

# MICRONUTRIENT DEFICIENCIES IN THE PRE-BARIATRIC SURGERY

*Deficiências de micronutrientes no pré-operatório de cirurgia bariátrica*

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**ABSTRACT – Introduction:** Data already demonstrated the increased prevalence of obesity in various segments of the population. In this context, bariatric surgery is accepted nowadays as the most effective tool in the treatment and control of morbid obesity. Several studies have evaluated the nutritional status after bariatric surgery, especially mixed by detecting a reduction in food intake of protein, vitamins and minerals. However, other studies have investigated the presence of nutritional deficiencies prior to surgery, which may be aggravated by the surgical procedure, resulting in serious postoperative complications.

**Aim:** To analyze the literature in relationship to micronutrient deficiencies in obese patients before bariatric surgery. **Method:** Was carried out a systematic review in several electronic databases, such as PubMed/ Medline, Scielo, Lilacs and Bireme. The following keywords were used alone or in combination: bariatric surgery, obesity, preoperative, gastric bypass, vitamin deficiencies, deficiencies and mineral nutrient absorption. Were included 40 review and original articles published between 2005 to 2012. **Results:** There were consensus on the combination of preoperative nutritional deficiencies, restrictions and malabsorption, possibly induced by bariatric surgery that can lead patients to experience significant nutritional deficits during the late postoperative period, especially of micronutrients, resulting in serious complications. **Conclusions:** The high occurrence of micronutrient deficiencies preoperatively detected in morbidly obese candidates for bariatric surgery, plus a malabsorptive procedure, may involve worse prognosis during the late postoperative period. Preoperative evaluation of nutritional parameters and food intake is recommended in conjunction with surgical interventions.

**HEADINGS** - Bariatric surgery. Obesity. Nutritional deficiencies. Preoperative. Micronutrient.

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**DESCRITORES** - Cirurgia bariátrica. Obesidade. Deficiências nutricionais. Pré-operatório. Micronutrientes.

**RESUMO – Introdução:** Achados epidemiológicos têm demonstrado o aumento da prevalência de obesidade em diversos segmentos da população mundial. Neste contexto, a cirurgia bariátrica é aceita, atualmente, como a ferramenta mais eficaz no tratamento e controle da obesidade mórbida. Vários estudos vêm avaliando o estado nutricional após operações bariátricas, principalmente as mistas, detectando redução no consumo alimentar de proteínas, vitaminas e minerais. No entanto, outros investigam a presença de deficiências nutricionais antes da realização da operação, que podem ser agravadas com o procedimento cirúrgico, resultando em complicações pós-operatórias graves. **Objetivo:** Analisar a literatura para as deficiências de micronutrientes em pacientes obesos antes da cirurgia bariátrica. **Método:** Realizou-se revisão sistemática em bases eletrônicas, a saber: PubMed/ Medline, Scielo, Lilacs e Bireme. As seguintes palavras-chave foram utilizadas individualmente ou em associação: bariatric surgery, obesity, preoperative, gastric bypass, vitamin deficiencies, mineral deficiencies and absorption nutrient. Foram incluídos 40 artigos de revisão e originais, publicados entre 2005 a 2012. **Resultados:** Encontrou-se como consenso o fato de que a combinação de deficiências nutricionais no pré-operatório, as restrições e má absorção induzidas pela cirurgia bariátrica podem levar a importante déficits nutricionais durante o período pós-operatório tardio, principalmente de micronutrientes, resultando em complicações graves. **Conclusão:** A alta ocorrência de deficiência de micronutrientes no pré-operatório detectada em obesos mórbidos candidatos à cirurgia bariátrica, somado a um processo disabsortivo, pode envolver pior prognóstico durante o período pós-operatório tardio. Avaliação pré-operatória dos parâmetros nutricionais e da ingestão de alimentos é recomendado em conjunto com as intervenções.

## INTRODUCTION

Epidemiological findings have shown increased prevalence of obesity in various segments of the world population, which is considered by the World Health Organization as a global epidemic of the XXI century<sup>25</sup>.

The complications of excess weight include type-2 diabetes mellitus, hypercholesterolemia, hypertension, cardiovascular disease, sleep apnea, psychosocial problems, orthopedic diseases and several types of cancer<sup>12</sup>. The reduction of excess weight in morbid obese patients provides positive effects on the metabolism of lipids and carbohydrates with decreased insulin resistance, and in many cases control of diabetes and hyperlipidemia<sup>18</sup>.

Since obesity is a chronic disease of multifactorial cause, its treatment involves several approaches: nutritional, pharmacological and increased physical activity<sup>5</sup>. However, many patients do not respond to these therapeutic approaches, requiring more effective intervention. In this context, bariatric surgery is accepted today as the most effective tool in the treatment and control of morbid obesity<sup>24</sup>. Among the main benefits of this intervention, loss and weight maintenance in the long term and improvement or control of associated diseases stand out, with consequent improvement in the quality of life<sup>4</sup>.

The criteria for bariatric surgery endorsed by the International Federation for Obesity Surgery and by the Brazilian Society for Bariatric Surgery include patients with obesity of large proportions, lasting more than two years with body mass index (BMI) greater than 40 kg/m<sup>2</sup>, resistant to conservative treatments (diet, exercise, medication, psychotherapy), being also indicated for obese patients with BMI greater than 35 kg/m<sup>2</sup> carriers of comorbidities such as diabetes mellitus, hypertension, apnea sleep, arthropathy and herniated discs that have medical condition aggravated by obesity<sup>3</sup>.

Different technical modalities have been employed in the surgical treatment such as restrictive techniques that promote early satiety by decreasing the stomach volume capacity, disabsorptive techniques that modify the intestinal anatomy to reduce its surface and combined techniques. Roux-en-Y gastric bypass is considered the "gold standard" and became the procedure most widely performed in the treatment of morbid obesity<sup>10</sup>.

Several studies have assessed the nutritional status after bariatric operations, especially combined ones, detecting reduction in the dietary intake of proteins, vitamins (A, D, B1, B6, folic acid) and minerals (calcium, iron, zinc, copper and magnesium), and nutrient intake often less than 50% the nutritional needs<sup>29,23,28</sup>. Diseases such as protein

malnutrition and anemia, among others, frequently occur and can be explained by the difficulty of digestion, by the reduced gastric acid secretion and pepsin, and by the fact that the site of absorption of various minerals and vitamins were excluded from the gastrointestinal tract (duodenum and proximal jejunum). The most common deficiencies can lead to secondary diseases<sup>14</sup>.

However, other studies have investigated the presence of nutritional deficiencies prior to surgery, which may be aggravated by the surgical procedure, resulting in more serious postoperative complications.

Thus, the aim of this study was to make a literature review focusing on micronutrient deficiencies in obese patients before bariatric surgery.

## METHOD

A systematic review in several electronic databases such as PubMed/ Medline, Scielo, Lilacs and Bireme was carried out. The following keywords were used alone or in combination: bariatric surgery, obesity, preoperative, gastric bypass, vitamin deficiencies, mineral deficiencies and nutrient absorption. Thirty review and original articles published between 2005 and 2012 were included.

### Causes of nutritional deficiencies in obesity

The existence of nutritional deficiencies in overweight and obese individuals may seem paradoxical due to excessive caloric intake; however, the prevalence of several micronutrient deficiencies seems to be higher in overweight adults and children and obese individuals<sup>15</sup>. The causes are multifactorial and include reducing the consumption of fruits and vegetables, increased intake of foods of high caloric value and low nutritional quality as well as increased adiposity, which may influence the storage and availability of some nutrients, such as water-soluble vitamins and antioxidants<sup>11</sup>.

This reality is the same found in candidates for bariatric surgery, in which nutrient deficiencies are common in this population. In fact, it has been concluded that the nutritional status of candidates for bariatric surgery is often unbalanced and poorly diversified, mainly of vitamins and minerals<sup>19</sup>.

The nutrition of obese children and adults in the United States is poor of nutrient-rich foods (fruits, vegetables, dairy products, whole grains, nuts, legumes, fish and various protein sources) that contribute for the intake of most vitamins and minerals from non-supplemented diet<sup>16</sup>. They have the habit of eating high-fat diets (>30% of total caloric intake), which are associated with decreased vitamins A, C and folate<sup>13</sup>. The increased consumption

of sugary drinks is also associated with lower intake of milk and therefore calcium and vitamin D<sub>3</sub><sup>17</sup>. In the case of vitamin D<sub>3</sub>, risk factors for its deficiency may include reduced physical activity, leading to decreased sun exposure, increased storage of adipose tissue, ethnicity and skin color<sup>27</sup>.

As the obesity epidemic remains unchanged and the popularity of bariatric surgery intensely increases among obese adults and adolescents, the medical staff must be aware of pre-existing nutritional deficiencies in overweight and obese patients and know how to recognize and treat them adequately<sup>21</sup>.

### Preoperative micronutrient deficiency

Nutritional deficiencies represent recognized complication of bariatric surgery. One of them, both in restrictive and disabsorptive operations, is thiamine deficiency, occurring more often after Roux-en-Y gastric bypass surgery. However, there are current reports that this deficiency would come from the pre-operative period, since patients have high intake of carbohydrates derived from refined sugars and white rice and fats and oils that are not source of this mineral. Therefore, Carrodeguas et al.<sup>2</sup> investigated the degree of thiamine deficiency in obese patients before bariatric surgery through medical records, including 303 patients. Forty-seven (15.5%) had low preoperative thiamine levels, which was more prevalent in women.

The combination of preoperative nutritional deficiencies, restrictions and malabsorption, possibly induced by bariatric surgery, can lead patients to experience significant nutritional deficits during the late postoperative period, especially of micronutrients. In this context, Flancbaum et al.<sup>9</sup> retrospectively analyzed the preoperative serum calcium, albumin, 25-OH vitamin D, iron, ferritin, hemoglobin, vitamin B<sub>12</sub> and thiamine values of 379 consecutive patients (320 women and 59 men, with mean body mass index of  $51.8 \pm 10.6$  kg/m<sup>2</sup>). Deficiencies in iron (43.9%), ferritin (8.4%), hemoglobin (22% in women and 19.1% men), thiamine (29%), and 25-OH vitamin D (68.1%) were observed. Low ferritin levels were more prevalent in women; however, anemia was more prevalent in men.

With the aim of increasing evidence that obese individuals have poor micronutrient status, Ernst et al.<sup>7</sup> assessed 232 patients with morbid obesity (BMI  $\geq 35$  kg/m<sup>2</sup>) before bariatric surgery through biochemical albumin, calcium, phosphate, magnesium, ferritin, hemoglobin, zinc, folic acid, vitamin B<sub>12</sub>, 25-OH vitamin D<sub>3</sub> and intact parathyroid hormone, and a sub-sample of 89 individuals additionally evaluated with copper, selenium, vitamin B<sub>1</sub>, B<sub>3</sub>, B<sub>6</sub>, A and E and the results indicated a high prevalence of micronutrient

deficiencies in patients with morbid obesity, with 36.6% of secondary hyperparathyroidism followed by severe deficiency of 25-OH vitamin D<sub>3</sub> in 25.4% of patients, 32.6% for selenium, 24.6% for zinc and 18.1% for vitamin B<sub>12</sub>.

With the purpose of evaluating nutritional deficiencies in morbid obesity, Schweiger et al.<sup>22</sup> collected blood samples from 114 patients (83 women and 31 men) for biochemical and hematological analyses (albumin, iron, ferritin, vitamin B<sub>12</sub>, folic acid, parathyroid hormone, calcium, phosphorus, hemoglobin and mean corpuscular volume). The prevalence of preoperative nutritional deficiencies was 35% for iron, 24% for folic acid, 24% for ferritin, 3.6% for vitamin B<sub>12</sub>, 2% for phosphorous and 0.9% for calcium. Hemoglobin levels and mean corpuscular volume were low (19%). High parathyroid hormone levels were found in 39% of patients. Hypoalbuminemia was not found. Iron deficiency and ferritin levels were more common in women. Men had higher prevalence of anemia. Patients with BMI  $> 50$  kg/m<sup>2</sup> were at increased risk of folic acid deficiency. Those of higher per capita incomes were less likely to have iron deficiency.

Also with the aim of describing the micronutrient status in obese women before bariatric surgery at a university hospital, De Luis et al.<sup>6</sup> analyzed a consecutive series of 115 women referred for evaluation, measuring their weight, height, BMI and waist circumference. Baseline hemoglobin, albumin, pre-albumin, ferritin, copper, zinc, calcium, phosphorus, parathyroid hormone and vitamins A, D, E, K, B<sub>12</sub> and folic acid were measured. Women with morbid obesity who sought operation showed high prevalence of micronutrient deficiency, with 73.9% of zinc, 71.3% of vitamin D, 67.8% of copper, 25.2% of folic acid and 21.7% of prealbumin.

Nicolletti et al.<sup>20</sup> characterized the dietary, anthropometric and biochemical profile of adults candidates for bariatric surgery in a university hospital through a retrospective study with 80 patients. The daily energy consumption reported before surgery was  $1981 \pm 882$  kcal, with  $48 \pm 11\%$  of carbohydrates,  $29 \pm 8\%$  of lipids and  $23 \pm 8\%$  of protein. The occurrence of nutritional deficiency was high for magnesium (19%), vitamin A (15%), vitamin C (16%), iron (9%),  $\beta$ -carotene (3%), and vitamin B<sub>12</sub> (3%). The presence of these deficiencies represented poor prognosis during the postoperative period by the disabsorptive process.

Valentino, Sriram and Shankar<sup>26</sup> made a literature review in order to analyze the perioperative strategies to detect, prevent and treat micronutrient deficiencies in patients undergoing bariatric surgery, and highlighted practical and clinical aspects of these nutritional problems. They confirmed frequent micronutrient deficiency in obese patients undergoing surgery both pre and

postoperatively, and that bariatric procedures with malabsorptive component are more likely to result in micronutrient deficiencies.

Regarding treatment, the approach based on a systematic teamwork facilitates confirmation of the clinical suspicion of specific or combined nutrient deficiency by appropriate laboratory tests that are not always requested in the preoperative routine.

## CONCLUSION

The high occurrence of preoperative micronutrient deficiency detected in morbid obese candidates for bariatric surgery added to a malabsorptive procedure may involve poor prognosis during the late postoperative period. Assessing nutritional parameters and food intake is recommended in the preoperative routine of morbid obese patients.

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