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Beyond Weight Loss: Investigating Irritability and Mood Swings after Bariatric Surgery: A Prospective Study

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ABSTRACT

The physical changes after bariatric surgery are evident, but the significant changes in psychological and emotional effects are underscored and have not received much attention. **Objectives:** To determine the prevalence of Irritability and Mood Swings After Bariatric Surgery and its impact on hormonal and nutritional changes. **Methods:** This prospective observational study was conducted from February 2022 to January 2023. Patients undergoing any type of bariatric surgery with no existing psychiatric conditions that required medication were included. Structured questionnaires were distributed among the participants, and informed consent was also provided. **Results:** The study comprised 1,014 patients, with a mean age of 33 ± 13 years. According to the Profile of Mood States (POMS), 679 (67%) of participants had clinically severe mood abnormalities before surgery, which then increased to 844 (83%) at three months and then reduced to 355 (35%) at six months ($p<0.001$). Compared to 740 (73%) before surgery, 902 (89%) of patients experienced moderate to severe irritation at three months ($p<0.001$). After six months, this percentage dropped to 446 (44%). **Conclusions:** The research concluded notable changes in mood, irritability, and hormone levels after bariatric surgery, including increased irritability and mood disturbance at three months, with improvement at six months. Prevalent nutritional deficiencies of vitamins B12 and D regression were also found to be associated with increased mood and irritability. Multiple hormonal variations and nutritional deficiencies were found to result in postoperative mood variation significantly.

INTRODUCTION

Bariatric surgery has become a revolutionary treatment option and is considered a very viable alternative that can lead to substantial and long-lasting weight loss for those suffering from obesity [1]. This surgical strategy includes several operations that change the gastrointestinal tract's structure, which lowers food consumption and nutritional absorption [2]. Although the physical changes post-bariatric surgery is usually the main outcome of interest, the psychological and emotional changes following surgery are just as significant and yet are often overlooked, and research on the psychological effects of bariatric surgery has not received much attention [3]. Among the many psychological aspects of bariatric surgery, irritability and mood swings stand out as prevalent but little-known issues that can have a big influence on a patient's long-term success [4]. Following surgery, certain patients exhibit a higher chance of experiencing negative mental health consequences [5]. High rates of preexisting depression, unfulfilled expectations about the transformative power of weight loss, and post-surgical changes in the hormonal and nutritional levels are some of the likely contributing factors leading to these adverse mental health outcomes, including mood changes and irritability [6]. After bariatric surgery, there are a variety of intricately linked physiological and psychological changes [7]. A key factor is the hormonal changes brought on by abrupt weight loss and changes in the gastrointestinal tract. RYBG and SG result in the enhancement of postprandial secretion of

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satiety hormones, including glucagon-like peptide-1 (GLP-1) and oxyntomodulin (OXM), which contribute to a feeling of fullness and decrease hunger, resulting in the postoperative appetite regulation [8]. Following bariatric surgery, Hormones including ghrelin, leptin, insulin Peptide YY (PYY) play a vital role in maintaining weight loss [9]. Ghrelin, a hunger hormone, also decreased after surgery due to the removal of ghrelin-secreting gastric tissue [10]. Leptin, produced by adipose tissue, sends feedback signals to the hypothalamus and regulates regular appetite and balances energy [11, 12]. The enteroendocrine changes brought on by sleeve gastrectomy and Roux-en-Y gastric bypass (RYGB) have an impact on mental health, owing to the evidence now available, which indicates that several hormones and neuropeptides that regulate hunger have an impact on mood [13]. Similarly, a deficiency of vital minerals such as iron, magnesium, vitamin B12, and vitamin D can impair neurological function and lead to mood swings [14, 15]. Patients frequently struggle with adjusting to new eating habits and managing their altered body image, which can cause them to feel frustrated, anxious, or even depressed [16, 17]. Some people may encounter emotional challenges for the first time, while others may have pre-existing mental health disorders that are made worse. Emotional sensitivity can also be increased by the strain of adjusting to new lifestyle demands as well as the environmental and social factors connected to severe weight reduction [18, 19]. It's imperative to recognize and manage mood swings and irritability in bariatric patients since they can impact the patient's quality of life, long-term weight control success, and compliance with postoperative instructions, in addition to their mental health.

This study aims to determine the prevalence and contributing factors of irritability and mood swings in post-bariatric surgery patients.

METHODS

This prospective observational study was carried out in the International Metabolic and Bariatric Center, Afridi Medical Complex, Peshawar, over a year, from February 2022 to January 2023. Before enrolment, all subjects were given their informed permission, and the Institutional Review Board (IRB) granted ethical approval with reference no.234/DME/AMC/2022. A sample size of 1014 patients was determined by using the WHO sample size calculator. The calculation was based on a 95% confidence interval (CI), 5% margin of error (d), population (50%), and estimated prevalence (p) of 85.8%. The sample size was calculated using the formula [20]: n=Z2×P×(1-P)/d2. A non-probability consecutive sampling technique was applied in this study. Patients who had bariatric surgery procedures such as Sleeve gastrectomy, Roux-en-Y gastric bypass (RYGB), and micro gastric bypass were among the surgeries carried out. Patients between the ages of 18-65 years, of both genders, who had no history of drug abuse or had any psychiatric conditions that required medication were eligible. Patients who refused to participate in follow-up or had any unstable medical conditions were excluded. Further, patients below 18 and above 65 years were not included in the current study. Profile of Mood States (POMS), a 5-point Likert scale comprised of 65 65-item inventory with six different subscales, including tension-anxiety, depression-dejection, Anger-Hostility, Fatigue-Inertia, Confusion-Bewilderment and Vigour-Activity. The scoring of this scale ranges from ('0=not at all' to '4=very strong') and is widely used for the assessment of mood [21]. The Irritation Questionnaire (IRQ), a two 4-point Likert scale, was employed to assess the frequency and severity of irritation symptoms. For frequency, the score ranges from ('0=never' to '3=most of the time') and for severity of symptoms, the score ranges from ('0=not at all' to '3=very much so' [22]. The Postoperative Adaptation Questionnaire (PAQ), a 15-item questionnaire, is used to assess how well the patient has adapted to lifestyle modifications, including eating habits and body image. Each item is reported on a 5-point Likert scale ranging from (0=strongly disagree to 5=strongly agree). Further sleep disorders, which can be a factor in mood swings, were assessed through the Sleep Quality Index (SQI). SQI is an 8-item questionnaire with three categories weighted 0,1, and 2 and scoring varied from 0-16 (23). Blood samples were collected after overnight fasting, centrifuged, and serum was stored at -80°C, at baseline(pre-operative), 3rd month, and 6th month. Vitamin B12 and D levels were measured using chemiluminescent immunoassays, a highly sensitive, specific and suitable laboratory technique for detecting low serum concentrations of these micronutrients. Serotonin, ghrelin, and leptin were evaluated using ELISA kits (Elabscience, USA) following the manufacturer's protocols. Clinical and Demographic Information that including Preoperative psychological history, age, gender, BMI, operation type, concomitant conditions, and other baseline variables, were taken from medical records. Before the surgery, patients were evaluated to determine baseline levels of hormones such as serotonin, ghrelin and leptin, which are associated with appetite regulation. Nutritional health was assessed via blood levels of vitamin B12 and vitamin D. Mood and irritability were evaluated through valid tools such as Profile of Mood States (POMS) and Irritability Questionnaire (IRQ). Participants filled out the IRQ and POMS questionnaires at follow-up assessments that were held three and six months after surgery. To track variations in hormone and nutritional levels, blood samples were taken at regular intervals. Samples were then centrifuged to separate serum and then stored at -80°C for preservation. The PAQ and SQI were used to collect psychosocial and sleep-related data during follow-ups. SPSS version 26.0 was used to analyze the data.

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Demographic information and baseline traits were compiled using descriptive statistics. Categorical variables such as gender, nutritional deficiencies, and surgery type were represented in percentages and frequencies, while the data in numerical form, such as age, BMI, irritability, mood disturbances, and nutritional and hormonal changes, were illustrated in mean and standard deviation. Relationships between mood swings and dietary or hormonal factors were investigated using an independent sample t-test, and the impact on hormonal and nutritional changes was found by multiple regression, and p≤0.05 was chosen as the threshold for statistical significance.

RESULTS

The study comprised 1,014 patients, whose mean age was 33 ± 13_ years. Of those who took part,659 (65%) were men and 335 (35%) were women. Before surgery, the average BMI was 29 ± kg/m^2. The majority of individuals had mini gastric bypass 385 (38%), followed by sleeve gastrectomy 304 (32%) and Roux-en-Y gastric bypass (RYGB) 324 (30%). According to the Profile of Mood States (POMS), 679 (67%) of participants had clinically evident mood abnormalities before surgery, and 740 (73%) of participants experienced mild irritation. With 284 (28%) of patients lacking vitamin B12 and 730 (72%) lacking vitamin D, nutritional deficiencies were common (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics

Variables	Categories	Mean ± SD	Frequency (%)
Mean Age (Years)	18-65	33 ± 13	–
Gender	Female	-	(335) 35%
	Male		659 (65%)
Mean BMI (kg/m^2)	-	29 ± 3	–
Surgery Type (%)	Sleeve Gastrectomy	-	385 (38%)
	Roux-en-Y Gastric		304 (30%)
	Mini Gastric Bypass		324 (32%)
Nutritional Deficiencies	Vitamin B12	-	284 (28%)
	Vitamin D		730 (72%)

Assessments conducted after surgery showed a marked rise in irritation. Compared to 740 (73%) before surgery, 902 (89%) of patients experienced moderate to severe irritation at three months (p<0.001). After six months, this percentage dropped to 446 (44%). Increased frustration, trouble controlling emotions, and heightened susceptibility to small stimuli were all signs of irritability. The percentage of patients reporting clinically significant mood disturbances increased from 679 (67%) before surgery to 844 (83%) at three months and 355 (35%) at six months (p<0.001), indicating a significant worsening of mood swings following surgery a subsequent decrease after 6 months (Table 2).

Table 2: Changes in Mood and Irritability Scores Over Time

Measures	Baseline	3rd Month	6th Month	p-value
	n (%)			
Moderate to Severe Irritability	740 (73%)	902 (89%)	446 (44%)	<0.001
Mood Disturbances	679 (67%)	844 (83%)	355 (35%)	<0.001

After surgery, there were notable hormonal changes that were linked to mood swings and increased irritation. From 593 ± 31 ng/L ng/mL before surgery to 258 ± 18 ng/L at six months, ghrelin levels significantly decreased (p<0.001), and patients who saw larger decreases also reported higher irritation scores (p<0.001). At six months, serotonin levels dropped dramatically from 120 ± 20 ng/mL to 80 ± 15_ ng/mL (p=0.04), which led to more frequent mood swings. A subgroup of patients continued to have nutritional deficiencies; at six months, 345 (34%) were still lacking in vitamin B12 and 588 (58%) in vitamin D. Increased irritability and mood disorders were highly associated with these inadequacies (respectively, p<0.003) (Table 3).

Table 3: Hormonal and Nutritional Changes

Measures	Baseline	6 Months	p-value	95% CI (Confidence Interval)
Serotonin (ng/mL)	120 ± 20	80 ± 15	<0.001	-12.7 to -8.3
Ghrelin (ng/L)	593 ± 31	258 ± 18	<0.001	-352.0 to -282.0
Vitamin B12 (ng/mL)	284 (28%)	345 (34%)	<0.003	0.12 to 0.25
Vitamin D (ng/mL)	730 (72%)	588 (58%)	<0.003	0.10 to 0.23

A decline in Postoperative Adaptation Questionnaire (PAQ) scores suggested that 345 (34%) of patients had postoperative adaptation issues. These patients showed noticeably more mood swings and irritation (p<0.001). At six months, 304 (30%) of patients reported sleep difficulties, as judged by the Sleep Quality Index (SQI), compared to 65% before surgery (p<0.01) (Table 4).

Table 4: Postoperative Adaptation Issues

Parameters	Preoperative	6 Months Post-operative	p-value	95% CI
Adaptation Issues	-	345 (34%)	<0.001	0.30 to 0.45
Mood Swings/ Irritation	-	Increased	<0.001	0.50 to 0.60
Sleep Difficulties	659 (65%)	304 (30%)	<0.01	-0.25 to -0.15

DISCUSSION

The objectives of this study included the evaluation of the bariatric surgery candidates and post-surgical mood disorders, irritability, and postoperative adaptation over six months on a psychological, hormonal, and nutritional level. Our results show alterations in mood and temper, which were at their worst at the three months following surgery and were relatively better at the six months. These changes are associated with a lower level of ghrelin and serotonin, and low levels of vitamin B12 and D remain low even many years postoperatively. Furthermore, only one-third of the patients responded that they did not have troubles with

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adaptation after surgery, and 304 (30%) reported persistent sleep disturbances. The results of this study, therefore, emphasize the importance of holistic care once the surgery is done. Our findings align with several previous studies, though with some differences in the magnitude and timing of changes.These changes of mood disturbances were described in bariatric patients by Loh *et al.*, where 45 % of the patients had depressive symptoms and 58 % had anxiety symptoms before the surgery and changes which seem to increase in the first 3 months of the surgery, as it is seen in this study [24]. Ivezaj *et al.*, also identified greater mood lability at three months after surgery, 13.1% of patients complained of irritability and depressive feelings.However, they noted that the resolution of these symptoms was slower, with 13 patients affected at 12 months in this study; only 44% of the patients still reported irritability at discharge at six months [25]. The changes in irritability and mood swings observed in bariatric surgery patients shortly after the surgery may be hormonal, nutritional, and psychosocial. One of the factors that aggravate such early mood disturbances is the hormonal change that follows surgery.Bariatric surgery results in a significant change in gut hormones, more specifically ghrelin, which is reported to fall swiftly after the operation. Ghrelin, which is also termed as the "hunger hormone", has some function in hunger as well as in the mood [26].Hormonal fluctuation has been reported to affect brain reward and emotional centers, hence reducing or increasing irritability and poor emotional control [27]. In addition, serotonin, which plays a role in mood regulation, also decreases after surgery, making irritability and depressive-like symptoms worse [28].Some of the changes also include the effects of nutritional deficiency, such as vitamin B12 and vitamin D deficiencies, which are usual after bariatric procedures, and worsen mood swings. These deficiencies may negatively affect the nervous system, which causes symptoms such as irritability, confusion, and fatigue [29].Other aspects of the lifestyle change are expressed in psychosocial areas requiring interests, higher levels of stress, and changes in the parameters of the body, causing postoperative irritability [30].Chronologically, these hormonal changes are balanced, nutritional deficiencies assuming a new diet, psychosocial adaptation is enhanced, and there is a decrease in mood disorders by six months after the surgery [31]. Therefore, the early postoperative period is a state of various physiological and psychological changes with relative amelioration of the process in the subsequent days after surgery.The hormonal changes documented by Hamad *et al.*, included a decrease in serotonin to an average of 54% of the preoperative levels, with a range of 36%–80% of the baseline value [32]. For that reason, Pasi *et al.*, ascertained that 24.7% of persons who have undergone bariatric surgery experienced a decrease in serotonin levels, which are associated with increased irritability and mood swings, similar to our findings [33]. Our study observed that the percentage of patients who were deficient in vitamin B12 was 34% and those who were deficient in vitamin D was 58% at six months.These findings concur with those of Çalapkorur and Küçükkatirci, who reported that, among the bariatric surgery patients, 24.7% saw their levels of serotonin drop, which the authors attributed to increased irritability and mood swings, exactly as documented in this study [34]. Song and Fernstrom also observed that these vitamins were claimed to show some deficiency that is coupled with symptoms related to psychological side effects, such as irritation and depression [35]. In the present paper, we noted that 34% of patients experienced some problems with postoperative adjustment and reported more pronounced oscillations of mood and increased irritability. This is supported by Dalrymple *et al.*, who observed that only 30% of bariatric patients had difficulties with emotional and psychological adjustment after the surgery. These difficulties were more pronounced in our poor sleep quality post-operative patients, who had 75% of them complaining of sleep disturbances at one-year follow-up, similar to our study, where 28% of the patients complained of sleep problems at six months follow-up [36]. Similarly, Lodewijks *et al.*, also found that self-reported Sleep problems were still present in 30% of patients after six months of bariatric surgery and pointed out the probability of endocrine hormonal changes together with behavioural and lifestyle alterations [37]. Our assessment of sleep quality indicated that poor sleep quality changed from 65% before surgery to 30% at the six-month follow-up. By the above observation, Ab *et al.*, reported that the patient had shown a 32% increase in sleep quality after surgery [38]. In a study by Sillo et al., they showed that 88.5% of bariatric patients had considerable clinical amendments in sleep apnea and other sleep disorders following weight loss, which is in agreement with our result of enhanced sleep quality; however, it also reveals that several patients continue to have some residual periods of sleep problem even after surgery [39].

CONCLUSIONS

The research found significant psychological and physiological changes after bariatric surgery. Mood disturbance and irritability status were increased at 3 months (83% and 89%, $p<0.001$), and then improved by 6 months (35% and 44%, $p<0.001$). Vitamins B12 and D deficiencies remained prevalent in 34% and 58% of patients throughout the 6-month follow-up, associated with increased irritability and mood issues ($p<0.003$). Ghrelin and serotonin levels dropped significantly after surgery, contributing to mood changes ($p<0.001$). Furthermore, Postoperative adaptation difficulties were observed in 34% of patients (PAQ), and sleep difficulties significantly reduced from 65% preoperatively to 30% at 6 months($p<0.01$).

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Authors Contribution

Conceptualization: MA[1]
Methodology: MA[1], MA[2], WA
Formal analysis: MA[2], WA
Writing review and editing: MA[1], MNDK, AHS
All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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