and examine the relationship between psychiatric disorders and post-surgery weight loss.	Axis I disorders (SCID)	Linear mixed models multivariable analysis Statistical sig set at p<.05	Age Race Pre-surgery BMI Type of surgery Surgery Site	No current or lifetime diagnoses were not significantly related to percentage weight change at 2 or 3 years	Not significant
Lanza et al., (2013)	To evaluate changes in psychological factors three years post bariatric surgery and [2] to explore the predictive value of psychological factors on weight loss three years post-surgery.	Depression (HAD) Anxiety (HAD) Eating Disorder (EDI-2)	Stepwise multiple regression used to look for predictors of EWL Model with both BMI and HAD scores selected	Age Baseline BMI	Greater scores of depression were related to a poorer loss of excess weight	Adjusted R^2 for overall model = 0.23 P <0.001 $\beta = -0.287$ t= - 2.33 p =0.024
Lapidoth et al., (2011)	To investigate the long-term associations between binge eating and outcome in bariatric surgery.	Objective binge eating (EDE-Q) (EDO) (CPRS-S-A)	ANCOVA performed to compare the long-term BMI outcome in patients with or without objective binge eating.	Pre-treatment BMI	No association found between binge eating and weight loss outcome at follow up. No significant difference between the groups	Not significant

Marek et al.,(2016)	To further establish the utility of presurgical psychological evaluations by examining mid-term (5-year) weight loss results in a sample of Roux-en-Y (RYGB) patients.	DSM-IV diagnoses (semi structured diagnostic interview) with DSM-V criteria used for BED	Latent growth curve analysis estimated using BMI across time	Age Pre-surgery BMI	History of suicide attempts History of physical or sexual abuse Other psychiatric diagnoses were not predictive of 5-year BMIs or BMI reduction over time	Not significant
		Hierarchical model of psychopathology (MMPI-2-RF)	Conditional Latent growth curve analyses used to predict 5 year BMIs and BMI reduction over time		Presurgical diagnosis of BED predicted higher BMI at 5-year outcome	$\beta = 0.16$, P=0.008
					Scores on MMPI-2-RF scales for the following:	
			Goodness of fit indexes used to evaluate the adequacy of the models and chi square difference testing was used to compare models		Behavioural/Externalizing dysfunction	$\beta = 0.11$ P= 0.030
					Low positive emotions	$\beta = 0.13$, P= 0.032
					Hypomanic activation	$\beta = 0.13$, P = 0.028
					All evidenced higher BMIs at 5-year outcome when controlling for age and BED	
					Scores on MMPI-2-RF scales for	
					Hypomanic activation	$\beta = 0.24$,P = 0.002
					Anger Proneness Activation	$\beta = 0.16, P = 0.004$ $\beta = 0.17, P = 0.036$
					Evidenced a slower rate of BMI reduction over 5 years after controlling for age, BED and the correlation between presurgical BMI and BMI reduction over time	
Morseth et al., (2015)	To report and compare the prevalence of eating disorder pathology after RYGB and DS and to	Eating Disorder symptoms (EDE-Q) Subscales:	A linear mixed model (LMM) with random effects for intercepts	Type of surgery	Baseline global EDE-Q score was not a significant predictor for change in BMI after surgery	Not significant

	investigate if pre-operative eating disorder symptoms predict post-operative weight loss after these two surgical procedures in a super obese population.	Three types of binge eating behaviour: Subjective bulimic episodes (defined as sense of losing control but normal amount of food) Objective bulimic episodes (defined as eating an unusually large amount of food with a sense of having lost control over eating) Objective overeating (defined as eating an unusually large amount of food without a sense of having lost control over eating) Self-induced vomiting Use of laxatives and diuretics Intensive exercise to control shape or weight	and time was estimated to assess the BMI development after surgery. Then a LMM with fixed effects for global EDE-Q score and bulimic episodes at baseline was estimated. Results were presented graphically as estimated mean BMI with 95% confidence intervals at each follow up point among those with and without objective bulimic episodes pre-operatively.	The estimated mean BMI was significantly lower in the group with pre-operative objective bulimic episodes after 2 years And after 5 years	P= 0.042 P=0.009
Sockalingham et al., (2017)	To assess pre-operative psychosocial predictors of HRQOL two years after bariatric surgery. The secondary objective was to identify predictors of weight loss after bariatric surgery.	Past history of psychiatric Illness (MINI) This includes: Mood Anxiety Eating Psychosis Binge Eating disorder Attention Defecit hyperactivity disorder Generalized anxiety disorder	Multivariate regression analysis Multiple regression	The multiple regression analysis indicated that of all the psychological factors only a history of mood disorder was a significant predictor of weight 2 years post-surgery	$\beta = -5.06$ Standard error = 2.53 P = 0.047

		Depressive symptoms (PHQ-9) Anxiety symptoms (GAD-7)		No association was found between depressive and anxiety symptoms and weight loss outcomes at 24 months	Not significant
Weineland et al., (2015)	To examine how well emotional eating and experiential avoidance perform as predictors of surgical outcomes: satisfaction with life, general well-being and weight loss two years post bariatric surgery.	Avoidance and inflexibility (AAQ-W) Emotional overeating (EOQ) Depression, Anxiety and Stress (DASS-21)	Linear regression analysis	No psychological predictors of weight loss at 2 years outcome were found	Not significant
Wezenbeck et al., (2016)	To identify potential psychosocial predictors for the long-term outcome after primary VBG.	Eating behaviour (DEBQ) (EDE_Q) (EDI-II) Personality (DPQ) Obesity related beliefs (OCG) Body attitude (BAT) Psychological and somatic symptoms (RAND 36) Coping (UCL)	The Mann Whitney U Test was used to determine any significance of observed differences between groups Statistical significance $p<0.05$	No psychological predictors were found to be significant	Not significant

White et al.,(2015)	To examine prospectively the prognostic significance of depressive symptoms on weight loss and psychosocial outcomes of gastric bypass surgery.	Depressive Features (BDI) Clinically significant depressive features were determined by a score of 15 or greater on the BDI	Binary logistic regression P= 0.001	Pre-surgery BMI	Clinically significant depressive symptoms at baseline were not related to weight outcomes at any follow up point	Not significant

BDI- Beck Depression Inventory, BS= bariatric surgery, EDI-2 = Eating Disorder Inventory, BMI =Body Mass Index, BIS – 11 = Barratt Impulsiveness Scale, SCL-90-R = 11 Symptom Checklist -90 Items-Revised, TCI-R = Temperament and Character Inventory-Revised, QEWP-R= The Questionnaire of Eating and Weight Patterns-R, PHQ-9= The Patient Health Questionnaire -9, GAD-7= The Generalized Anxiety Disorder-7, LABS-2= Longitudinal Assessment of Bariatric Surgery, YFAS = Yale Food Addiction Scale , EDE= Eating Disorder Examination, BED=Binge Eating Disorder, BMI= Body Mass Index, EDE-BSV = Eating Disorder Examination–Bariatric Surgery Version, SCID= Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) Axis I Disorders, HAD= Hospital Anxiety and Depression Scale, (CPRS-S-A)Short Form -36 Comprehensive Psychopathological Rating Scale for Affective Syndromes, EDO= Eating Disorders in Obesity, MMPI-2-RF= Minnesota Multiphasic personality inventory, MINI= mini international neuropsychiatric interview, AAQ-W = Acceptance and action questionnaire for weight related problems (AAQ-W), EOQ = Emotional Overeating Questionnaire, DASS-21 = Depression, Anxiety, Stress Scales 21, DPQ= Dutch personality questionnaire, DEBQ= Dutch Eating Behaviour Questionnaire, BAT = Body attitude Test , RAND 36 – Rand 36 Health survey OCG = Overweight Cognition Questionnaire, EDI-II= Eating Disorder Inventory II UCL= Utrecht Coping List, %WL = percentage weight loss, %EBMIL= percentage excess body mass index loss

Finally, the third study (Lanza, Carrard, Pataky, Reiner, & Golay, 2013) reported a small negative correlation between greater scores of depression on a self-report measure and poorer loss of excess weight up to 3 years after surgery ($\beta = -0.287, t = -2.33$,p = 0.024). The remaining 8 studies reported no significant association between pre-operative mood or anxiety disorders and weight loss outcomes by 24 months after surgery.

In summary, only 3 out of 9 studies found associations between weight change and a pre-operative diagnosis of a mood or anxiety disorder. The results for how this impacted were also contradictory. Two suggested a diagnosis of depression or anxiety was associated with poorer weight loss outcomes at 24 months (de Zwaan et al., 2011; Lanza et al., 2013) and a third study (Sockalingham et al.,2017) found that a history of mood disorder predicted greater reduction in weight. Each of these studies used different methods for assessing anxiety and depression.

Eating disorders and maladaptive eating habits

Once again, a wide range of methods were used to measure eating disorders and behaviours. The most commonly used self-report measure was the Eating Disorder Examination Questionnaire (EDE-Q) (Chao et al., 2016; de Man Lapidoth et al., 2011; Morseth et al., 2016; van Wezenbeek et al., 2016) which assesses BED as per DSM-5 criteria. Two studies used the Eating Disorder Examination semi structured interview (Conceicao et al., 2017; Devlin et al., 2016). Only 2 studies used versions adapted for bariatric surgery patients (de Man Lapidoth et al., 2011; Devlin et al., 2016).

Summary of findings

Thirteen studies reported on the potential association between pre-operative eating disorders, maladaptive eating habits and surgical weight outcomes. One further study looked at past history of eating disorders and binge eating disorder specifically (Sockalingam et al.,

2017). Eating behaviours across studies included: binge eating, night eating, food addiction and emotional overeating. One further study looked at problematic eating behaviours (PEBs) which comprised LOC, picking, nibbling and grazing (Conceicao et al., 2013).

A total of 4 studies found significant associations between pre-operative eating disorders/maladaptive eating habits and weight changes 24 months after surgery and beyond. One study (Marek et al., 2017) which looked at DSM-IV diagnoses, found a small positive association between Binge Eating Disorder (BED) prior to surgery and higher BMI, 5 years after surgery (β = 0.16, p=0.008). A second study (Chao et al., 2016) also reported a negative association between BED and weight outcomes despite finding no association at 12 months follow up. In contrast, Morseth et al's., (2016) study found that only pre-operative objective bulimic episodes were associated with post-surgical BMI and predicted lower weight loss at 24 months (p=0.042) and 60 months (p = 0.009) after surgery A final, fourth study (Conceicao et al., 2013) found that pre-operative PEBs were significant predictors of total weight loss 2 years after surgery ($\beta = 6.301$, Wald X^2 = 5.823, p = 0.016). The remaining 10 studies found no association with eating disorders/maladaptive eating habits and weight loss outcomes by 24 months post-surgery.

In conclusion, 4 out of 13 studies found an association between weight changes and eating disorders/maladaptive eating habits. A pre-operative diagnosis of BED resulted in poorer weight loss at 24 months post-surgery in 2 studies at 24 months (Chao et al., 2016) and 60 months (Marek et al., 2017). While objective bulimic episodes in one study were significant predictors of low weight loss (Morseth et al., 2016), another study found that problematic eating behaviours prior to surgery were associated with greater weight loss at 24 months (Conceição et al., 2017).

Other mental health diagnoses

Five studies measured associations with mental health diagnoses other than anxiety, mood or eating disorders. This included psychosis, personality disorders, history of physical or sexual abuse, adjustment disorders and ADHD (Aguera et al., 2015; Hayden et al., 2014; Kalarchian et al., 2016; Marek et al., 2017, Sockalingham et al., 2017). The most commonly used assessment was the SCID interview for Axis 1 disorders. One study drew on DSM-IV criteria and the final study used the MINI (Marek et al. 2017; Sockalingham et al., 2017). There were no associations found between other psychiatric diagnoses and weight loss outcomes by 24 months after bariatric surgery.

Other psychological factors

Four of the included studies looked at psychological factors other than psychiatric diagnoses. These were temperament (Aguera et al., 2015), experiential avoidance (Weineland et al., 2015) and obesity related beliefs beliefs, body attitude, somatic symptoms and coping (van Wezenbeek et al., 2016). A fourth study (Marek et al., 2017) used a hierarchical model of psychopathology (MMPI-2-RF) to measure dimensional facets of psychopathology rather than psychiatric diagnoses.

Aguera et al., (2015) found a small positive correlation between cooperativeness and predicted % EWL levels at 24 months of follow up when controlling for surgery type (β = 0.049, x^2 = 4.628, p =.0.022,*)*. A second study by Marek et al. (2017) found that behavioural/externalising dysfunction ($\beta = 0.11, \mathrm{p} = .030$), low positive emotions, ($\beta = 0.13, \mathrm{p} = 0.032$) and hypomanic activation ($\beta = 0.13, \mathrm{p} = 0.028$) were all negatively associated with weight loss (resulting in higher BMI at 5 years), when controlling for age and a diagnosis of BED. Higher scores for hypomanic activation and anger proneness/activation

were also associated with a slower rate of BMI reduction over 5 years, after controlling for age, BED and presurgical BMI. A summary of the associations found between psychological factors and weight loss outcomes is shown in table 4.

Table 4. Summary of results

Pre-operative psychological predictor	**Number of articles**	**Number of articles associated with weight loss**		
		Positive association	No association	Negative association
Anxiety and Mood Disorder	11	1	8	2
Eating disorders and maladaptive eating habits	13	2	10	1
Other mental health diagnoses	5	0	5	0
Other psychological factors	4	1	3	1

Discussion

This review synthesised literature on the associations between pre-operative psychological factors and weight change at least 24 months after bariatric surgery. Although 8 of the 16 studies reviewed reported at least one significant association, considerable

heterogeneity was found in the range of psychological variables studied and the number of different measures used to do so. Based on these findings, longitudinal evidence that psychological factors have an impact on weight changes more than 2 years after surgery was found to be limited.

Main Findings

Mood and Anxiety Disorders

Only 3 studies out of 11 found a significant association between pre-operative mood and anxiety disorders and bariatric weight loss outcomes after 24 months. This is consistent with other literature reviews (Dawes et al., 2016, Livhits et al., 2016) which have shown mixed results for the impact of anxiety and depression diagnoses. Two studies in this review found that depression and anxiety scores were negatively associated with weight loss. However only one of these controlled for known predictors of weight loss (type of surgery, age and baseline BMI) in their analysis (de Zwaan et al., 2011). In 3 other studies where those covariates were accounted for, mood and anxiety disorders were not found to be significant (Conceição et al., 2017, Hayden et al., 2014; Kalarchian et al., 2016). Two studies looked at the significance of lifetime diagnoses of depressive disorders with contradictory results. However, it is important to note that one used a retrospective design and was potentially under-powered (de Zwaan et al., 2011) and the second study reported that despite having a historical diagnosis, participants scored low for depression at the time of surgery (Sockalingam et al., 2017). This may suggest participants in this study may not have been representative of those with the most severe/enduring symptoms of mood disorder. In line with previous findings on pre-operative anxiety and mood disorders, one study found that associations between depression and weight loss outcomes at 12 months post-surgery were no longer significant at 2 years follow up (Aguera et al.,2015).

Eating disorders and maladaptive eating habits

According to 2 studies in this review, a pre-operative diagnosis of BED was associated with poorer weight loss at 24 months post bariatric surgery (Chao et al., 2016; Marek et al., 2016). This extends the findings of Livhits et al. (2012) which found some evidence of an association between binge eating and weight loss outcomes at 12 months. Both studies in this review used DSM-V criteria, however they differed in their measurement of weight loss. High rates of attrition (43.7%) were also an issue in one of the studies (Chao et al., 2016) resulting in a small sample size at 24 months follow up. The second study had a larger sample of patients (n= 446) but relied on data extracted from health records of pre-surgery assessments, which raises possible limitations regarding selection bias (Marek et al.,2016). This study found higher BMI results in patients with pre-operative BED up to 5 years post-surgery however this study looked exclusively at RYGB patients. To qualify for this study patients with a diagnosis of BED also had to complete binge eating treatment and show positive benefits before surgery and so it is not clear to what extent these results can be generalised (Marek et al., 2016). Six further studies found no significant associations between pre-operative BED and weight change, despite using the same diagnostic criteria.

Problematic eating behaviours (PEBs) prior to surgery in one study were significant predictors of increased %TWL at 24 months when controlling for type of surgery, baseline BMI and age (Conceicao et al., 2017). Patients with pre-operative PEBs however showed no difference in BMI trajectory over two years suggesting that in the longer term this may cease to be significant. PEBs in this study had been grouped into one category as a result of their low frequency and high co-occurrence, the criteria for identification of PEBs in this study was also below the threshold recommended in other research. Conflicting results were found between this and a second study using the EDE-Q. Although Conceicao et al. (2017) found

total scores predicted lower %TWL at 24 months, Morseth et al. (2016) found that only the objective binge eating subscale was significant. This was found to predict better weight loss outcomes at 2 and 5 years.

In keeping with the results of the Livhits et al., (2012) review therefore, 10 studies found insufficient amounts of evidence to support the predictive value of pre-operative eating habits on weight loss after surgery.

Other psychiatric diagnoses

There were no significant associations found between weight change and any other psychiatric diagnoses. It is perhaps important to note that disorder-specific measures were only used for depression, anxiety and eating disorders. A systematic review on the surgical management of obesity among people with schizophrenia and bipolar disorder (Kouidrat, Amad, Stubbs, Moore & Gaughran, 2017) recently highlighted the lack of attention paid to these diagnoses across the literature, particularly in relation to medium and long term outcomes. Notably absent from studies included in this review were investigations into the impact of having been given a diagnosis of personality disorder which was found to be significantly associated with short term weight loss in Livhits's (2012) review but was contested by Dawes et al., (2016).

Other psychological factors

One possible explanation for the finding that cooperativeness predicted % EWL is that those patients high in cooperativeness participated well in the research study and may have also successfully attended post-operative support programs (Aguera et al., 2015). Cooperativeness in bariatric surgery populations has also been linked to increased social support which has also been shown to impact weight loss outcomes (Gerlach, Herpertz & Loeber, 2015). Conversely, personality traits associated with poorer BMI reduction over time

in Marek et al. (2016) (including low positive emotions and anger proneness) were linked to low frustration tolerance and thus may have impacted responses to weight gain and engagement.

Limitations of studies included in this review

The overall evidence for the association of psychological factors with weight outcomes 24 months after bariatric surgery is limited by a number of methodological issues. These were highlighted in the risk of bias assessment. The evidence base in this area could therefore be improved by seeking to address a number of the limitations outlined. This would include: 1) the use of a priori power calculations 2) addressing issues of sample size and attrition, 3) developing validated tools for the measurement of psychological factors in this patient group, 4) employing a consistent measure of weight loss, 5) using analyses that control for known variables, 6) recruiting across multiple surgery sites to increase representativeness and reduce the risk of selection bias 7) confidential, independent assessments that will not impact eligibility for surgery.

Only 2 studies used scales that had been adapted for bariatric populations (Conceicao et al., 2017; Devlin et al., 2016). This is linked to an interesting debate in the literature which suggests that some symptoms of depression (such as energy levels or reduced appetite) may overlap with obesity and other physical health related problems (Hayden, Dixon, Dixon & O'Brien, 2010). One study even argued that prevalence rates could indicate that depression would be better considered a comorbidity of obesity (Sockalingham et al, 2017). It is possible therefore, that heterogeneity across the evidence base potentially reflects broader issues inherent in the current diagnostic system which does not always account for the subjective impact or severity of a person's difficulties or sufficiently capture comorbidity. These issues are highlighted in Marek et al., (2014) which argues for a greater focus on broader

psychological constructs in the assessment of suitability for bariatric surgery. Similarly, there is a need for greater consensus on the how weight loss should be measured and reported (Hatoum & Kaplan, 2013). While 2 studies used self-reported weight loss measurements in this review, the reliability of this is debated in the literature (Christian, King, Yanovski, Courcoulas & Belle, 2013).

Finally, as well as extending the evidence base to longer term outcomes, future research could address existing significant gaps in the literature such as the impact of neurodevelopmental diagnoses such as Autistic Spectrum Disorder and learning disabilities as well as a broader range of psychological constructs including self-esteem and resilience.

Strengths and limitations of current review

To the best of the author's knowledge, this is the first review to consider the association of pre-operative psychological factors with longer term weight changes at least 24 months post bariatric surgery. Its strengths include the wide range of databases used and the fact that the majority of studies used a prospective design. This extends the findings of previous reviews (Dawes et al., 2016; Livhits et al., 2012) by including a broader range of psychological factors and a wider range of sample sizes as well as focussing exclusively on medium- and longer-term weight loss outcomes. In so doing this review underlines the potential significance of time since surgery when thinking about the association of psychological factors on weight change results. It also highlights a number of methodological weaknesses in the existing literature which are consistent with those identified in work on psychological predictors of earlier weight loss outcomes. This review therefore contributes to the ongoing debate on how and when psychological factors should be thought about and measured in relation to bariatric surgery outcomes.

Despite its strengths, this review also has a number of limitations. Although the inclusion of a broad range of sample sizes and psychological variables is potentially a strength of this review, this definition may also have added to the heterogeneity of the studies included, making comparisons difficult. The range of measures and variables also prevented the use of meta-analysis which may have added to the robustness of the review. It is possible that only including studies published after 2010 may have potentially excluded earlier literature missed by the Livhits et al., (2012) review and that the exclusion of grey literature may have increased publication bias. It was also agreed that alcohol and substance misuse data would be excluded from the review. However it is perhaps important to note that Alcohol Use Disorders are included in DSM-V meaning that this could be considered to be a psychological variable if taken by that definition. It may be interesting for future reviews to therefore consider whether to includes studies that used that diagnosis. Finally, although this study looked at all outcome data from 24 months post-surgery and beyond, only 7 studies included follow up periods of much greater than 2 years. This review is therefore largely limited to medium term weight loss outcomes and more research is needed on outcomes at 5 years post-surgery and beyond.

Clinical Implications and Future Research

The overall findings of this review suggest limited and inconclusive evidence that psychological factors reliably impact weight outcomes at 24 months or more after surgery. This could have significant clinical implications for informing eligibility criteria for surgery and the nature of pre-surgery assessments. Most crucially it may reduce exclusions from surgery on the basis of particular mental health diagnoses. This is important not just in the name of inclusivity and reducing discrimination, but also given the increasing drive in NHS and government policy to achieve parity of esteem between physical and mental health

(NHS, 2016). A better understanding of bariatric surgery outcomes is therefore relevant to the urgent focus on reducing the mortality gap for individuals with severe mental illness (which often includes health concerns linked to obesity) (Mitchell, Hardy & Shiers, 2017). It also contributes to the need for greater acknowledgement of the inter-dependent relationship between physical and mental health (The Kings Fund, 2016).

Current guidelines recommend that all patients seeking bariatric surgery receive a comprehensive, pre-operative assessment of the psychological and clinical factors that may affect surgical outcomes and adherence to post-operative care (NICE, 2019). The findings of this review therefore raise important points regarding the suitability and relevance of psychometric measures used in pre-surgery mental health assessments as well as the need for increased sensitivity to the potential under-reporting of difficulties prior to surgery. It is also important that patients are made aware of the possibility of weight changes after the 2 years of follow up typically offered by specialist bariatric services. This may indicate a need for greater focus on the timing of post-operative support and the promotion of longer-term coping strategies, irrespective of diagnosis. This review also highlights some of the complexities in the relationship between psychological factors and weight outcomes which potentially emphasises the need for more individualised assessment and support. One answer to this could be the use of clinical formulations which allow for the impact of a patient's context, past experiences and expectations for surgery to be thought about. It may also be helpful for clinicians to consider and explore the impact of psychological factors with prospective patients in order to allow individual coping styles and the impact of difficulties to be reviewed.

Future reviews may wish to consider the impact of post-operative psychological factors on medium term weight loss outcomes. Given the potentially complex relationship

between weight loss outcomes and psychological wellbeing more understanding is also needed on predictors of psychosocial outcomes.

Conclusion

This review aimed to investigate the associations between pre-operative psychological factors and bariatric surgery weight change outcomes at least 24 months post-operatively. Its findings are consistent with previous reviews which to date have largely focussed on the associations between psychiatric diagnoses and shorter-term weight loss outcomes but also found inconclusive results. Results suggest patients should not be excluded from surgery on the basis of psychological factors, however this review has highlighted numerous methodological limitations in the literature which make firm conclusions difficult to draw. The findings potentially support the need for more individualised pre and post-surgery assessments that do not exclusively draw on diagnoses or psychometrics but think about the impact of psychological factors over the longer term course of bariatric surgery. More research is needed on psychological predictors of longer-term weight loss outcomes after surgery as well as a broader understanding of what may constitute a relevant psychological factor.

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Chapter 2: Empirical Paper

Predictors of Problematic Alcohol Use in Post Bariatric Surgery Patients

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Abstract

Background: Bariatric surgery is increasingly considered an effective treatment in cases of severe obesity, however research has shown that a small number of patients may be at increased risk of problematic alcohol use post-surgery. However, little is currently known about the psychosocial factors which may help identify those most at risk. **Objectives**: The aim of this study was to investigate which factors were most predictive of problematic alcohol use at least 24 months after bariatric surgery. More specifically it aimed to explore a possible model of drinking to cope by considering associations between problematic alcohol use and drinking motives, attachment style, childhood adversity, difficult life events and self-compassion. **Method:** Adults who had undergone bariatric surgery at least 24 months ago were invited to participate in an online study. Participants were recruited through online bariatric support networks. Problematic alcohol use was assessed using the AUDIT. **Results:** A total of 78 adults completed the survey. A multiple hierarchical regression was used to analyse results. The overall model predicted 61% of the variance in AUDIT scores. In the final model however only drinking to cope ($p = 0.00$) and time since surgery ($p = 0.02$) were significant predictors. Drinking in order to cope and increased time since surgery were both associated with greater risk of problematic alcohol use. **Conclusions:** Results were ultimately impacted by a lack of statistical power. Findings suggest support for a possible model of drinking to cope. A focus on exploring individual strategies and resources for coping may be therefore beneficial in both pre and post-surgery support interventions. The significance of time since surgery suggests the timing of interventions may also be important. The need for more prospective research on psychosocial predictors of problematic alcohol use, including pre-operative drinking behaviours and expectations, is discussed.

Key Words: Bariatric surgery, problematic alcohol use, drinking to cope, childhood adversity, attachment, self-compassion

Introduction

Statement of the problem

The prevalence of obesity and its related health problems is increasing (Lindekilde et al., 2015). In 2016, 26 percent of adults in the UK were classified as obese, (defined as a BMI >30 kg/m^2 or higher) (National Health Service, NHS, 2018). This is associated with elevated risk for type 2 diabetes, cardiovascular disorders and a number of cancers (Sun, Borisenko, Spelman & Ahmed, 2018). Bariatric surgery has been increasingly considered as an effective treatment, particularly in cases of severe obesity (>BMI 40 kg/m^2) (Huberman, 2016). The term 'bariatric' is used to refer to any type of weight loss surgery, of which the most commonly used procedures in the UK are Roux-en-Y Gastric Bypass (RYGB), sleeve gastrectomy (SG) and laparoscopic adjustable gastric band (LAGB) (National Bariatric Surgery Register, NBSR, 2017). Weight loss mechanisms vary between interventions but are based on restriction and/or mal-absorption. Depending on surgery type, weight loss results can be as much as 60% of excess body weight within the first year (Buchwald et al., 2004). However, research suggests there can be considerable variation in these outcomes (Maggard et al., 2005) with approximately 15-20% of patients reporting unsatisfactory weight change or weight re-gain between 2-10 years after surgery (McGrice & Paul, 2015).

Variation is also found in the results of studies examining the impact of bariatric surgery on post-operative wellbeing and quality of life (Aarts, Hinnen, Gerdes, Brandjes & Gennen,. 2014). This is particularly significant as patients' goals for surgery extend far beyond weight loss, despite success typically being defined by change in BMI (Wimmelman et al., 2013). Although there is considerable evidence for the positive effects of surgery on mental health and psychosocial functioning (Kubik, Gill, Laffin & Karmali, 2013; Pataky, Carrard & Golay, 2011), there are also reports of negative outcomes for some patients

(Weineland et al., 2015). These include elevated risk of suicide, increased rates of depression (Backman, Stockeld, Rasmussen, Naslund & Marsk, 2016), problematic eating behaviours (Conceicao et al., 2017) and greater marital discord (Bruze et al., 2018). One example emerging in the literature is the increased risk of problematic alcohol use after surgery. Estimates of precise prevalence rates are generally small, varying between 7-28% across studies (Buffington et al., 2013; Ertelt et al., 2008), and appear dependent on time since surgery (King et al., 2012). Problematic alcohol use occurs in patients both with and without previous/pre-operative histories of alcohol misuse (Li & Wu, 2016) and in some cases irrespective of weight loss results (Alfonsson, Sundbom & Ghaderi, 2014).

Problematic alcohol use – defining terms

Studies on the development of problematic alcohol misuse in bariatric patients are emerging in the literature (Conason et al., 2013, Svensson et al., 2013, Wee et al, 2013). A number of different terms to describe alcohol misuse are used inter-changeably across studies. In this study, 'problematic alcohol use' is used to refer to all forms of drinking which may cause substantial risk or harm to the individual. This includes high levels of drinking each day and repeated episodes of drinking to intoxication as well as harmful drinking and drinking that has resulted in the person becoming dependent upon or addicted to alcohol (Saunders, Aasland, Babor, La Fuente & Grant, 1992).

Problematic alcohol misuse and bariatric surgery

Pre-operative alcohol use is frequently considered a contra-indication for bariatric surgery (Spadola et al., 2015). Bariatric services typically require a minimum of 12 months abstinence prior to surgical intervention and patients are advised to then avoid alcohol for the first several months after surgery (Mechanick et al., 2013). Studies therefore regularly report

small to zero levels of alcohol use in pre-operative patients (Kalarchian, Marcus & Levine, 2007; Suzuki, Haimovici & Chang, 2012). Alcohol presents a unique concern following bariatric surgery due to anatomical changes which can alter the metabolism of alcohol (Bak, Siebold-Simpson & Darling, 2016). Though the precise impact is dependent on surgical procedure, blood alcohol levels may generally peak higher and faster after surgery and take longer to return to normal (Hagerdorn, Encarnacion, Brat & Morton, 2007). The result can be that patients may therefore become more intoxicated, more quickly, and stay intoxicated for longer periods than they did prior to surgery. Alongside the personal, relational and psychological impact, problematic alcohol use in bariatric patients also carries increased risk of alcohol related health outcomes, including ulcer diseases and malnutrition (Coblijn, Goucham, Lagarde, Kuiken & van Wagensveld, 2014).

Addiction transfer

Although well documented, biological theories of alcohol misuse based on post-surgery metabolic changes insufficiently explain why problematic use may only occur in certain patients (Haegerdon et al., 2007; Wee et al., 2014). One alternative theory in the literature is the idea of 'addiction transfer', in which coping strategies related to food and eating are replaced with alcohol as an alternative (Conason et al., 2013). Several studies have shown that negative emotions may serve as antecedents to binge-eating in this patient group, with bariatric patients evidencing higher scores on emotional eating measures than the general population (Canetti, Berry & Elizur, 2009). Following the restriction of food intake that is enforced by bariatric procedures, it has been proposed that alcohol may therefore have a unique appeal to patients who often report experiencing nausea or dizziness (referred to as 'dumping syndrome') after consuming too much fat or sugar in food (Tack & Deloose, 2014). Post-surgical effects such as these may create a need for patients who have previously

relied on food to seek alternative coping behaviours (Klockhoff, Naslund & Jones; Mcfadden, 2012). To date, this idea has largely been taken up by popular media (Souter, Shapiro & Shef-Cahan, Lopez & York, 2007). However, based on symptom substitution theory (Reslan, Saules, Greenwald & Schuh, 2014) it is also supported in the literature on obesity and food addiction (Byrne, Barry & Petry, 2009; Clark & Saules, 2013) as well as in links between food, alcohol and emotion regulation (Grothe et al. 2014, Weineland et al. 2012).

Drinking to cope

The use of food, drink or substances as a form of coping is established in research on distress tolerance (Koball et al., 2016). The addictions literature offers a number of theories of alcohol use and its relationship to coping, including models of affective processing (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004), motivation (Cooper, Frone, Russell, Mudar, 1995; Cox & Klinger, 1988), self-medication (Khantzian, 1997) and tension reduction (Conger, 1956). Each of these theories emphasises emotion regulation as a primary motive for alcohol use (Berking et al., 2011).

Research on predictors of alcohol misuse in this population have largely focussed on demographic and surgery related variables (Conason et al., 2013, King et al., 2012; Lent et al., 2013; Svensson et al., 2013). These studies have found that male gender, younger age and receiving RYGB surgery, may increase the risk of problematic alcohol use. A recent qualitative study comparing problematic and non-problematic alcohol use after bariatric surgery identified drinking to cope as a core motivation in problematic alcohol use post-operatively (Reaves, Dickson, Halford, Christiansen & Hardman, 2019). This study extended the findings of Yoder and colleagues (2017) who explored a ‘filling the void’ model of alcohol use disorder development after surgery. This work highlighted the potential role of

‘unresolved psychological issues’ in the development of alcohol misuse in this patient group, with the majority of patients reporting significant histories of developmental trauma, major losses and childhood attachment difficulties (Hardman & Christiansen, 2018). There has been an increasing interest in the role of psycho-social factors on post- bariatric surgery outcomes. These studies have highlighted the potential significance of features such as a lower sense of belonging, social drinking and self-image (King et al, 2013, Reaves et al, 2017). However to date there have been no empirical investigations into the role of difficult life experiences, attachment style or the role of shame. These factors may become increasingly relevant to explore alongside the growing recognition of the prevalence of trauma experiences in this patient group and a broader move within the NHS to promote trauma informed care, across patient services (Macdonald, 2017).. It is hoped that this study may contribute to the consideration of why alcohol may become problematic for a small number of bariatric patients. In doing so, the study will explore further the idea of a possible model of drinking to cope by providing more information on the psychosocial variables that might inform both a need to cope after surgery and the use of alcohol as a coping strategy.

Attachment style

Attachment theory proposes that coping styles may be shaped by early childhood experiences (Bowlby, 1969). Individual ways of coping may then become maladaptive and habitual over time (Carver, Scheier & Weintraub, 1989). Studies show that adults with secure attachment exhibit higher levels of distress tolerance and often draw on coping strategies that involve seeking proximity to others (Shaver, Mikulincer & Chun, 2008). In contrast, individuals with an insecure attachment style (often characterised by increased levels of attachment anxiety and or avoidance), may be more likely to either become overwhelmed by problems, or cope using external regulatory mechanisms such as smoking and drinking

(Shakory et al., 2015). Links between coping style and attachment are well established in the literature with coping styles presented as having a possible mediating role between attachment representations and physical and mental functioning in the general population (Kotler, Buzwell, Romeo & Bowland, 1994) as well as patients seeking bariatric surgery (Aarts, Hinnen, Gerdes, Acherman & Branjes, 2014b).

Childhood adversity and difficult life events

The significant impact of early childhood events, in particular, the experience of trauma on attachment style is well documented (Sloman & Taylor, 2016). Studies have also shown that childhood adversity may impact both emotion regulation and attachment styles and in so doing may help predict how an individual responds to stressful events later in life (Berry & Kingswell, 2012; Ein-Dor, Viglin & Doron, 2016). Levels of childhood maltreatment in bariatric patients have been found to be comparable to clinical populations and are significantly higher than in community samples (Grilo et al., 2005). Childhood trauma has also been linked to both eating disorder symptoms and alcohol use (Burns, Fischer, Jackson & Harding, 2012). Research on the relationship between childhood sexual abuse and bariatric surgery weight loss outcomes is beginning to emerge (Steinig, Wagner, Shang, Dolemeyer & Kersting, 2012), however evidence on the impact of difficult life events (early and proximal) on problematic alcohol use in this patient group is lacking. Given the challenges of adapting to life following weight loss surgery, greater understanding is needed of the factors that might predict how an individual might cope post-operatively. The EA 0.88, 0.87, 0.97, 0.92, 0.86

Self-Compassion

Alongside the role of drinking to cope, another theme identified in Reaves et al., (2019) was the impact of negative self-image on problematic alcohol use, which had been linked to feelings of shame. The prevalence of shame in pre and post-operative bariatric surgery is noted in the literature (Homer, Tod, Thompson, Allmark & Goyder, 2016) Self-compassion (Neff, 2003) has been defined as the ability to extend kindness and understanding to oneself, particularly in times of suffering (Neff, Rude & Kirkpatrick, 2007). Studies show that individuals with a history of childhood adversity may have reduced self-compassion as an adaptive resource for coping and for managing distress (Gilbert & Proctor, 2006; Tanaka, Werkerle, Schmuck & Paglia-Boak, 2011). Self-compassion has been highlighted as an important explanatory variable in promoting well-being (Collett, Pugh, Waite & Freeman, 2016). Further, self-compassion improves the success rate of health promotion and behavioural interventions such as smoking reduction (Kelly, Zuroff, Foa & Gilbert, 2009). However, the role of self-compassion in bariatric surgery outcomes is noticeably absent from the literature. Research suggests that high levels of self-compassion may reduce risk of alcohol misuse by providing individuals with an alternative coping response (Brooks, Kay-Lambkin, Bowman, & Childs, 2012). Understanding more about the role of self-compassion could, therefore, be an area of interest in identifying possible protective factors against problematic alcohol use after weight loss surgery.

Evidence suggests that the risk of problematic alcohol use gradually increases after surgery and is most likely to emerge after at least 2 years post-operatively (Wimmelman, Dela & Mortenson, 2014). Studies around this time point have largely focussed on the role of demographic and surgery related factors. Literature on psychosocial predictors of alcohol use in this population is currently scarce (Koball et al., 2016, Wimmelman et al., 2013), however

these are important to explore as they are potentially modifiable factors which could inform targeted interventions at the community level or within bariatric services.

A greater understanding of the mechanisms through which problematic alcohol use may emerge as well as the factors that may contribute to its development also allows for more effective assessments of suitability for bariatric surgery. Increasingly, research emphasises the need to address patients' expectations for surgery and their understanding of possible outcomes and risks, particularly in the longer term (Ames et al., 2016). A greater understanding of the role of psychosocial factors could therefore help identify those patients who might be at greater risk of problematic alcohol use, better inform patients' choices around treatment and ensure appropriate support in order for positive outcomes to be maintained in the long term.

Aims

The overall aim of this study was to investigate which factors were most predictive of problematic alcohol use at least 24 months after bariatric surgery. More specifically it aimed to:

1. Investigate the role of drinking motives, attachment style and difficult life events (both childhood adversity and recent stressful life events) in predicting problematic alcohol-use
2. Explore whether self-compassion may serve as a protective factor against alcohol misuse
3. Develop a model of drinking to cope (using alcohol to manage negative affect), which could inform pre and post-surgery psychological interventions

It was hypothesised that when controlling for demographic and surgery related variables:

1. Drinking motives, attachment style, experiences of childhood adversity, stressful life events and self-compassion would significantly predict variance in problematic alcohol use
2. Problematic alcohol use would be positively associated with higher levels of attachment anxiety and avoidance, childhood adversity, stressful life events and drinking to cope
3. Problematic alcohol use would be negatively associated with levels of self-compassion

Method

Participants

Adults who had undergone any form of bariatric surgery at least 24 months ago were invited to participate and were recruited through online bariatric support networks using social media and online forum platforms. Eligibility criteria for the study was as follows: Participants must i) be aged 18 or older, ii) have sufficient skills in English to complete written questionnaires, iii) have had bariatric surgery at least 24 months prior to taking the survey.

Materials

Participants completed a questionnaire which was accessed using a link to Qualtrics online survey software. The questionnaire was made up of the following measures: (*see Appendix D for specific question items).*

Predictor variables

Demographics: a demographic information sheet was constructed to capture information on age, gender, ethnicity, occupation, marital status, date and type of surgery and mental health diagnosis history. Height and weight information was requested in the participant's preferred metric, which was used to calculate current and pre-surgery BMI.

Childhood Adversity: *The Childhood Trauma Questionnaire* – short version (CTQ; Bernstein et al., 2003) is a validated 28-item self-report measure of childhood maltreatment across five domains: physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect. Respondents rate statements on a five-point Likert scale ranging from 'never true' to 'very often true' with higher scores on these domains representing increased levels of maltreatment. The psychometric properties for the CTQ are well documented and include its internal consistency, test-retest reliability, factor structure and convergent validity with structured interviews (Bernstein & Fink, 1998; Scher et al. 2001). Past research has attested to the reliability and validity of the CTQ (Macdonald et al., 2016) which has been used in numerous studies using bariatric patient samples (Grilo et al., 2005; Wildes, Kalarchian, Marcus, Levine, Courcoulas, 2008). In this sample the Cronbach's alpha coefficient was between 0.87 and 0.97 across the 5 subscales.

Attachment: The Experiences in Close Relationships Scale Revised (ECRS-R, Fraley, Waller & Brennan, 2000) is a 36 item, self-report measure of adult attachment style and has demonstrated good psychometric properties. It measures the two dimensions of attachment: attachment avoidance and attachment anxiety in close relationships. Items are measured on a 7-point Likert scale with higher scores representing higher attachment insecurity. Both subscales are correlated, evidencing conceptual and empirical commonalities between the

two. It is recommended that these are treated as conceptually independent in analyses as each subscale represents a different construct of attachment security (Aarts et al., 2014a). Both the ECRS-R and a modified 16 item version (ECR-M16, Lo et al., 2009) have been shown to have good reliability and validity (Fraley et al., 2000) and have been used with bariatric populations (Aarts et al., 2014; Sockalingham, Wnuk, Strimas, Hawa & Okrainec, 2011). In the current study Cronbachs alpha coefficients were 0.94 for both subscales.

Self-Compassion: *The Self Compassion Scale* (SCS) (Neff, 2003) is a 26 item self-report scale. It provides an overall self-compassion score made up of means scores for the 6 sub-scales which measure the 3 elements of self-compassion. These include the following: a sense of common humanity, mindfulness and self-kindness alongside their opposing elements of personal isolation, over-identification, and self-judgement. The scoring range for the SCS is 1-5 with 5 representing a high level of self-compassion. Although this measure has not been validated in a bariatric population, the SCS demonstrates good construct validity (Neff, 2016) and has been shown to be a reliable measure of self-compassion (a =0.93) (Neff, 2003). It has been widely used in a number of clinical and physical health populations (Neff, 2016). In the current study, the Cronbach alpha coefficient was .0.94

Drinking to Cope: The Drinking Motives Questionnaire – Revised Short Form (DMQ – RSF Kuntsche & Kuntsche, 2009,). Based on Cox and Clinger's (1998, 1990) Motivational Model, the DMQ - RSF measures the outcomes individuals hope to obtain through alcohol across a four-dimensional structure of drinking motivation. This includes coping, enhancement, social and conformity. Each dimension is measured using three items assessed on a 5-point Likert scale with higher scores representing endorsement of a particular drinking motivation. Originally revised as a short form for adolescent use, this measure has since been shown to have good reliability and validity across age groups and nationalities (Cooper et al.,

1995, Crutzen & Kuntsche, 2013). In the current study, the Cronbach's alpha coefficient ranged from 0.82 to 0.88 across the 4 subscales.

Significant Life Events: *The Social Readjustment Scale* (SRS, Holmes & Rahe, 1967) is a 43-item scale which considers the impact of a wide range of common stressors over the past two years. It asks participants to indicate the events they have experienced in the past two years, ticking as many as apply. Individual life events such as 'getting married' or 'losing a job' represent a numerical 'significance' score based on the possible impact of a particular life event. Higher scores therefore represent increased exposure to significant life events. This scale was initially developed to explore the relationship between social readjustment, stress and susceptibility to illness and has good validity (Scully, Tosi & Banning, 2000). The Crohnbach's alpha coefficient in this study was 0.90

Dependent Variable

Problematic alcohol use: The Alcohol Use Disorders Identification Test (AUDIT) (Saunders et al. 1993) was used to measure problematic alcohol use. The AUDIT is a 10-item screening tool developed by the World Health Organization (WHO) to assess risky and harmful alcohol consumption as well as alcohol dependence and abuse. The AUDIT includes questions on alcohol consumption, drinking behaviours and possible alcohol-related problems and can be broken down into separate scores for consumption (amount and frequency of intake), dependence, and hazardous drinking. The AUDIT has been validated across genders and in a wide range of racial/ethnic groups (de menses-Gaya, Zuardi, Loureiro & Crippa, 2009). The AUDIT has been used in other studies looking at the prevalence of alcohol misuse in bariatric populations (King et al., 2012; Suzuki et al., 2012). A total score of 8 or more is recommended as an indicator of hazardous and harmful alcohol use, as well as possible alcohol dependence (Conigrave, Hall & Saunders, 1995). Higher total scores on the

AUDIT were used in this study to indicate potentially high levels of problematic alcohol use. In the current study, the Cronbach's alpha coefficient was 0.90.

Design

A cross sectional, quantitative online survey design was used.

Procedure

Permission to conduct this study was acquired from the University of Liverpool Ethics Committee. (Approval documents located in Appendix E and F). The BPS (2009) Code of Ethics and Conduct as well as the BPS Ethics Guidelines for Internet Mediated Research (2017) were also adhered to throughout the study. Participants were recruited through online bariatric support networks. These groups offer peer support to post-operative patients using social media and online forum platforms. A voluntary organisation (WLSinfo) which supports individuals after weight loss surgery helped design the study and agreed to advertise the study advert for recruitment through their closed social media support groups. WLSinfo also helped identify other relevant organisations that could be approached by the researcher. An advert with a brief outline of the study and a link to more information/to take part was shared through online and social media platforms (Appendix G). Many of these are closed groups and require permission from the administrator. Participants who clicked on the link were first directed to an online participation information sheet which detailed the process and purpose of the study (Appendix H) followed by an online consent form (Appendix I). These forms confirmed that participation was voluntary, that participants were free to withdraw and that their information would not be shared with any other members of their healthcare team. As a way of thanking those who took part, participants also had the opportunity to opt into a prize draw to win Amazon vouchers. As the study focussed on

potentially sensitive and personal information such as childhood adversity, a debrief sheet was used at the end of the questionnaire to signpost participants to support services if necessary.

Patient Involvement

The primary researcher attended the WLSinfo national meeting and Annual General Meeting to discuss the proposed research idea in October 2015. Members of this organisation reviewed the research documents and advised on the structure and wording of the research documents, ethics application and final questionnaire. The Liverpool University Experts by Experience group were also consulted with regards to the project's utility and feasibility.

Method of Analysis

All analyses were performed using IBM SPSS software version 25.0 for Mac. Data were initially screened for data entry errors and missing values. A total of 132 participants had accessed the survey. Only those participants who had responded to the AUDIT questionnaire were included in the final analyses (n = 81). Three of these were then excluded as they did not meet eligibility criteria for time since surgery (minimum of 24 months). The final sample was n = 78. G * power software was used to calculate the minimum number of participants required to detect a medium effect size at a power of .8 at a significance level of .05. This effect size was selected in line with previous studies in this area which had evidenced small to medium effect sizes with samples between 90 and 155 (Conason et al., 2013, Reslan, Saules, Greenwald & Schuh, 2013). The results indicated that between 123-169 participants would be required for a hierarchical regression based on between 11-24 predictor variables. The final number of variables included was determined by the results of the initial bivariate analyses as outlined below.

Missing data

Missing data were coded in SPSS and accounted for in the analysis using pairwise exclusion. Two items were found to be missing at point of analysis due to a technical error (item 23 on the ECRS- R and item 22 on SCS) and these were treated as missing data. Little's Missing Completely at Random (MCAR) test was conducted to assess the pattern of missing data (Tabachnick & Fidell, 2013). The result was significant which suggested the data did not meet the assumption required to be missing completely at random (X^2= 173.9, DF=124, p=.002). Further analysis of the pattern of missing data indicated that time since surgery had more than 10% missing data (n = 10, 12.8%).

Descriptive statistics were used to capture the demographic and surgery characteristics of the sample. The distribution of continuous data for the dependent variable (AUDIT) was analysed prior to bivariate analysis using a histogram to indicate normality and calculations of skewness and kurtosis (Appendix I). Bivariate analyses were used to measure the relationship between potential confounders (demographic and surgery related variables), significant predictors and problematic alcohol use. Associations between continuous variables and problematic alcohol use (as measured by the AUDIT) were investigated using Pearson's correlation coefficient. Independent samples t-tests were used for binary, categorical variables (gender and mental health diagnosis history). One way between group analysis of variance was used to measure associations between categorical variables and AUDIT scores. Hierarchical multiple regression was then used to establish the unique variance in problematic alcohol use accounted for by attachment style, difficult life events, self compassion and drinking motives when controlling for the influence of significant demographic and surgery related factors. To identify potential confounders and develop a comprehensive model, demographic- and surgery-related variables had been identified from

previous literature. Confounders identified as statistically significant in bivariate analyses were entered at Step 1 (BMI, Presurgery BMI and Time Since Surgery). Psychological predictor variables were then entered at Step 2. The following order of predictor variables was therefore used: Step 1: BMI, Pre-surgery BMI and Time Since Surgery, Step 2: DMQ (all 4 subscales), ECRS ((both subscales), SRS, SCS and CTQ (all 5 subscales). Preliminary analyses were conducted to ensure no violation of multicollinearity and variance inflation factors were confirmed to be <5 (Appendix J)

Results

Sample characteristics

Detailed demographic characteristics and surgery related information for the sample are included in Table 1. Participants were recruited between August 2018 and February 2019. Of the total 132 participants who started the survey, a final sample of 78 (59%) were eligible for analysis. Participants were aged between 27-69 years (M = 50.92, SD = 8.30). The majority were female (n = 71, 89.3%), and over 85% of the sample were white British. This is in line with most studies in this area and demographic data on recipients of surgery in the UK. Further demographic and surgery characteristics for the sample are depicted in Table 1.

While almost a quarter were in professional occupations, a fifth were not in paid employment. Sixty-one percent were married. The most common type of surgery was gastric bypass (64.1%) and the amount of time since surgery ranged from 24 months to 257 months. Mean BMI before surgery was 48.5 and 31.2 post operatively. Of the 48.7% of participants who had been given a mental health diagnosis, 79% had been diagnosed with anxiety and or depression.

Table 1

Demographic and surgery related characteristics of the sample

Characteristic	N	Mean (S.D)	Percentage
Gender	76		
Male	5		6.6
Female	71		93.4
Age	78	51(8.31)	
BMI (kg/m$^{2)}$	78	31.2(10.5)	
Pre-Surgery BMI	76	48.5(10.5)	
Ethnicity	78		
British	67		85.9
Irish	4		5.1
Any other white background	5		6.4
White and black African	1		1.3
Any other ethnic origin	1		1.3
Occupation	78		
Managers, directors and	8		10.3
senior officials	18		23.1
Professional Occupations	2		2.6
Associate professionals and	10		12.8
technical occupations	2		2.6
Administrative and	8		10.3
secretarial occupations	3		3.8
Skilled trades occupations	16		20.5
Caring, leisure and other	11		14.1
service occupations			
Other			
Marital Status	77		
Married	47		61.0
Living with partner	6		7.8
Divorced	10		13.0
Widowed	2		2.6
Separated	2		13
Single	10		13
Mental Health Diagnosis			
Yes	38		48.7
No	39		50.0
Prefer not to say	1		1.3
Of those with a mental			
health diagnosis	38		
Anxiety Disorder	3		7.9
Depressive disorder	17		44.8
Depression and anxiety	10		26.3
Bipolar disorder	1		2.6
Personality Disorder	1		2.6
PTSD	3		7.9
Prefer not to say	3		7.9
Type of Surgery	78		
Gastric band	7		9.0
Gastric bypass	50		64.1
Gastric sleeve	16		20.5
Duodenal switch	4		5.1
Other	1		1.3
Time since surgery (months)	68	72.7(51.0)	

Descriptive Statistics

Descriptive statistics are presented in Table 2. The mean score for problematic alcohol use as measured as a total score on the AUDIT was 12.38 which is above the clinical cut off for hazardous drinking. The highest scores on the CTQ were for the sexual abuse subscale (mean = 9.87) which ranks in the moderate to severe range, between the 80th and 90th percentiles (Bernstein & Fink, 1998). All other scores on the childhood trauma measure fell between the low to moderate and moderate to severe ranges. The mean SCS score for self-compassion was 2.6 (SD= 0.67) with 5 being the maximum score representing the highest levels of compassion.

Table 2

Descriptive statistics for the sample (N = 78)

Variable	**N**	**Mean**	**Range**
AUDIT	78	12.38	0-38
CTQ (EA)	77	12.70	5-25
CTQ (PA)	77	7.8	5-25
CTQ (SA)	77	9.87	5-25
CTQ (EN)	77	13.36	5-25
CTQ (PN)	77	8.65	4-19
DMQ (Cop)	78	6.96	1-15
DMQ (En)	76	2.67	3-15
DMQ (Soc)	76	7.62	3-15
DMQ (Con)	76	5.25	3-15
ECRS (AAn)	77	2.87	1-7
ECRS (AAv)	75	3.59	1-7
SRS	77	238.36	13- 981
SCS	78	2.68	1.00 – 4.73

CTQ= Childhood trauma questionnaire, EA= Emotional Abuse subscale, PA=Physical Abuse subscale, SA=Sexual Abuse subscale, EN= Emotional Neglect subscale, PN= Physical Neglect subscale, DMQ Cop= Drinking Motives Questionnaire Coping Subscale, DMQ EN= Drinking Motives Questionnaire Emotional Neglect Subscale, DMQ Soc = Drinking Motives Questionnaire Social Subscale, DMQ (Con) = Drinking Motives Questionnaire Conforming subscale. ECRS AAn= Early Childhood Experiences Attachment Anxiety subscale, ECRS AAv – Early Childhood Experiences Attachment Avoidance subscale, SRS = Social Readjustment Scale, SCS = Self Compassion Scale

Bivariate Analyses

Based on bivariate analyses only BMI, pre-surgery BMI and time since surgery were found to be significantly associated ($p < 0.05$) with problematic alcohol use. The results from Pearson's correlations are shown in Table 3.

Multiple Hierarchical Regression Analyses

Results from the regression analysis are presented in Table 4. The final regression model predicted 61% of the variance in AUDIT scores ($R^2 = 0.61$, $F(16,49) = 4.83$, $p = 0.000$). The covariates in step 1 explained 21% of the variance in problematic alcohol use, with time since surgery the only significant predictor.

A further 40% of overall variance was explained by the variables in Step 2 when BMI, pre-surgery BMI and time since surgery were controlled for. This represented a statistically significant contribution (F change $(3,49) = 3.92$, $p = 0.002$). In the final model, only time since surgery and drinking to cope were statistically significant. Higher scores on drinking to cope were associated with increased scores on the AUDIT measure ($\beta = 0.62$, $p = 0.000$). Increased time since surgery was also associated with higher AUDIT scores ($\beta = 0.24$, $p = 0.015$)

Table 3

Pearson's correlations of continuous variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. AUDIT																		
2. Age	-0.21 *N=78*																	
3. Time Since Surgery	.299* *N=68*	0.23 *N=68*																
4. BMI	-.316** *N=78*	0.10 *N=78*	-0.18 *N=68*															
5. PreSurgBMI	-.319** *N=76*	0.18 *N=76*	0.05 *N=66*	.559** *N=76*														
6. CTQ (EA)	0.19 *N=77*	0.12 *N=77*	0.04 *N=68*	-0.10 *N=77*	0.02 *N=75*													
7. CTQ (PA)	0.12 *N=77*	-0.01 *N=77*	0.00 *N=68*	-0.22 *N=77*	-0.12 *N=75*	.614** *N=77*												
8. CTQ (SA)	0.10 *N=77*	0.16 *N=77*	0.05 *N=77*	-0.12 *N=77*	0.18 *N=75*	.445** *N=77*	.383** *N=77*											
9. CTQ (EN)	0.18 *N=77*	0.18 *N=77*	0.08 *N=77*	-0.03 *N=77*	0.05 *N=75*	.735** *N=77*	.434** *N=77*	.371** *N=77*										
10.CTQ (PN)	0.13 *N=77*	-0.04 *N=77*	0.01 *N=77*	0.00 *N=77*	0.11 *N=75*	.573** *N=77*	.464** *N=77*	.293** *N=77*	.659** *N=77*									
11. DMQ (Cop)	.739** *N=78*	-0.16 *N=78*	0.13 *N=68*	-.318** *N=78*	-.426** *N=76*	0.17 *N=77*	0.11 *N=77*	0.07 *N=77*	0.19 *N=77*	0.16 *N=77*								
12. DMQ (Enh)	.443** *N=76*	-0.14 *N=76*	0.04 *N=66*	-0.21 *N=76*	-.399** *N=74*	-0.02 *N=75*	-0.13 *N=75*	-0.04 *N=75*	0.04 *N=75*	-0.08 *N=75*	.608** *N=76*							
13. DMQ (Soc)	.367** *N=76*	-.311** *N=76*	-0.01 *N=66*	-0.17 *N=76*	-.313** *N=74*	-0.01 *N=75*	-0.08 *N=75*	-0.08 *N=75*	-0.08 *N=75*	-0.08 *N=75*	.438** *N=76*	.644** *N=76*						
14. DMQ (Con)	.386** *N=76*	-0.22 *N=76*	0.02 *N=66*	-.281* *N=76*	-.253* *N=74*	0.18 *N==75*	.229* *N=75*	-0.03 *N=75*	0.14 *N=75*	0.13 *N=75*	.481** *N=76*	.360** *N=76*	.589** *N=76*					
15. ECRS (Att Anx)	0.18 *N=77*	0.01 *N=77*	0.05 *N=67*	-0.20 *N=77*	-0.15 *N=75*	.260* *N=76*	.233* *N=76*	0.17 *N=76*	.321** *N=76*	0.14 *N=76*	0.21 *N=77*	0.02 *N=75*	0.11 *N=75*	.411** *N=75*				
16. ECRS (Att Avo)	.266* *N=75*	0.02 *N=75*	-0.09 *N=66*	0.05 *N=75*	*-0.03* *N=73*	0.05 *N=74*	0.03 *N=74*	0.07 *N=74*	0.12 *N=74*	0.04 *N=74*	.312** *N=75*	0.10 *N=74*	0.19 *N=74*	.386** *N=75*	.626** *N=75*			
17. SRS	.341** *N=77*	-0.04 *N=77*	-0.03 *N=67*	-.248* *N=77*	-0.17 *N=75*	.369** *N=76*	.269* *N=76*	0.17 *N=76*	.314** *N=76*	.301** *N=76*	.419** *N=77*	0.21 *N=75*	.254* *N=75*	.291* *N=75*	.297** *N=74*	.358** *N=75*		
18. SCS	-.264* *N=78*	0.02 *N=78*	0.13 *N=68*	0.03 *N=78*	0.18 *N=76*	-.367** *N=77*	-0.16 *N=77*	-0.19 *N=77*	-.458** *N=77*	-0.22 *N=77*	-.338** *N=78*	-0.16 *N=76*	-0.08 *N=76*	-.301** *N=77*	-.663** *N=77*	-.342** *N=75*	-.527** *N=78*	

CTQ=Childhood trauma questionnaire, EA= Emotional Abuse subscale, PA=Physical Abuse subscale, SA=Sexual Abuse subscale, EN= Emotional Neglect subscale, PN= Physical Neglect subscale, DMQ Cop= Drinking Motives Questionnaire Coping Subscale, DMQ EN= Drinking Motives Questionnaire Emotional Neglect Subscale, DMQ Soc = Drinking Motives Questionnaire Social Subscale, DMQ (Con) = Drinking Motives Questionnaire Conforming subscale. ECRS AAn= Early Childhood Experiences Attachment Anxiety subscale, ECRS AAv – Early Childhood Experiences Attachment Avoidance subscale, SRS = Social Readjustment Scale, SCS = Self Compassion Scale

Table 4

Multiple hierarchical regression analysis

Step	Variable Entered	R^2 - change	F Change	*β*	*P*
1	BMI	0.21	F (3,62) = 5.46*	-0.11	0.43
	Pre-surgery BMI			*-0.27*	*0.06*
	Time since surgery			*0.29*	*0.02*
2	BMI			-0.09	0.49
	Pre-surgery BMI			-0.01	0.95
	Time since surgery			0.24	0.02
	DMQ (Con)	0.40	F (16,49) = 4.83**	-0.02	0.86
	DMQ (Cop)			*0.62*	*0.00*
	DMQ (En)			-0.04	0.76
	DMQ (Soc)			0.11	0.46
	ECRS(AttAv)			0.13	0.37
	ECRS(AttAn)			-0.13	0.41
	SRS			-0.01	0.95
	SCS			-0.09	0.55
	CTQ (EA)			0.08	0.64
	CTQ (EN)			-0.03	0.87
	CTQ (PA)			0.01	0.92
	CTQ (PN)			0.00	1.00
	CTQ (SA)			0.01	0.92

* p < .01, ** p < .001

CTQ= Childhood trauma questionnaire, EA= Emotional Abuse subscale, PA=Physical Abuse subscale, SA=Sexual Abuse subscale, EN= Emotional Neglect subscale, PN= Physical Neglect subscale, DMQ Cop= Drinking Motives Questionnaire Coping Subscale, DMQ EN= Drinking Motives Questionnaire Emotional Neglect Subscale, DMQ Soc = Drinking Motives Questionnaire Social Subscale, DMQ (Con) = Drinking Motives Questionnaire Conforming subscale. ECRS AAn= Early Childhood Experiences Attachment Anxiety subscale, ECRS AAv – Early Childhood Experiences Attachment Avoidance subscale, SRS = Social Readjustment Scale, SCS = Self Compassion Scale

Post-Hoc Analysis

Given the unexpected negative correlation between current and pre-surgery BMI and problematic alcohol use in bivariate analyses, post-hoc analyses were conducted to explore the relationship between weight loss after surgery and AUDIT scores. Percentage weight loss was calculated using last recorded weight before surgery and lowest weight recorded after surgery (M = 41.3%, SD = 12.3).

Using Pearson's correlation, a strong negative correlation was found between weight loss and problematic alcohol use (r = - 0.68). However, given that less people (n=72) had complete weight loss data, this reduced the sample size and meant that the result was not statistically significant (p = 0.57). This was therefore not entered into any further analysis.

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There are many forms of problematic alcohol use which may cause substantial risk or harm to the individual. A frequently reported strength of the AUDIT is that it measures problematic alcohol use on a continuum of risky and hazardous drinking behaviours and includes subscales on total consumption, hazardous drinking and the existence of alcohol dependence. Post-hoc analyses were therefore conducted to investigate further the impact of psychological variables on different types of problematic alcohol use with the view that this information might be helpful in informing future inteventions and adding to an understanding of drinking in order to cope. Hierarchical multiple regressions were again used to establish the unique variance in the 3 AUDIT subscales accounted for by attachment style, difficult life events, self-compassion and drinking motives when controlling for the influence of significant demographic and surgery related factors. Confounders found to be significant in bivariate analyses and entered at Step 1 in the initial analyses were again entered at Step 1 for each subscale (BMI, Presurgery BMI and Time Since Surgery). Psychological predictor variables

were then entered at Step 2 in line with initial analyses. Full results are included in Appendix K and summarised below.

Multiple Hierarchical Regression for Consumption Scores

The final regression model predicted 57 % of the variance in consumption scores (R^2 = 0.57, F (16,49) = 4.11, p =0.001). The covariates in step 1 explained 19% of the variance in total alcohol consumption. A further 38% of overall variance was explained by the psychological variables in Step 2 when BMI, pre-surgery BMI and time since surgery were controlled for. In the final model, drinking to cope (β = 0.56, p =0.000), time since surgery (β = 0.28, p = 0.004) and drinking for social motives (β = 0.40, p = 0.013) were statistically significant.

Multiple Hierarchical Regression for Dependence Scores

The final regression model predicted 57 % of the variance in dependence scores (R^2 = 0.57, F (13,49) = 4.01, p =0.002). The covariates in step 1 explained 21% of the variance in total alcohol dependence. A further 36% of overall variance was explained by the psychological variables in Step 2 when BMI, pre-surgery BMI and time since surgery were controlled for. In the final model, only drinking to cope (β = 0.42, p =0.007) and time since surgery (β = 0.29, p =0.016) were statistically significant.

Multiple Hierarchical Regression for Hazardous Drinking Scores

The final regression model predicted 61 % of the variance in hazardous drinking scores (R^2 = 0.61, F (16,49) = 4.71, p =0. 000). The covariates in step 1 explained 16% of the variance in total hazardous drinking scores. A further 45% of overall variance was explained by the psychological variables in Step 2 when BMI, pre-surgery BMI and time since surgery

were controlled for. In the final model for hazardous drinking however only drinking to cope ($\beta = 0.67$, $p = 0.000$) was statistically significant.

Finally, given the significance of time since surgery and drinking to cope across subscales a standard multiple regression was conducted to investigate the predictive ability of these two variables alone on problematic alcohol use. Both time since surgery and drinking to cope were entered into the regression simultaneously. Results suggested that these two variables explained 60% of the variance in problematic alcohol use (adjusted R Square = 0.60). Of these two variables, drinking to cope made the largest unique contribution ($\beta = 0.73$, $p=0.000$), although time since surgery also made a significant contribution ($\beta = 0.21$, $p=0.011$) Drinking to cope uniquely contributed 51.84% of the variance in total audit scores. Time since surgery uniquely contributed 4%.

Discussion

The aim of this study was to investigate predictors of problematic alcohol use at least 24 months after bariatric surgery. It also aimed to explore the extent to which problematic alcohol use post-operatively may represent a coping strategy to manage negative affect. To the best of the author's knowledge, this is the first study to investigate the impact of attachment style, traumatic life events (both recent and in childhood), drinking motives and levels of self-compassion on problematic alcohol use at least 2 years post-operatively.

Main Findings

Summary of hypotheses

In multivariate analyses childhood adversity, attachment style, self-compassion, stressful life events and drinking motives explained 40% of the overall variance in

problematic alcohol use, when controlling for BMI, pre-surgery BMI and time since surgery. Hypothesis 1 was therefore supported as the overall model predicted a significant amount of variance.

In the final model only time since surgery and drinking to cope made a statistically significant and unique contribution to AUDIT scores. Hypothesis 2 was therefore only partially supported by the findings for drinking to cope, which was positively associated with problematic alcohol use. Contrary to expectations, higher levels of attachment avoidance and anxiety, a large number of stressful life events and the experience of childhood adversity were not significantly associated with alcohol misuse.

As predicted, self-compassion was negatively associated with total AUDIT scores, however the result was not statistically significant.

Drinking to cope

This study was ultimately under-powered and therefore the results should be interpreted with caution. The findings suggest however that a model of drinking to cope may be an interesting area of future study in the investigation of problematic alcohol use in this client group. The amount of time since surgery was also a significant predictor. The idea that alcohol can become increasingly established as a coping strategy over time is supported in the literature on alcohol misuse in the general population (Cho et al., 2019). Theories suggest that drinking behaviours are initially supported by positive re-enforcement of alcohol use and so in its early stages, the uptake of increased drinking is often associated with social and enhancement motives (Brown, Goldman, Inn & Anderson, 1980; Cooper et al., 1995). Problematic alcohol use is maintained through patterns of negative re-enforcement over time, in which alcohol is used to provide relief from negative states (Kwako & Koob, 2017). Post-hoc analyses in this study suggested that social drinking motives were significant in

determining only the amount of alcohol consumed whereas increased risk of alcohol dependence was only significantly associated with drinking to cope and time since surgery. Drinking to cope was also the only significant predictor of hazardous drinking.

Difficult life events

Based on an idea of drinking in order to cope, it was hypothesised that both a greater number of difficult life events and the experience of childhood trauma might predict increased problematic alcohol use. This is supported in the literature which shows that the experience of stressful life events can predict the amount and frequency of alcohol consumed (Dawson et al., 2005) and can act as a risk factor for alcohol dependence (Lloyd & Turner, 2008). However, in this study neither childhood adversity (CTQ) nor recent difficult life events (SRS) were significantly associated with problematic alcohol use. Indeed, contrary to hypothesis 2, both stressful life events and emotional neglect were negatively associated with increased misuse. One interpretation of this outcome is that this study was not sufficiently powered to detect a significant relationship. However, it is potentially important to note that although the SRS score is calculated using the potential significance of life events, neither the SRS or CTQ account for the frequency or subjective impact and severity of adversity (Argorastos et al., 2014). Furthermore, information is not provided on other things that could have determined how individuals may have coped, such as the existence of protective factors or having received psychological intervention. The significance and potential impact of adversity, particularly childhood trauma, is well documented. However, caution should also be exercised in assuming that those who have experienced adversity will struggle to cope. This is captured in the literature on post traumatic growth (Tedeschi & Calhoun, 2004) and on the range of other psychological factors which influence an individual's response to trauma. One recent study on problematic alcohol use suggested that levels of distress

tolerance were far more predictive of drinking to cope than intensity of negative effect or number of difficult life experiences (Khan et al., 2018). It is possible therefore that levels of distress tolerance and the existence of effective strategies for managing difficult emotions may have reduced the impact of previous difficult life events and could go some way to explaining why in this study the existence of difficult life events alone did not predict difficulties with problematic alcohol use.

Attachment Style

Literature on emotion regulation and coping styles suggests that attachment style may be one way of predicting how an individual will respond to adversity and manage distress (Kim et al., 2013). Hypothesis 2 had predicted that insecure attachment (as evidenced by highs scores on both subscales of the ECRS) would be positively associated with problematic alcohol use. In final analyses neither attachment avoidance or anxiety were significant predictors once BMI, pre-surgery BMI and time since surgery were controlled. Only attachment avoidance was positively associated with problematic alcohol use. This is supported in the literature which demonstrates that individuals higher in attachment avoidance rather than anxiety, may be more likely to engage in lower levels of support and rely on more externalised methods of emotion regulation such as alcohol in order to cope (Berry & Kingswell, 2012). A recent study by Lan le, Levitan, Mann & Maunder (2018) disputed the association between attachment avoidance and harmful drinking in their results but instead proposed that attachment anxiety possibly mediated the relationship with childhood adversity. Participants in this study who had experienced higher levels of emotional abuse and neglect, physical abuse and more stressful life events, scored higher on attachment anxiety than avoidance and these associations were significant in bivariate analyses. The small sample size in this study however precluded the use of more

sophisticated analyses to investigate this further. People with high attachment insecurity are more likely to report symptoms of anxiety and depression (Bifulco, Moran, Ball & Bernazzani, 2002) and this is turn is related to alcohol consumption although the nature of the relationship is not clear (Fergusson, Boden & Horwood, 2009). Despite almost half the sample having received a mental health diagnosis and the majority of those having been a diagnosis of anxiety and or depression, the relationship between problematic alcohol use and having a mental health diagnosis was not statistically significant.

Again in considering the lack of significant findings for an association between attachment style, mental health diagnosis and increased problematic alcohol use, it is important to note that this study did not account for a number of factors which may have affected the relationship between attachment style and coping. That may include any treatment or interventions received, the existence of helpful and adaptive strategies and the role of occupation, quality of life and supportive relationships. An understanding of attachment style has been shown to be useful in predicting help seeking behaviour and engagement with health and support services. It is possible that the participants in this sample, having chosen to take part in research, could represent those individuals more likely to engage effectively in help seeking which may also have impacted the results further and could reduce the generalisability of the findings.

Self-compassion

As predicted in hypothesis 3, self-compassion was negatively associated with problematic alcohol use however this result was not statistically significant. Skills in self-compassion have been associated with promoting positive health and wellbeing (Galla, O'Reilly, Kitil, Smalley & Black, 2015). Studies have also evidenced its impact on psychological outcomes in a number of areas of physical health including obesity (MacBeth

& Gumley, 2012). A brief literature search found very little on the study of self-compassion in bariatric surgery patients however there is an emerging evidence base on its use in other areas of surgery which shows positive impact of mindfulness and compassion on body image concerns and distress (Sherman, Woon, French & Elder, 2017).

Demographic and surgery related factors

Existing literature on predictors of problematic alcohol use has largely focussed on demographic and surgery related factors. According to the results of this study, pre and post-surgery BMI and the amount of time since surgery accounted for 21% of the variance in problematic alcohol use as measured by scores on the AUDIT questionnaire. Evidence suggests that the demographic factors associated with alcohol dependence in bariatric samples are the same as those in the general population (Buffington, 2007). This includes younger age and being male (King et al., 2012). Although age was negatively associated with AUDIT scores in this study, neither age nor gender were found to be significantly correlated. It is possible that the small number of male participants in this sample precluded any gender related findings. Similarly, although alcohol misuse was associated with certain types of surgery in one previous study (King et al, 2012), 64% of participants had received gastric bypass which may have introduced further sampling bias. While marital status was not found to be significantly associated with increased risk of problematic alcohol misuse in this study, qualitative research has suggested that the quality of interpersonal relationships is a more reliable predictor of overall wellbeing post-surgery (Ferriby et al., 2017). Positive social support has also been shown as a possible protective factor against high risk drinking in the first two years following bariatric surgery (King et al., 2012).

The finding that time since surgery was significant fits with the prevalent idea in the literature of a possible ‘honeymoon phase’ for some patients in the first 12 months after

surgery, during which the most dramatic weight loss typically occurs (de Zwaan et al., 2011). Other wellbeing outcomes, as well as possible weight regain, have been shown to be more likely to emerge as time since surgery increases (Legenbauer et al., 2009). It is thought that over time the initial effects of surgery may begin to wane, and patients also become less likely to follow initially strict post-surgery guidelines (Parretti, Hughes & Jones, 2019). By 24 months after surgery however most patients are routinely discharged from specialist bariatric services and referred back to primary care. The association with lower pre and post-operative BMI and problematic alcohol use in this study was unexpected. This finding was supported by only one study in this area (Burgos et al., 2015). Reasons for this relationship are difficult to draw and may possibly also be an outcome of an under-powered study. A higher number of studies found evidence for the impact of weight loss on alcohol-related outcomes but again the results here are mixed. In this study post-surgery weight loss was not found to be significantly associated with problematic alcohol use.

Strengths and limitations

The results of this study must be interpreted in the context of a number of limitations. The first of these relates to sampling; the small sample size due to a relatively low response rate does not provide sufficient power to appropriately test the hypotheses. This increased the likelihood of type-II error and precluded the use of more sophisticated analyses. In particular the small sample size combined with a high number of predictor variables increased the risk of multicollinearity which may have impacted the precision of estimate coefficients and again may have weakened the statistical power of the regression. As such, results must be interpreted with caution and future studies would either require a larger sample size or fewer variables entered into the analysis. The sample was also primarily made up of white and female patients who had received gastric bypass procedures. Although this accurately reflects

demographic trends in bariatric surgery, it is difficult to ascertain how these findings might apply to more diverse populations. A criticism of many studies in this area is that participants are often selected from single surgical sites or clinics. One of the advantages of this study therefore was that the use of social media and online support groups which potentially increased the reach of the recruitment strategy. It is important to note however that this sample was self-selecting and participants were members of established support organisations. They were already seeking help and had access to an established peer-support network. These factors have been shown to be influential in supporting positive post-operative outcomes and may be particularly significant given that a sense of belonging may serve as a protective factor against the development of alcohol misuse in this population (King et al., 2012). This may therefore have impacted levels of problematic alcohol use in this sample and potentially mitigated the impact of other variables by providing participants with social support and alternative ways of coping. Participants in this sample also required the computer access and skills to navigate online/social media platforms, as well as the motivation to participate in research and this may make generalising findings to other patient groups more difficult.

Secondly there were a number of methodological limitations. The cross-sectional design precludes any inference of causality. While a strength of this study was the use of online questionnaires which allowed anonymous responses, it is possible that social desirability effects may still have impacted the results given the sensitive and emotive nature of the subject matter and variables used. Individuals struggling with or concerned about their alcohol consumption or even their weight loss after surgery, may have been less inclined to take part. The results of this study are further impacted by missing data. In some instances, this reduced the sample further to allow analysis of variables such as weight loss which did not reach statistical significance. Although an error occurred that meant one item was missing

from both the ECRS and SCS, both measures do have validated short forms (ECR-M16, Lo et al., 2009; Raes, Pommier, Neff & Van Gucht, 2011). Future studies could perhaps reduce the amount of missing data by making small change such as asking for approximate rather than precise dates for year of surgery. On the advice of the ethics committee, measures in the online questionnaire were ordered to ensure the self-compassion questionnaire (as a potentially protective factor) was positioned towards the end of the survey. It would be interesting to investigate whether randomising the measures increased participation or reduced missing data. This would have to be carefully balanced with consideration for how the chance of ending on more emotive measure might impact potential levels of distress.

Finally, a significant strength of this study was the use of the AUDIT and other highly validated, well known measures. The AUDIT has been recommended for studies into alcohol misuse in this population because it is capable of identifying individuals along a continuum of alcohol misuse. It thus potentially provides opportunity for early intervention and identification. The AUDIT has also been used to screen for alcohol misuse in other studies on bariatric surgery populations (King et al., 2012, Steffen et al., 2014).

Future Research

This study aimed to investigate predictors of problematic alcohol use in post bariatric surgery patients and to develop a possible model of drinking to cope. Given that many of the predictors lacked significance, more work is needed to explore which other factors might necessitate the ‘need to cope’ after bariatric surgery, as well as factors which could determine individual coping styles and ways of managing distress. Future studies could therefore examine the role of variables associated with coping and wellbeing, including factors such as resilience and the use of support networks. Indeed, ‘resilience’ was identified as a key theme distinctive to non-problematic drinking bariatric participants in a study by Reaves et al.

(2019). Self-esteem has also been evidenced as a relatively stable characteristic in bariatric patients, and so this could also be another valuable area of interest. Given the currently limited research into the role of self-compassion in this patient group, it could be interesting to investigate this further. In particular it would be helpful to examine the individual subscales of the SCS to determine which elements of self-compassion might be most useful.

Given the significance of surgery related factors on the development of problematic alcohol use identified in the literature, more research is needed on the impact of surgery related outcomes/events on a possible model of drinking to cope. This could go beyond the current literature which has largely focused on of the psychological impact of weight loss results. Studies have shown that the very experience of seeking and receiving bariatric surgery can be challenging and requires significant life adjustments post-operatively (Coulman, MacKichan, Blazeby & Owen-Smith, 2017). Even in cases of 'successful outcome', weight loss surgery can have a significant impact on identity, relationships and lifestyle (Reaves et al., 2019). Patients may also require further surgical intervention such as body contouring to treat excess skin (Monpellier et al., 2019) or corrective surgery (Ames et al., 2016).

Another important area not covered in this study is the role of pre-operative alcohol or drug use. This has been identified as a potential predictor (Conasen et al., 2013; King et al., 2012) however many previous studies have been criticised for their over-reliance on retrospective data (Shakory et al., 2015). Accurate information on this is also hard to obtain as prospective bariatric patients who report difficulties with alcohol use are either deemed ineligible for surgery or are required to undergo treatment beforehand (Mechanick et al., 2013). Information on sub-clinical drinking behaviours and attitudes as well as historical alcohol and substance concerns could however help differentiate between 'new' cases of increased alcohol risk post-surgery and instances where hazardous drinking or dependence

has represented a relapse or return to a historical coping strategy. It would also be important to consider predictors of alcohol use outside of drinking motives and specifically drinking to cope. Highlighted as significant in the alcohol literature is the role of alcohol expectancies (Kwako & Koob, 2017) and the presence of certain personality traits such as impulsivity. One study captured anecdotal feedback from patients which proposed that increased socialisation after bariatric surgery may serve as a trigger for increased consumption (Burgos et al., 2015) which over time led to more problematic use. This may be an important area to explore and also potentially highlights the need for greater patient input regarding research in this area.

Given that the overall model predicted a significant amount of the variance in problematic alcohol use, further study on the impact of these variables may be warranted. Future studies can address the limitations of this study, notably a larger sample in order to reach sufficient statistical power. Opinions in the literature vary as to whether attachment representations are best conceptualized as continuous dimensions or categories (Fraley et al., 2015), which could also be an interesting area of future study. It would also be valuable to conduct an offline version of this study to observe how this might have impacted recruitment numbers, missing data and responses. The use of semi-structured interviews rather than psychometric measures could possibly allow for a greater exploration of the subjective impact of life events and the development of coping styles. Qualitative methodologies could also be used to provide insight in to motives and expectations around pre and post-surgery drinking behaviours.

More broadly, research is needed to improve understanding of the interaction between psychosocial predictors and bariatric surgery outcomes. Prospective studies extending more than 2 years beyond surgery are critical in order for more conclusive statements on consistent predictors to be made. International and longitudinal studies should include diverse samples

with equal number of both male and female participants. Outcomes on bariatric surgery in adolescents is an emerging area of interest and work on alcohol use and surgery outcomes in this population may add to understanding of this topic in adults.

Clinical Implications

Findings from the present study highlight the complexity and variety inherent in the relationships between the social, physical and psychological factors associated with bariatric surgery outcomes. Although results should be interpreted with caution due to low statistical power there are a number of potential clinical implications based on the findings presented here.

Firstly, the wide range of post-operative outcomes and trajectories for individual patients suggests there is a need for greater and more individualised pre and post-surgery psychosocial support. This could represent a shift from a dichotomous model of inclusion/exclusion in pre-surgery assessments, to a focus on achieving meaningful and sustainable outcomes for individual patients. This could include exploring expectations and motivations for surgery (including those beyond weight loss), as well as ensuring possible challenges are identified and anticipated as much as possible. Rather than a focussed screening on the basis of mental health diagnosis for example, assessments could therefore involve a discussion around coping styles, the identification of possible stressors and the management of distress. It could also include an emphasis in services on the development of support networks and identification of protective factors either prior to surgery or in the early weeks afterwards, when patients may be most motivated to engage.

The timing of post-surgery intervention is another aspect worth consideration. Currently National Institute for Health and Care Excellence (NICE) guidance recommends follow up services up to 24 months after surgery (NICE, 2019). However, the evidence

suggests that long term outcomes might need closer monitoring from a specialist service. Consistent with the previous suggestion, this could mean offering more individualised follow up plans depending on individual presentations and risk factors or could require a greater focus on offering specialist training to primary care professionals in supporting bariatric surgery patients and increasing awareness of possible complications and long-term outcomes of surgery. Investment in post-surgery peer support groups could be another component of this. One further solution could also be increased efforts to engage bariatric patients in existing follow up provision in order to maximise outcomes and support in the first 24 months. Attendance to follow up appointments is often low and failure to attend is associated with poorer outcomes (Paretti et al., 2019). Bariatric services may therefore benefit from investigating possible barriers to engagement and issues of access as well as exploring the use of new technologies and remote consultation/support. It may also be that an understanding of attachment style prior to surgery could provide insight into help seeking behaviour and appropriate support.

This study also highlights specific clinical implications related to problematic alcohol use. This could include assessment of individual drinking behaviours, motives and expectancies to help identify those who may be most at risk as well as increased awareness of issues related to alcohol after surgery. Routine use of the AUDIT at pre and post-surgery assessments could be a helpful way of assessing and monitoring risk, as well as informing a graded intervention based on levels of drinking.

More research is needed into the use of self-compassion interventions in bariatric surgery patients. Given its proven efficacy in other areas compassion informed approaches could be helpful in supporting wellbeing outcomes after surgery. Techniques designed to increase self-compassion may be delivered in relatively short interventions and can also provide a way of formulating individual perspectives and difficulties (Neff, 2003).

Conclusions

This study aimed to explore the predictive value of drinking motives, attachment style, adverse life experiences and levels of self-compassion on problematic alcohol use at least 24 months after bariatric surgery. Results showed that after controlling for BMI variables and time since surgery, drinking to cope predicted a significant amount of the variance in problematic alcohol use at least 24 months after surgery. Cautious interpretation of the results should be applied due to low statistical power, which potentially highlights challenges of recruiting through an online study in this population. A model of drinking to cope in this population may be helpful to explore further in future studies. However, in order to explore drinking to cope in a bariatric patient population, more research is needed to explore factors which predict the need to cope and determine the strategies an individual uses to do so. Increased information is also needed on pre and post-operative alcohol behaviours and motivations. Overall more prospective, large sample studies over longer time periods are needed to improve understanding of the interaction between psychosocial predictors and bariatric surgery outcomes including the risk of problematic alcohol use. Candidates for bariatric surgery often represent a complex and diverse population seeking a procedure which produces a range of outcomes and represents a significant period of transition for patients and their families. This research highlights some of the challenges in predicting outcomes, which may be based on a complex relationship of physical, psychological and social variables. The clinical implications of this include the need for more individualised pre and post-surgery support which either extends past 24 months or enables those at risk of negative, longer term outcomes to be identified and supported early on.

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Appendix A: Author Guidelines for Journal of Eating Behaviours

This document has been abbreviated but the full guidelines can be retrieved from

https://www.elsevier.com/journals/eating-behaviors/14710153/guide-for-authors#900

Your Paper Your Way

We now differentiate between the requirements for new and revised submissions. You may choose to submit your manuscript as a single Word or PDF file to be used in the refereeing process. Only when your paper is at the revision stage, will you be requested to put your paper in to a 'correct format' for acceptance and provide the items required for the publication of your article.

References

There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements

There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction,

Materials and Methods, Results, Conclusions, Artwork and Tables with Captions.

If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes.

Divide the article into clearly defined sections.

Figures and tables embedded in text

Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. The corresponding caption should be placed directly below the figure or table.

Peer review

This journal operates a single blind review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. More information on types of peer review.

REVISED SUBMISSIONS

Use of word processing software

Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Article structure

Introduction

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods

Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

Theory/calculation

A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lay the foundation for further work. In contrast, a Calculation section represents a practical development from a theoretical basis.

Results

Results should be clear and concise.

Discussion

This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices

If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc. in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Appendix B: Prisma Checklist

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Appendix C

Agency for Research and Healthcare Quality Assessment Quality Assessment Tool

General instructions: Grade each criterion as “Yes,” “No,” “Partially,” or “Can’t tell.” Factors to consider when making an assessment are listed under each criterion. Note that some criteria will only apply to specify types of study.

1) Unbiased selection of the cohort?

Factors that help reduce selection bias:

- Prospective study design
- Inclusion/exclusion criteria
- Clearly described
- Recruitment strategy
    - Clearly described
    - Relatively free from bias (selection bias might be introduced, e.g., by recruitment via advertisement)
    - If a comparison group was used, was the sample and selection appropriate? And did the study investigators ensure groups were comparable

2) Sample size calculated?

Factors to consider:

- Did the authors report conducting a power analysis or describe some other basis for determining the adequacy of study group sizes for the primary outcome(s) of interest?
- Did the eventual sample size deviate by $\leq$ 10% of the sample size suggested by the power calculation? (only applicable if power calculation conducted)

3) Adequate description of the cohort?

Factors to consider:

- Age
- Gender
- Type of Surgery

4) Validated method for recording weight loss?

Factors to consider:

- Was the method used to ascertain weight loss clearly described? (Details should be sufficient to permit replication in new studies.)
- Were these measures implemented consistently across all study participants?

5) Validated method for ascertaining psychological predictors?

Factors to consider:

- Were predictors assessed using valid and reliable measures? (standardised measure, self-report measures tend to have lower reliability and validity than clinical interview, single items of scales taken form larger measures are likely to lack content validity and reliability)
- Were these measures implemented consistently across all study participants?

6) **Was the psychological assessment for the purpose of the research study conducted separately to the pre-surgery screening?**

Factors to consider:

- Was this made clear to participants
- Were results kept confidential

6) Missing data?

Factors to consider:

- Did attrition from any group exceed 30%? (Attrition is measured in relation to the time between baseline/allocation and outcome measurement. Where different numbers of patients are followed up for different outcomes, use the number followed up for the primary outcome for this calculation.)
- If missing data is present and substantial, were steps taken to minimize bias (e.g. sensitivity analysis or imputation)

7) Analysis controls for confounding?

Factors to consider:

- Did the analysis control for any baseline differences between groups?
- Does the study identify and control for important confounding variables and effect modifiers? These may include demographic and clinical variables (e.g., using demographics or clinical factors likely to be correlated with predictor and outcome)

9) Analytic methods appropriate?

Factors to consider:

- Was the kind of analysis done appropriate for the kind of outcome data?
    - Dichotomous – logistic regression, survival

  - Categorical – mixed model for categorical outcomes
  - Continuous – ANCOVA, mixed model
- Was the analysis done on an intention-to-treat basis? (That is, was the impact of loss to follow-up [or differential loss to follow up] assessed, e.g., through sensitivity analysis or another intent-to-treat adjustment method?
- Was the number of variables used in the analysis appropriate for the sample size? (The statistical techniques used must be appropriate to the data and take into account issues such as controlling for small sample size, clustering, rare outcomes, multiple comparison, and number of covariates for a given sample size)

Appendix D

Study Questionnaires
Demographic Questionnaire

Screening questions (participants will be unable to continue if they select no):

1. **Have you undergone weight loss surgery more than two years ago?**

   Yes/No
2. **Are you over the age of 18?**
   Yes/No
3. **What is your age?**

   ----
4. **Are you**
   Male/Female

The following questions ask for some information about your weight loss surgery. Your responses are anonymous, strictly confidential, and will only be used for research purposes in combination with those of other participants.

5. **What kind of weight loss surgery have you had?**

6. **When did you have the surgery?**
   Month _____ Year _____

7. **What is your current BMI?**
   (Participants in Qualtrics software able to give height and weight in preferred metric)

8. **What was your BMI before weight loss surgery?**
   (Participants in Qualtrics software able to give height and weight in preferred metric)

The following questions ask for some *background information* about you. This information is important so that we can understand the context of your experiences. Your responses are anonymous, strictly confidential, and will only be used for research purposes in combination with those of other participants.
Please select *one* response for each of the following questions:

9. **I describe my ethnic origin as... (please select relevant box)**

   White
   Pakistani
   Black Caribbean
   Bangladeshi
   Black African

Chinese
Indian
Black Other
Other (please specify)
Prefer Not to Say

10. Are you:

Married
Living with Partner
Divorced
Widowed
Separated
Single

11. What is your occupation?

Managers, Directors and Senior Officials
Professional Occupations
Associate Professional and Technical Occupations
Administrative and Secretarial Occupations
Skilled Trades Occupations
Caring, Leisure and Other Service Occupations
Sales and Customer Service Occupations
Process, Plant, and Machine Operatives
Elementary Occupations (Caretakers, Cleaners and labourers)
Not in a Paid Occupation

The following questions ask for some information about your current mental health. We are asking these questions because they can have an impact on some of the other questions that you will complete. We understand that these are sensitive questions and you may not want to answer them. Because of the sensitive nature of the questions we have provided a "prefer not to say" option. We would like to stress again that your responses are completely anonymous, strictly confidential, and will only be used for research purposes in combination with those of other participants.

12. Have you ever been given a mental health diagnosis

Yes
No
Prefer not to say

13. What diagnosis were you given?

- **- - - - - - - -**
- **Prefer not to say**

14. When was this diagnosis made?

Year:

Prefer not to say

15. Who was this diagnosis made by?

GP

Psychiatrist

Other

Prefer not to say

16. Do you still agree with this diagnosis?

Yes

No

Partly

Prefer not to say

The AUDIT Questionnaire

The Alcohol Use Disorders Identification Test: Self-Report Version

PATIENT: Because alcohol use can affect your health and can interfere with certain medications and treatments, it is important that we ask some questions about your use of alcohol. Your answers will remain confidential so please be honest. Place an X in one box that best describes your answer to each question.

Questions	0	1	2	3	4	
1. How often do you have a drink containing alcohol?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week	
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	1 or 2	3 or 4	5 or 6	7 to 9	10 or more	
3. How often do you have six or more drinks on one occasion?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
4. How often during the last year have you found that you were not able to stop drinking once you had started?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
9. Have you or someone else been injured because of your drinking?	No		Yes, but not in the last year		Yes, during the last year	
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	No		Yes, but not in the last year		Yes, during the last year	
					Total	

The Childhood Trauma Questionnaire

CTQ

Name: _____ _____

Age: _____ Sex: _____

Ready Score® Answer Document

When I was growing up ...	Never True	Rarely True	Sometimes True	Often True	Very Often True
1. I didn't have enough to eat.	●	●	●	●	●
2. I knew that there was someone to take care of me and protect me.	●	●	●	●	●
3. People in my family called me things like "stupid," "lazy," or "ugly."	●	●	●	●	●
4. My parents were too drunk or high to take care of the family.	●	●	●	●	●
5. There was someone in my family who helped me feel that I was important or special.	●	●	●	●	●
6. I had to wear dirty clothes.	●	●	●	●	●
7. I felt loved.	●	●	●	●	●
8. I thought that my parents wished I had never been born.	●	●	●	●	●
9. I got hit so hard by someone in my family that I had to see a doctor or go to the hospital.	●	●	●	●	●
10. There was nothing I wanted to change about my family.	●	●	●	●	●
11. People in my family hit me so hard that it left me with bruises or marks.	●	●	●	●	●
12. I was punished with a belt, a board, a cord, or some other hard object.	●	●	●	●	●
13. People in my family looked out for each other.	●	●	●	●	●
14. People in my family said hurtful or insulting things to me.	●	●	●	●	●
15. I believe that I was physically abused.	●	●	●	●	●
16. I had the perfect childhood.	●	●	●	●	●
17. I got hit or beaten so badly that it was noticed by someone like a teacher, neighbor, or doctor.	●	●	●	●	●
18. I felt that someone in my family hated me.	●	●	●	●	●
19. People in my family felt close to each other.	●	●	●	●	●
20. Someone tried to touch me in a sexual way, or tried to make me touch them.	●	●	●	●	●
21. Someone threatened to hurt me or tell lies about me unless I did something sexual with them.	●	●	●	●	●
22. I had the best family in the world.	●	●	●	●	●
23. Someone tried to make me do sexual things or watch sexual things.	●	●	●	●	●
24. Someone molested me.	●	●	●	●	●
25. I believe that I was emotionally abused.	●	●	●	●	●
26. There was someone to take me to the doctor if I needed it.	●	●	●	●	●
27. I believe that I was sexually abused.	●	●	●	●	●
28. My family was a source of strength and support.	●	●	●	●	●

The Drinking Motives Questionnaire

This questionnaire is composed of 12 statements regarding possible reasons why people drink alcohol. Thinking of all the times you consume alcohol, how often would you say that you drink for each of the following reasons

To forget about your problems

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

To be liked

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

Because I like the feeling

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

To cheer you up when you are in a bad mood

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

Because it makes social gatherings more fun?

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

To fit in with a group you like?

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

Because it's fun?

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

Because it helps you when you feel depressed or nervous?

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

To get high

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

Because it helps you enjoy a party?

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

So you won't feel left out?

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

Because it improves parties and celebrations

Never/Almost Never Sometimes Half of the Time Mostly Almost Always/Always

Holmes-Rahe Social Readjustment Rating Scale (SRRS)

Identifier _____ Date _____

This questionnaire asks about the number of events you have endured over the last 12 months, and shows how they can add up in terms of their effects. Each of the listed events has a score - the higher the score, the higher the stress associated with the event. Identify which have happened to you in the last 12 months by ticking the grey boxes; the questionnaire will add the scores for you.

Death of a spouse		Child leaving home	
Divorce		Trouble with in-laws	
Marital separation		Outstanding personal achievement	
Imprisonment		Spouse starts or stops work	
Death of a close family member		Begin or end school	
Personal injury or illness		Change in living conditions	
Marriage		Revision of personal habits	
Dismissal from work		Trouble with boss	
Marital reconciliation		Change in working hours or conditions	
Retirement		Change in residence	
Change in health of family member		Change in schools	
Pregnancy		Change in recreation	

Sexual difficulties		Change in church activities	
Gain a new family member		Change in social activities	
Business readjustment		More minor mortgage or loan	
Change in financial state		Change in sleeping habits	
Death of a close friend		Change in number of family reunions	
Change to a different line of work		Change in eating habits	
Change in frequency of arguments		Holiday	
Major mortgage or loan		Christmas	
Foreclosure of mortgage or loan		Minor violation of law	
Change in responsibilities at work			
		Total SRRS score	0

Experiences in Close Relationships Scale

	QUESTION	1=Strongly Disagree.....7=Strong Agree						
1.	I'm afraid that I will lose my partner's love.	1	2	3	4	5	6	7
2.	I often worry that my partner will not want to stay with me.	1	2	3	4	5	6	7
3.	I often worry that my partner doesn't really love me.	1	2	3	4	5	6	7
4.	I worry that romantic partners won't care about me as much as I care about them.	1	2	3	4	5	6	7
5.	I often wish that my partner's feelings for me were as strong as my feelings for him or her.	1	2	3	4	5	6	7
6.	I worry a lot about my relationships.	1	2	3	4	5	6	7
7.	When my partner is out of sight, I worry that he or she might become interested in someone else.	1	2	3	4	5	6	7
8.	When I show my feelings for romantic partners, I'm afraid they will not feel the same about me.	1	2	3	4	5	6	7
9.	I rarely worry about my partner leaving me.	1	2	3	4	5	6	7
10.	My romantic partner makes me doubt myself.	1	2	3	4	5	6	7
11.	I do not often worry about being abandoned.	1	2	3	4	5	6	7
12.	I find that my partner(s) don't want to get as close as I would like.	1	2	3	4	5	6	7
13.	Sometimes romantic partners change their feelings about me for no apparent reason.	1	2	3	4	5	6	7
14.	My desire to be very close sometimes scares people away.	1	2	3	4	5	6	7
15.	I'm afraid that once a romantic partner gets to know me, he or she won't like who I really am.	1	2	3	4	5	6	7
16.	It makes me mad that I don't get the affection and support I need from my partner.	1	2	3	4	5	6	7
17.	I worry that I won't measure up to other people.	1	2	3	4	5	6	7
18.	My partner only seems to notice me when I'm angry.	1	2	3	4	5	6	7
19.	I prefer not to show a partner how I feel deep down.	1	2	3	4	5	6	7
20.	I feel comfortable sharing my private thoughts and feelings	1	2	3	4	5	6	7

	with my partner.							
21.	I find it difficult to allow myself to depend on romantic partners.	1	2	3	4	5	6	7
22.	I am very comfortable being close to romantic partners.	1	2	3	4	5	6	7
23.	I don't feel comfortable opening up to romantic partners.	1	2	3	4	5	6	7
24.	I prefer not to be too close to romantic partners.	1	2	3	4	5	6	7
25.	I get uncomfortable when a romantic partner wants to be very close.	1	2	3	4	5	6	7
26.	I find it relatively easy to get close to my partner.	1	2	3	4	5	6	7
27.	It's not difficult for me to get close to my partner.	1	2	3	4	5	6	7
28.	I usually discuss my problems and concerns with my partner.	1	2	3	4	5	6	7
29.	It helps to turn to my romantic partner in times of need.	1	2	3	4	5	6	7
30.	I tell my partner just about everything.	1	2	3	4	5	6	7
31.	I talk things over with my partner.	1	2	3	4	5	6	7
32.	I am nervous when partners get too close to me.	1	2	3	4	5	6	7
33.	I feel comfortable depending on romantic partners.	1	2	3	4	5	6	7
34.	I find it easy to depend on romantic partners.	1	2	3	4	5	6	7
35.	It's easy for me to be affectionate with my partner.	1	2	3	4	5	6	7
36.	My partner really understands me and my needs.	1	2	3	4	5	6	7

Self Compassion Scale

HOW I TYPICALLY ACT TOWARDS MYSELF IN DIFFICULT TIMES

Please read each statement carefully before answering. To the left of each item, indicate how often you behave in the stated manner, using the following scale:

Almost never				Almost always
1	2	3	4	5

_____ 1. I'm disapproving and judgmental about my own flaws and inadequacies.

_____ 2. When I'm feeling down I tend to obsess and fixate on everything that's wrong.

_____ 3. When things are going badly for me, I see the difficulties as part of life that everyone goes through.

_____ 4. When I think about my inadequacies, it tends to make me feel more separate and cut off from the rest of the world.

_____ 5. I try to be loving towards myself when I'm feeling emotional pain.

_____ 6. When I fail at something important to me I become consumed by feelings of inadequacy.

_____ 7. When I'm down and out, I remind myself that there are lots of other people in the world feeling like I am.

_____ 8. When times are really difficult, I tend to be tough on myself.

_____ 9. When something upsets me I try to keep my emotions in balance.

_____ 10. When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people.

_____ 11. I'm intolerant and impatient towards those aspects of my personality I don't like.

_____ 12. When I'm going through a very hard time, I give myself the caring and tenderness I need.

_____ 13. When I'm feeling down, I tend to feel like most other people are probably happier than I am.

_____ 14. When something painful happens I try to take a balanced view of the situation.

_____ 15. I try to see my failings as part of the human condition.

_____ 16. When I see aspects of myself that I don't like, I get down on myself.

_____ 17. When I fail at something important to me I try to keep things in perspective.

_____ 18. When I'm really struggling, I tend to feel like other people must be having an easier time of it.

_____ 19. I'm kind to myself when I'm experiencing suffering.

_____ 20. When something upsets me I get carried away with my feelings.

_____ 21. I can be a bit cold-hearted towards myself when I'm experiencing suffering.

_____ 22. When I'm feeling down I try to approach my feelings with curiosity and openness.

_____ 23. I'm tolerant of my own flaws and inadequacies.

_____ 24. When something painful happens I tend to blow the incident out of proportion.

_____ 25. When I fail at something that's important to me, I tend to feel alone in my failure.

_____ 26. I try to be understanding and patient towards those aspects of my personality I don't like.

Appendix E: University Ethics Committee Approval Letter

Dear Prof Halford

I am pleased to inform you that your application for research ethics approval has been approved. Application details and conditions of approval can be found below. Appendix A contains a list of documents approved by the Committee.

Application Details

Reference:	2693
Project Title:	Alcohol dependence in weight loss surgery patients
Principal Investigator/Supervisor:	Prof Jason Halford
Co-Investigator(s):	Mrs Sarah Cottam, Dr Vicky Fallon
Lead Student Investigator:	-
Department:	Psychological Sciences
Approval Date:	20/02/2018
Approval Expiry Date:	Five years from the approval date listed above

The application was **APPROVED** subject to the following conditions:

Conditions of approval

- All serious adverse events must be reported via the Research Integrity and Ethics Team (ethics@liverpool.ac.uk) within 24 hours of their occurrence.
- If you wish to extend the duration of the study beyond the research ethics approval expiry date listed above, a new application should be submitted.
- If you wish to make an amendment to the research, please create and submit an amendment form using the research ethics system.
- If the named Principal Investigator or Supervisor leaves the employment of the University during the course of this approval, the approval will lapse. Therefore it will be necessary to create and submit an amendment form using the research ethics system.
- It is the responsibility of the Principal Investigator/Supervisor to inform all the investigators of the terms of the approval.

Kind regards,

Central University Research Ethics Committee A

ethics@liverpool.ac.uk

CURECA

Appendix F: Research Review Committee Approval Letter

UNIVERSITY OF LIVERPOOL

D.Clin.Psychology Programme
Division of Clinical Psychology
Whelan Building, Quadrangle
Brownlow Hill
LIVERPOOL
L69 3GB

Tel: 0151 794 5530/5534/5877
Fax: 0151 794 5537
www.liv.ac.uk/dclinpsychol

Sarah Cottam
Clinical Psychology Trainee
Doctorate of Clinical Psychology Doctorate Programme
University of Liverpool
L69 3GB

30 November 2017

RE: ***Predictors of alcohol dependence in post bariatric surgery patients***
Trainee: Sarah Cottam
Supervisors: Jason Halford & Irina Yelland

Dear Sarah,

Thank you for your notification of minor amendment to your proposal submitted to the Chair of the D.Clin.Psychol. Research Review Committee (dated 12/11/17).

I can now confirm that your amended proposal (version number 3, dated 12/11/17) and revised budget (version number 2, dated 12/11/17) meet the requirements of the committee and have been approved by the Committee Chair.

Please take this Chairs Action decision as ***final*** approval from the committee.

You may now progress to the next stages of your research.

I wish you well with your research project.

Dr Catrin Eames
Vice-Chair D.Clin.Psychol. Research Review Committee.

Appendix G: Study Advert

UNIVERSITY OF LIVERPOOL

Researchers in the Department of Psychological Sciences at the University of Liverpool are seeking individuals to take part in an online survey.

We are interested in understanding more about the psychological factors that might contribute to well-being after bariatric surgery. This study looks at the role of alcohol in how people may cope after weight loss surgery. We are interested in whether there is any link between difficult life events, attachment style and drinking to cope.

- The online survey will take approximately 40 minutes to complete and will ask questions about: your surgery, alcohol consumption, traumatic or stressful life events, how you feel in close relationships and how you typically respond when things are difficult. Any information you provide will be anonymous.

We are seeking individuals who: - Have had bariatric surgery more than two years ago

- Are 18 years old or older

- Are fluent in English

If you take part – not only will you have the chance to participate in research that could help future patients, but you will also have the opportunity to enter your email address into a prize draw. First prize will be £50 Amazon Voucher, with two second prizes of £20.

To take part or find out more information. Please click on the link below:

Go to questionnaire now

Appendix H: Participant Information Sheet

Online Participant Information Sheet

Alcohol Dependence in Weight Loss Surgery Patients

We would like to invite you to take part in our research study.
Before deciding whether you would like to take part please have a look at the information below. This will tell you more about the study and explain why the research is being done. If anything in this information isn't clear or if you have any questions you can contact the researcher directly using the details provided.

Sarah Cottam
Trainee Clinical Psychologist

Email: sarahj12@liverpool.ac.uk

Address: Doctorate of Clinical Psychology Programme, University of Liverpool, G.05 Ground Floor, Whelan Building, Brownlow Hill, L69 3GB

What is the purpose of the study?
Surgery is currently considered to be one of the most effective weight loss treatments. However its success is often only measured by the amount of weight lost and how long that is sustained. Research shows that there are also other outcomes that are important to people who choose surgery and that these can impact a person's wellbeing, mental health and relationships.
Studies have shown that for a small but significant number of people there exists a risk of developing alcohol dependence post-surgery. Currently however little is known about why and how this occurs.

This research aims to investigate which factors might help predict whether somebody might develop alcohol dependence after weight loss surgery. We are interested in finding out whether alcohol may be used as a way of coping and if there is any link between stressful life events, (either recent or in childhood), attachment style and drinking to cope. It is our hope that this research will contribute to the question of how best to assess suitability for surgery and consider further the support people may need afterwards.

Why have I been invited to take part?
We are inviting individuals who have had weight loss surgery at least two years ago to take part. To do this we are approaching weight loss surgery support networks. You have been asked to take part because you are likely a weight loss online support group member.

Do I have to take part?
No, taking part in this study is entirely voluntary.

If you decide you would like to take part you will be asked to complete a consent form to say you agree to be involved. If you do decide to take part, you are free to withdraw up until the point of analysis (approximately two weeks after questionnaire completion) without giving a reason, and without incurring any disadvantage. During the study you may withdraw by closing the survey. However, responses to questions you have completed up until this point will be used unless you inform the research team otherwise. If you are unhappy with any aspect of the study, please feel free to contact the researcher and we will try to help.

What would I have to do?
The study consists of an online questionnaire. If you choose to take part you can complete this anywhere, including your computer at home. The questionnaire is run through a secure website and should take around 20 minutes to complete.

If you agree to take part you will first be asked to confirm that you understand what the study involves and a tick box to say that you agree to participate. You will then be asked to confirm that you are over the age of 18 and to provide some information about yourself including; your gender, ethnicity, occupation, relationship status. You will also be asked for details about your weight loss surgery including the date it took place, the type of surgery you had and your pre and post surgery BMI. You will be asked if you have ever received a mental health diagnosis.

You will then be directed to the main questionnaires. These include questions on your weight loss surgery and alcohol consumption and will also ask about:

- **Whether you have experienced any stressful or traumatic life events (either recently or when you were younger)**
- **How you feel in your close relationships**
- **Whether you respond to yourself with compassion when things are difficult**

Once you have completed the questionnaire you will be asked if you are still happy to take part and are happy for your answers to be submitted as part of the study.

As a thank you for participating you will also be given the option to enter into a prize draw to win an Amazon voucher (either a £50 voucher or one of 2 £20 vouchers)

What are the possible risks of taking part?
There should be no direct risks to you taking part. *However it is acknowledged that it can be difficult to think about personal, past or traumatic experiences.* There will therefore be information provided at the end of the questionnaires on how best to seek support if you feel upset or distressed after completing the study.

Are there any benefits to taking part?
In sharing information about your experience it is hoped that the research will inform future clinical screening tools for weight loss surgery. With better understanding of how outcomes such as alcohol dependence can be predicted it is hoped that the research will help identify the types of psychological interventions that might be useful before and after surgery.

What about confidentiality?

All information you provide will be kept confidential. It will not be shared with anyone other than the research team and will be securely stored. All questionnaires will remain anonymous. The information you provide may be used by other researchers at the university but this will be done anonymously and there will be no way for you to be identified by your data.

What if I want to find out the results of the study?

The results of this study will be included in a university report. It is intended that this study will be submitted for publication in a professional journal. Any data included in this study will not be identifiable.

Who can I contact for further information?

You can contact the researcher directly using the details below

Sarah Cottam
Trainee Clinical Psychologist

Email: sarahj12@liverpool.ac.uk

Address: Doctorate of Clinical Psychology Programme, University of Liverpool, G.05 Ground Floor, Whelan Building, Brownlow Hill, L69 3GB

Or alternatively you can contact the principal investigator:

Professor Jason Halford,

Email: jhalford@liverpool.ac.uk

Department of Psychological Sciences, Eleanor Rathbone Building, Bedford Street South, University of Liverpool, L69 7ZA.

What if I am unhappy or there is a problem?

Please do let us know if you are unhappy or have any problem related to the study. You can contact either the researcher or principal investigator to discuss this using the contact details outlined above. If however you remain unhappy or if you have a complaint that you feel unable to talk to us about then you can also contact the University of Liverpool Research Ethics and Integrity Office at ethics@liv.ac.uk. In this instance, you will be required to provide details of the name or a description of the study and the names of the researcher (s) as well as details of the complaint you wish to make.

Appendix I: Online Consent Form

UNIVERSITY OF LIVERPOOL

Online Consent Form

Alcohol Dependence in Weight Loss Surgery Patients

	Please tick to confirm
1. I have read and have understood the information explaining the above study.	☐
2. I am over 18 years of age	☐
3. I have had weight loss surgery at least 24 months ago	☐
4. I understand that my participation in this study is completely voluntary and I can therefore withdraw my involvement up to two weeks after taking part without having to give a reason and at no disadvantage to myself	☐
5. I agree to take part in the above study.	☐

If you have any questions or would like any more information you can contact the researcher directly using the details below

Sarah Cottam
Trainee Clinical Psychologist

Email: sarahj12@liverpool.ac.uk

Address: Doctorate of Clinical Psychology Programme, University of Liverpool, G.05 Ground Floor, Whelan Building, Brownlow Hill, L69 3GB

Appendix J: Skewness, Kurtosis and Normality

Skewness and Kurtosis for AUDIT scores

	N	Mean	St. Dev	Skewness (Standard Error)	Kurtosis (Standard Error)
Total Audit Score	78	12.38	10.10	0.81 (0.27)	-0.12 (0.54)

Outliers

Mahalanobis distance values were all below the critical chi square value and Cook's distance values were all below 1, suggesting that no cases had undue influence on the regression model (Tabachnick & Fiddell, 2013).

Multicollinearity

Recommended cut off points for determining the presence of multicollinearity taken from Pallant (2007). Tolerance values were all less than .10. indicating no violation of the multicollinearity assumption. This was also supported by VIF values where were below the cut-off of 10.

SPSS output shown below.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	26.491	6.711		3.947	.000					
	BMI	-.181	.227	-.112	-.798	.428	-.316	-.101	-.090	.644	1.552
	PreSurgBMI	-.261	.134	-.270	-1.950	.056	-.319	-.240	-.220	.664	1.506
	TiimeSinceSurgery	.058	.023	.292	2.502	.015	.299	.303	.283	.935	1.069
2	(Constant)	2.640	10.738		.246	.807					
	BMI	-.144	.206	-.089	-.699	.488	-.316	-.099	-.062	.486	2.059
	PreSurgBMI	-.009	.129	-.009	-.069	.946	-.319	-.010	-.006	.444	2.253
	TiimeSinceSurgery	.047	.020	.235	2.384	.021	.299	.322	.212	.811	1.233
	EmotionalAbuse	.129	.275	.075	.468	.642	.192	.067	.042	.312	3.207
	PhysicalAbuse	.032	.305	.014	.103	.918	.121	.015	.009	.460	2.173
	SexualAbuse	.017	.161	.012	.106	.916	.097	.015	.009	.644	1.552
	EmotionalNeglect	-.051	.311	-.026	-.164	.870	.178	-.023	-.015	.305	3.280
	PhysicalNeglect	-.001	.346	.000	-.002	.999	.130	.000	.000	.476	2.100
	DMQCoping	1.635	.375	.617	4.358	.000	.739	.529	.388	.396	2.527
	DMQenhancement	-.121	.396	-.044	-.306	.761	.443	-.044	-.027	.380	2.631
	DMQSocial	.311	.414	.110	.751	.456	.367	.107	.067	.368	2.720
	DMQConform	-.080	.460	-.024	-.175	.862	.386	-.025	-.016	.408	2.452
	AttachmentAnxiety	-.827	.997	-.127	-.830	.411	.183	-.118	-.074	.336	2.979
	StressEventsTotal	.000	.006	-.008	-.069	.945	.341	-.010	-.006	.609	1.642
	AttachmentAvoidance3	.824	.901	.125	.915	.365	.266	.130	.081	.423	2.365
	TotalScScore2	-1.048	1.722	-.090	-.609	.546	-.264	-.087	-.054	.363	2.755

a. Dependent Variable: TotalAuditScore

Appendix K: Post-Hoc Analyses

Multiple Hierarchical Regression - Consumption Scores

Step	Variable Entered	R^2 - change	F Change	β	*P*
1	BMI	0.19	F (3,62) = 4.92*	0.00	0.66
	Pre-surgery BMI			0.04	0.77
	Time since surgery			0.28	0.01
2	DMQ Conformity	0.57	F (16,49) = 4.11**	-0.18	0.22
	DMQ Coping			0.56	0.00
	DMQ Enhancement			-0.06	0.68
	DMQ Social			0.40	0.01
	ECRS (AttAv)			0.10	0.48
	ECRS (AttAn)			-0.18	0.00
	SRS			-0.04	0.74
	SCS			0.00	0.99
	Emotional Abuse			0.00	1.00
	Emotional Neglect			0.12	0.48
	Physical Abuse			0.05	0.69
	Physical Neglect			-0.11	0.43
	Sexual Abuse			-0.02	0.89

Multiple Hierarchical Regression - Dependence Scores

Step	Variable Entered	R^2 - change	F Change	*β*	*P*
1	BMI	0.21	F (3,62) =5.50*	-0.08	0.56
	Pre-surgery BMI			-0.10	0.48
	Tim since surgery			*0.29*	*0.01*
2	DMQ Conformity	0.36	F (16,49) = 4.00**	0.12	0.42
	DMQ Coping			*0.42*	*0.01*
	DMQ Enhancement			-0.03	0.83
	DMQ Social			-0.15	0.34
	ECRS (AttAv)			0.20	0.17
	ECRS (AttAn)			-0.18	0.28
	SRS			0.22	0.08
	SCS			-0.03	0.84
	Emotional Abuse			0.09	0.62
	Emotional Neglect			-0.20	0.24
	Physical Abuse			0.03	0.81
	Physical Neglect			0.13	0.33
	Sexual Abuse			0.00	0.98

Multiple Hierarchical Regression Hazardous Drinking

Step	Variable Entered	R^2-change	F Change	β	*P*
1	BMI	0.16	F (3,62) = 3.80*	-0.11	0.40
	Pre-surgery BMI			0.02	0.90
	Time since surgery			0.11	0.27
2	DMQ Conformity	0.45	F (16,49) = 4.70***	0.00	0.99
	DMQ Coping			0.67	*0.00*
	DMQ Enhancement			-0.04	0.78
	DMQ Social			0.06	0.71
	ECRS (AttAv)			0.07	0.60
	ECRS (AttAn)			-0.03	0.84
	SRS			-0.13	0.26
	SCS			-0.16	0.29
	Emotional Abuse			0.08	0.61
	Emotional Neglect			0.00	0.99
	Physical Abuse			0.05	0.69
	Physical Neglect			0.00	1.00
	Sexual Abuse			0.05	0.65

*0.05, **0.01, ***0.001