

Original article

# Effects of bariatric surgery on night eating and depressive symptoms: a prospective study

Thisciane Ferreira Pinto, M.Sc.<sup>a</sup>, Pedro Felipe Carvalho de Bruin, M.D., Ph.D.<sup>a,\*</sup>,  
Veralice Meireles Sales de Bruin, M.D., Ph.D.<sup>a</sup>, Francisco Ney Lemos, M.D.<sup>b</sup>,  
Fernando Henrique Azevedo Lopes, M.Sc.<sup>a</sup>, Paulo Marcos Lopes, M.D.<sup>b</sup>

<sup>a</sup>Laboratory of Sleep and Biological Rhythms, Universidade Federal do Ceará, Fortaleza, Brazil

<sup>b</sup>Hospital Geral Dr. César Cals, Fortaleza, Brazil

Received June 20, 2016; accepted December 14, 2016

## Abstract

**Background:** Night eating syndrome (NES) is characterized by a delayed pattern of food intake and is clinically defined by the presence of evening hyperphagia, nocturnal ingestion, morning anorexia, and sleep problems. Although most studies report an association of obesity, depressive mood, and NES, very little is known about the impact of bariatric surgery in the course of this syndrome, particularly in patients with depressive symptoms.

**Objectives:** To assess the effects of bariatric surgery on night eating and depressive symptoms.

**Setting:** Tertiary hospital, Brazil.

**Methods:** Sixty patients consecutively submitted to bariatric surgery were included in the study. Baseline depressive symptoms were assessed by the Beck Depression Inventory–Short Form (BDI-SF) and night eating by the Night Eating Questionnaire. Measurements were repeated post-operatively for comparison.

**Results:** Participants were predominantly female (M/F = 9/51). Mean ( $\pm$ SD) age was  $34.7 \pm 9.2$  years and body mass index was  $46.04 \pm 7.52$  kg/m<sup>2</sup>. On average, BDI-SF scores improved after bariatric surgery ( $9.77 \pm 7.01$  versus  $4.70 \pm 4.60$ ;  $P = .001$ ). Patients with baseline depressive symptoms (BDI-SF >4), in contrast to those without, showed a significant improvement in Night Eating Questionnaire scores ( $16.03 \pm 7.73$  versus  $12.80 \pm 7.76$ ;  $P = .01$ ), despite a similar post-operative reduction in weight.

**Conclusion:** Bariatric surgery is associated with a reduction in depressive symptoms. After the surgical intervention, improvement of night eating can be observed predominantly in patients with preoperative depressive symptoms. These findings are consistent with the hypothesis of an important role of mood problems in NES. (Surg Obes Relat Dis 2017;13:1057–1062.) © 2017 American Society for Metabolic and Bariatric Surgery. All rights reserved.

## Keywords:

Obesity; Depression; Eating disorders; Circadian rhythm; Bariatric surgery; Night eating questionnaire

The contribution of nonnormative eating patterns to the development of weight gain and obesity has been the focus

\*Correspondence: Pedro F. C. de Bruin, Laboratory of Sleep and Biological Rhythms, Department of Medicine, Universidade Federal do Ceará, Rua Prof. Costa Mendes, No. 1608, 4º andar, CEP 60430-140, Fortaleza (CE), Brazil.

E-mail: [pedrobruin@gmail.com](mailto:pedrobruin@gmail.com)

<http://dx.doi.org/10.1016/j.soard.2016.12.010>

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of increasing interest [1]. Night eating syndrome (NES), originally described by Stunkard et al. [2], is characterized by a delayed pattern of food intake that can manifest behaviorally as the ingestion of a disproportionate amount of the daily caloric intake later in the day (“evening hyperphagia”) and/or eating episodes occurring after the person awakens during the night and then returns to sleep

(“nocturnal eating”). Other important features of NES are morning anorexia and trouble getting to sleep or staying asleep [2,3]. Prevalence of NES in community cohorts has been estimated to range from 1.1%–1.6% [4–6] and although much higher frequencies have been found in various groups of obese patients [7–10], not all patients with NES are overweight or obese [11].

Since its original description, NES has been linked to depression and the majority of subsequent studies indicate that these 2 conditions often coexist [12–14]. It has been argued that many investigations were conducted in predominantly overweight and obese populations, which usually present higher psychological distress rates independently of NES. However, studies of nonobese patients with NES have also shown a high prevalence of depressed mood, with a history of lifetime depression being described in 53%–56% of these individuals [15]. Moreover, it has been reported that in obese patients with NES, mood falls as the day progresses, reaching its lowest when individuals awake at night, which suggests that eating patterns in NES may reflect mood fluctuations [14,16]. Selective serotonin reuptake inhibitors and behavioral therapy have both been reported to significantly improve night eating symptoms in a small number of studies [17].

As the problem of obesity worsens worldwide, there has been a marked increase in individuals seeking bariatric surgery. Many common characteristics of NES, such as depressed mood, frequent snacking, evening hyperphagia, and nocturnal ingestion have the potential to adversely affect surgical outcomes, such as weight loss, medical complications, or psychological symptoms. Previously, few studies have addressed these questions, with conflicting results [7,18]. Similarly, very little is known about the course of NES after bariatric surgery [19,20]. This study aims to improve current understanding of the course of depression and night eating after bariatric surgery in association with postoperative weight loss. Additionally, the relationship between the surgical intervention and individual symptoms of NES, including morning anorexia, nocturnal intake, evening hyperphagia, and sleep and mood problems, has been prospectively investigated.

## Methods

This was a prospective study of patients referred to the Obesity Surgery Outpatient Clinic at Hospital Geral Dr. César Cals, in Fortaleza, Brazil. Consecutive patients of both sexes, aged 18 years or more, with body mass index (BMI)  $\geq 40$  or a BMI  $\geq 35$  with at least one co-morbid obesity-related condition were approached to take part in the study on the occasion of their initial visit to the Clinic. Individuals with serious co-morbidities (including neoplasms, heart failure, and kidney or liver failure), shift workers, and women who were pregnant or breastfeeding were not included. The research protocol was approved by

the local Research Ethics Committee, and written informed consent was obtained in all cases.

Sociodemographic and anthropometric data, including age, sex, weight, and height, were obtained from all patients at the initial visit. BMI was calculated as the ratio between weight (kg) and squared height ( $m^2$ ). Presence and severity of NES were evaluated by the Night Eating Questionnaire (NEQ), an instrument widely used for this purpose. This questionnaire has a 4-factor structure, each one related to a major feature of NES (nocturnal ingestions, evening hyperphagia, morning anorexia, and mood/sleep) and comprises 14 questions rated on a 5-point Likert-type scale. One item is intended to differentiate NES from sleep-related eating disorder and, therefore, is not included in the final score. Scores may range from 0 to 52, and a score  $\geq 25$  is considered positive for NES. The psychometric properties of NES were previously examined in a large sample and the Cronbach's alpha for the total scale was reported to be 7.0 [21]. A Portuguese language version of the NEQ, previously adapted and validated for the Brazilian population, was used in this study [22].

Depressive symptoms were measured by the Beck Depression Inventory–Short Form (BDI-SF). This instrument consists of 13 items, each scored from 0 to 3. A score of 0 to 3 indicates no depressive symptoms; 4 to 7 mild depressive symptoms; 8 to 15 moderate depressive symptoms; 16 or more, severe depressive symptoms. For the purpose of this study, patients were divided into 2 groups: with (BDI-SF  $\geq 4$ ) or without depressive symptoms (BDI-SF  $< 4$ ). The BDI-SF is generally considered a reliable and valid screening measure of depression. Its internal consistency reliability has been previously reported to be .78 [23]. A Portuguese version, adapted for the Brazilian population, was used in the present study [24].

As part of a routine evaluation, all patients were assessed by a multidisciplinary team, including a surgeon, endocrinologist, pneumologist, cardiologist, nurse, psychologist, and dietician. Laparoscopic Roux-en-Y gastric bypass was performed in all cases. Measurements and questionnaires were repeated postoperatively, after a mean period of  $16.1 \pm 6.0$  (6–33) months.

## Data analysis

Values are presented as mean  $\pm$  SD or frequency, as appropriate. Patients were divided into 2 groups according to the presence (BDI-SF  $\geq 4$ ) or absence of preoperative depressive symptoms. Data were examined for normality using the Kolmogorov–Smirnov test. For normally distributed variables with homogeneity of variance, between-group comparisons were performed using unpaired Student *t* test and within-group comparisons (pre- versus postsurgery) using paired *t* test. Wilcoxon test was used for within-group comparisons (pre- versus postsurgery) of those variables that did not meet the homogeneity of variances

requirement. Categorical variables were analyzed by the  $\chi^2$  test. Pearson's correlation coefficients were calculated to evaluate the relationship between BDI-SF and NEQ scores. Internal consistency of NEQ and BDI-SF in this special sample was assessed by calculating Cronbach's alpha coefficient. Analyses were carried out by Statistical Package for Social Sciences (SPSS) for Windows, version 20.0 (SPSS Inc, Chicago, IL, USA). Differences were considered to be significant at  $P < .05$ .

## Results

Sixty patients consecutively submitted to bariatric surgery, aged between 21 and 56 years, with a BMI ranging from 35.0 to 72.4 kg/m<sup>2</sup>, were included into the study. At baseline, depressive symptoms were present (BDI-SF >4) in 39 (65%) patients, and were classified as mild in 6 (10%) cases, moderate in 20 (33.3%), and severe in 13 (21.7%). Five (8.3%) patients were on antidepressants (fluoxetine:  $n = 4$ ; amitriptyline:  $n = 1$ ). On average, there was a postoperative improvement in BDI-SF scores ( $9.77 \pm 7.01$  versus  $4.70 \pm 4.60$ ;  $P = .001$ ) for the entire sample. The frequency of patients with BDI-SF scores >4 postsurgery was reduced to 25 (41.7%) and 2 patients remained on antidepressants (fluoxetine:  $n = 1$ ; amitriptyline:  $n = 1$ ). A trend for NEQ global scores to improve after bariatric surgery was also observed ( $14.18 \pm 7.69$  versus  $12.32 \pm 7.66$ ;  $P = .05$ ), although the number of participants who met the cut-off for NES (NEQ  $\geq 25$ ) did not change significantly (7 versus 6 individuals). The group with baseline depressive symptoms (BDI-SF >4), in contrast to the group without, showed a significant improvement in NEQ scores ( $16.03 \pm 7.73$  versus  $13.26 \pm 7.84$ ;  $P = .03$ ), despite a similar postoperative reduction in weight. Of the 39 patients with baseline depressive symptoms, 7 met the cut-off for NES before surgery and 5 after the intervention. Patients who met the cut-off for NES at baseline, showed a similar postoperative reduction in BMI as those with NEQ <25 ( $-14.21 \pm 5.0$  versus  $-15.98 \pm 7.66$ ;  $P = .636$ ). Overall, no correlation was found between NEQ scores at baseline and postoperative changes in BMI. A positive correlation was observed at baseline between BDI and NEQ scores ( $R = 0.481$ ;  $P = .001$ ). A positive correlation was observed at baseline between BDI and NEQ scores ( $R = 0.481$ ;  $P = .001$ ). Cronbach's alpha reliability coefficient for NEQ and BDI-SF was, respectively, .80 and .88. General characteristics and results for BDI-SF, NEQ (global and domains scores) before and after surgery are summarized in [Table 1](#).

## Discussion

This study confirms the beneficial effect of bariatric surgery on depressive symptoms and indicates that this procedure can be associated with an improvement in night

eating, particularly in obese patients with preoperative depressive symptoms.

A postoperative improvement in depressive symptoms was observed in the participants of this study. Previously, De Zwaan et al. also reported an improvement in depressive symptoms after obesity surgery [25]. Psychological factors, including changes in self-esteem, body satisfaction, and weight-related stigmatization as well as biologic factors, such as deactivation of proinflammatory states, normalization of the hypothalamic-pituitary-adrenal axis, and improved insulin resistance, have been implicated in the improvement of depressive symptoms following bariatric surgery [26]. Additionally, the present results show that patients with and without depressive symptoms have similar postoperative weight reduction. Some centers consider mood disorders to be a potential contraindication for bariatric surgery, although their ability to negatively influence surgical outcomes has not been consistently proven [27]. It should be noted that despite the high frequency of preoperative depressive symptoms in this study, very few patients were on antidepressants.

More than 10% of the participants of this study had NEQ scores consistent with the diagnosis of NES. Previous studies of bariatric surgery candidates reported NES rates ranging from 8.9 to 42% [6,9,10]. This wide variability may be related to the lack of uniformity of NES criteria, especially in early publications [3]. In the present study, there was an overall tendency for an improvement in NEQ scores after bariatric surgery, although the number of patients who met the cut-off for NES did not change significantly (11.7% versus 10%). Previous investigations on the longitudinal course of night eating symptoms after bariatric surgery have been scarce. A retrospective study by Rand et al. described a slight improvement in NES prevalence from a preoperative 30.6% to 27% at 32 months after bariatric surgery [6]. On a small prospective study, Adami et al. were unable to demonstrate a significant change in the frequency of NES when patients were reassessed 3 years after bariatric surgery (7.9% and 6.3%, respectively) [28]. Importantly, the present study shows that night eating improvement after bariatric surgery seems to occur mainly in patients with preoperative depressive symptoms. Although the etiopathogenesis of NES has not been satisfactorily clarified, biologic, behavioral, and psychological factors, including mood changes, all seem to play a role [14,29,30].

Evidence indicates that a high proportion of patients with NES show co-morbid depression [6,8,15], and it has been recommended that patients with NES be routinely evaluated for this condition [13]. In addition, therapeutic modalities, such as cognitive behavioral therapy and selective serotonin reuptake inhibitor, which have been reported to improve symptoms of NES, are also effective for treating depression. These observations appear to suggest that depressed mood could be a relevant factor for the development of NES [31].

**Table 1**  
Baseline and follow-up demographic characteristics, body mass index, BDI, and NEQ scores according to the presence of depressive symptoms at preoperative evaluation in 60 patients submitted to bariatric surgery

	All (n = 60)		With baseline depressive symptoms (n = 39)		Without baseline depressive symptoms (n = 21)		P value
	Before	After	Before	After	Before	After	
Age (yr)	34.7 ± 9.2	-	35.49 ± 10.07	-	33.38 ± 7.66	-	.369*
Sex (m/f)	9/51	-	5/34	-	4/17	-	.519†
BMI (kg/m <sup>2</sup> )	46.04 ± 7.52	30.27 ± 4.34	46.27 ± 8.30	30.49 ± 4.74	45.60 ± 5.99	29.84 ± 3.56	< .001‡
NEQ global score	14.18 ± 7.69	12.32 ± 7.66	16.03 ± 7.79	13.26 ± 7.83	10.76 ± 6.35	10.57 ± 7.19	.03§
Morning anorexia	3.50 ± 1.90	3.45 ± 1.41	3.54 ± 1.91	3.54 ± 1.50	3.43 ± 1.93	3.29 ± 1.27	.89§
Evening hyperphagia	4.58 ± 2.98	3.15 ± 2.48	5.28 ± 2.80	3.31 ± 2.25	3.29 ± 2.93	2.86 ± 2.90	< .001§
Nocturnal intake	2.42 ± 3.50	3.03 ± 3.65	3.08 ± 3.86	3.51 ± 3.56	1.19 ± 2.35	2.14 ± 3.71	.53§
Sleep and mood	4.42 ± 2.79	3.37 ± 2.97	4.97 ± 2.85	3.90 ± 3.00	3.38 ± 2.41	2.38 ± 2.71	.03§
BDI global score	9.77 ± 7.01	4.70 ± 4.60	13.51 ± 5.89	5.31 ± 4.88	2.81 ± 1.03	3.48 ± 4.04	< .001§

BMI = body mass index; NEQ = Night Eating Questionnaire; BDI = Beck Depression Inventory.

Data are expressed as mean ± standard deviation.

\*Unpaired Student's t test.

†χ<sup>2</sup> test.

‡Paired Student t test.

§Wilcoxon test.

However, it should be considered that the association between mood problems and NES was not confirmed by some investigators [18] and that the response of depressive symptoms and NES to treatment seems to occur independently [32]. Additionally, this study shows that the structural factor “sleep and mood disorders,” 1 of the 4 major clinical components evaluated by the NEQ, improved significantly after surgery.

It can be speculated that the relationship between depressive symptoms and NES may be mediated by sleep problems, such as insomnia, which is common in both conditions. Improvement in depressive symptoms after bariatric surgery has been previously reported. It has been attributed to better self-concept, body image, and self-esteem secondary to weight reduction, although other factors could also play a role, such as patients feeling in greater control over their lives and having health team support [33]. Another hypothesis for the relationship between mood changes and night eating is that, as patients become less depressed, they are less likely to see night eating as a significant problem. It should be mentioned that, based on the present data, it is not possible to rule out that a third factor, such as improved sleep, accounted for the observed benefits in both night eating and depressive symptoms.

In the present study, improvement of NES was accompanied by a reduction of evening hyperphagia, but not of nocturnal ingestion, in patients with preoperative depressive symptoms. This seems relatively surprising, as the scarce literature available suggests that depressed mood is more consistently related with nocturnal eating than with evening hyperphagia [18,34]. Colles et al. found evidence of elevated psychologic distress only in patients with NES who also reported nocturnal eating [18]. Rein et al. observed that nocturnal eating was significantly associated with high depression and anxiety scores in bariatric surgery candidates [34]. Because nocturnal eating is defined solely based on the timing and not on the size of the eating episode, it might be the case that after bariatric surgery, patients could still be experiencing nocturnal eating episodes that now involve smaller amounts of food, thereby reducing the total amount of late food intake. This possibility deserves further investigation.

Among the limitations of this study, it should be mentioned that no objective assessment of the eating pattern and food intake was performed, and the presence of NES was subjectively evaluated by NEQ. However, as mentioned, this questionnaire has been widely used both in the clinical and research settings for the screening and assessment of symptom severity in patients with NES [13,21,35], and its reliability in this particular sample has been proved to be good. It is also important to emphasize the distinction between the presence of depressive symptoms, demonstrated by a self-report instrument like the BDI-SF, and the diagnosis of a depressive disorder, as defined by the

Diagnostic and Statistical Manual of Mental Disorders, which usually requires a structured clinical interview.

## Conclusion

Patients submitted to bariatric surgery show an improvement in depressive symptoms. Night eating symptoms appear to decrease after bariatric surgery, predominantly in individuals with preoperative depressive symptoms. This reinforces the hypothesis of an association between mood problems and night eating, both frequent in the obese. Further prospective studies are warranted, using standardized diagnostic criteria and adequate methodology, to characterize a possible causal relationship between these 2 conditions.

## Disclosures

*The authors have no commercial associations that might be a conflict of interest in relation to this article.*

## Acknowledgements

Thisiane F. Pinto and Fernando H. A. Lopes were recipients of scholarships from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Brazil. The authors thank Mr. Antonio Brazil Viana Júnior for technical assistance.

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