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Psychological profiles of candidates of bariatric surgery: An investigation of its outcome predictors

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Psychological profiles of candidates of bariatric surgery: An investigation of its outcome predictors

A thesis for the title of Doctor of Philosophy (PhD) in Cognitive Sciences in the department of cognitive, psychological, pedagogical sciences, and cultural studies (COSPECS)

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Contents

1 ABSTRACT

Obesity is significantly associated with decreased life expectancy of about 5–20 years depending on its severity and presence of other comorbidities. Bariatric surgery is considered the most effective long-term treatment for severe obesity and the only intervention that provides short-term and long-term weight loss and significant improvement of comorbid conditions in people with severe obesity. In this naturalistic study with a follow-up, potential candidates for bariatric surgery were initially assessed in the University Hospital of Messina and referred to the surgery unit. All patients who underwent these assessments from September 2021 to September 2022 were then called up for another round of assessment almost 1 year after completing the surgery, out of whom 34 agreed to fill out the questionnaires again online. The findings show that at baseline, no differences in any of the psychological assessments existed between males and females. In the sample with a follow-up, when males and females were combined, significant changes were found in some of the measures such as the BMI (decreased after the intervention) and the BUT_PSDI (increased after the intervention). Although the results suggest a mild effect of the bariatric surgery on the psychological profile of patients, the regression analysis yielded some insights about the patients after the surgery, most importantly the independence of pre-intervention BMI values and post-intervention body image complications, emphasizing the role of psychological help to address these issues. More extensive investigations taking advantage of a wide range of psychological and cognitive examinations can potentially provide more insight regarding the treatment outcome and psychological states of the patients undergoing a significant change in their lives: Bariatric Surgery.

Keywords: Bariatric Surgery; Body Image; Outcome predictors; Obesity

CHAPTER 1

2 INTRODUCTION

2.1 General remarks on prevalence, etiology, and contributing factors in obesity.

According to the WHO, cardiovascular diseases, cancer, and diabetes mellitus, so called as noncommunicable diseases, are the cause for more than 70% of early deaths all around the world. Obesity, being a major risk factor for NCDs, is significantly associated with decreased life expectancy of about 5–20 years depending on its severity and presence of other comorbidities (Berrington de Gonzalez et al., 2010; Fontaine et al., 2003; Prospective Studies Collaboration, 2009). Obesity is defined by the WHO as excessive fat accumulation that can compromise health and is diagnosed with a BMI of over 30 (Prospective Studies Collaboration, 2009). The risk of developing metabolic diseases such as diabetes, fatty liver, cardiovascular diseases, musculoskeletal disease , Alzheimer's disease, depression, and some types of cancer (e.g., breast, ovarian, liver, kidney, and colon) significantly increases in obese individuals. Furthermore, obesity might lead to reduced quality of life, unemployment, lower productivity, and social disadvantages. For example, osteoarthritis, a common consequence of obesity, is considered one of the leading causes of disability and early retirement by WHO. It's worth noting that the World Obesity Federation and many other organizations, have categorized obesity as a chronic progressive disease and not just a risk factor for other diseases (Bray et al., 2017).

A study on the trends in BMI for all countries in the world on 128.9 million children, adolescents and adults shows that obesity prevalence increased in every country between 1975 and 2016 (Abarca-Gómez et al., 2017; Blüher, 2019). Considerable regional differences in BMI changes over time have been found, with a particularly sharp increase in BMI in south and southeast Asia, the Caribbean, and southern Latin America (NCD Risk Factor Collaboration (NCD-RisC), 2017). Controlling for age, changes over the last 40 years varied from almost zero BMI increase in the region of eastern Europe to significant increases in central Latin America (Abarca-Gómez et al.,

2017). The prevalence of a BMI ≥30 also varies by country and ranges from 3.7% in Japan to 38.2% in the United States (Fig. 1). It is worth noting that except for parts of Africa and Asia, as of now there are more obese than underweight people all throughout the world ("Trends in Adult Body-Mass Index in 200 Countries from 1975 to 2014," 2016).

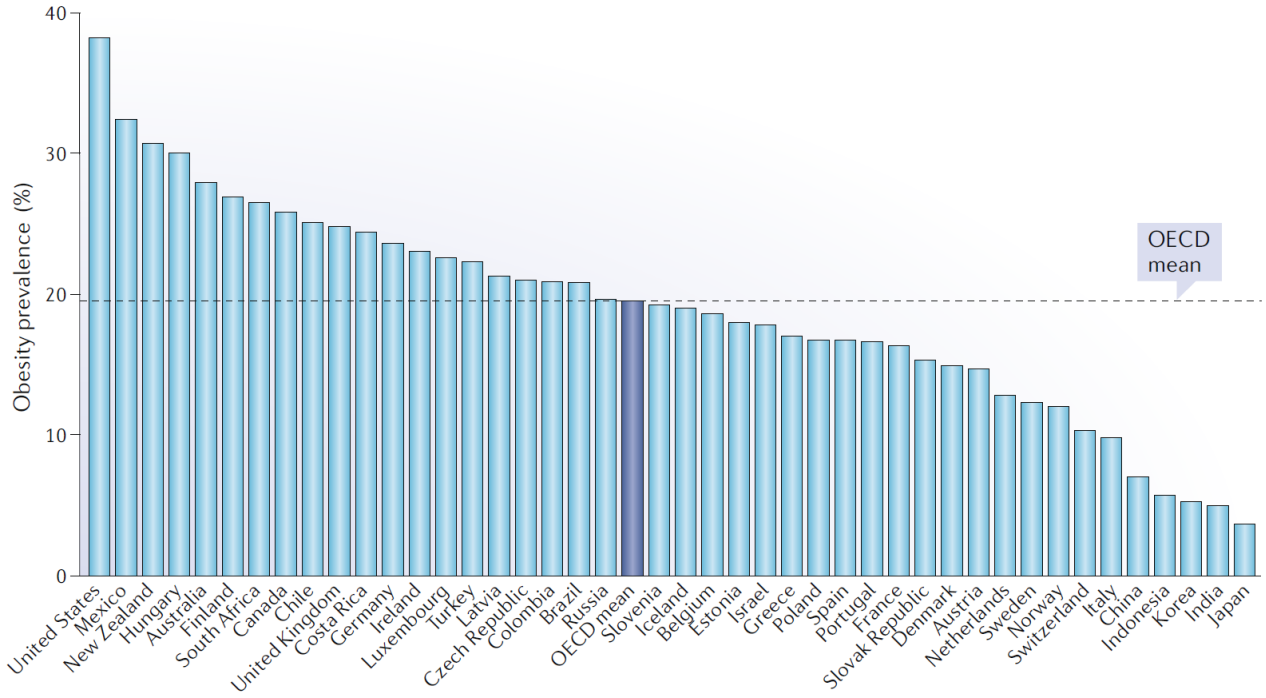

Figure 1 - Worldwide prevalence of obesity (BMI ≥30).(Organization for Economic Cooperation and Development (OECD), 2017; percentage of adults with obesity from measured data).

2.2 Pathogenesis of obesity

Considering an evolutionary perspective, humans have dealt with and survived from extensive periods of undernutrition. The problem of overnutrition has only recently become a more serious health threat than undernutrition, meaning that more people are now dying from being overweight than being underweight. Therefore, it is safe to suppose that natural selection would have favored a genotype that facilitates overeating, low energy consumption, and physical immobility (Blüher, 2019). This means that humans who could tolerate longer famines and who reserve and use energy more efficiently were more successful in reproducing. This process may have led to the overrepresentation of genetic mutations that promote rapid eating and absorbing and storing calories better, thus promoting a state of obesity in times of abundance of food and food stimuli (Yanovski, 2018).

There is evidence in the literature about how the neural mechanisms of food craving is disturbed in obese individuals (Heymsfield & Wadden, 2017; Murray et al., 2014). For example, observations of animals with lesions and humans with tumors in or in the vicinity of the hypothalamus leading to abnormal food-seeking behavior and obesity, have helped researchers understand the impact of specific brain regions in weight regulation (Anand & Brobeck, 1951; Farooqi, 2014). Twin and adoption studies (Börjeson, 1976; Stunkard et al., 1990) suggest that obesity might be considered a hereditary problem in energy homeostasis. It has been estimated that the BMI is around 40–70% heritable (Börjeson, 1976), however, monogenic explanations for obesity are not common (Blüher, 2019). Considering that genetic studies report that only around 2% of the variability in BMI can be explained by common polymorphisms (Hebebrand et al., 2010), thus the changes in population genetics cannot explain the rise of obesity prevalence in the last 40 years and there is room for a lot of environmental, epigenetic, and psychological factors to discuss and explain the obesity problem, the last of which is the objective of the current work, especially in the context of bariatric surgery outcomes.

Obesity is the result of the interaction among many heterogeneous factors and components, rooted in a person's eating tendencies, level of physical activity, and energy expenditure (Blüher, 2019). Based on this point of view, the 'Tackling Obesities' project in the UK Foresight Programme have identified seven clusters that are involved in obesity, including: physiology, individual psychology, physical activity, food intake, food production, social psychology, and ambient of physical activity.

A study on the causes of obesity in Germany found that the strongest risk factors for childhood obesity were parental obesity, low socio-economic status, immigration background, and a higher weight at birth (Beyerlein et al., 2014). Furthermore, in a longitudinal birth cohort study among more than 8,000 children in the United Kingdom, parental obesity, early adiposity and rapid weight gain during the first year of life, high television consumption, and birthweight were identified as being most strongly associated with the risk of obesity, among other variables (Reilly et al., 2005).

2.3 Is obesity a disease?

Considering obesity as a chronic disease is rooted in its pathophysiology affecting the homeostatic mechanisms that complicate weight loss and facilitate further weight gain. These biological and psychological mechanisms in obese people may shed some light on why short-term behavioral or

medical interventions are frequently not efficacious and do not result in weight loss in the long-term (Blüher, 2019). Although healthy eating and physical activity can be effective in preventing obesity in general, they are not sufficient to reduce BMI in people who already have a significantly high body weight. This emphasizes the fact that effective obesity management requires systematic assessments of biological and psychological factors that potentially affect eating behaviors, energy intake, metabolism, and expenditure of energy.

Considering that BMI is highly variable among individuals that even share the same environment, one could suppose that individual body weight regulation is the most important factor in weight gain and is the best target in weight-loss interventions, however, interventions based on changes in behaviors related to energy intake and promoting exercise is often not successful (Blüher, 2019), which suggests that the interaction between all these factors, considering the psychological condition of the individual are only incompletely understood and deserve more research attention since individual physiology and behavior are shaped by social and local environmental components as well as biological, psychological, and genetic factors and of course the interactions between all of them (Blüher, 2019).

2.4 The social component

Body size preferences seem to play a significant role in the development and the psychological consequences of obesity. It is believed that until the early decades of the past century, obesity was considered a sign of beauty, health, and financial well being. In some cultures, higher body weight makes a person attractive for marriage (Lundborg et al., 2007). On the other hand, the preferences and 'norms' regarding the body shape and size can influence individual choices, for example, obesity develops faster in countries in which a large body is seen as attractive (McCabe et al., 2011) compared to countries like Japan, where a smaller body is considered as desirable (Hayashi et al., 2006).

The socio-economic status has also been a determining factor in the rise of obesity since the obesity problem started in high-income countries around the 1970s and continued in most middle-income countries and even recently in some low-income countries (Swinburn et al., 2011) suggesting a close relationship between the levels of obesity and wealth. However, there is a high level of heterogeneity in obesity prevalence between and within countries, which again emphasizes the ethnic, genetic, environmental and other potential differences in addition to the economic factor..

Another important factor to consider is food marketing promoting foods or beverages that are high in fat and sugar thus modulating children's and adults' behavior in a way that soon after being exposed to advertisements, their dietary intake and desire for energy-dense foods and beverages increases (Sadeghirad et al., 2016) with potential consequences for their long-term food seeking behavior.

2.5 Emotional disturbances in obesity

Emotion regulation (ER) refers to automatic and/or controlled processes that are involved in the initiation, maintenance, and modification of the occurrence, intensity, and duration of emotions (Eisenberg et al., 2000) and has been investigated as a transdiagnostic risk factor in a many different psychological disorders, including eating disorders (EDs) and obesity (Aldao et al., 2010; Brockmeyer et al., 2012; Mallorquí-Bagué et al., 2018), with some researchers suggesting that dysfunctional eating patterns may be considered as maladaptive means to regulate distressing emotional states (Overton et al., 2005). There is evidence showing that difficulties in differentiating, describing, and regulating emotions can have an important role in EDs (Aldao et al., 2010; Lavender et al., 2015; Leehr et al., 2015; Westwood et al., 2017).

Models of ER (Aldao et al., 2010) have differentiated between adaptive and maladaptive emotion regulation strategies. ER strategies, such as acceptance, reappraisal (re-evaluation of potentially stressful stimuli in order to decrease their emotional relevance), and problem solving (ability to change or modify the situation or its consequences by engaging in goal-directed behaviors) are examples of adaptive ER, while rumination, avoidance, and suppression are considered maladaptive responses and risk factors for emotional disturbances (Prefit et al., 2019). Absence of adaptive ER strategies is associated with eating pathology in both clinical, like bulimia nervosa and binge eating disorder (BED) patients (Aldao et al., 2010; Svaldi et al., 2012) and non-clinical (Hughes & Gullone, 2011) populations. It has been shown that negative emotions in general act as a trigger for binge eating in BED patients, but not in the obese patients that do not present with BED (Leehr et al., 2015) and that rumination and suppression positively correlate, while problem solving negatively correlates with ED symptoms. Studies suggest that individuals with EDs pay less attention to, and are consequently less aware of their emotions, have poorer emotional clarity that is difficulties in identifying or describing feelings of their own or of others, and show a

tendency not to accept negative emotions in general (Brockmeyer et al., 2012; Mallorquí-Bagué et al., 2018).

2.6 Personality factors in obesity

The synthesis of the included studies in a systematic review on the role of personality traits in obesity (Gerlach et al., 2015) revealed that there seems to be a consensus regarding the associations between 'neuroticism', 'impulsivity', 'extraversion', and 'conscientiousness' as well as 'novelty seeking', 'reward dependence', 'harm avoidance', 'persistence', and 'self-directedness' with overweight/obesity and some aspects of eating behavior, such as binge eating (Gerlach et al., 2015). In specific, there seems to be a positive association between 'neuroticism' and overweight/obesity, at least in women. Comparisons between obese individuals with and without binge eating points out that 'neuroticism' and 'impulsivity' are more noticeable in obese individuals who also suffer from binge eating (Dahl et al., 2013; De Zwaan et al., 1994). Moreover, other data suggest that 'extraversion' defined as a lifestyle that is oriented towards interactions with others, is significantly correlated with overweight/obesity, at least in men (Gerlach et al., 2015). Other considerable features associated with 'extraversion' are 'sensitivity to reward', that is thought to be related to calorie intake, preference for sweets, and 'fast food' (Paquet et al., 2010). In obese individuals that suffer from binge eating, 'sensitivity to reward' is significantly higher, which is also predictive of future weight gain. In a study by Armon et al. (2013) an association have been reported between 'extraversion' and all the three markers of weight, being body mass index, waist circumference, and waist to hip ratio (Armon et al., 2013). Finally, the majority of the cross-sectional population-based studies included in the review of Gerlach et al., (2015) provide evidence for 'conscientiousness' to act as a protective factor against the development of overweight which is in line with the results of some clinical studies reporting a positive correlation between 'conscientiousness' and weight loss (Gerlach et al., 2015).

2.7 Neuropsychiatric comorbidities in obesity

Different psychiatric comorbidities such as mood and anxiety disorders, binge eating, and mild cognitive impairment, is often diagnosed along with obesity which is significantly correlated with decreased quality of life and social functioning of obese patients (Castanon et al., 2014).

Depressive symptoms are highly prevalent among obese individuals being as frequent as up to 30% compared to non-affected age-matched population (Lin et al., 2013).

Comparisons between performance of obese as opposed to lean individuals in many studies have revealed problems in memory (irrespective of age) (Gunstad et al., 2006) and cognitive functions such as planning, problem solving, mental flexibility, and inhibitory control in obese individuals, which may suggests a distrurbed frontal lobe function (Boeka & Lokken, 2008; Fagundo et al., 2012). Moreover, development of age-related cognitive deficits have also been found to be associated with obesity (Cournot et al., 2006; Dahl et al., 2013; Sabia et al., 2009). Although it is quite hard, if not impossible, to draw causal conclusions regarding the relationship between obesity and neuropsychiatric problems in clinical studies, the huge improvement in mood and cognitive functions after significant weight loss by means of bariatric surgery or dietary means, reinforces the hypothesis that neuropsychiatric status is significantly influenced by obesity (Alosco et al., 2014; Brinkworth, 2009; Miller et al., 2013; Siervo et al., 2011). However, there is also evidence which suggests that previous mood and cognitive problems can lead to or predict the development of obesity in later stages of life (Luppino et al., 2010), thus suggesting a bidirectional relationship between obesity and neuropsychiatric conditions (Castanon et al., 2014).

2.8 Treatment options

2.8.1 Diet

The main principle of every dietary plan to counteract obesity is to induce a state of negative daily energy balance to achieve a weight loss of several hundred grams per week (Cannon & Kumar, 2009). A review of randomized controlled trials of different types of diets concluded that a weight loss of about 8% of baseline body weight that can also lead to a reduction in abdominal fat, can be realized by a low-calorie diet for a time window of 3 to 12 months (Expert Panel on the Identification et al., 1998).

2.8.2 Medications

Anti-obesity medications are another avenue that can be considered as part of a weight loss program that comprises dietary plans and physical activity, especially for those individuals with a BMI of more than 27 and other risk factors or diseases related to obesity, however, it should be

noted that the pharmacological approach to treat obesity is limited to a few options and the risks and side-effects are still a major concern that require proper attention and consideration (Cannon & Kumar, 2009).

2.8.3 Behavioral and psychological interventions

Behavioral therapy is rooted in the belief that obesity is the result or at least is significantly affected by maladaptive eating and exercise habits, which could be modified and corrected through the use of the principles of learning, in summary, by specifying weight goals, identifying strategies to overcome the difficulties to achieve those goals, and focusing on small incremental changes (Cannon & Kumar, 2009). Self-monitoring, stimulus control (ie, controlling eating cues), stress management, education regarding nutrition, slower eating routine, and physical activity are the most important components of a behavioral therapy plan for obesity, potentially resulting in a short-term weight loss of about 10 % (Foster et al., 2005).

Cognitive behavioral therapy (CBT) is another effective psychological approach for the management of obesity especially when used in combination with dietary or exercise interventions, leading to more weight loss in obese patients compared to when only dietary or exercise interventions are used (Shaw et al., 2005). CBT focuses more on cognitive rather than only on behavioral changes with the aim to fix the negative thoughts and beliefs of the sufferers of obesity (Fabricatore, 2007). There is evidence that taking advantage of a combination of the cognitive treatment with dietary practices enabled the maintenance of the achieved weight loss, since a regain of about 25% of the already lost weight has been reported in individuals only partaking in dietary and exercise interventions (Werrij et al., 2009).

2.8.4 Bariatric surgery

Bariatric surgery is considered the most effective long-term treatment for severe obesity especially if complicated by type 2 diabetes and the only intervention that provides short-term and long-term weight loss and significant improvement of comorbid conditions in people with severe obesity (Mingrone et al., 2015). As of 2018, almost 252000 bariatric surgeries were annually performed only in the United States (Arterburn et al., 2020). Significant clinical outcomes of bariatric surgery include long-term weight loss, amelioration of obesity-related comorbidities and quality of life and increased life expectancy, which although are favorable, should be examined against the potential

risks of the operation (Nguyen & Varela, 2017). The evidence suggests that early and long-term complications of bariatric operation are lower than that might be expected with about a 4.3% chance of significant adverse events in the early postoperative time window (Flum et al., 2009). Some risk factors for the surgery are the male gender, being older than 50 years, vascular disease, and renal problems (Nguyen et al., 2011, 2013). However, risk factors do not necessarily exclude an individual from bariatric surgery and only need to be considered in the clinical context to come up with the most optimal decision for the patient. In the context of the current study, a sample of patients are assessed at baseline before receiving the bariatric surgery, a percentage of have been assessed again after the intervention. Using this database helped us evaluate the risk factors and the predictors to response to this intervention in an Italian sample.

CHAPTER 2

3 METHODS

3.1 Study design

This is a naturalistic retrospective study with a follow-up. Potential candidates for bariatric surgery were initially assessed in the University Hospital of Messina and referred to the surgery unit. All patients who underwent these assessments from September 2021 to September 2022 were then called up for another round of assessment almost 1 year after completing the surgery. Out of all the 97 patients contacted, 34 agreed to fill out the questionnaires again online.
This study was designed and conducted to:

- Provide an understanding of the psychological states of candidates of bariatric surgery in an Italian sample
- Detect the possible changes in the psychological profiles of these patients after undergoing the surgery
- Investigate the possible psychological predictors of the success of the surgery, i.e., the weight loss or the patients' psychological state after the surgery
- Point out the potential differences between males and females in terms of the psychological impact of their extreme obesity and how sex may affect the physical and psychological effects of bariatric surgery

The following hypotheses were central to the theme of the work:

- Bariatric surgery is an effective intervention for patients suffering from severe obesity and offers substantial weight loss after surgery.
- Considering the prevalence of mood symptoms as a result or concomitant of body-image and/or physical concerns in these patients, following the a successful surgery, i.e., substantial loss of weight, mood or other ego-dystonic symptoms decrease in patients.

3.2 Psychological assessments

3.2.1 BDI-II

Self-report tools, such as the Beck Depression Inventory – second edition (BDI-II) (Beck et al., 1996) are still common means of psychological assessment. BDI-II, being one of the most common tools to quantify depressive symptoms. The 21-item Italian version of the BDI-II was used to assess the level of depression among the patients in the current study (Sica, Claudio; Ghisi, Marta, 2007). The items in the questionnaire are selected by the examinee on a Likert scale, two of which are presented in Table 1 as examples.

1. Tristezza
0. Non mi sento triste. 1. Mi sento triste per la maggior parte del tempo 2. Mi sento sempre triste 3. Mi sento così triste o infelice da non poterlo sopportare.
18. Appetito
0. Non ho notato alcun cambiamento nel mio appetito. 1a. Il mio appetito è un po' diminuito rispetto al solito. 1b. Il mio appetito è un po' aumentato rispetto al solito 2a. Il mi appetito è molto diminuito rispetto al solito 2b. Il mio appetito è molto aumentato rispetto al solito. 3a. Non ho per niente appetito. 3b. Mangerei in qualsiasi momento

Table 1 - Two examples of the items in the Italian version of Beck Depression Inventory second edition (BDI-II)

3.2.2 BES

Binge eating scale (BES) was developed more than 40 years ago to assess the severity of binge eating, i.e., the uncontrolled intake of a large amount of food (Gormally et al., 1982). The BES includes 16 items, 8 of them associated with behavioral manifestations of binge eating and 8 being associated with feelings and cognitions regarding binge eating with each item consisting of a couple of statements that quantify the level of severity of this condition. The higher the examinee scores in BES the more severe their condition would be (Timmerman, 1999). A sample of the items (Item 1 and 8) in the Italian version of this survey is presented in Table 2.

1. □ Non penso consciamente al mio peso ed alle dimensioni del mio corpo quando sono con altre persone. □ Mi preoccupo del mio aspetto, ma questo non mi rende normalmente insoddisfatto/a di me stesso/a. □ Sono consapevole del mio aspetto e del mio peso e questo mi rende deluso/a di me stesso/a. □ Sono molto consapevole del mio peso e spesso provo forte vergogna e disgusto per me stesso/a. Perciò cerco di evitare di incontrare altre persone.
8. □ Raramente mangio così tanto da sentirmi sgradevolmente pieno/a. □ Circa una volta al mese, mangio così tanto da sentirmi sgradevolmente pieno/a. □ Ci sono periodi regolari durante il mese in cui mangio grandi quantità di cibo, ai pasti o fuori dai pasti. □ Mangio così tanto che di solito, dopo aver mangiato, mi sento piuttosto male ed ho nausea.

Table 2 - Two examples of the items in the Italian version of Binge Eating Scale (BES).

3.2.3 BUT

Body uneasiness test (BUT) was developed for the purposes of screening and the clinical assessment of abnormal body image perceptions (Cuzzolaro et al., 2006) consisting of two parts, namely BUT A measuring weight phobia (WP), body image concerns (BIC), avoidance, compulsive self-monitoring (CSM), and feeling of detachment from one's own body (depersonalization); and BUT B focusing on worries about specific body parts or their function. A sample of the items (Item 6 and 12) in the Italian version of BUT A is presented in Table 3 and BUT B in Table 4.

	Mai	Raramente	Qualche volta	Spesso	Molto spesso	Sempre
6. Penso che la mia vita cambierebbe profondamente se potessi correggere alcuni miei difetti estetici	0	1	2	3	4	5
12. Farei qualsiasi cosa per modificare certe parti del mio corpo	0	1	2	3	4	5

Table 3 - Two examples of the items in the Italian version of the Body Uneasiness Test A (BUT A).

Del mio corpo, in particolare, detesto:	Mai	Raramente	Qualche volta	Spesso	Molto spesso	Sempre
9. il naso	0	1	2	3	4	5
26. i genitali	0	1	2	3	4	5

Table 4 - Two examples of the items in the Italian version of the Body Uneasiness Test B (BUT B).

3.2.4 SF-36

The 36-Item Short Form Survey (SF-36) is a set of generic and easily administered quality-of-life self-report measures which was originally developed to explain variations in patient outcomes. Item 2 of the Italian version of this survey is presented in Table 5.

Rispetto ad un anno fa, come giudicherebbe, ora, la Sua salute in generale? *(indichi un numero)*:	
Decisamente migliore adesso rispetto ad un anno fa	1
Un po' migliore adesso rispetto ad un anno fa	2
Più o meno uguale rispetto ad un anno fa	3
Un po' peggiore adesso rispetto ad un anno fa	4
Decisamente peggiore adesso rispetto ad un anno fa	5

Table 5 - Item 2 of the Italian version of the Short Form Survey (SF-36)

3.3 Statistical analysis

The statistical analysis has been conducted using the SPSS software and the significance threshold has been considered at 0.05. Appropriate statistical tests have been applied accordingly. Paired samples or independent samples t tests if normality could be assumed and their non-parametric equivalents, Mann-Whitney U and Wilcoxon Signed Ranks tests, when data did not meet normality criteria. In order to investigate the predictive value of the baseline assessments, forward stepwise multiple regression was used.

CHAPTER 3

4 RESULTS

The issue of missing values in the pre-intervention assessments have been addressed by replacing them with the series mean values (Shrive et al., 2006; Van Der Heijden et al., 2006). The results will be presented for the overall sample (n=97) first and then for the smaller sample on which a follow-up assessment has been conducted (n=33). Throughout the text the following abbreviations will be used to refer to the assessments that have been conducted before and after the intervention: BMI=Body mass index; BDI-II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_GSI=Global severity index of BUT-A; BUT_WP= Weight phobia subscale of BUT-A; BUT_BIC= Body image concerns subscale of BUT-A; BUT_AV= Avoidance subscale of BUT-A; BUT_CSM= Compulsive self-monitoring subscale of BUT-A; BUT_DEP=Depersonalization subscale of BUT-A; BUT_PST=Positive symptom total subscale of BUT-B; BUT_PSDI=Positive symptom distress index of BUT-B; SF= 36-Item Short Form Survey (SF-36); SF_PF= Physical functioning subscale of SF; SF_RLP= Role limitation due to physical health subscale of SF; SF_RLE=Role limitation due to emotional problems subscale of SF; SF_WELL= Emotional well-being subscale of SF; SF_SF= Social functioning subscale of SF; SF_GH= General health subscale of SF.

4.1 Total sample

In total, the initial database consisted of 97 patients. The minimum, maximum, mean, and standard deviation of all the scores and sub scores of all the assessments are presented in Table 6. Out of the 97 patients, 25 were males (age= 41.68±10.58, years of education= 10.45±3.01) and 72 females (age= 44.05±11.59, years of education= 10.59±3.66). The results are presented for males and females separately in Table 7 and illustrated in Figure 2.

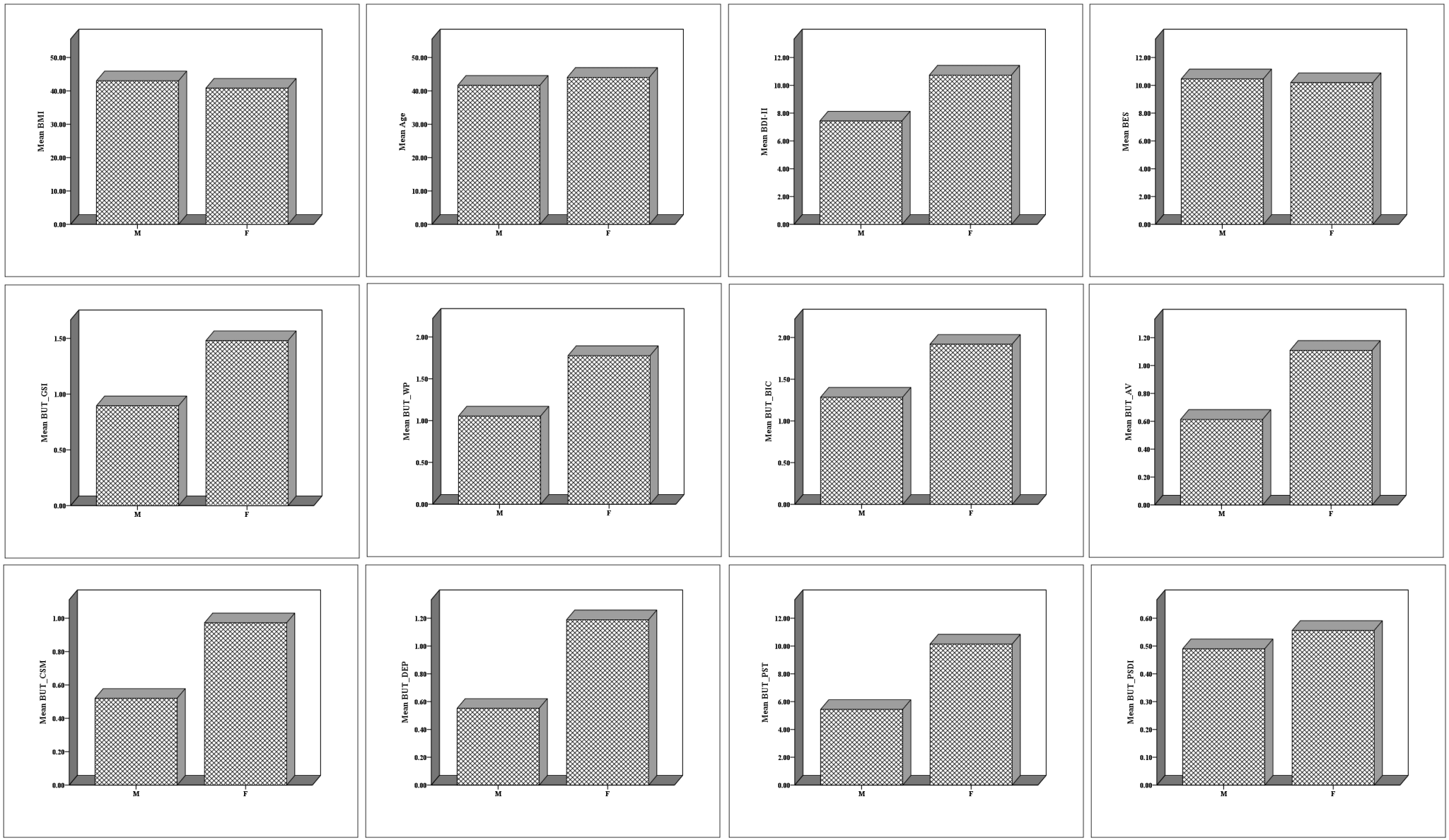

Figure 2 – Bar graphs representing the values of the psychological assessments for males and females separately. Abbreviations: BMI=Body mass index; BDI_II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_GSI=Global severity index of BUT-A; BUT_WP= Weight phobia subscale of BUT-A; BUT_BIC= Body image concerns subscale of BUT-A; BUT_AV= Avoidance subscale of BUT-A; BUT_CSM= Compulsive self-monitoring subscale of BUT-A; BUT_DEP=Depersonalization subscale of BUT-A; BUT_PST=Positive symptom total subscale of BUT-B; BUT_PSDI=Positive symptom distress index of BUT-B.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
BMI	97	32.00	61.60	41.3770	5.94330
AGE	97	20.00	69.00	43.4433	11.33576
BDI_II	94	0.00	33.00	9.8830	7.72492
BES	91	0.00	36.00	10.2637	8.36638
BUT_GSI	97	0.00	4.09	1.3290	1.21620
BUT_WP	96	0.00	5.00	1.5898	1.47531
BUT_BIC	97	0.00	5.00	1.7560	1.52766
BUT_AV	97	0.00	4.67	0.9811	1.20326
BUT_CSM	97	0.00	3.50	0.8557	0.88572
BUT_DEP	97	0.00	4.40	1.0247	1.25075
BUT_PST	97	0.00	33.00	8.9278	8.05353
BUT_PSDI	97	0.20	1.00	0.5391	0.16969
EDUCATION	97	5.00	19.00	10.5610	3.21810
Valid N (listwise)	97				

Table 6 - Baseline descriptive statistics of the clinical assessments of all the sample before the surgery out of whom a random number of patients were assessed again after the surgery. Abbreviations: BMI=Body mass index; BDI_II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_GSI=Global severity index of BUT-A; BUT_WP= Weight phobia subscale of BUT-A; BUT_BIC= Body image concerns subscale of BUT-A; BUT_AV= Avoidance subscale of BUT-A; BUT_CSM= Compulsive self-monitoring subscale of BUT-A; BUT_DEP=Depersonalization subscale of BUT-A; BUT_PST=Positive symptom total subscale of BUT-B; BUT_PSDI=Positive symptom distress index of BUT-B.

Group Statistics

	SEX	N	Mean	Std. Deviation	Std. Error Mean
BMI	M	25	43.0080	6.88076	1.37615
	F	72	40.8107	5.52220	.65080
AGE	M	25	41.6800	10.58584	2.11717
	F	72	44.0556	11.59272	1.36622
BDI_II	M	25	7.4353	7.34159	1.46832
	F	72	10.7329	7.55669	.89056
BES	M	25	10.4611	10.01213	2.00243
	F	72	10.1952	7.40435	.87261
BUT_GSI	M	25	.8953	1.00018	.20004
	F	72	1.4796	1.25404	.14779
BUT_WP	M	25	1.0536	.97950	.19590
	F	72	1.7760	1.56574	.18452

BUT_BIC	M	25	1.2844	1.34374	.26875
	F	72	1.9198	1.56194	.18408
BUT_AV	M	25	.6133	.95224	.19045
	F	72	1.1088	1.25975	.14846
BUT_CSM	M	25	.5200	.61486	.12297
	F	72	.9722	.93782	.11052
BUT_DEP	M	25	.5520	1.04288	.20858
	F	72	1.1889	1.28124	.15100
BUT_PST	M	25	5.4400	6.54523	1.30905
	F	72	10.1389	8.21250	.96785
BUT_PSDI	M	25	.4900	.16991	.03398
	F	72	.5561	.16744	.01973
EDUCATION	M	25	10.4722	2.68483	.53697
	F	72	10.5918	3.40035	.40074

Table 7 - Descriptive statistics regarding all the clinical assessments of male and female patients before the surgery out of whom a random number were assessed again after the surgery. Abbreviations: BMI=Body mass index; BDI_II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_GSI=Global severity index of BUT-A; BUT_WP= Weight phobia subscale of BUT-A; BUT_BIC= Body image concerns subscale of BUT-A; BUT_AV= Avoidance subscale of BUT-A; BUT_CSM= Compulsive self-monitoring subscale of BUT-A; BUT_DEP=Depersonalization subscale of BUT-A; BUT_PST=Positive symptom total subscale of BUT-B; BUT_PSDI=Positive symptom distress index of BUT-B.

4.1.1 Normality tests

The results of the normality tests are presented in Table 8, as it can be seen, the majority of the variables do not meet the normality criteria so non-parametric statistical tests will be used to compare the groups, e.g., males versus females.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
EDUCATION	.241	97	.000	.889	97	.000
BMI	.122	97	.001	.941	97	.000
AGE	.061	97	.200*	.982	97	.222
BDI_II	.133	97	.000	.931	97	.000
BES	.144	97	.000	.895	97	.000
BUT_GSI	.137	97	.000	.900	97	.000
BUT_WP	.139	97	.000	.900	97	.000
BUT_BIC	.153	97	.000	.903	97	.000
BUT_AV	.207	97	.000	.806	97	.000

BUT_CSM	.167	97	.000	.869	97	.000
BUT_DEP	.206	97	.000	.804	97	.000
BUT_PST	.175	97	.000	.907	97	.000
BUT_PSDI	.160	97	.000	.943	97	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 8 – Results of the normality tests for the variables of interest. Abbreviations: BMI=Body mass index; BDI_II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_GSI=Global severity index of BUT-A; BUT_WP= Weight phobia subscale of BUT-A; BUT_BIC= Body image concerns subscale of BUT-A; BUT_AV= Avoidance subscale of BUT-A; BUT_CSM= Compulsive self-monitoring subscale of BUT-A; BUT_DEP=Depersonalization subscale of BUT-A; BUT_PST=Positive symptom total subscale of BUT-B; BUT_PSDI=Positive symptom distress index of BUT-B

4.1.2 Sex differences

After the application of False Discovery Rate (FDR) correction on the output of the Mann-Whitney U tests to address the issue of multiple comparisons, no significant differences were observed between sexes in any of the measured scales, meaning that males and females in this sample did not show any significant differences in their BMI or their psychological profile, e.g., depression, binge eating, physical functioning, etc.

4.2 Follow up sample

Out of all the patients in the initial database, a total of 33 responded to our inquiry and completed the forms and questionnaires in the follow up phase on average 311 days after the surgery, out of whom 8 were males (age= 45.62±9.13, years of education= 9.66±2.58) and 25 females (age= 43.48±13.92, years of education= 11.81±4.01). The minimum, maximum, mean, and standard deviation values of all the scores and sub scores of all the assessments before and after the surgery are presented in Table 9.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EDUCATIONN	33	5.00	18.00	11.0000	3.69966
MAX_WEIGHT	33	83.00	167.00	125.2727	22.76822
BMI_PRE	33	34.80	56.19	42.8882	5.37253
BMI_POST	33	22.43	48.28	29.8901	5.62705
AGE	33	20.00	69.00	44.0000	12.83063
TIME	33	127.52	503.87	311.4797	108.72454
BDI_II_POST	33	.00	23.00	7.0000	7.18505
BES_POST	33	1.00	22.00	5.9697	4.59269
BUT_GSI_POST	33	.15	3.06	1.2825	.82448
BUT_WP_POST	33	.25	3.63	1.7917	.96757

BUT_BIC_POST	33	.00	4.00	1.4899	1.13188
BUT_AV_POST	33	.00	3.00	.7323	.90613
BUT_CSM_POST	33	.00	2.20	.8909	.58329
BUT_DEP_POST	33	.00	2.83	.8838	.82966
BUT_PST_POST	33	.00	36.00	13.7879	8.42525
BUT_PSDI_POST	33	1.00	4.14	2.2143	.69847
SF_PF_POST	33	.00	100.00	73.6364	31.55533
SF_RLP_POST	33	.00	100.00	81.8182	34.95126
SF_RLE_POST	33	.00	100.00	76.7677	38.62646
SF_ENERGY_POST	33	30.00	95.00	66.5152	18.85325
SF_WELL_POST	33	20.00	100.00	75.0303	17.94520
SF_SF_POST	33	25.00	100.00	68.0303	22.33934
SF_PAIN_POST	33	10.00	100.00	78.4848	26.10779
SF_GH_POST	33	5.00	95.00	67.1212	20.88025
BDI_II_PRE	33	.00	28.00	9.8125	7.79197
BES_PRE	33	.00	36.00	9.2188	8.44739
BUT_GSI_PRE	33	.00	3.71	1.4875	1.08478
BUT_WP_PRE	33	.00	4.50	1.8164	1.37464
BUT_BIC_PRE	33	.00	5.00	2.0337	1.39484
BUT_AV_PRE	33	.00	4.67	.9949	1.06839
BUT_CSM_PRE	33	.00	2.83	.9293	.76038
BUT_DEP_PRE	33	.00	4.00	.9455	1.11722
BUT_PST_PRE	33	.00	26.00	10.1818	7.23902
BUT_PSDI_PRE	33	.20	1.00	.5073	.18500
SF_PF_PRE	33	30.00	90.00	60.5026	13.73800
SF_RLP_PRE	33	.00	100.00	66.6667	29.53635
SF_RLE_PRE	33	.00	100.00	77.7773	25.45903
SF_ENERGY_PRE	33	35.00	90.00	60.4762	12.17738
SF_WELL_PRE	33	44.00	100.00	69.5619	11.62837
SF_SF_PRE	33	25.00	100.00	75.5952	18.08082
SF_PAIN_PRE	33	12.50	100.00	64.8750	20.99549
SF_GH_PRE	33	30.00	93.75	65.6548	13.28996
Valid N (listwise)	30				

Table 9 - Descriptive statistics of all the assessments before and after the surgery regarding the sample on which the follow-up was conducted. Abbreviations: BMI=Body mass index; BDI_II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_GSI=Global severity index of BUT-A; BUT_WP= Weight phobia subscale of BUT-A; BUT_BIC= Body image concerns subscale of BUT-A; BUT_AV= Avoidance subscale of BUT-A; BUT_CSM= Compulsive self-monitoring subscale of BUT-A; BUT_DEP=Depersonalization subscale of BUT-A; BUT_PST=Positive symptom total subscale of BUT-B; BUT_PSDI=Positive symptom distress index of BUT-B; SF= 36-Item Short Form Survey (SF-36); SF_PF= Physical functioning subscale of SF; SF_RLP= Role limitation due to physical health subscale of SF; SF_RLE=Role limitation due to emotional problems subscale

of SF; SF_WELL= Emotional well-being subscale of SF; SF_SF= Social functioning subscale of SF; SF_PAIN= Pain subscale of the SF-36; SF_GH= General health subscale of SF.

4.2.1 Normality tests

The results of the normality tests are presented in Table 10, showing that the majority of the variables do not exhibit a normal distribution.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
EDUCATIONN	.306	33	.000	.833	33	.000
MAX_WEIGHT	.123	33	.200*	.958	33	.231
BMI_PRE	.073	33	.200*	.968	33	.438
BMI_POST	.111	33	.200*	.919	33	.017
AGE	.077	33	.200*	.974	33	.583
BDI_II_POST	.257	33	.000	.837	33	.000
BES_POST	.220	33	.000	.825	33	.000
BUT_GSI_POST	.175	33	.011	.880	33	.002
BUT_WP_POST	.167	33	.020	.932	33	.040
BUT_BIC_POST	.193	33	.003	.869	33	.001
BUT_AV_POST	.246	33	.000	.780	33	.000
BUT_CSM_POST	.138	33	.115	.953	33	.161
BUT_DEP_POST	.209	33	.001	.867	33	.001
BUT_PST_POST	.083	33	.200*	.970	33	.480
BUT_PSDI_POST	.213	33	.001	.922	33	.021
BDI_II_PRE	.157	33	.038	.914	33	.013
BES_PRE	.190	33	.004	.810	33	.000
BUT_GSI_PRE	.088	33	.200*	.943	33	.082
BUT_WP_PRE	.093	33	.200*	.940	33	.069
BUT_BIC_PRE	.116	33	.200*	.955	33	.180
BUT_AV_PRE	.195	33	.003	.821	33	.000
BUT_CSM_PRE	.168	33	.018	.928	33	.030
BUT_DEP_PRE	.199	33	.002	.811	33	.000
BUT_PST_PRE	.102	33	.200*	.948	33	.115
BUT_PSDI_PRE	.210	33	.001	.935	33	.049
SF_PF_PRE	.227	33	.000	.929	33	.033
SF_RLP_PRE	.258	33	.000	.846	33	.000
SF_RLE_PRE	.258	33	.000	.786	33	.000
SF_ENERGY_PRE	.258	33	.000	.904	33	.007
SF_WELL_PRE	.227	33	.000	.945	33	.095
SF_SF_PRE	.244	33	.000	.893	33	.004

SF_PAIN_PRE	.198	33	.002	.868	33	.001
SF_GH_PRE	.197	33	.002	.942	33	.079

Table 10 - Normality tests results for the variables in the follow-up sample showing the majority of variables not meeting the normality criteria. Abbreviations: BMI=Body mass index; BDI_II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_GSI=Global severity index of BUT-A; BUT_WP= Weight phobia subscale of BUT-A; BUT_BIC= Body image concerns subscale of BUT-A; BUT_AV= Avoidance subscale of BUT-A; BUT_CSM= Compulsive self-monitoring subscale of BUT-A; BUT_DEP=Depersonalization subscale of BUT-A; BUT_PST=Positive symptom total subscale of BUT-B; BUT_PSDI=Positive symptom distress index of BUT-B. SF= 36-Item Short Form Survey (SF-36); SF_PF= Physical functioning subscale of SF; SF_RLP= Role limitation due to physical health subscale of SF; SF_RLE=Role limitation due to emotional problems subscale of SF; SF_WELL= Emotional well-being subscale of SF; SF_SF= Social functioning subscale of SF; SF_PAIN= Pain subscale of the SF-36; SF_GH= General health subscale of SF.

4.2.2 Sex differences

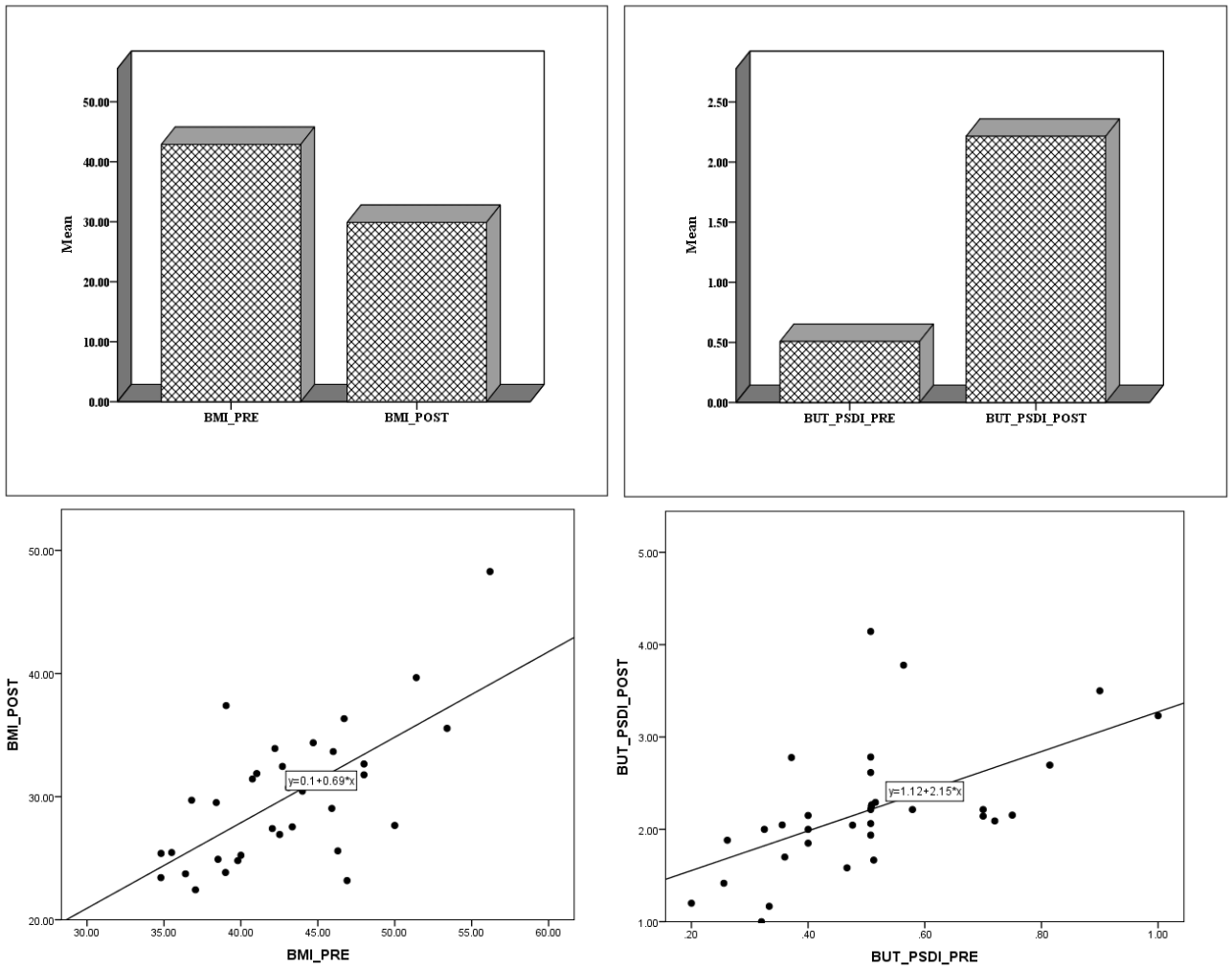

Figure 3 - Bar graphs representing significant changes before and after the surgery. Abbreviations: BMI=Body mass index; BUT=Body uneasiness test; BUT_PSDI=Positive symptom distress index of BUT-B.

After the FDR correction, no significant differences were observed between sexes in any of the

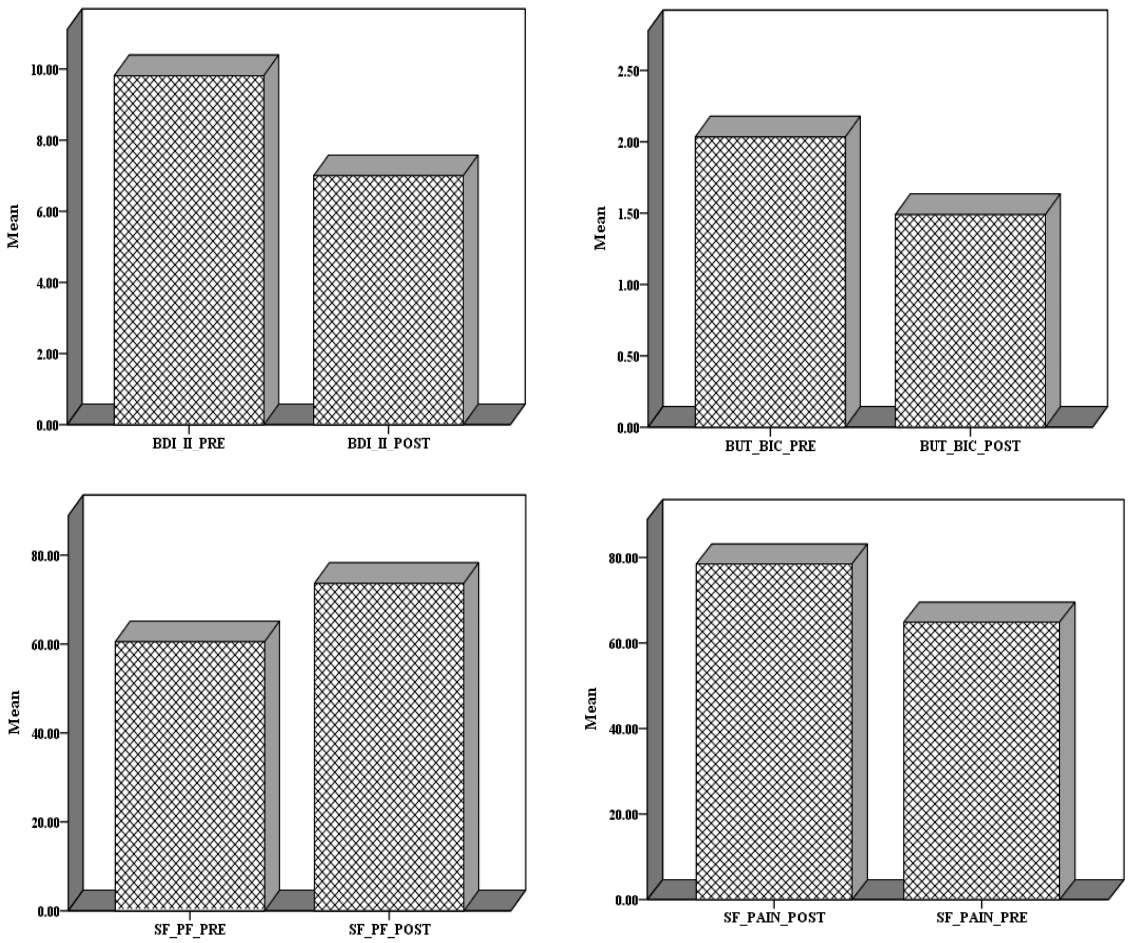

Figure 4 - Bar graphs representing variables showing marginally significant changes after the intervention. Abbreviations: BDI_II=Beck depression inventory-second version; BUT=Body uneasiness test; BUT_BIC= Body image concerns subscale of BUT-A; SF= 36-Item Short Form Survey (SF-36); SF_PF= Physical functioning subscale of SF; SF_PAIN= Pain subscale of the SF-36

measured scales, meaning that males and females in this sample did not show any significant differences in their BMI or their psychological profile, e.g., depression, binge eating, physical functioning, etc., neither before nor after the intervention.

4.2.3 Post versus pre in total sample

Comparisons of pre versus post assessments using the Wilcoxon Signed Ranks Test in all the sample, i.e., males and females combined, after applying the FDR correction revealed a significant decrease in the BMI ($Z=-5.012$, $p<0.001$, corrected, effect size=0.616) and marginally significant decrease in BDI-II ($Z=-2.525$, $p= 0.057$, corrected, effect size=0.310) and BUT_BIC ($Z=-2.375$, $p= 0.068$, effect size=0.292) and increase in BUT_PSDI ($Z=-5.012$, $p<0.001$, effect size=0.616), SF_PF ($Z=-2.245$, $p=0.073$, effect size=0.276) and SF_PAIN ($Z=-2.597$, $p=0.057$, effect size=0.319). The variables showing significant changes after the surgery are illustrated in Figure

3 showing the trends before and after intervention. Bar graphs of all the variables showing marginally significant changes after the intervention are shown in Figure 4 and their scatter plots

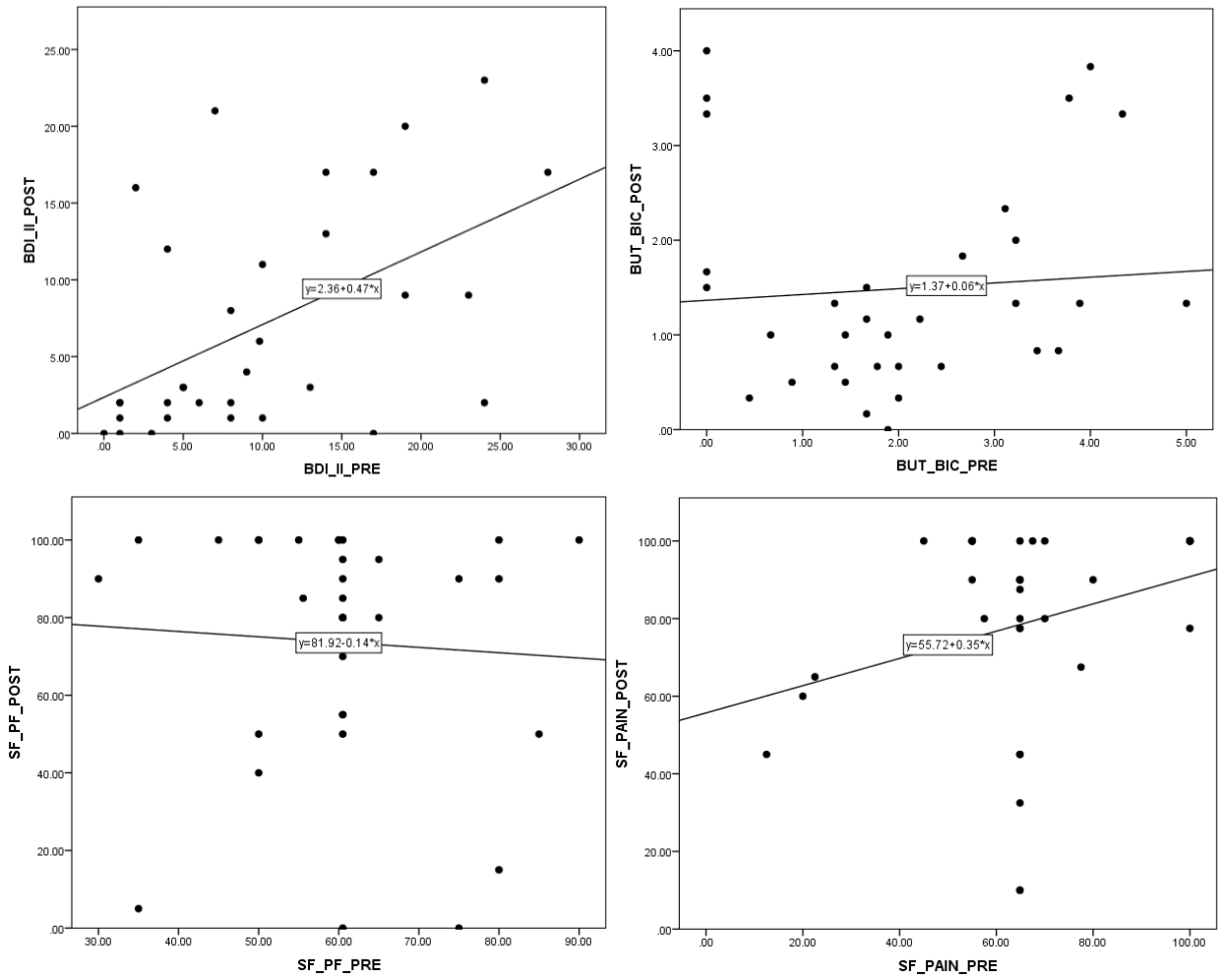

Figure 5 - Scatter plots representing the trends in variables showing marginally significant changes after the surgery. Abbreviations: BDI_II=Beck depression inventory-second version; BUT=Body uneasiness test; BUT_BIC= Body image concerns subscale of BUT-A; SF= 36-Item Short Form Survey (SF-36); SF_PF= Physical functioning subscale of SF; SF_PAIN= Pain subscale of the SF-36

are presented in Figure 5. The formulae to calculate the effect size is based on (Tomczak & Tomczak, 2014) defined as the division of the Z value over the square root of the sample size in independent samples and total number of pairs for paired samples. Based on the suggestions of the Tomczak & Tomczak (2014) effect sizes between 0 to 0.19, 0.20 to 0.49, 0.50 to 0.79, and more than 0.80 are considered very small, small, medium, and large, respectively.

4.2.4 Post versus pre in males and females

If the post versus pre assessments are compared separately in males and females, the results vary other than in BMI which decreased in both males ($t(7)=9.136$, $p<0.001$, corrected, effect size=2.284) and females ($Z=-4.372$, $p<0.001$, corrected, effect size=0.618). It is worth mentioning

that the non-parametric equivalent of the paired samples t test has been used for the female group because the distribution of the BMI values after the intervention does not meet the criteria of normal distribution in females. Considering the rest of the variables, no significant changes can be seen in the male group when comparing before and after the intervention. However, females show significant changes in BUT_PSDI ($Z=-4.372$, $p<0.001$, effect size= 0.618). It is noteworthy that this value was not found to be different between males and females in the baseline assessment. Figure 6 includes the bar graphs representing the significant changes before and after the intervention that were found in the BMI and PSDI in males and females, separately.

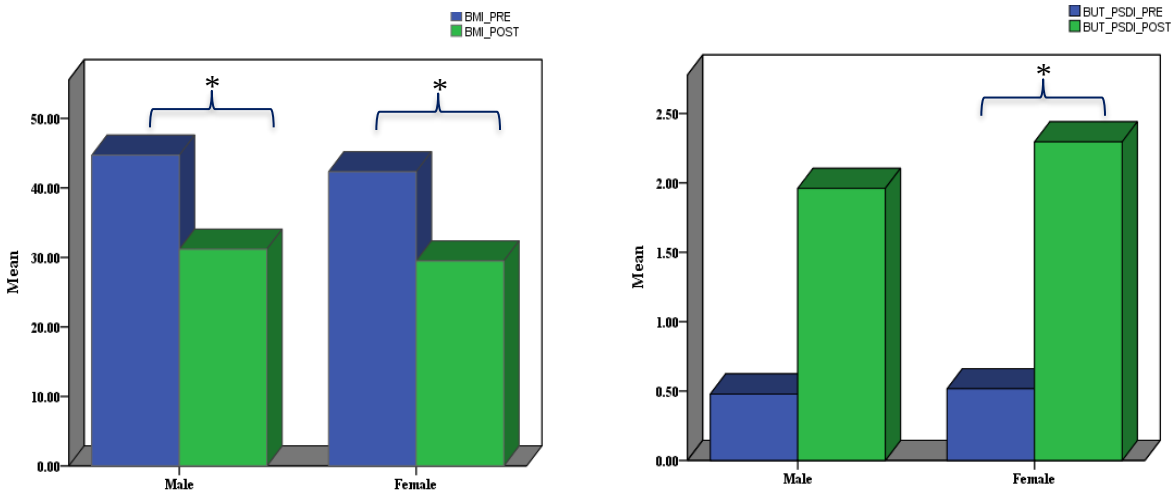

Figure 6 - Variables showing significant changes after the surgery in males and females. * represents a significant change, emphasizing the finding that the value of BUT_PSDI does not show a significant change after the surgery in males. Abbreviations: BMI=Body mass index; BUT=Body uneasiness test; BUT_PSDI=Positive symptom distress index of BUT-B

4.3 Regression results

In order to address the issue of multicollinearity, variance inflation factor (VIF) which provides an index of the degree of the correlation between the independent variables was calculated (Thompson et al., 2017). Multicollinearity happens when there is a high correlation between the independent variables in a regression model in which case one cannot assume those as truly independent and examine their contribution in explaining the variations in the outcome. It has been suggested that a value of VIF between 1 and 5 be considered acceptable in the context of regression analysis.

The forward stepwise multiple regression analysis was performed to find predictors of the BMI, BDI-II, BUT_BIC, BUT_PSDI, SF_PF, and SF_PAIN scores, namely the variables that showed significant changes after the surgery. The scatter plots in Figure 7 shows the trends between the

all of these values and the predictors that resulted from running the regression analysis.

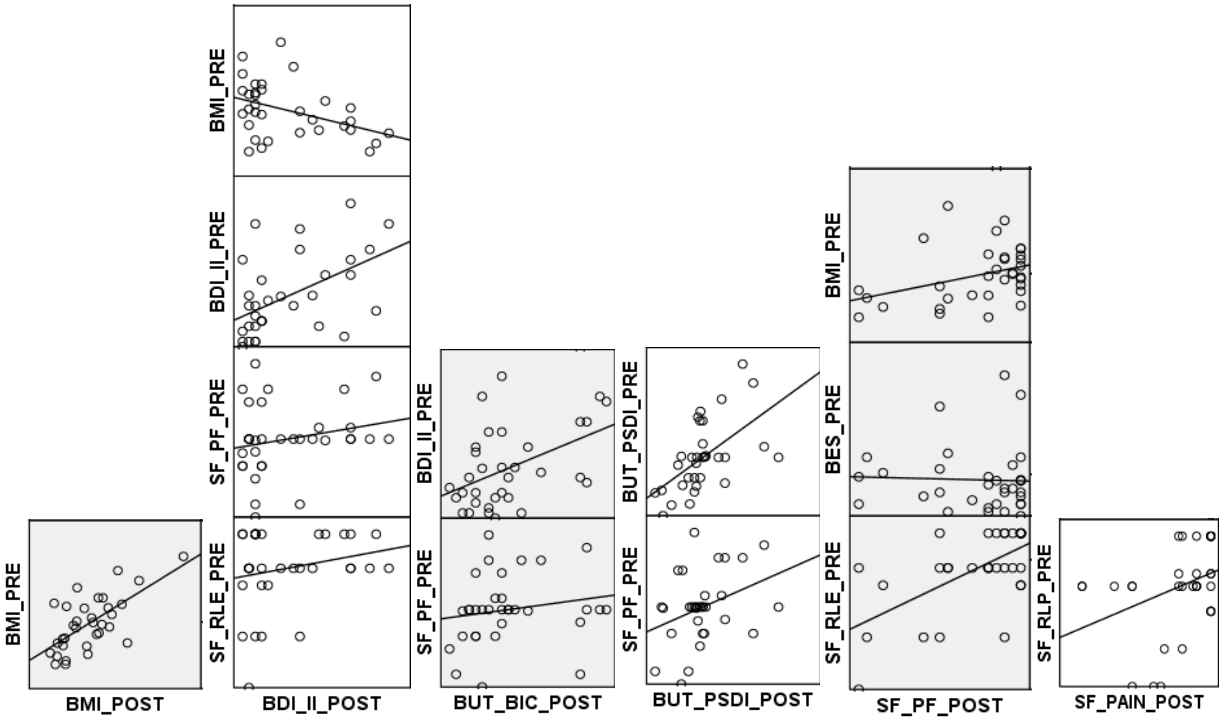

Figure 7 - Trends between the all of these values and the predictors that resulted from running the regression analysis with each column representing a regression model consisting of the significant predictors. Abbreviations: BMI=Body mass index; BDI_II=Beck depression inventory-second version; BES=Binge eating scale; BUT=Body uneasiness test; BUT_BIC= Body image concerns subscale of BUT-A; BUT_PSDI=Positive symptom distress index of BUT-B. SF= 36-Item Short Form Survey (SF-36); SF_PF= Physical functioning subscale of SF; SF_RLP= Role limitation due to physical health subscale of SF; SF_RLE=Role limitation due to

4.3.1 Prediction of post-surgery BMI

Considering BMI, the only baseline variable that had a predictive value was the pre-intervention BMI explaining 44% of the variance (R^2 =0.440, F(1,32)=24.342, p<0.001, β=0.695, p<0.001, effect size=0.785).

4.3.2 Prediction of post-surgery BDI-II

Regarding BDI-II scores after the treatment, the results of the multiple regression showed that a model consisting of BDI-II_PRE (β=0.578, p<0.001), SF_PF_PRE (β=0.141, p=0.055), BMI_PRE (β=-0.419, p=0.019), and SF_RLE_PRE (β=0.092, p=0.020) can explain 57.8% of the BDI-II scores after the intervention (R^2 =0.578, F(4,32)=9.59, p<0.001, effect size=1.369).

4.3.3 Prediction of post-surgery BUT_BIC

Considering the BUT_BIC_POST as the dependent variable, a model consisting of BDI_II_PRE (β=0.081, p=0.001) and SF_PF_PRE (β=0.028, p=0.042) was able to explain 31.9 % of the

variations in BUT_BIC scores after the intervention (R^2 =0.319, F(2,32)=7.040, p=0.003, effect size=0.468).

4.3.4 Prediction of post-surgery BUT_PSDI

Considering the BUT_PSDI_POST as the dependent variable, a model consisting of BUT_PSDI_PRE (β=2.124, p<0.001) and SF_PF_PRE (β=0.017, p=0.019) was able to explain 43.9 % of the variations in BUT_PSDI scores after the intervention (R^2 =0.439, F(2,32)=11.733, p<0.001, effect size=0.782).

4.3.5 Prediction of post-surgery SF_PF

Considering the SF_PF_POST as the dependent variable, a model consisting of SF_RLE_PRE (β=0.903, p<0.001) and BMI_PRE (β=2.461, p=0.002), and BES_PRE (β=1.440, p=0.009) was able to explain 58.7% of the variations in SF_PF scores after the intervention (R^2 =0.587, F(3,32)=13.735, p<0.001, effect size=1.421).

4.3.6 Prediction of post-surgery SF_PAIN

Considering the SF_PAIN_POST as the dependent variable, a model consisting of SF_RLP_PRE (β=0.316, p=0.041) was able to explain 12.8% of the variations in SF_PAIN_POST scores after the intervention (R^2 =0.128, F(1,32)=4.556, p=0.041, effect size=0.146).
Based on the recommendations of (Selya et al., 2012) effect size values more than 0.15 indicate a medium effect and more than 0.35 indicate a large effect.

CHAPTER 4

5 DISCUSSION

This retrospective naturalistic investigation was conducted to examine the psychological profile of candidates of bariatric surgery and search for potential predictors of response to this intervention in a smaller sample for which a follow-up assessment has been performed. The findings show that at baseline, no differences in any of the psychological assessments existed between males and females, neither in the original sample, nor in the smaller sample for whom a follow-up assessment was conducted.

In the sample with a follow-up, when males and females were combined, comparisons between pre and post-surgery revealed significant changes in some of the measures such as the BMI (decreased after the intervention) and the BUT_PSDI (increased after the intervention). The established effectiveness of bariatric surgery in reducing BMI after surgery (Buchwald et al., 2004) is also observed in the sample studied in the current study, however, the improvements in psychological health, is not as pronounced in the current sample as reported in the literature (Jumbe et al., 2017; Kubik et al., 2013; G. Van Hout & Van Heck, 2009). One reason for this may be due to the fact that the sample in this investigation did not exhibit a lot of variations regarding the concomitant psychological conditions such as depression or eating behavior such as binge eating which were both already at a relatively low level at baseline. As a matter of fact, the previously reported correlation between the BMI and depression (Friedman & Brownell, 1995) is not found neither in the baseline sample nor in the follow-up sample in the current investigation. However, patients in the follow up sample were more likely to present less depressive symptoms after the surgery with more pre-surgery BMI levels, which may suggest that the greater change from pre to post surgery comes with better mood profiles.

The increase in PSDI after the intervention is a finding with relevance to clinical practice. The Body Uneasiness Test is designed to identify the body related sentiments in a clinical context with different sub scores such as body image concerns, compulsive self-monitoring, general severity index, etc., (Marano et al., 2007). Although nearly all baseline values of the BUT sub scores were higher than average in non-clinical samples and are in line with those reported for obese individuals in other investigations, not only none of them showed any decrease after the surgery which in line with some other findings (Pecori et al., 2007), one, namely PSDI showed a steep increase after the surgery, suggesting that patients, even after a huge reduction in their BMI still struggle with body image issues. Although this can be interpreted in light of the lack of a correlation between BMI values at baseline with this index, it is still crucial to consider the lack of the sensitivity of this index to significant changes in the BMI, in the clinical and

psychotherapeutic context, both before and after the intervention. This finding can be interpreted in light of the reported BUT scores in a study in which groups of patients with and without cosmetic surgeries after the bariatric surgery were compared and the impact of the cosmetic surgery on BUT scores have been emphasized (Pecori et al., 2007). Furthermore, the absence of changes in the subscales of BUT, and the increase in one of its components, namely PSDI, is in line with the findings of Rosta and colleagues, who report an independence of body image from BMI values and once again emphasizing the importance of other forms of interventions along with the surgery to help candidates of bariatric surgery deal with this aspect of obesity (Rosta et al., 2017). Another way to interpret the increase in PSDI and absence of improvements in other measures of BUT can be associated to the problems regarding excess skin and associated concerns after a massive weight loss in patients undergoing bariatric surgery, which may lead some to seek complementary body contouring procedures (Ivezaj & Grilo, 2018).

When males and females were considered as separate groups and measurements before and after the surgery were compared, BMI showed a decreasing trend in both which is in line with the literature on sex differences in bariatric surgery outcome (Risi et al., 2022), however, BUT_PSDI only increased in females not males, although at baseline there was no significant difference between them which is also expected to some degree considering the sex differences in body image and concern between males and females (Cullasi et al., 1998; Feingold & Mazzella, 1998). This may point to the possibility that although males and females at baseline may not show differences in psychological assessments, however, they may eventually respond differently to the same intervention and experience different outcomes.

Regarding the outcome predictors, other studies have considered personality factors (Bordignon et al., 2017), psychosocial predictors (G. C. M. Van Hout et al., 2005). A review and meta-analysis run by Livhits et al., (2012) reports that preoperative BMI, super-obesity, and personality disorders all can negatively affect the outcome of the intervention (Livhits et al., 2012). In similar studies aiming to find psychological predictors of response to bariatric surgery, greater success has been found in younger and female patients with a high self-esteem, good mental health, high socio-economic status who are concerned about their obesity and have realistic expectations and undisturbed eating behaviors (G. C. M. Van Hout et al., 2005).

In the context of the current study, the prediction analysis revealed that the only variable that could predict the BMI after the surgery was the value of the BMI before the intervention, in line with previous findings (Livhits et al., 2012), which could explain 44 percent of variations in the BMI values post-surgery. This emphasizes that, at least in the current sample, none of the administered tests, i.e., psychological characteristics were able to explain any variation in the “success of the surgery”, defined as the decrease in BMI in this context.

Considering other outcomes such as the level of depression measured via BDI-II, exploratory multiple regressions analysis yielded that a combination of scores of BDI-II, SF_PF, BMI, and SF_RLE at baseline was able to predict the values of BDI-II after the surgery, pointing to the relationship between physical functioning and role limitations due to emotional problems before the surgery to depressive symptoms after the operation. These results should indeed be considered

exploratory as the values of BDI after the surgery are on average below a clinical threshold for the diagnosis of depression. BUT_PSDI after the surgery could be predicted in a model consisting of baseline values of BUT_PSDI and SF_PF, emphasizing once again the importance of one the components of the SF-36, namely physical functioning to have a predictive value considering the psychological outcome of the intervention.

6 Limitations

Although a portion of the baseline sample was contacted again to participate in a follow-up assessment, no control groups including weight and sex matched patients were considered in the current study, thus limiting the investigator's ability to draw more firm and reliable conclusions regarding the exact effects of the intervention on patients. Moreover, notwithstanding the relatively large number of patients in the baseline sample, a relatively low number of patients are included in the follow-up analysis, limiting the statistical power of the tests, especially when considering the differences between male and female patients. Another limitation of the current investigation is the use of online tools in the follow-up assessment which raises the issue of adherence to instructions associated with each assessment tool.

7 Conclusion and future directions

In general, although the results suggest mild effect of the bariatric surgery on the psychological profile of patients, the regression analysis yielded interesting and potentially useful insight about patients after the surgery. Considering the widespread use of psychological assessments before surgery as a screening tool, more extensive investigations taking advantage of a wide range of psychological and cognitive examinations, can potentially provide more insight regarding the treatment outcome and psychological states of the patients undergoing a significant change in their lives. Another insightful variable regarding the efficacy and effects of bariatric surgery specially considering the psychological state of patients is the prevalence of body contouring surgery and its relationship with the other psychological and physical conditions in patients. These insights can be useful for clinicians to better prepare patients for what awaits them in the future and develop more personalized help along the way.

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