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REVIEW ARTICLE

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Major clinical and nutrological findings of the relationship among obesity, metabolic syndrome, and bariatric surgery in the process of hair loss: a systematic review

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Abstract

Introduction: According to the World Obesity Atlas, overweight and obesity will affect nearly 3 billion adults (around 50%) by 2030. Bariatric surgery is an effective option for the treatment of obesity. However, nutritional deficiencies of vitamins, minerals, and trace elements can occur after bariatric surgery and are associated with hair loss (alopecia). **Objective:** It was to present the main clinical studies and meta-analyses on the relationship between obesity, metabolic syndrome, and bariatric surgery in the process of hair loss (alopecia). **Methods:** The PRISMA guidelines for systematic reviews were followed. Clinical studies and meta-analyses were included. The literature search process was conducted from July to August 2025 and developed based on Web of Science, Scopus, Embase, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods up to the present day. **Results and Conclusion:** Seven studies with 9,940 participants were selected to comprise this systematic review. According to the GRADE instrument, most studies showed homogeneity in their results, with X^2=92.7%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 20 studies with a high risk of bias and 24 studies that did not meet the GRADE and AMSTAR-2 criteria. It was concluded that hair loss related to obesity and post-bariatric surgery hair loss can have a significant impact on individuals, including emotional distress that should not be underestimated. Further investigation is needed on the relationship between obesity/bariatric surgery and hair loss. Laparoscopic vertical sleeve gastrectomy alters the serum amino acid profile in obese patients, and the serum leucine concentration at 3 months post-operatively is an influential factor in post-operative alopecia. Hair loss is a frequent condition after vertical sleeve gastrectomy. In most cases, iron and zinc levels are within the normal range. The variable composed of the sum of zinc and iron is a good predictor of hair loss.

Keywords: Obesity. Bariatric surgery. Metabolic syndrome. Alopecia. Hair loss.

Introduction

According to the World Obesity Atlas, overweight and obesity will affect nearly 3 billion adults (around 50%) by 2030 **[1]**. There are also worrying increases in the number of adults with obesity who are likely to need medical intervention during their lifetime, with serious implications for health systems. Obesity is a disease and one of the main drivers of NCDs, including some types of cancer, heart disease, alopecia, stroke, and type II diabetes **[1-3]**.

In this context, bariatric surgery is an effective

option for the treatment of obesity. Despite high caloric intake, the poor eating habits of people with obesity result in deficiencies in various vitamins, minerals, and trace elements essential for body metabolism and normal physiological processes. Furthermore, current bariatric surgical approaches, such as vertical sleeve gastrectomy (VSG), Roux-en-Y gastric bypass (RYGB), laparoscopic adjustable gastric banding (LAGB), and jejunoileal bypass (JIB), can cause or exacerbate these deficiencies. As examples, LAGB and VSG affect the absorption of iron, selenium, and vitamin B12, while RYGB, JIB, and biliopancreatic diversion can impact the absorption of essential vitamins, minerals, and trace elements. Nutritional deficiencies of vitamins, minerals, and trace elements can occur after bariatric surgery and are associated with clinical manifestations and diseases, such as alopecia, anemia, and ataxia **[4,5]**.

In addition, people with obesity may experience skin and hair problems **[6,7]**. The authors have published that obesity can accelerate hair thinning, impacting stem cells located in hair follicles. It has also been described that metabolic syndrome is more prevalent in patients with androgenetic alopecia compared to the control group **[8,9]**. In this sense, one of the notable repercussions of bariatric surgery on hair health is the development of telogen effluvium **[10]**. Telogen effluvium is a type of non-scarring alopecia. This condition is characterized by increased hair loss and thinning **[11]**. Individuals undergoing bariatric surgery frequently experience temporary hair loss, attributed to the stress of surgery, rapid weight loss, and nutritional deficiencies **[12]**.

Therefore, this systematic review study presented the main clinical studies and meta-analyses on the relationship between obesity, metabolic syndrome, and bariatric surgery in the process of hair loss (alopecia).

Methods

Study Design

This study followed an international model for systematic review, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. Accessed on: 08/21/2025. The methodological quality standards of AMSTAR-2 (Assessing the methodological quality of systematic reviews) were also followed. Available at: https://amstar.ca/. Accessed on: 08/21/2025.

Research Strategy and Sources

The literature search process was conducted from July to August 2025 and developed based on Web of Science, Scopus, Embase, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The following descriptors were used (DeCS / MeSH Terms): "Obesity. Bariatric surgery. Metabolic syndrome. Alopecia. Hair loss", and using the Boolean operator "and" between MeSH terms and "or" between historical findings.

Study Quality and Risk of Bias

Quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident highlight was for systematic review articles or meta-analyses of randomized clinical trials, followed by randomized clinical trials. Low-quality evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument through the analysis of the Funnel Plot (Sample size versus Effect size), using Cohen's d test.

Results and Discussion

Summary of Findings

A total of 72 articles were submitted to eligibility analysis, with 7 final studies selected, involving 9,940 participants. The selected studies presented medium to high quality (Figure 1), considering the level of scientific evidence of studies such as meta-analyses, consensus studies, randomized clinical trials, and prospective and observational studies. Biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies showed homogeneity in their results, with X^2=92.7%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 5 studies with a high risk of bias and 24 studies that did not meet the GRADE and AMSTAR-2 criteria.

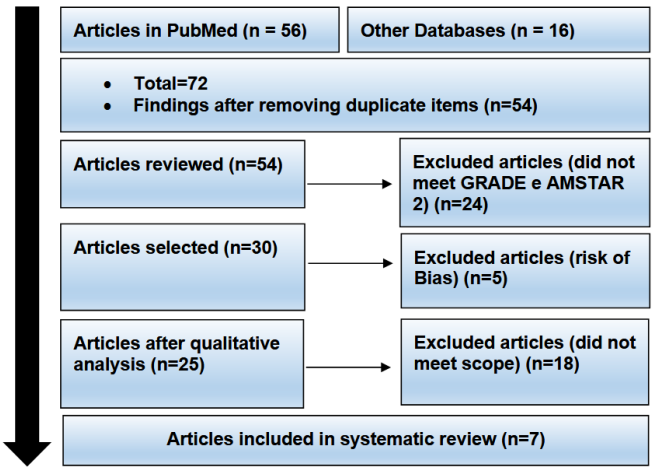

Figure 1. Selection of articles. Source: Own authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). The precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, both between studies with small sample sizes (lower precision) that are shown at the bottom of the graph and in studies with large sample sizes that are presented in the upper region.

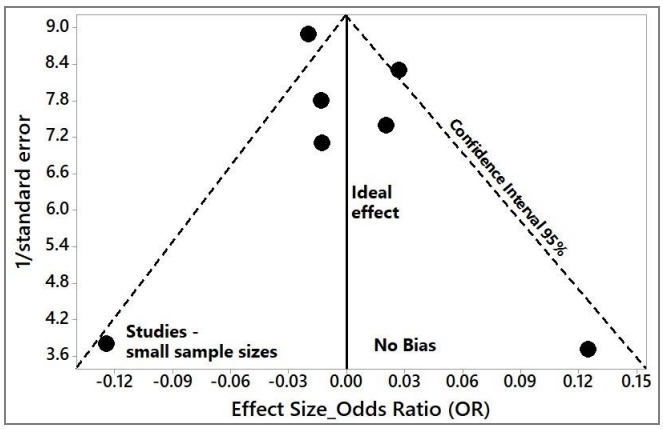

Figure 2. The symmetrical funnel plot does not suggest a risk of bias between the small sample size studies that are shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph. N= 7 studies. Source: Own authorship.

Major Clinical Findings

The authors Wang et al. (2025) **[13]** conducted a prospective cohort study to investigate the association between changes in serum amino acids and alopecia in obese patients before and after bariatric surgery. Obese patients underwent laparoscopic sleeve gastrectomy (LSG), categorized into non-mild alopecia groups (NM group, n=24) and moderate to severe alopecia groups (SA group, n=43). Among the 67 patients analyzed, LSG significantly decreased serum concentrations of arginine, alanine, threonine, glutamic acid, branched-chain amino acids (valine, isoleucine, leucine), and aromatic amino acids (tyrosine, phenylalanine, tryptophan) ($p < 0.05$), while serine and glycine increased ($p<0.05$). At 3 months post-surgery, leucine levels were higher in the MS group compared to the NM group. Threonine, γ-aminobutyric acid, and leucine levels were associated with the severity of alopecia ($p<0.05$). Logistic regression identified serum leucine as a risk factor for postoperative alopecia (OR=1.119, 95% CI 1.006-1.245, p=0.038).

The authors Zhang et al. (2021) **[14]** conducted a systematic review and meta-analysis on hair loss after bariatric surgery. A total of 18 studies (n = 2538) were included. The pooled results showed that the incidence of hair loss after bariatric surgery was 57% (95% CI 42-71%). This incidence decreased with increasing follow-up time. Hair loss was significantly more common in younger women (mean difference (MD), -2.45; 95% CI, -4.26 to -0.64; p = 0.008) and in females (OR, 3.87; 95% CI, 0.59 to 17.59; p = 0.08). Serum levels of zinc (standardized mean difference (SMD), -1.13; 95% CI, -2.27 to 0.01, p = 0.05), folic acid (SMD = -0.88, 95% CI -1.29 to -0.46, p < 0.0001) and ferritin (SMD, -0.22; 95% CI, -0.38 to -0.05; p = 0.01), but not serum levels of iron and vitamin B12, were associated with hair loss after bariatric surgery.

In addition, a recent meta-analysis conducted by the authors Taghizadeh et al. (2025) **[15]** analyzed the rate of hair loss after bariatric and metabolic surgery. 41 articles with 7044 patients were included. The results showed that the incidence of hair loss after bariatric and metabolic surgery was 47%. In addition, Roux-en-Y gastric bypass had a significantly higher rate of hair loss than vertical sleeve gastrectomy (OR=1.91). However, Roux-en-Y gastric bypass had a significantly lower rate of hair loss compared to duodenal switch (OR=0.41).

The authors Şen and Türkçapar (2021) **[10]** determined the incidence of hair loss in patients undergoing laparoscopic vertical sleeve gastrectomy (LSG) and observed whether the use of biotin has an impact on hair loss. 156 female patients who underwent LSG for the treatment of obesity were included and completed a 1-year follow-up. All patients with vitamin deficiency were screened in the pre- and postoperative period. Hair loss was observed in 72% of patients after LSG (n=112). Seventynine percent of patients reported hair loss between the third and fourth month after surgery, and the hair loss persisted for an average of 5.5 ± 2.6 months. Permanent alopecia was not observed in any of the patients. Patients who presented with hair loss and biotin deficiency after GVL were prescribed 1000 mcg/day of biotin for 3 months. Of these 22 patients, only 5 (23%) reported a significant reduction in hair loss. In addition, 29 patients self-initiated 1000 mcg/day of biotin for an average of 2.5 months after the onset of hair loss, despite blood biotin levels being within the normal range. Eleven (38%) of these patients reported a significant reduction in hair loss. The effect of biotin use on hair loss was compared between patients with and without biotin deficiency. There was no significant difference (p=0.2).

Furthermore, the authors Ruiz-Tovar et al. (2014) **[16]** conducted a prospective observational study with

42 morbidly obese women undergoing GVL. The incidence of hair loss was monitored. Micronutrient levels were investigated preoperatively and at three, six, and 12 months after surgery. Sixteen patients (41%) reported postoperative hair loss. A significant association was observed between hair loss and zinc levels (p=0.021), but mean zinc levels were within the normal range in patients who reported hair loss. Only three patients (7.7%) had low zinc levels, all of whom reported hair loss. There was also a significant association between iron levels and alopecia (p=0.017), but the mean values of patients with hair loss were within the normal range. Only four patients (10.2%) had low iron levels, all of whom had hair loss. A variable composed of the sum of zinc and iron levels showed a significant association with hair loss (p=0.013). All patients, except two, who reported hair loss had zinc and iron serum levels below 115. This variable had a sensitivity of 88%, specificity of 84%, positive predictive value of 79%, and negative predictive value of 91% for predicting hair loss.

Thus, patients with zinc and iron levels below 115 are four times more likely to experience hair loss. It is also noted that another prospective study evaluated the prevalence of hair loss after GVL. A total of 50 patients undergoing GVL were included and evaluated preoperatively and 6 months after surgery. Hair loss was observed in 56% of patients, with 46% in women and 10% in men. Analysis of variance indicated statistically significant differences for hair loss between the groups with and without hair loss in relation to preoperative zinc levels (p<0.001), postoperative zinc levels (p<0.001), preoperative vitamin B12 levels (p<0.001), postoperative vitamin B12 levels (p<0.001), postoperative folic acid levels (p=0.039) and postoperative use of supplements (p<0.001). Patients with hair loss had lower pre- and postoperative zinc levels compared to patients without hair loss (0.61 vs 0.81 mcg/mL) (0.46 vs 0.73 mcg/mL) and also lower pre- and postoperative vitamin B12 levels compared to patients without hair loss (243.04 vs 337.41 pg/mL) (261.54 vs 325.68 pg/mL). Interestingly, zinc levels were normal preoperatively and below normal postoperatively, and vitamin B12 levels were below normal preoperatively in patients with hair loss. Patients with hair loss had lower mean postoperative folic acid levels (8 ng/mL) **[17]**.

Finally, the authors Rojas et al. (2011) **[18]** assessed the nutritional status of zinc, iron, copper, selenium, and visceral proteins in women with different degrees of hair loss six months after gastric bypass surgery or vertical sleeve gastrectomy. Patients were categorized into two groups according to the degree of hair loss: group 1, with mild hair loss (n = 42), and group 2, with severe hair loss (n = 45). In both groups, there was a significant reduction in body weight six months after surgery (- 38.9% ± 16.4%). Patients in group 1 had a significantly higher intake of zinc (20.6 ± 8.1 vs. 17.1 ± 7.7 mg/day) and iron (39.7 ± 35.9 vs. 23.8 ± 21.3 mg/day), and less impairment of zinc and iron nutritional status than group 2. However, patients in group 2 had less impairment of copper nutritional status. Patients with less hair loss six months after surgery had higher zinc and iron intake and less impairment of their nutritional status for both minerals.

Limitations

Significant gaps remain in the research, including inconsistent methodologies, small sample sizes, and limited data on long-term effects, requiring more robust clinical trials. Individualized recommendations and cautious interpretation of results are essential, especially due to variability in results based on study designs and populations.

Conclusion

It was concluded that obesity-related hair loss and post-bariatric surgery hair loss can have a significant impact on individuals, including emotional distress that should not be underestimated. Further investigation into the relationship between obesity/bariatric surgery and hair loss is needed. Laparoscopic sleeve gastrectomy alters the serum amino acid profile in obese patients, and serum leucine concentration at 3 months post-surgery is an influential factor in postoperative alopecia. Hair loss is a frequent condition after sleeve gastrectomy. In most cases, iron and zinc levels are within the normal range. The composite variable of zinc and iron is a good predictor of hair loss.

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Daniella Bandim Cruz; **Supervision-** Daniella Bandim Cruz; **Writing - original draft-** Daniella Bandim Cruz, Leonardo Bandim Cruz, Guilherme da Conti Oliveira Sousa, Lucas Augusto Rodrigues de Oliveira, Laura Guerrera Figueiredo, Bruna de Castro Oliveira, Jessica Inojosa Aguiar; **Writing-review & editing-** Daniella Bandim Cruz, Leonardo Bandim Cruz, Guilherme da Conti Oliveira Sousa, Lucas Augusto Rodrigues de Oliveira, Laura Guerrera Figueiredo, Bruna de Castro Oliveira, Jessica Inojosa Aguiar.

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Not applicable.

Informed Consent

Not applicable.

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Data Sharing Statement

The data supporting the findings of this study are derived from previously published studies and publicly available datasets cited in the References section. No new experimental or human participant data were generated for this review. All referenced sources are accessible through the respective journals or public repositories.

Conflict of Interest

The authors declare no conflict of interest.

Similarity Check

It was applied by Ithenticate[@].

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

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