

Telogen Effluvium in Patients After Bariatric Surgery: A Scoping Review

Izabella Dias Muniz de Andrade ¹, Matheus Vitoretti ¹, Gabriella Catharino Caliman ¹, David de Freitas Mota ¹, Gabriel Thiago da Silva ¹, Ana Clara Warkentin Araújo Carneiro ², João Kleber de Almeida Gentile^{3,4,*}

¹ Faculty of Medicine, Centro Universitario São Camilo (CUSC), São Paulo, SP, Brazil.

² Faculty of Higher Education of Amazônia Reunida (FESAR), Redenção, PA, Brazil.

³ Brazilian College of Digestive Surgery, São Paulo, SP, Brazil.

⁴ Emilio Ribas Institute of Infectious Diseases (IIER), São Paulo, SP, Brazil.

* Correspondence: joaokleberg@gmail.com.

Abstract: Telogen Effluvium (TE) is excessive hair loss caused by the premature transition of follicles to the resting phase. After bariatric surgery, especially in women, hair loss is associated with nutrient deficiencies, although the exact cause is still uncertain. A structured review, following PRISMA-ScR, was conducted in July 2023 to evaluate the prevalence of telogen effluvium after bariatric surgery, using data from PubMed, BVS, and Scielo. After bariatric surgery, hair loss is linked to nutritional deficiencies (zinc, iron, proteins, vitamin B12, and folic acid) and rapid weight loss. The surgery affects nutrient absorption, making it essential to monitor and address the nutritional needs of patients. Hair loss after bariatric surgery is common, especially in women between the third and sixth months, due to nutritional deficiencies, stress, and restrictive diets. Supplementation with zinc, vitamins C and D, as well as medications, can help. The study highlights the relationship between vitamin deficiencies (such as zinc, iron, and vitamin B12) and telogen effluvium after bariatric surgery. However, it notes the need for more studies, including randomized research. This underscores the importance of monitoring and treating these deficiencies in post-bariatric surgery patients.

Keywords: Bariatric Surgery; Telogen Effluvium; Avitaminosis.

Citation: Andrade IDM, Vitoretti M, Caliman GC, Mota DF, Silva GT, Carneiro ACWA, Gentile JKA. Telogen Effluvium in Patients After Bariatric Surgery: A Scoping Review. Brazilian Journal of Clinical Medicine and Review. 2025;Jan- Dec; 03(1):bjcmr9.

<https://doi.org/10.52600/2763-583X.bjcmr.2025.3.1.bjcmr9>

Received: 18 May 2024

Accept: 25 June 2024

Published: 24 July 2024



Copyright: This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0).

1. Introduction

The term Telogen Effluvium (TE) was first introduced by Kligman in 1961 to differentiate it from normal excessive hair shedding in the telogen phase [1]. It is characterized by the premature transition of anagen hair follicles to the telogen phase, leading to diffuse and non-scarring hair loss [2]. It constitutes a common cause of alopecia, and various factors such as medications, trauma, emotional and physiological stress can contribute to the development of this hair cycle abnormality [3]. TE can manifest as acute or chronic hair loss, often accompanied by symptoms such as trichodynia, which presents as complaints of sensitivity, pain, burning, itching, or a stinging sensation, along with diffuse alopecia [3].

In 1993, Headington proposed that there are five functional types of TE, with three of these related to events in the anagen phase and two related to the telogen phase. Additionally, it can be histologically divided into inflammatory types, predominantly infectious (syphilis, dermatophytosis), and non-inflammatory types, resulting from various causes and mechanisms. However, they usually share a common histological finding, an increased number of follicles in the telogen phase [1]. Hair loss is notably related to al-

terations in the homeostasis of vitamins and minerals. In fact, micronutrients play an active role in the normal hair cycle, serving as enzymatic cofactors in highly active cells of the hair bulb, as well as acting as immunomodulators, anti-inflammatories, reducers, chelators, among other functions [4].

Reports of hair loss after bariatric surgery, such as alopecia or telogen effluvium, primarily occur in women and usually begin after the third postoperative month [5, 6, 7, 8, 9]. Despite deficiencies in some substances being described in the literature as influential in hair loss, there is no consensus on the primary causal element [10, 11]. Studies suggest that deficiencies of Selenium (Se), Iron (Fe), Vitamin D, and Vitamin C are directly associated with telogen-phase hair loss and are described as nutritional deficiencies post-bariatric surgery, implying a possible connection [4, 12-17].

Therefore, Telogen Effluvium after bariatric surgery has been the subject of investigation in various studies. However, the current literature lacks a definitive consensus on this topic. Findings to date have been variable and often contradictory, underscoring the complexity of this relationship. Given the absence of a comprehensive and coherent understanding, a scoping review serves as a valuable tool to consolidate available information, analyze different perspectives and approaches, and thus substantially contribute to the clarification of this important topic. Through a synthesis of existing evidence, it is hoped that this review can shed light on the possible causes, contributing factors, and underlying mechanisms of hair loss after bariatric surgery, providing essential concepts to guide future research and clinical approaches [10, 18].

2. Material and Methods

This review followed the Preferred Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) protocol for structuring. Two independent reviewers conducted a literature review following selection criteria for the studies. To provide a comprehensive perspective on the prevalence of telogen effluvium in postoperative bariatric surgery patients, we conducted a search on the PubMed, BVS, and Scielo search platforms in July 2023 to identify articles. In this search, we used MeSH terms and boolean operators (as summarized in Figure 1): telogen effluvium, hair loss, bariatric surgery.

- Inclusion criteria: cross-sectional studies; (controlled and non-controlled) randomized trials; cohort studies; case-control studies.
- Exclusion criteria: Unavailable articles; No clinical outcomes; non-related to telogen effluvium or hair loss; New studies involving human or animal participants; Systematic Reviews.

Data acquisition focused on the following details: participant characteristics, type of surgery performed, laboratory parameters, presence or absence of effluvium, treatment regimen, comparisons, and clinical outcomes related to the proposed treatment.

3. Results

3.1 Data compilation and summary

Data compilation and summary were carried out in a single stage, following recommended methodological procedures in the literature. A descriptive summary of each study was prepared, consisting of the following elements: author, year, and key findings (see Table 1). The Figure 2 summarizes the key findings from various studies on hair loss and nutritional deficiencies, particularly in the context of bariatric surgery.

Figure 1. Main Results Presented by the Studies Included in the Review in Chronological Order of Publication.

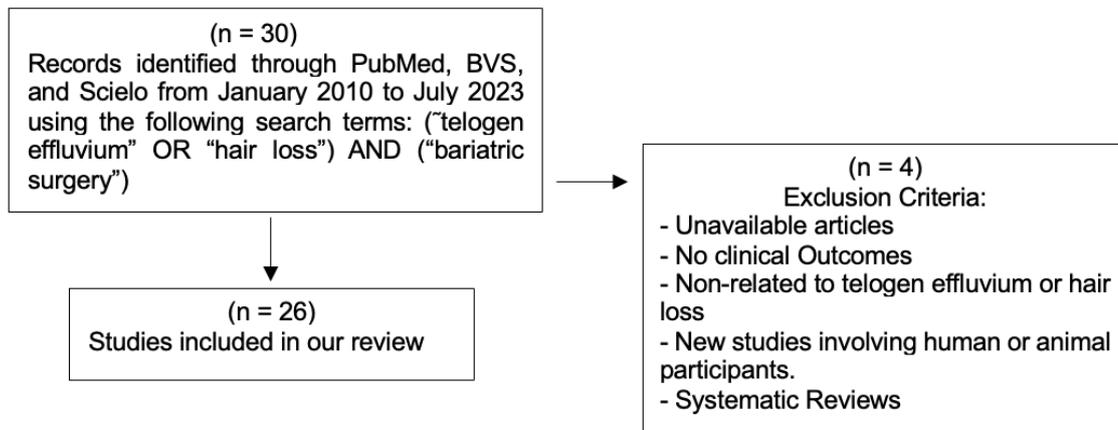


Table 1. Main Results Presented by the Studies Included in the Review in Chronological Order of Publication.

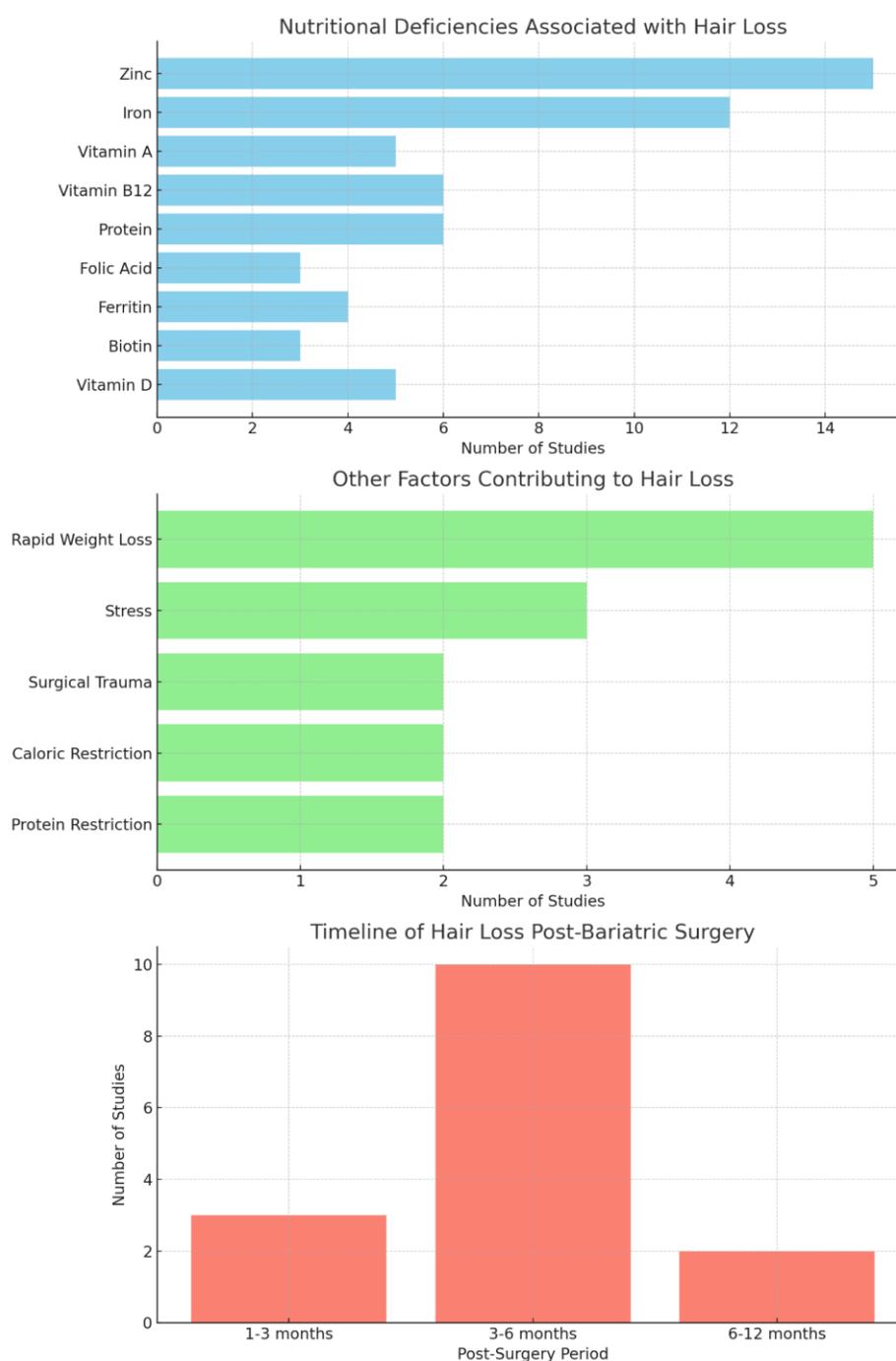
| Reference | Summary |
|-----------|---|
| [16] | <p>Urea, creatinine, uric acid, and pre-albumin levels were lower in individuals with hair loss, as well as ferritin and hemoglobin.</p> <p>Deficiencies in vitamin A and iron were significantly more common in individuals with hair loss.</p> <p>Caloric and protein restriction were associated with hair loss.</p> <p>No link was observed between vitamin B6 and hair loss.</p> |
| [5] | <p>Hair loss was observed in 72% of the patients and appears to be more pronounced between the third and fourth month.</p> <p>Hair loss persisted for an average of 5.5 ± 2.6 months.</p> <p>Laboratory tests revealed some patients with biotin deficiency or suboptimal levels.</p> <p>There was no statistically significant difference in the effect of biotin on hair loss.</p> |
| [18] | <p>Low levels of zinc, ferritin, and folic acid were associated with hair loss.</p> <p>There is a higher susceptibility to hair loss in young women.</p> <p>Inconclusive evidence regarding iron or vitamin B12 deficiency.</p> <p>Similar incidence between vertical gastrectomy and Roux-en-Y surgery.</p> <p>Suggested supplementation of 30 mg of zinc daily to prevent hair loss.</p> <p>Lower blood protein parameters in individuals with hair loss.</p> <p>Acute stress, such as surgical trauma and psychological stress, may inhibit hair growth.</p> |
| [19] | <p>Association of alopecia with nutritional deficiency and abrupt, massive weight loss.</p> <p>41% of post-bariatric surgery women developed alopecia associated with iron and zinc deficiency.</p> <p>Zinc supplementation as a potential solution to improve bariatric surgery-related alopecia.</p> <p>Significantly higher prevalence of alopecia in patients with successful weight loss.</p> |

| Reference | Summary |
|-----------|---|
| [12] | <p>Authors suggest supplementing vitamin D in patients with hair loss and vitamin D deficiency.</p> <p>There is no data to support the role of vitamin E.</p> <p>Supplementing iron has been suggested in patients with iron deficiency and/or low ferritin levels (below 40ng/dL).</p> <p>L-lysine supplementation is recommended for vegan individuals with iron deficiency.</p> <p>Studies correlating zinc, selenium, riboflavin, biotin, vitamin B12, or folate are not consistent, preventing any screening or supplementation recommendations.</p> <p>Hypervitaminosis A causes hair loss.</p> |
| [13] | <p>Worsening of vitamin B12 deficiency after one year of post-bariatric surgery follow-up due to decreased intrinsic factor production and the risk of inadequate intake due to the reduced stomach size after surgery.</p> <p>Supplementation with multivitamins containing vitamin B12 to maintain normal levels in patients after sleeve gastrectomy (SG).</p> <p>Conclusion that nutritional deficiencies are common in morbidly obese patients, both before and after bariatric surgery.</p> |
| [4] | <p>Low doses of vitamin C and D may improve telogen effluvium (TE).</p> <p>There is no data to prescribe zinc, riboflavin, folic acid, or vitamin B12.</p> <p>Vitamin E and biotin are not supported by the literature.</p> <p>Excess vitamin A can contribute to hair loss.</p> <p>TE has been reported in patients supplemented with selenium.</p> <p>Controversy surrounds the importance of iron deficiency in hair loss.</p> |
| [3] | <p>In the treatment of telogen effluvium, it is essential to identify and address the causal factors and use medications such as corticosteroids, minoxidil, and novel treatments like CNPDA (caffeine, niacinamide, panthenol, dimethicone, and an acrylate polymer).</p> |
| [20] | <p>A woman with obesity and polycystic ovary syndrome who underwent bariatric surgery developed hair loss characteristic of telogen effluvium seven weeks after the procedure.</p> <p>The patient's laboratory studies, including calcium, ferritin, folate, iron, and vitamins (A, B1, B6, B12, and 25-hydroxy vitamin D), did not reveal any abnormalities.</p> <p>After 11 months, the patient showed improvement in the rate and extent of hair loss, and her laboratory studies remained normal.</p> |
| [7] | <p>There was a trend of increasing reports of excessive hair loss from the 3rd month to the 6th month, which then decreased again between the 6th and 12th months ($p < 0.001$).</p> |
| [8] | <p>74.2% of the patients mentioned hair loss as the primary late complication.</p> |
| [9] | <p>After the surgery, patients more frequently experienced alopecia and vomiting.</p> |

| Reference | Summary |
|-----------|---|
| [21] | <p data-bbox="352 342 1262 371">Alopecia can be attributed to zinc deficiency, protein, or essential fatty acids.</p> <p data-bbox="352 416 1439 528">It has been suggested that the onset of alopecia may be due to zinc deficiency and protein malnutrition. However, there are reports that iron, selenium, and copper deficiency can also cause this phenomenon.</p> |
| [14] | <p data-bbox="352 573 1439 730">In the first year after biliopancreatic diversion with or without duodenal switch, there was a decrease in plasma levels of zinc, vitamins A, K, and D, which could suggest that the deficiency in fat-soluble vitamins was already present in most of them before the intervention.</p> <p data-bbox="352 745 1439 819">Deficiency in fat-soluble vitamins and zinc can quickly appear after this surgery. Hair loss regressed after supplementation with high doses of zinc sulfate.</p> |
| [15] | <p data-bbox="352 864 1439 938">Dry gastric fundus reduces the absorption of certain micronutrients, including iron, zinc, selenium, and vitamin B12.</p> <p data-bbox="352 954 1439 1028">Post-bariatric surgery zinc deficiency can lead to poor wound healing and promote hair loss.</p> <p data-bbox="352 1043 1302 1072">Sudden and excessive weight loss after bariatric surgery contributes to hair loss.</p> <p data-bbox="352 1088 1439 1149">The most common nutritional deficiency associated with hair loss is linked to iron and related proteins rather than zinc and B-complex vitamins.</p> |
| [2] | <p data-bbox="352 1193 1439 1312">The authors suggest that zinc deficiency manifests as progressive, diffuse, irregular, and non-scarring alopecia. Similarly, deficiency in essential fatty acids presents similar clinical findings.</p> <p data-bbox="352 1328 1439 1395">According to the authors, hair follicle matrix cells may be adversely affected by low iron levels.</p> |
| [11] | <p data-bbox="352 1440 1439 1514">It has been suggested that hair loss occurs due to rapid weight loss and deficiencies in nutrients such as zinc, iron, and other micronutrients.</p> <p data-bbox="352 1529 1439 1603">Restrictive diet and surgical oxidative stress can prematurely push hair into the telogen phase for about 3 months.</p> <p data-bbox="352 1619 1439 1693">Hair loss affected 56% of the patients, being more prevalent in women (46%) than in men (10%).</p> <p data-bbox="352 1709 1406 1738">Patients with hair loss had lower levels of zinc and vitamin B12 before and after surgery.</p> <p data-bbox="352 1753 1374 1783">Average postoperative folic acid levels were lower (8 ng/ml) in patients with hair loss.</p> |
| [16] | <p data-bbox="352 1821 1439 1939">The results indicate that the overall nutritional status does not worsen at 3 years or later after gastric bypass in patients who receive dietary recommendations and multivitamin supplements.</p> <p data-bbox="352 1955 1439 2022">Vitamin B12, vitamin D, and iron deficiencies were not adequately corrected by standard commercial multivitamin preparations.</p> |

| Reference | Summary |
|-----------|---|
| [22] | After Roux-en-Y surgery, there may be a reduced capacity and presence of proteins, leading to decreased zinc absorption. It is suggested that supplements are effective in most of the studied conditions. |
| [23] | Serum transferrin levels showed reduced values at 6 months. The higher prevalence of symptoms occurred at the 6th month: alopecia (19%), vomiting (18%), food intolerance (12.2%). |

Figure 2. Summary of findings of the studies.



4. Discussion

Hair loss after bariatric surgery is common, especially between the third- and sixth-months post-surgery, primarily affecting women. In this review, retrospective and prospective studies have shown that possible causes include nutritional deficiencies such as iron, zinc, selenium, proteins, fatty acids, and vitamin B12, as well as surgical stress (cortisol stress hormones reduce the synthesis and accelerate the shedding of important skin components), psychological factors, restrictive diets, and rapid weight loss [11]. Prospective study showed that post-bariatric surgery women developed hair loss related to iron and zinc deficiency, and that zinc supplementations could improve the condition [19]. Alopecia is not uncommon after bariatric surgery. It was observed after the following procedures: laparoscopic adjustable gastric band, laparoscopic sleeve gastrectomy, roux-em-Y gastric bypass and vertical band gastroplasty [20].

The literature demonstrates difficulty in separately evaluating the effect of various micronutrients on alopecia and, more specifically, on telogen effluvium. Patients' health conditions are multifactorial and complex, often involving one or more comorbidities that interact throughout the health-disease process. Bariatric surgery has a significant impact on the physiology of the digestive tract, altering the absorption of various nutrients partially or completely, necessitating a case-by-case assessment to identify the need for supplementation [2,15].

A literature review conducted by Almohanna et al. in non-bariatric patients suggested the use of low-dose vitamin C and D for those with deficiencies in these nutrients as a factor in improving hair loss [12]. A second review by Reborna A. suggested treatment with medications such as corticosteroids for specific conditions like SLE, minoxidil and finasteride for androgenetic alopecia, and new treatments like CNPDA as factors for improvement [4]. Laboratory evaluation may be helpful in excluding other causes of hair loss in women after bariatric surgery. Preliminary studies may include complete blood count, comprehensive serum chemistry, dehydroepiandrosterone sulfate, ferritin, follicle-stimulating hormone, iron, luteinizing hormone, testosterone (free and total), thyroid panel (free triiodothyronine, free thyroxine and thyroid stimulating hormone), total iron binding capacity and prolactin [20].

A meta-analysis in 2018 by Zhang W et al. found a strong relationship between post-bariatric zinc deficiency and telogen effluvium, recommending a daily 30mg zinc supplementation for hair loss prevention in surgical patients [18]. This recommendation was corroborated by Ruiz-Tovar J et al. with a lower dose of 12.5mg of daily zinc, as this author found zinc to be a common deficiency in a prospective study of 42 women who underwent LSG.

A prospective study published by Ledoux S et al. in 2020 suggested that iron and protein deficiencies are directly linked to hair loss, accompanied by zinc and vitamins, concluding that a balanced diet plays a critical role in preventing telogen effluvium [10]. It is worth noting that zinc levels showed a significant relationship with hair loss. The average was 72.1 ± 5.7 mg/dL in the hair loss group versus 88.7 ± 8 mg/dL in the group of patients who did not report hair loss ($p=0.021$). However, the normal range of serum zinc levels is between 70-114 mg/dL. Jaime Ruiz-Tovar et al. represented in their study that only three patients in the analyzed series (7.2%) had zinc levels below 70 mg/dL, and all of them had hair loss [24].

The same was observed with regard to iron, with a significant difference in iron levels between those patients who reported hair loss and those who did not (42.2 ± 5.7 mg/dL vs 91.8 ± 16.6 mg/dL; $p = 0.017$) [24].

This article has some limitations, including the lack of recent studies on telogen effluvium after bariatric surgery. Future research should aim to establish a clear causal relationship for this condition and develop more effective treatment protocols to adequately address affected patients. The mentioned studies present several potential biases that may affect the validity and generalizability of the results. Some of the notable potential biases include sample size limitations. Only one study [1] had a sample size

greater than 250 patients (550 patients), which may not be representative of the general population undergoing bariatric surgery, thereby limiting the generalizability of the results. Additionally, case studies, by definition, focus on a single patient or a very small number of patients, which may not reflect the experiences of a broader population.

Information regarding dietary intake, food intolerance, physical activities, and supplementation may be based on self-reports from the patients, introducing self-report bias. The accuracy of biochemical and diagnostic tests may vary depending on the laboratory or the technician performing the tests, introducing variability in the results. The observation of hair loss can also be subjective, potentially introducing confirmation bias, where researchers might be more inclined to confirm hair loss in patients who previously reported this condition, leading to an overestimation of the prevalence or severity of the issue.

Uncontrolled variables, such as the use of medications, other health conditions, and lifestyle changes that were not controlled or adjusted for in the study, may confound the results. Additionally, patients may be receiving other nutritional or medical interventions that were not considered in the study, affecting the outcomes. Differences in diagnostic evaluation and varying methods for assessing hair loss, such as hair wash tests, trichograms, and phototrichograms, can produce variable results, introducing inconsistencies in the data. Acknowledging these biases is crucial for interpreting the study results with caution and designing future research that minimizes these sources of error.

4. Conclusions

The evidence discussed in this study points to a clear relationship between vitamin deficiencies after bariatric surgery and telogen effluvium. Due to the complexity of the condition, a thorough nutritional assessment is recommended to identify specific nutritional deficiencies in each patient. Factors such as deficiencies of selenium, iron, vitamin D and vitamin C after bariatric surgery have been shown to contribute to telogen effluvium and supplementation of these micronutrients may be beneficial, however, there is variation in the recommended dosages. Therefore, it is essential to emphasize that the dosage recommendation should be made by a qualified physician or nutritionist, considering the individual needs of each patient. Diet also plays a crucial role in preventing telogen effluvium. Nutritional counseling allows for the development of a balanced eating plan that meets post-bariatric surgery nutritional needs and promotes hair health. Regular medical follow-up is essential to assess the effectiveness of nutritional and supplementation interventions, as well as to allow for the detection of other potential causes of telogen effluvium.

While the studies provide valuable insights into the effects and management of hair loss after bariatric surgery, it is essential to recognize the inherent biases and limitations present in the research. The limited number of studies published on this topic, sample size constraints, reliance on self-reported data, variability in diagnostic methods and the presence of uncontrolled variables all contribute to the potential for skewed or non-generalizable results. Understanding these biases underscores the need for caution in interpreting the findings and highlights the need for randomized studies to establish definitive causal relationships, the long-term effects of bariatric surgery on hair health and even more effective treatment protocols.

Funding: None.

Research Ethics Committee Approval: None.

Acknowledgments: None.

Conflicts of Interest: The authors declare no conflict of interest.

Supplementary Materials: None.

References

1. Headington JT. Telogen effluvium. New concepts and review. *Arch Dermatol*. 1993 Mar;129(3):356-363. doi: 10.1001/archderm.129.3.356.
2. Halawi A, Abiad F, Abbas O. Bariatric surgery and its effects on the skin and skin diseases. *Obes Surg*. 2013 Mar;23(3):408-413. doi: 10.1007/s11695-012-0859-x.
3. Asghar F, Shamim N, Farooque U, Sheikh H, Aqeel R. Telogen Effluvium: A Review of the Literature. *Cureus*. 2020 May;12(5). doi: 10.7759/cureus.8320.
4. Rebora A. Telogen effluvium: a comprehensive review. *Clin Cosmet Investig Dermatol*. 2019 Aug;12:583-590. doi: 10.2147/CCID.S200471.
5. Şen O, Türkçapar AG. Hair Loss After Sleeve Gastrectomy and Effect of Biotin Supplements. *J Laparoendosc Adv Surg Tech A*. 2021 Mar;31(3):296-300. doi: 10.1089/lap.2020.0468.
6. Braghetto I, Korn O, Burgos A, Figueroa M. When should be converted laparoscopic sleeve gastrectomy to laparoscopic Roux-en-Y gastric bypass due to gastroesophageal reflux? *ABCD, arq bras cir dig [Internet]*. 2020;33(4). doi: 10.1590/0102-672020200004e1553.
7. Sherf Dagan S, Keidar A, Raziell A, Sakran N, Goitein D, Shibolet O, Zelber-Sagi S. Do Bariatric Patients Follow Dietary and Lifestyle Recommendations during the First Postoperative Year? *Obes Surg*. 2017 Sep;27(9):2258-2271. doi: 10.1007/s11695-017-2633-6.
8. Barros LM, Frota NM, Moreira RA, de Araújo TM, Caetano JÁ. Evaluation of the results of bariatric surgery. *Rev Gaucha Enferm*. 2015 Mar;36(1):21-27. doi: 10.1590/1983-1447.2015.01.47694.
9. Silva PRB, Souza MR, Silva EM, Silva SA. Nutritional status and life quality in patients undergoing bariatric surgery. *ABCD, arq bras cir dig [Internet]*. 2014;27:35-38. doi: 10.1590/S0102-6720201400S100009.
10. Ledoux S, Flamant M, Calabrese D, Bogard C, Sami O, Coupaye M. What Are the Micronutrient Deficiencies Responsible for the Most Common Nutritional Symptoms After Bariatric Surgery? *Obes Surg*. 2020 May;30(5):1891-1897. doi: 10.1007/s11695-020-04412-8.
11. Katsogridaki G, Tzovaras G, Sioka E, Perivoliotis K, Zachari E, Magouliotis D, Tasiopoulou V, Chatedaki C, Zacharoulis D. Hair Loss After Laparoscopic Sleeve Gastrectomy. *Obes Surg*. 2018 Dec;28(12):3929-3934. doi: 10.1007/s11695-2018-3433-3.
12. Almohanna HM, Ahmed AA, Tsatalis JP, Tosti A. The Role of Vitamins and Minerals in Hair Loss: A Review. *Dermatol Ther (Heidelb)*. 2019 Mar;9(1):51-70. doi: 10.1007/s13555-018-0278-6.
13. Caron M, Hould FS, Lescelleur O, Marceau S, Lebel S, Julien F, Simard S, Biertho L. Long-term nutritional impact of sleeve gastrectomy. *Surg Obes Relat Dis*. 2017 Oct;13(10):1664-1673. doi: 10.1016/j.soard.2017.07.019.
14. Folope V, Coëffier M, Déchelotte P. Nutritional deficiencies associated with bariatric surgery. *Gastroenterol Clin Biol*. 2007 Apr;31(4):369-377. doi: 10.1016/S0399-8320(07)89395-X.
15. Gasmi A, Björklund G, Mujawdiya PK, Semenova Y, Peana M, Dosa A, Piscopo S, Gasmi Benahmed A, Costea DO. Micronutrients deficiencies in patients after bariatric surgery. *Eur J Nutr*. 2022 Feb;61(1):55-67. doi: 10.1007/s00394-021-02619-8.
16. Ledoux S, Calabrese D, Bogard C, Dupré T, Castel B, Msika S, Larger E, Coupaye M. Long-term evolution of nutritional deficiencies after gastric bypass: an assessment according to compliance to medical care. *Ann Surg*. 2014 Jun;259(6):1104-1110. doi: 10.1097/SLA.0000000000000249.
17. Lupoli R, Lembo E, Saldamacchia G, Avola CK, Angrisani L, Capaldo B. Bariatric surgery and long-term nutritional issues. *World J Diabetes*. 2017 Nov 15;8(11):464-474. doi: 10.4239/wjd.v8.i11.464.
18. Zhang W, Fan M, Wang C, Mahawar K, Parmar C, Chen W, Yang W, Global Bariatric Research Collaborative. Hair Loss After Metabolic and Bariatric Surgery: a Systematic Review and Meta-analysis. *Obes Surg*. 2021 Jun;31(6):2649-2659. doi: 10.1007/s11695-021-05311-2.
19. Itthipanichpong Y, Damkernsuntorn W, Tangkijngamvong N, Udomsawaengsup S, Boonchayaanant P, Kumtornrut C, Kerr SJ, Asawanonda P, Rerknimitr P. Skin manifestations after bariatric surgery. *BMC Dermatol*. 2020 Dec 9;20(1):21. doi: 10.1186/s12895-020-00120-z.
20. Cohen-Kurzrock RA, Cohen P. Bariatric Surgery-Induced Telogen Effluvium (Bar SITE): Case Report and a Review of Hair Loss Following Weight Loss Surgery. *Cureus*. 2021 Apr;13(4). doi: 10.7759/cureus.14617.
21. Dos Santos TD, Burgos MG, de Lemos Mda C, Cabral PC. Clinical and Nutritional Aspects in Obese Women During the First Year After Roux-en-Y Gastric Bypass. *Arq Bras Cir Dig*. 2015;28 Suppl 1(Suppl 1):56-60. doi: 10.1590/S0102-6720201500S100016.
22. Mahawar KK, Bhasker AG, Bindal V, Graham Y, Dudeja U, Lakdawala M, Small PK. Zinc Deficiency after Gastric Bypass for Morbid Obesity: a Systematic Review. *Obes Surg*. 2017 Feb;27(2):522-529. doi: 10.1007/s11695-016-2474-8.
23. Pedrosa IV, et al. Nutritional Aspects in Obese Patients Before and After Bariatric Surgery. *Rev Col Bras Cir*. 2009;36(4):316-322. doi: 10.1590/S0100-69912009000400008.
24. Ruíz-Tovar J, Oller I, Llaverro C, Zubiaga L, Diez M, Arroyo A, Calero A, Calpena R. Hair loss in females after sleeve gastrectomy: predictive value of serum zinc and iron levels. *Am Surg*. 2014 May;80(5):466-471.