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Association Between Food Addiction Symptoms, Clinical and Nutritional Factors, Mental Health, Sleep, and Physical Activity in Candidates for Bariatric Surgery

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Abstract

Food addiction (FA) has been associated with obesity and unfavorable outcomes in the context of bariatric surgery (BS), particularly during the preoperative period. Emotional factors, sleep quality, and physical activity (PA) may influence this behavior; however, these variables have rarely been investigated in an integrated manner. *Objective:* To investigate the association between FA, symptoms of anxiety, depression, stress, sleep quality, physical activity, and clinical and nutritional factors in candidates for bariatric surgery. *Methods:* This cross-sectional correlational study included 125 candidates for bariatric surgery treated at a referral hospital in the state of Pará, Brazil. The Modified Yale Food Addiction Scale 2.0 (mYFAS 2.0), Depression, Anxiety and Stress Scale-21 (DASS-21), Pittsburgh Sleep Quality Index (PSQI), and sociodemographic, clinical, anthropometric, and physical activity questionnaires were administered. *Results:* The prevalence of FA was 34.4% and was associated with higher levels of depression ($p < 0.001$), anxiety ($p = 0.002$), and stress ($p = 0.001$). Physical activity was negatively associated with severe FA ($p = 0.046$). A high prevalence of poor sleep quality was observed, which was associated with worse emotional outcomes but not directly associated with FA. *Conclusion:* Food addiction is common in the preoperative period of bariatric surgery and is associated with emotional factors.

INTRODUCTION

Contemporary lifestyles influence eating behavior through intense food-related stimuli and frequent consumption of foods high in sugar and fat. These stimuli interfere with satiety mechanisms and the brain reward system, potentially overriding homeostatic control, increasing food intake, and contributing to unhealthy dietary patterns and chronic non-communicable diseases (NCDs). [1, 2]

Among NCDs, obesity is a multifactorial disease characterized by excessive adipose tissue accumulation and increased risk of cardiovascular diseases and type 2 diabetes mellitus. In 2022, one in eight people worldwide had obesity. [3] In Brazil, the 2023 VIGITEL survey reported an obesity prevalence of 24.3% among adults in state capitals and the Federal District, with approximately one-quarter of adults in Belém affected. [4] Severe obesity (body mass index [BMI] ≥ 40 kg/m²) affects more than one million Brazilians, and approximately eight million meet criteria for bariatric surgery. [5] At Jean Bitar Hospital, 1,844 bariatric procedures have been performed since implementation of the Obesidade Zero ("Zero Obesity") program. [6] In 2023, 80,441 bariatric surgeries were performed in Brazil, including 7,570 through the Brazilian Unified Health System (SUS); by July 2024, 6,008 procedures had been completed. [5]

Bariatric surgery is indicated when conventional treatment, including dietary therapy, pharmacotherapy, and lifestyle modification, fails to achieve sustained weight loss. It is recommended for individuals with BMI ≥ 40 kg/m² or ≥ 35 kg/m² with obesity-related comorbidities. [5, 7] Despite its effectiveness, weight regain and recurrence of associated diseases remain common, [8] often related to dysfunctional eating

behaviors, poor mental health, impaired sleep, and physical inactivity. [9, 10, 11] These factors may already be present preoperatively.

Disordered eating behaviors are frequently observed before surgery. [12] Among 140 candidates, binge-eating episodes were associated with greater daily food intake, [13] while systematic reviews have reported high prevalence of binge-eating disorder and strong associations with psychosocial factors. [14] Food addiction (FA), characterized by impaired control over food consumption and persistent intake despite adverse consequences, [15] has also emerged as an important behavioral pattern. Neurobiological mechanisms involving the endocannabinoid and dopaminergic reward systems contribute to obesity and FA.[2, 16, 17] Foods rich in fat and sugar activate these systems, increasing motivation for highly palatable foods, disrupting satiety, and stimulating dopamine release in the nucleus accumbens, which is associated with pleasure and impulsivity. [2, 18]

Quality of life, mental health, nutritional status, physical activity, and emotional factors are also associated with FA. Among bariatric surgery candidates, 16.5% met FA criteria, associated with poorer quality of life and higher depression levels. [19] Women with overweight had higher FA scores than women with normal weight, [20] while 26.4% of participants in a dietary intervention met FA criteria, which was associated with lower weight loss. [21] A systematic review and meta-analysis reported a pooled FA prevalence of 32% among bariatric surgery candidates (6.3%–69%), with higher prevalence preoperatively than postoperatively. [22] Longitudinal studies have shown an initial reduction in FA symptoms after surgery, followed by possible recurrence within 24 months. [23]

Emotion dysregulation has been associated with binge eating and FA, [24] while lower physical activity levels have been reported among individuals with FA.17 Sleep disturbances are also associated with binge eating and night eating, [10, 25] although evidence regarding the direct relationship between sleep quality and FA remains limited. Studies addressing these factors specifically in the preoperative bariatric population remain scarce.

Therefore, this study aimed to investigate the association between FA, anxiety, depression and stress symptoms, sleep quality, physical activity, and clinical and nutritional factors among individuals awaiting bariatric surgery. Understanding these relationships may help identify challenges among patients on the bariatric surgery waiting list in the metropolitan region of Belém, supporting more effective interventions and informing public health policies.

METHODS

Study Design

This non-probabilistic, cross-sectional correlational study was conducted between August and November 2023 as part of the research project “Comparison of Eating Behavior in Individuals During the Preoperative Period and at Different Postoperative Stages of Bariatric Surgery.”

Participants

Data from 125 candidates for bariatric surgery (BS), aged 18–59 years according to the World Health Organization (WHO) adult age classification, were analyzed. [26] Eligible participants were literate men and women residing in Pará, in the preoperative period, officially registered on the BS waiting list at Jean Bitar Hospital (JBH), receiving care at its endocrinology outpatient clinic, and willing to participate.

Setting

Recruitment and data collection were conducted at the Endocrinology Outpatient Clinic of JBH, the state referral center for obesity care and the hospital performing the largest number of bariatric surgeries through the Brazilian Unified Health System (SUS) under the Obesidade Zero (“Zero Obesity”) Program.

Materials and Instruments

Anthropometric Assessment

Weight and height were measured using a Welmy® platform scale (300-kg capacity) and wall-mounted stadiometer (maximum height: 200 cm). Measurements were obtained barefoot, standing upright, with weight evenly distributed, arms alongside the body, heels together, and anatomical landmarks aligned with the stadiometer, following Brazilian Food and Nutrition Surveillance System recommendations. [27] BMI was calculated as weight (kg)/height² (m²) and classified according to WHO criteria. [28]

Screening Protocol

A study-specific screening questionnaire assessed eligibility according to the inclusion and exclusion criteria, obesity-related comorbidities, medications potentially affecting study outcomes, and previous diagnoses of eating disorders, anxiety, and depression.

Sociodemographic and Clinical Questionnaire

Participants completed a questionnaire addressing preoperative information, time on the surgical waiting list, age, educational level, marital status, household composition, family income, and use of legal (alcohol and tobacco) and illegal substances.

Physical Activity Assessment

Physical activity was assessed using a questionnaire adapted from the Brazilian Telephone Survey for Surveillance of Risk and Protective Factors for Chronic Diseases (VIGITEL). [4] It collected information on regular exercise, weekly frequency, session duration, modality, and perceived intensity. Modalities

were classified as resistance training, walking, or other aerobic exercise, and intensity as light, moderate, or vigorous according to the Modified Borg Rating of Perceived Exertion Scale. [29]

Modified Yale Food Addiction Scale 2.0 (mYFAS 2.0)

Food addiction (FA) was assessed using the short version of the Yale Food Addiction Scale 2.0 (mYFAS 2.0), developed by Schulte and Gearhardt [30] and validated in Brazil by Nunes Neto [.31] The 13-item instrument assesses FA symptoms according to Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for substance-related and addictive disorders.

Categorical scoring was used. FA was considered positive when at least two symptoms were accompanied by clinically significant distress or psychosocial impairment. Severity was classified as mild (2–3 symptoms), moderate (4–5), or severe (≥ 6).

Depression, Anxiety, and Stress Scale – 21 Items (DASS-21)

Depression, anxiety, and stress symptoms were assessed using the DASS-21, developed by Lovibond and Lovibond and validated in Brazilian Portuguese by Vignola and Tucci (2014).[32] The instrument assesses symptoms during the previous seven days through 21 items divided into three seven-item subscales, rated on a four-point Likert scale (0–3). Subscale scores were summed and multiplied by two for comparability with the original 42-item version, with severity ranging from normal to extremely severe.

Pittsburgh Sleep Quality Index (PSQI)

Sleep quality over the previous four weeks was assessed using the PSQI, developed by Buysse et al. [33] and validated in Brazil by Bertolazi et al. [34] The seven-component instrument produces a global score of 0–21; scores > 5 indicate poor sleep quality.

Procedures

Participants were recruited while awaiting appointments at the JBH Endocrinology Outpatient Clinic. After receiving information about the study and being assured that participation would not affect medical care, those who agreed signed written informed consent.

Participants then completed the screening, sociodemographic, and physical activity questionnaires. Anthropometric measurements were obtained in a private room, followed by the DASS-21, mYFAS 2.0, and PSQI. Data collection required approximately 30 minutes per participant.

Statistical Analysis

Data were entered into Microsoft Excel 2010® and analyzed using SPSS®, version 24.0. Normality was assessed using the Kolmogorov–Smirnov test. Continuous variables were presented as mean ± standard

deviation (SD) or median and interquartile range (IQR), according to distribution; categorical variables were presented as frequencies and percentages.

FA was categorized as presence or absence of suggestive FA behavior. A composite psychological distress variable was created by summing the depression, anxiety, and stress DASS-21 domain scores. This provided a global measure of psychological distress, considering the conceptual overlap and frequent clinical co-occurrence of these constructs, while reducing multicollinearity among individual DASS-21 domains in multivariable analyses.

Multiple linear regression was performed with FA score as the dependent variable and age, sex, BMI, PSQI score, physical activity duration, and psychological distress as independent variables, selected based on clinical relevance and literature evidence. Regression assumptions were assessed before model fitting, including residual normality and independence, homoscedasticity, and absence of multicollinearity. Statistical significance was set at $p < 0.05$.

RESULTS

The sample consisted of 125 candidates for bariatric surgery, with a mean age of 38.6 ± 9.9 years and a BMI of 46.3 ± 7.4 kg/m². The majority of participants were women (72%), had class III obesity (80%), and lived in the capital city or metropolitan area (64.8%). Approximately half of the participants engaged in regular physical activity (51.2%), with a mean duration of 21.9 ± 31.8 minutes per day. The mean scores for psychological distress, sleep quality (Pittsburgh Sleep Quality Index [PSQI]), and FA, as well as the frequency of participants classified as having FA and sleep disturbances, are presented in Table I.

Table I - Sociodemographic, Clinical, and Behavioral Characteristics of Candidates for Bariatric Surgery, 2023.

Age (years)	n / média ± DP*	Intervalo / %	p-valor[b]
	38,60 ± 9,86	**20–59**	
Sex			
Female	90	72	0,430
Male	35	28	
Place of residence			
Capital city and metropolitan area	81	64,80	0,703
Other municipalities	44	35,20	
Occupation			
Unemployed	5	4	0,001
Formal employment	73	58,40	
Self-employed	22	17,60	
Homemaker	21	16,80	
Student	4	3,20	
Retired	0	0	
Household income			
No income	5	4	0,001
Up to three minimum wages	81	64,80	
More than three minimum wages	39	31,20	
Household size			
Up to 4 household members	92	73,60	0,001
Five or more household members	33	26,40	
Marital status			
With a partner	58	46,40	0,001
Without a partner	67	53,60	
Education			
Higher education	92	73,60	0,001
No higher education	33	26,40	

Age (years)	n / média ± DP*	Intervalo / %	p-valor[b]
	38,60 ± 9,86	**20–59**	
Current weight (kg)	124,84 ± 26,92	79,9–220	0,001
Height (m)	1,64 ± 0,11	1,43–1,98	
Body mass index (kg/m²)	46,25 ± 7,40	33,56–73,51	0,211
Class I obesity	1	0,8	
Class II obesity	24	19,20	
Class III obesity	100	80	
Waiting time for surgery (months)	17,93 ± 13,45	1–84	
Use of weight-loss medication			
Yes	35	28	0,703
No	90	72	
Physical activity			
Physically active	64	51,20	0,046
Physically inactive	61	48,80	
Mental health and sleep			
Psychological distress (escore)			< 0,001
PSQI (escore)	7,70 ± 4,45	0–19	
Good sleeper	36	28,8	
Poor sleeper	53	42,4	0,083
Sleep disturbance	36	28,8	
Food addiction	2,50 ± 2,73	0 – 11	
Present	43	34,40	
Absent	82	65,60	

*SD: Standard deviation; Minimum wage: BRL 1,412.

Clinically relevant symptoms of depression, anxiety, and stress were significantly associated with food addiction (all $p < 0.001$). No significant bivariate associations were observed between food addiction and physical activity ($p = 0.073$) or sleep quality ($p = 0.226$). However, sleep quality emerged as an independent predictor of food addiction in the adjusted multiple regression model (Table II).

Table II - Associations Between Clinically Relevant Psychological Symptoms, Physical Activity, Sleep Quality, and Food Addiction in Candidates for Bariatric Surgery, 2023.

Variable	Category	Without food addiction n (%)	With food addiction n (%)	p-value	Effect size
Clinically relevant depression	No	106 (80.3)	26 (19.7)	< 0.001	Φ = 0.452
	Yes	16 (32.7)	33 (67.3)		
Clinically relevant anxiety	No	103 (78.0)	29 (22.0)	< 0.001	Φ = 0.372
	Yes	19 (38.8)	30 (61.2)		
Clinically relevant stress	No	111 (75.0)	37 (25.0)	< 0.001	Φ = 0.343
	Yes	11 (33.3)	22 (66.7)		
Physical activity	Yes	79 (72.5)	30 (27.5)	0.073	Φ = 0.133
	No	43 (59.7)	29 (40.3)		
Sleep quality	Good sleeper	22 (62.9)	13 (37.1)	0.226	V = 0.154
	Sleep disturbance	20 (54.1)	17 (45.9)		
	Poor sleeper	38 (71.7)	15 (28.3)		

Data are presented as *n* (% within category); p-values were obtained using Pearson's chi-square test. Effect sizes are presented as Phi coefficient (2×2 tables) or Cramer's V (tables larger than 2×2).

Multiple linear regression was performed to investigate the factors associated with food addiction (FA) scores among candidates for bariatric surgery. The model was statistically significant ($F(6,118) = 8.910$; $p < 0.001$), explaining 31.2% of the variance in FA scores ($R^2 = 0.312$; adjusted $R^2 = 0.277$). The Durbin–Watson statistic (2.106) indicated adequate independence of residuals, while the low variance inflation factor (VIF) values (1.02–1.21) demonstrated the absence of multicollinearity among the independent variables. After adjustment for age, sex, and body mass index (BMI), psychological distress remained the strongest predictor of FA scores ($\beta = 0.501$; $p < 0.001$). In addition, higher Pittsburgh Sleep Quality Index (PSQI) scores were positively associated with FA ($\beta = 0.164$; $p = 0.036$), whereas longer time spent in physical activity was inversely associated with the outcome ($\beta = -0.225$; $p = 0.006$). Age ($p = 0.244$), BMI ($p = 0.426$), and sex ($p = 0.091$) were not significantly associated with FA scores (Table III).

Table III - Multiple Linear Regression Analysis of Predictors of Food Addiction Among Candidates for Bariatric Surgery (n = 125), 2023.

Variável	B	EP	β	p-value
Constant	1,277	1,897	—	0,502
Age (years)	-0,026	0,023	-0,095	0,244
Sex	0,843	0,494	0,139	0,091
Current BMI (kg/m²)	-0,025	0,031	-0,067	0,426
PSQI (escore)	0,100	0,047	0,164	0,036
Physical activity time (min/day)	-0,019	0,007	-0,225	0,006
Psychological distress	0,045	0,007	0,501	< 0,001

B = unstandardized coefficient; SE = standard error; β = standardized coefficient. Model statistics: R = 0.558; R^2 = 0.312; adjusted R^2 = 0.277; F(6,118) = 8.910; p < 0.001; Durbin–Watson = 2.106.

Overall, the results indicate that behaviors suggestive of food addiction were associated with poorer emotional outcomes. Sleep quality and physical activity showed limited associations with food addiction.

DISCUSSION

The main finding was that global psychological distress was the strongest predictor of food addiction (FA), regardless of age, sex, body mass index (BMI), sleep quality, and physical activity (PA). This reinforces the hypothesis that FA among bariatric surgery candidates is strongly associated with emotional factors. [35] Individuals with higher anxiety, depression, and stress may consume highly palatable foods as an emotional regulation strategy, promoting loss of control over eating and behaviors consistent with FA.

Sarwer et al. [36], in 300 individuals, found that current psychiatric diagnoses, particularly anxiety, and lifetime diagnoses, particularly depression, were associated with FA and night eating syndrome. Similarly, a systematic review of FA in bariatric surgery reported that preoperative FA was associated with higher psychopathology. [37] Martins et al. [38], in an integrative review of 22 studies, also found a higher prevalence of psychiatric disorders among bariatric surgery candidates than in the general population.

The association between emotional factors and FA suggests that excessive consumption of highly palatable foods may provide temporary mood enhancement and relief from psychological distress, functioning as an emotional regulation strategy. [39] Huang et al. [40], in 219 young adults with overweight or obesity, found direct associations among weight-related stigma, psychological distress, and FA, suggesting that distress related to weight stigma may contribute to disordered eating. Likewise, among 128 women awaiting bariatric surgery, those with eating disorders and FA had higher emotional

dysregulation and emotional eating scores, reinforcing the role of emotional and psychosocial factors in FA and other addictive behaviors. [24]

Poorer sleep quality was also independently associated with FA. Sleep disturbances may affect eating behavior through impaired appetite regulation, increased neural responsiveness to highly palatable foods, greater impulsivity, and reduced inhibitory control. [41] Thus, sleep may represent a modifiable factor to consider during preoperative assessment.

Approximately half of participants reported being physically active. PA showed a trend toward an association with FA presence, although it did not reach statistical significance ($p = 0.060$), and was not associated with FA severity or sleep quality. Nevertheless, longer PA duration was associated with lower FA scores, suggesting a potential protective effect. Although causality cannot be inferred from this cross-sectional design, PA may improve emotional regulation, anxiety and depression symptoms, sleep quality, and eating control, potentially explaining this association. [42, 43, 44]

Zielińska et al. [45], in 172 adults with overweight or obesity, found that sedentary individuals were more likely to develop depression and generalized anxiety disorder. Thus, PA may protect against dysfunctional eating behaviors while also mitigating associated psychopathology.

Age, sex, and BMI were not independently associated with FA after adjustment, suggesting that FA among bariatric surgery candidates may be more strongly related to psychological and behavioral factors than to obesity severity or demographic characteristics. Clinically, these findings support systematic screening of psychological distress, sleep quality, and PA during preoperative assessment to identify patients at greater risk for FA and facilitate multidisciplinary interventions before surgery.

This study has limitations, including its relatively small sample, convenience sampling, absence of longitudinal follow-up, and use of self-reported instruments, which may have introduced information bias and limit generalizability. Nevertheless, this pioneering study in the Brazilian Amazon contributes to understanding clinical, psychological, and behavioral factors potentially associated with FA among individuals awaiting bariatric surgery and provides a basis for further research.

CONCLUSION

Food addiction was primarily associated with psychological distress, as well as poorer sleep quality and shorter duration of physical activity (PA), highlighting the importance of emotional and behavioral factors in this phenomenon. These findings reinforce the need for a comprehensive multidisciplinary preoperative assessment encompassing nutritional, psychological, behavioral, and lifestyle aspects to identify patients at greater risk and guide early interventions before bariatric surgery.

Declarations

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

INFORMED CONSENT

Informed consent was obtained from all individual participants included in the study.

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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