Relationship between Pre-Operative Psychological and Behavioral Characteristics and Excess Weight after Bariatric Surgery

Lucena MCMD*[1] and Alchieri JC[2]

[1]PhD Student, Postgraduate Program in Health Sciences, Federal University of Rio Grande do Norte, Brazil

[2]Professor, Postgraduate Program in Health Sciences, Federal University of Rio Grande do Norte, Brazil

*Corresponding author: Marianna Carla Maia Dantas de Lucena, Federal University of Rio Grande do Norte, Center for Human Sciences Literature and Arts, Department of Psychology, University Campus, Lagoa Nova 93022-000, Natal, RN, Brazil, Tel: + 55 (84) 991299263; Email: mariannacarla.lucena@gmail.com

Abstract

Objective: Evaluating the association between pre-operative psychological and behavioral characteristics and high levels of excess weight in the first 4 years after bariatric surgery using scales for evaluating behavior and the general physical and psychological health of patients.

Methods: The study included 66 women and 14 men (mean age: 41.0 ± 10.9 years) who underwent bariatric surgery for weight loss. To identify psychological and behavioral characteristics related to post-operative weight outcomes, the Millon Behavioral Medicine Diagnostic (MBMD) assessment and General Health Questionnaire (GHQ) were used. A linear mixed model for repeated measurements was used for defining the association between scores and poor outcomes in the first 4 years after surgery.

Results: The scales Anxiety–Tension, Depression, Guardedness, Dejected, and Spiritual Absence from the MBMD were significantly associated to higher levels of post-operative excess weight. In the GHQ, the scales Performance Diffidence and Death Ideation were significantly associated to high levels of excess weight in the first 4 years after the surgery.

Conclusions: A set of pre-operative psychological characteristics can be related to high levels of excess weight following bariatric surgery. Therefore, effective assessment of these factors is necessary to facilitate the planning of supportive psychological interventions in order to promote the adherence of the patient to a long-term weight loss plan.

Keywords: Adherence to treatment; Bariatric surgery; Obesity; Post-operative outcomes; Psychological evaluation

Introduction

Obesity has emerged as a health concern of epidemic proportions across countries. The bariatric surgery is a well-known effective treatment option for weight loss, and Roux-en-Y gastric bypass (RYGB) is one of the most commonly performed techniques. RYGB decreases stomach volume, reduces absorption of nutrients, and promotes satiety via the release of incretins [1]. The technique can result in the sustained reduction of body mass index (BMI) within 10 years after surgery. Furthermore, it can lead to remission from obesity-related co-morbidities [2], and improvement in quality of life [3]. However, a comprehensive follow-up by a multidisciplinary team, such as medical, nutritional, and

Relationship between Pre-Operative Psychological and Behavioral Characteristics and Excess Weight after Bariatric Surgery

Psychol Psychology Res Int J

psychology experts, is necessary, during the pre- and post-operative periods in order to promote successful weight loss outcomes [4]. Specifically, psychological assessments can be useful in identifying psychological and behavioral characteristics that may be related to weight loss outcomes. In this regard, early identification of such characteristics may enable physicians to focus their efforts on patient-specific issues [5].

A weight nadir can typically be achieved at 18–24 months after a gastric bypass surgery. However, patients are at risk of regaining weight in the long term, particularly in the first 2 years post operation [1,6]. The percentage of excess weight loss is calculated by (weight loss/excess weight) × 100, in which excess weight consists of pre-operative weight - ideal weight [7]. The main criterion of a successful bariatric surgery is a loss of > 50% of the pre-operative excess weight with an expected regain of approximately 10% of this number [7]. Cases in which approximately 50% loss of excess weight is not achieved and those in which >50% of the excess weight lost is regained are considered non-successful [1].

A number of sociodemographic variables, civil status, and pre-operative BMI appear to be associated with weight regain in a sample of the population who has undergone bariatric surgery [8]. Caucasians and people of high socio-economic status are, in particular, associated to improved weight loss 2 years after surgery [9]. In the same way, patients who are younger, married, and with low pre-operative BMI achieved the best weight loss outcomes [10-12]. In contrast, patients with severe obesity experienced less weight loss than non-superobese patients [12]. To date, however, the relationship between gender and weight loss remains unclear [11,13].

Stress, anxiety, depression, emotional eating, and binge eating, as well as individual characteristics, such as self-efficacy, self-determination, and self-esteem can hinder the success of any weight loss treatment [14]. Notably, mild symptoms of anxiety, distress, and worry are deemed related to good adherence to the treatment, change in eating habits, and regular physical activity [10]. In addition, a history of substance abuse is a positive aspect for adherence to treatment in situations where it is associated with overcoming addictions, reflecting the fact that such patients may have undergone counseling [12]. Other studies have evaluated personality traits during the pre-operative period to identify the characteristics related to good adherence to treatment. In this regard, cooperativeness, a characteristic that encourages social interactions and may provide benefits through increased social support, is associated with improved post-operative outcomes [10]. Individuals with high levels of cooperativeness are frequently described as empathic and tolerant and perceive themselves as sociable [15].

Persistence, defined as continued performance of an action despite the absence of reinforcement, is another factor that contributes to positive results. As social reinforcement tends to decrease with time, persistence becomes an important trait for adherence, as it is a behavior required for long-lasting positive results [16].

Identifying pre-operative characteristics predictive of treatment adherence can facilitate the implementation of interventions, such as multidisciplinary consultations, which may help patients at risk of being non-responsive to the treatment to make lifestyle changes throughout the process, including adherence to regular physical activities and improved eating behaviors [17]. Therefore, the study aims to evaluate the association between pre-operative psychological and behavioral characteristics and high levels of excess weight on the first 4 years after bariatric surgery through scales that evaluate patient behavior and general physical and psychological health. As noted in the literature review, our hypothesis is that some behavioral and psychological characteristics are related to the highest percentages of excess weight over 4 years after bariatric surgery. To the extent that we use scales with adequate validity evidence to assess behaviors and psychological aspects related to treatment adherence.

Materials and Methods

Participants

A total of 110 patients were evaluated prior to the bariatric surgery, which was performed in the author's institution, a public university hospital. Out of the total patients, 30 were excluded because they required revision surgery before the 4-year endpoint or lacked follow-up data regarding weight loss. Furthermore, out of the 30 patients who dropped out of the study during the 4 years, 20 underwent revision surgery, 5 moved to another state and were followed up by other teams, and 5 failed to attend consultations. The remaining 80 patients were included in the analysis (66 women and 14 men; mean age: 21–60 years). At the time of the pre-operative data collection (2012–2013), RYGB was the most common technique used by the surgical team. To ensure a homogeneous sample population, only patients who underwent the procedure were enrolled. All participants attended pre- and post-operative appointments at the bariatric surgery outpatient clinic with a psychologist, a bariatric surgeon, a nutritionist, and an endocrinologist. They completed all follow-up assessments with the multidisciplinary team over a 4-year period after the surgery. To avoid bias of participation in the research on the measured outcomes, the participants provided consent as part of the regular orientation to the post-operative plan of attending periodic consultations with the multidisciplinary team. Thus,

Lucena MCMD and Alchieri JC. Relationship between Pre-Operative Psychological and Behavioral Characteristics and Excess Weight after Bariatric Surgery. Psychol Psychology Res Int J. 2020, 5(4): 000252.

Copyright© Lucena MCMD and Alchieri JC.

the study infers that the researchers exerted no influence on the selection of patients that were initially assessed for the study. Additionally, all participants provided written informed consent before enrolment, and the Research Ethics Committee of the Federal University of Rio Grande do Norte has approved the study (protocol number 95/100).

Procedures

A bio–socio-demographic questionnaire was used to collect information from the patients regarding gender, age, education, and marital status. The patients completed the Millon Behavioral Medicine Diagnostic (MBMD), which is considered valid if no more than 11 items are left unanswered [18]. In addition, the patients completed the General Health Questionnaire (GHQ). Weight was recorded at visits to the post-operative multidisciplinary team, scheduled at 1, 3, and 6 months and at 1, 2, 3, and 4 years after surgery. Patients who failed to attend the regular follow-ups or underwent revision procedures within the first 4 years after the bariatric surgery were excluded from the study. During the visitations, the patients participated in group interventions regarding pre- and post-operative management and attended psychological, nutritional, and medical appointments.

Excess weight was calculated pre-operation and at 2, 3, and 4 years post-operation, using the following equation: (weight – ideal weight) [7]. Over the first 18 months, all patients presented < 50% of pre-operative excess weight, which indicates successful surgical outcomes.

Data Collection Instruments

Millon Behavioral Medicine Diagnostic (MBMD): The MBMD is a self-administered questionnaire that assesses behavioral and psychosocial factors, and it can assist in the identification of characteristics related to the adaptation of a patient to an illness or treatment. It is composed of 165 true or false items, 3 response pattern scales (i.e., Disclosure, Desirability, and Debasement), 1 validity indicator, 6 negative health habit indicators (i.e., Alcohol, Drugs, Eating, Caffeine, Inactivity, and Smoking), 29 clinical scales divided into 5 psychiatric indications (Anxiety–Tension, Depression, Cognitive Dysfunction, Emotional Lability, and Guardedness), 6 stress moderators (Illness Apprehension, Functional Deficits, Pain Sensitivity, Social Isolation, Future Pessimism, and Spiritual Absence), 11 coping styles (Introversive, Inhibited, Dejected, Cooperative, Sociable, Confident, Non-conforming, Forceful, Oppositional, Respectful, and Denigrated), 5 treatment prognostic factors (Interventional Fragility, Medication Abuse, Information Discomfort, Utilization Excess, and Problematic Compliance), and 2 management guides (Adjustment Difficulties and Psych Referral) [18].

Previous studies have questioned the validity of the MBMD, these conclusions come from the internal consistency of some of the scales that present consistency below 0,7. Thus, the following scales from the test were used in the present study, considering the appropriate internal consistency in the population of the patients candidate to bariatric surgery: Anxiety–Tension (0.76), Depression (0.85), Cognitive Dysfunction (0.73), Emotional Lability (0.76), Guardedness (0.70), Inhibited (0.80), Dejected (0.77), Oppositional (0.77), Denigrated (0.73), Illness Apprehension (0.80), Functional Deficits (0.77), Pain Sensitivity (0.77), Social Isolation (0.82), Future Pessimism (0.79), Spiritual Absence (0.89), and Interventional Fragility (0.71). Internal consistency coefficients between 0.70 and 0.90 are considered acceptable for clinical purposes [19]. As a self-report instrument, the MBMD comprises only one part of a complex psychological assessment and should be complemented with additional sources of information, which can be collected through interviews and other assessment instruments [20].

Moreover, Brazil-specific normative data for psychological instruments on evaluating outcomes after bariatric surgery are scarce. Additionally, options regarding tools for assessing treatment adherence in Brazil are extremely limited. Therefore, the study selected the MBMD to evaluate certain pre-operative characteristics that may be related to outcomes.

General Health Questionnaire (GHQ): The GHQ assesses non-severe (non-psychotic) psychiatric illnesses in a manner that detects symptoms and normal behaviors. The Brazilian version used in the study consists of 60 self-reported items evaluating psychological stress, death ideation, performance diffidence, sleep disorders, and psychosomatic disorders. The items are rated on a four-point Likert-type scale ranging from 1 (less than usual) to 4 (much more than usual) with several items rated in reverse format, that is, from 1 (much more than usual) to 4 (less than usual). The GHQ is the only instrument validated in Brazil that can be used for the evaluation of psychopathological characteristics in the context of health, with a good indicator of validity and reliability. Cronbach's alpha coefficients indicated adequate levels of homogeneity for all scales from the GHQ: Psychic stress, 0.87; Death ideation, 0.87; Performance diffidence; Sleep disorders, 0.83; Psychosomatic disorders, 0.81. The alpha coefficient for the full GHQ set (60 items), reflecting general severity of mental health problems, was very high (0.95) [21].

Statistical Procedures

Descriptive analyses are used to describe the study group. Data analysis of repeated measurements over time using a linear mixed model was based on the following steps:

selection of fixed effects, which are related to the mean response profiles; identification of random effects, which are related to the individual; and selection of the best covariance matrix structure [22]. In this context, a linear mixed model for repeated measures was used to verify the effect of the independent variables on measurements of excess weight measurements at four points of the analysis: excess 1 = at the time of surgery, excess 2 = 2 years of post-operation, excess 3 = 3 years of post-operation, and excess 4 = 4 years of post-operation. Student's t-test was used to select the random effects based on the significance of parameters of the respective polynomials.

Age, gender, marital status, education, and presence of co-morbidities were considered as the independent sociodemographic variables. The MBMD scales, with adequate internal consistency (internal consistency coefficients between 0.70 and 0.90,) were as it follows: Anxiety–Tension, Depression, Cognitive Dysfunction, Emotional Lability,

Guardedness, Inhibited, Dejected, Oppositional, Denigrated, Illness Apprehension, Functional Deficits, Pain Sensitivity, Social Isolation, Future Pessimism, Spiritual Absence, and Interventional Fragility. In addition, the following GHQ scales were used: Psychological Stress, Death Ideation, Performance Diffidence, Sleep Disorders, and Psychosomatic Disorders.

Effect-size measurements were calculated using eta-squared, and categorized into four levels, namely, very small: eta < 0.20; small: 0.2 < eta < 0.50; average: 0.50 < eta < 0.80, and large: eta > 0.80 [22].

Results

Table 1 summarizes the basic characteristics of the patients. Pre-operative age (mean ± standard deviation) was 41.0 ± 10.9 years (range: 21–65 years). The participants lost 50% of excess weight within the first 18 months of post-operation. Table 2 provides inter-subject differences in weight regain identified at 2, 3, and 4 of years post-operation.

Characteristic		Absolute frequency	%
Gender	Female	66	82.0
	Male	14	17.50
Marital status	Married or common-law marriage	52	65.00
	Single	22	27.50
	Widowed	4	5.00
	Divorced	2	2.50
Education	Elementary School	20	25.00
	High school	46	57.50
	Higher education	14	17.50
Pre-operative co-morbidities	Yes	55	68.75
	No	25	31.25
	Total	80	100.00

Table 1: Patient characteristics.

Time of post-operative weight loss evaluation		Absolute frequency	%
2 years	<50%[a]	53	66.5
	>50%[b]	27	33.75
3 years	<50%[a]	48	60.00
	>50%[b]	32	40.00
4 years	<50%[a]	41	51.25
	>50%[b]	39	48.75
	Total	**80**	**100.00**

[a]Weight regain is less than 50% of excess weight loss
[b]Weight regain is more than 50% of excess weight loss
Table 2: Frequency of weight loss after surgical procedure.

No association was observed between gender, pre-operative BMI, marital status, education, age, or presence of pre-operative co-morbidities and negative health indicators of the MBMD during the post-operative period according to the linear mixed model for repeated measurements. Analysis of excess of weight percentage over time showed statistically significant differences between measurements performed at 2, 3, and 4 years of post-operation (all, P < 0.05) (Table 3). In addition, a significant association was observed between the GHQ scales and increased excess weight (Table 4), whereas the MBMD scales were related to high levels of excess weight in the 4 years after the surgery (Tables 5, 6, and 7).

Groups	Mean difference	P-value
Excess 2 vs. Excess 3	−2.435	0.000[*]
Excess 2 vs. Excess 4	−4.852	0.000[*]
Excess 3 vs. Excess 2	2.435	0.000[*]
Excess 3 vs. Excess 4	−2.417	0.000[*]
Excess 4 vs. Excess 2	4.852	0.000[*]
Excess 4 vs. Excess 3	2.417	0.000[*]

[*]Statistically significant at a significance level of 5%.
Vs. = versus; excess 1 = at the time of surgery; excess 2 = 2 years of post-operation; excess 3 = 3 years of post-operation; and excess 4 = 4 years of post-operation.
Table 3: Mean differences between high levels of excess weight measurements at the four points of the analysis.

Origin	Sum of squares	Degrees of freedom	Z	P-value	Partial eta-squared	Observed power
Stress	29.67	1.40	1.08	0.04[*]	0.11	0.20
Death Ideation	78.40	1.40	2.86	0.08[**]	0.04	0.46
Performance Diffidence	115.09	1.40	4.20	0.03[*]	0.05	0.62
Error	2,001.68	102.36				

[*]Statistically significant at a significance level of 5%.
[**]Statistically significant at a significance level of 10%.
GHQ = General Health Questionnaire
Table 4: Multivariate analysis of the GHQ regarding the effect of high levels of excess weight over time.

Origin	Sum of squares	Degrees of freedom	Z	P-value	Partial eta-squared	Observed power
Psychiatric Indications						
Anxiety–Tension	131.07	1.41	4.60	0.02[*]	0.06	0.66
Depression	12.62	1.41	0.44	0.05[*]	0.16	0.11
Guardedness	75.85	1.41	2.66	0.09[**]	0.03	0.43
Error	2107.52	104.30				

[*]Statistically significant at a significance level of 5%.
[**]Statistically significant at a significance level of 10%.
MBMD = Millon Behavioral Medicine Diagnostic.
Table 5: Multivariate analysis of MBMD Psychiatric Indications regarding the effect of high levels of excess weight over time.

Origin	Sum of squares	Degrees of freedom	Z	P-value	Partial eta-squared	Observed power
Spiritual Absence	315.92	1.42	10.85	<0.001[*]	0.13	0.96
Error	2097.22	102.21				

[*]Statistically significant at a significance level of 5%.
MBMD = Millon Behavioral Medicine Diagnostic.
Table 6: Multivariate analysis of MBMD stress moderators regarding the effect of high levels of excess weight over time.

Origin	Sum of squares	Degrees of freedom	Z	P-value	Partial eta-squared	Observed power
Dejected	89.76	1.39	2.89	0.08[**]	0.04	0.46
Error	2327.98	104.26				

[**]Statistically significant at a significance level of 10%.

MBMD = Millon Behavioral Medicine Diagnostic.

Table 7: Multivariate analysis of MBMD Coping Styles regarding the effect of high levels of excess weight over time.

Discussion

General Health Characteristics of the Participants

In general, patients achieve ideal weight loss between 18 and 24 months after bariatric surgery with possible regain after this period [1,6]. Similarly, all patients assessed in this study had successful weight loss before the 24 months post-surgery. In contrast to previous researches, the current study did not observe a significant relationship between age, gender, pre-operative BMI, pre-operative co-morbidities, or Negative Health Habits (from the MBMD assessment) and excess weight after bariatric surgery. The reason underlying this notion may be that the effect of age may be broader in younger patients, who are more likely to regain weight and less likely to acquire pre-operative co-morbidities [23]. On the other hand, other studies have observed a significant relationship between sedentary lifestyle and low-quality pre-operative nutritional status with greater excess weight post-surgery [7].

Association between Psychiatric Characteristics and Weight Loss

Several psychological factors are associated to weight loss after surgery. Out of these factors, Anxiety–Tension is significantly associated with worst weight loss over 4 years after surgery. Symptoms of anxiety, as well as mood and eating disorders, are frequently reported for patients with obesity, although the specific influence of such factors on post-operative outcomes after weight loss surgery remains controversial [24]. The pre-operative presence of symptoms of anxiety may be a predictor of poor weight loss, as previous studies have associated them with poor adherence to a healthy diet [25,26]. Notably, however, the finding in one study indicates that a moderate level of anxiety may promote positive adherence to dietary improvement and physical activity and, thus, a potentially positive outcome after surgery for weight loss [10].

The Depression scale was a significant predictor for additional excess weight after surgery. Patients with high levels of emotional variability and symptoms of depression are more likely to experience eating disorders and engage in emotional eating [27]. Additionally, symptoms of depression tend to decrease in the first few months after surgery and re-emerge 2 years after the procedure [24]. Therefore, depression is a possible obstacle to long-term dietary management [16,27].

As a possible symptom of depression, the Death Ideation scale from the GHQ was also associated with high levels of excess weight over 4 years. It indicates that a person may envision life as worthless and meaningless, with no hope, presenting the desire to take one's own life [21]. Pre-surgery history of suicidal tendencies was reported in 30.3% of 396 surgery-seeking individuals, and this rate suggests that health care professionals should pay close attention to such patients [28]. These characteristics were associated to increased suicidality and self-harm/suicidal ideation within 5 years post-surgery [29]. In the context of the present study, such a significant association indicates that the symptoms of depression and anxiety can contribute to increased feelings of stress during treatment and, consequently, decreased adherence to new health habits. Consistent with this view, the GHQ Psychological Stress scale was also significantly associated to high levels of excess weight after the surgery. A profile of hypersensitivity to criticism and difficulty with problem-solving can exacerbate stress and depression scores, which is associated to low adherence to guidelines and poor follow-up attendance [16].

Coping Styles and Their Contribution to Positive Adherence to Treatment

The Coping Style scales reflect the cognitive, behavioral, and interpersonal strategies used by patients to seek reward and avoid discomfort [18]. In our study, the Dejected scale was statistically associated with additional excess weight post-surgery. It reflects the traits of discouragement and inability to feel pleasure or pessimism, with a tendency of giving up, as a means of coping with emotional or physical problems. This scale represents the profiles that limit the ability to utilize helpful interventions and oppose to optimistic views that can reduce the symptoms of depression and anxiety or facilitate coping with adversities during treatment [30]. Lattie, et al. [31] used the same Coping Style scales to predict the success of chronic pain treatment and identified a relationship between these scales and non-response to treatment during follow-up. This finding indicates that patients with high scores may have increased difficulty in

Lucena MCMD and Alchieri JC. Relationship between Pre-Operative Psychological and Behavioral Characteristics and Excess Weight after Bariatric Surgery. Psychol Psychology Res Int J. 2020, 5(4): 000252.

Copyright© Lucena MCMD and Alchieri JC.

adhering to treatment or lifestyle recommendations. Such characteristics are oppose to treatment persistence and motivation. Moreover, Ghoneim and O'Hara [32], reported persistence as the best predictor for weight loss after surgery, whereas low motivation was recognized as a poor predictor of treatment success in general [18].

Another characteristic related to high levels of excess weight was the Guardedness scale of the MBMD. It describes medical and surgical patients who display mistrust and an edgy defensiveness against people they perceive as hostile and deceptive. Many of these patients expressed irritability, suspiciousness and frequently made health care providers feel uncomfortable [18]. Defensiveness was also reported as a characteristic present in the evaluation process for the bariatric surgery, as the patient is at risk of having the surgery denied or delayed. The level of defensiveness in patients tends to decrease during a second testing. After feedback on their defensiveness and an alternative instructional set are provided, such patients were less defensive and more willing to admit their shortcomings [33]. In the present study, the Guardedness scale was related to high levels of excess weight, which suggested that these patients may experience difficulties in providing health care professionals with additional information about their psychological and clinical status. Results can guide professionals on planning interventions for better treatment responses regarding patients who require further support.

However, belief in spiritual sources of protection and care may be an effective method of increasing adherence to treatments for many chronic diseases, such as antihypertensive and HIV treatments [34]. Furthermore, in the face of the burden, stress, and difficulties imposed by a chronic illness, patients may find relief and control in religion. Positive religious/spiritual coping was higher among non-depressed patients than in depressed ones with end-stage renal disease [35]. This finding highlights the fact that patients can still use religion to confront health-related problems or illnesses [36]. The Spiritual Absence versus Spiritual Faith scale assesses the degree to which patients lack religious or spiritual resources for dealing with stressors, such as fears and uncertainties about their medical condition. High scores on this scale indicate a lack of a spiritual support system [18]. In our sample, spiritual absence was related to the worst post-operation results.

Sense of Loss of Independence and Ability to Engage in Activities

The Deficient Performance Scale from the GHQ, which relates to the belief of an individual in their capacity to perform daily tasks [21], was significantly associated to high levels of excess weight post-surgery. Individuals with this trait may feel a decreased sense of self-efficacy for a variety of behaviors, such as adherence to a healthy diet and regular physical activity.

Limitations

It is necessary to acknowledge the limitations of the current study, such as the small sample size and difficulties associated to post-operative evaluations in the context of a public health system. Attending post-operative consultations is problematic for most patients, as transportation to the bariatric surgery outpatient clinic is limited or their moving to a different state. Many patients were excluded from the study because they underwent revision surgery within 4 years of post-operation. The new surgery could be an intervening variable in the weight loss of these patients and thus compromising the homogeneity in terms of the surgical technique used in the study. Therefore, we have made this choice in order to avoid interference from other variables in the weight loss results from the patients, such as hormonal and gastrointestinal changes resulting from the new surgical technique. Other patients were excluded because they failed to attend regular follow-up visits with the multidisciplinary team. Thus, all characteristics associated with weight loss or regain may have been partially identified.

Although MBMD is one of the few tools for assessing aspects related to adherence to treatment in the context of bariatric surgery, with valid evidence provided by studies in Brazil, it features several limitations regarding internal consistency. For this reason, a few of the scales were excluded from data analysis. The inclusion of other variables, such as post-operative management of co-morbidities, can help enhance the evaluation of the success of bariatric surgery.

Conclusions

The MBMD is an instrument that is easy to implement and interpret, developed to assist in the understanding of the psychological aspects and health behavior of patients for the development of other effective strategies and plans of treatment. Furthermore, it presents specific normative data for the population with bariatric surgery, which may aid in the evaluation of the adaptation of a patient to the post-operative routine, given that it is complemented by additional psychological evaluations.

The study presented a linear mixed model for repeated measurements of factors associated to high levels of excess weight after bariatric surgery. Several characteristics, such as anxiety, depression, and stress can hinder treatment adherence over time mainly because they impair food behavior control and adherence to the recommendations of the multidisciplinary team. Additionally, the study

identified the influence of specific personality profiles on non-response to treatment. Patients who were more likely to acquire negative attitudes and become prone to pessimistic perceptions about their health status displayed mistrust and an edgy defensiveness during interaction with the health team. Furthermore, they lacked religious or spiritual resources to help with treatment adherence. Therefore, the pre-operative assessment of the personality traits may enhance understanding of the likely treatment prognosis, enabling health professionals to tailor patient care and develop cost-effective psychological treatments.

On the basis of the results, the study proposes that considering the predictive characteristics of post-operative success as part of the pre- and post-operative planning is necessary. This identification can serve as reference in the design of patient-specific interventions to promote treatment adherence and, consequently, in the long-term success of bariatric surgery. For example, psychological interventions to control anxiety should be considered throughout the treatment because this characteristic predicts weight regain at 2 years of post-operation. In the same manner, the need emerges for psychological interventions that favor patient participation in the treatment and that helps them to reframe pessimistic views of their lives and future. Additionally, the stress moderators scales can help monitor stress throughout the treatment of the patient, which may be related to psychiatric and personality features that, associated to life challenges, exert an impact on medical outcomes.

Expansion of this research is recommended, with a greater number of participants and also with follow-up time superior to 4 years after the bariatric surgery. In this way, we could better observe how these behavioral and psychological characteristics influence excess weight for longer periods. Another study recommendation would be to evaluate the effectiveness of psychological interventions in preventing weight regain in these patients. The knowledge of some of the behavioral and psychological characteristics related to greater excess weight may serve as a guide for interventions, whether individual or in group, that can consider this information in the planning of more accurate conducts according to the main points of sensitivity in this population.

Acknowledgments

References

1. Mechanick JI, Kushner RF, Sugerman HJ, Gonzalez-Campoy JM, Collazo-Clavell ML, et al. (2008) American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery Medical Guidelines for Clinical Practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. Surg Obes Relat Dis 4(5): S109-84.

2. Jiménez A, Ibarzabal A, Moizé V, Pané A, Andreu A, et al. (2019) Ten-year outcomes after Roux-en-Y gastric bypass and sleeve gastrectomy: an observational nonrandomized cohort study. Surg Obes Relat Dis 15(3): 382-388.

3. Nickel F, Schmidt L, Bruckner T, Büchler MW, Müller-Stich BP, et al. (2017) Influence of bariatric surgery on quality of life, body image, and general self-efficacy within 6 and 24 months-a prospective cohort study. Surg Obes Relat Dis 13(2): 313-319.

4. Peacock JC, Zizzi SJ (2011) An assessment of patient behavioral requirements pre- and post-surgery at accredited weight loss surgical centers. Obes Surg 21(12): 1950-1957.

5. Moroshko I, Brennan L, O'Brien P (2011) Predictors of dropout in weight loss interventions: a systematic review of the literature. Obes Rev 12(11): 912-934.

6. Courcoulas AP, King WC, Belle SH, Berk P, Flum DR, et al. (2018) Seven-year weight trajectories and health outcomes in the Longitudinal Assessment of Bariatric Surgery (LABS) study. JAMA Surg 153(5): 427-434.

7. Freire RH, Borges MC, Alvarez-Leite JI, Toulson Davisson Correia MI (2012) Food quality, physical activity, and nutritional follow-up as determinant of weight regain after Roux-en-Y gastric bypass. Nutrition 28(1): 53-58.

8. Thalheimer A, Bueter M, Wierlemann A, Lager C, Jurowich C, et al. (2009) Predictability of outcome in laparoscopic gastric banding. Obes Facts 2 Suppl 1(1): 27-30.

9. Toussi R, Fujioka K, Coleman KJ (2009) Pre-and post-surgery behavioral compliance, patient health, and postbariatric surgical weight loss. Obesity 17(5): 996-1002.

10. Agüera Z, García-Ruiz-de-Gordejuela A, Vilarrasa N, Sanchez I, Baño M, et al. (2015) Psychological and Personality Predictors of Weight Loss and Comorbid Metabolic Changes After Bariatric Surgery. Eur Eat Disord Rev 23(6): 509-516.

11. Snyder B, Nguyen A, Scarbourough T, Yu S, Wilson E (2009) Comparison of those who succeed in losing significant excessive weight after bariatric surgery and those who fail. Surg Endosc 23(10): 2302-2306.

12. Livhits M, Mercado C, Yermilov I, Parikh JA, Dutson E, et al. (2012) Preoperative predictors of weight loss following bariatric surgery: systematic review. Obes Surg 22(1): 70-89.

13. Courcoulas AP, Christian NJ, O'Rourke RW, Dakin G, Patchen Dellinger E, et al. (2015) Preoperative factors and 3-year weight change in the Longitudinal Assessment of Bariatric Surgery (LABS) Consortium. Surg Obes Relat Dis 11(5): 1109-1118.

14. Georgiadis MM, Biddle SJH, Stavrou NA (2006) Motivation for weight-loss diets: A clustering, longitudinal field study using self-esteem and self-determination theory perspectives. Health Educ J 65(1): 53-72.

15. Cloninger CR, Svrakic DM, Przybeck TR (1993) A psychobiological model of temperament and character. Arch Gen Psychiatry 50(12): 975-990.

16. Bordignon S, Aparício MJG, Bertoletti J, Trentini CM (2017) Personality characteristics and bariatric surgery outcomes: a systematic review. Trends Psychiatry Psychother 39(2): 124-134.

17. Konttinen H, Peltonen M, Sjöström L, Carlsson L, Karlsson J (2015) Psychological aspects of eating behavior as predictors of 10-y weight changes after surgical and conventional treatment of severe obesity: results from the Swedish Obese Subjects intervention study. Am J Clin Nutr 101(1): 16-24.

18. Millon T, Antoni M, Millon C, Minor S, Grossman S (2006) Manual Millon Behavioral Medicine Diagnostic. 2nd (Ed.), Minneapolis: NCS Pearson, pp: 1-222.

19. Walfish S, Wise EA, Streiner DL (2008) Limitations of the Millon Behavioral Medicine Diagnostic (MBMD) with bariatric surgical candidates. Obes Surg 18(10): 1318-1322.

20. Millon T, Antoni M, Millon C, Minor S, Grossman G (2007) MBMD Manual supplement: bariatic report. Minneapolis: NCS Pearson.

21. Pasquali L, Gouveia VV, Andriola WB, Miranda FJ, Ramos ALM (1994) Goldberg's General Health Questionnaire (QSG): Brazilian Adaptation, Psychology Theory and Research 10(3): 421-437.

22. (2012) Analysis of data with repeated measures in experiment with coffee intake. SBICafe Coffee Library.

23. Shantavasinkul PC, Omotosho P, Corsino L, Portenier D, Torquati A (2016) Predictors of weight regain in patients who underwent Roux-en-Y gastric bypass surgery. Surg Obes Relat Dis 12(9): 1640-1645.

24. De Zwaan M, Enderle J, Wagner S, Mühlhans B, Ditzen B, et al (2011) Anxiety and depression in bariatric surgery patients: a prospective, follow-up study using structured clinical interviews. J Affect Disord 133(1-2): 61-68.

25. Christou NV, Look D, Maclean LD (2006) Weight gain after short- and long-limb gastric bypass in patients followed for longer than 10 years. Ann Surg 244(5): 734-740.

26. Aarts F, Geenen R, Gerdes VE, Brandjes DP, Hinnen C (2015) Attachment anxiety predicts poor adherence to dietary recommendations: an indirect effect on weight change 1 year after gastric bypass surgery. Obes Surg 25(4): 666-672.

27. Sevinçer GM, Konuk N, İpekçioğlu D, Crosby RD, Cao L, et al. (2017) Association between depression and eating behaviors among bariatric surgery candidates in a Turkish sample. Eat Weight Disord 22(1): 117-123.

28. Chen EY, Fettich KC, McCloskey MS (2012) Correlates of suicidal ideation and/or behavior in bariatric-surgery-seeking individuals with severe obesity. Crisis 33(3): 137-143.

29. Gordon KH, King WC, White GE, Belle SH, Courcoulas AP, et al (2019) A longitudinal examination of suicide-related thoughts and behaviors among bariatric surgery patients. Surg Obes Relat Dis 15(2): 269-278.

30. Bannen MA, Lambert PJ, Gustafson HL, Mathiason MA, Larson CJ, et al. (2008) Use of the Minnesota Multiphasic Personality Inventory-2 to identify challenging-to-manage bariatric patients: efforts to promote success in all patients. Bariatr Nurs Surg Patient Care 3(3): 211-216.

31. Lattie EG, Antoni MH, Millon T, Kamp J, Walker MR (2013) MBMD coping styles and psychiatric indicators and response to a multidisciplinary pain treatment program. J Clin Psychol Med Settings 20(4): 515-525.

32. Ghoneim MM, O'Hara MW (2016) Depression and postoperative complications: an overview. BMC Surg 16: 5.

33. Walfish S (2007) Reducing Minnesota Multiphasic Personality Inventory defensiveness: effect of specialized instructions on retest validity in a sample of preoperative bariatric patients. Surg Obes Relat Dis 3(2): 184-188.

34. Abel WM, Joyner JS, Cornelius JB, Greer DB (2017) Self-care management strategies used by Black women who self-report consistent adherence to antihypertensive medication. Patient Prefer Adherence 11: 1401-1412.

35. Santos PR, Capote JRFG, Cavalcante Filho JRM, Ferreira TP, Dos Santos Filho JNG, et al. (2017) Religious coping methods predict depression and quality of life among end-stage renal disease patients undergoing hemodialysis: a cross-sectional study. BMC Nephrol 18(1): 197.

36. Yates T, Yates S, Rushing J, Schafer KR (2018) Effects of religious involvement on HIV management outcomes among HIV-positive adults in Central North Carolina. South Med J 111(10): 612-618.