REVIEW

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Risk factor of anemia post-bariatric surgery: a systematic review

Ni Putu Trisna Widyanthi[1*], Luh Seri Ani[2], Gede Eka Rusdi Antara[3]

[1]Master Program of Public Health Science, Faculty of Medicine, Universitas Udayana, Bali, Indonesia
[2]Department of Community and Preventive Medicine, Faculty of Medicine, Universitas Udayana, Bali, Indonesia
[3]Digestive Surgery Division, Surgery Department, Faculty of Medicine, Universitas Udayana Prof. I.G.N.G. Ngoerah General Hospital, Denpasar, Bali-Indonesia

*Corresponding to:
Ni Putu Trisna Widyanthi; Master Program of Public Health Science, Faculty of Medicine, Universitas Udayana, Bali, Indonesia;
trisnawidyanthipt@gmail.com

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ABSTRACT

Obesity continues to represent a significant global public health concern, and it acts as a risk factor for the development of several non-communicable diseases. Nowadays, bariatric surgery has emerged as the most effective and durable treatment for severe obesity, producing substantial and sustained weight loss as well as improvement in obesity related comorbidities. However, anemia was found to be a common long-term complication following bariatric surgery, which is mainly due to alterations in gastrointestinal anatomy that affect micronutrient absorption. Despite the increasing number of bariatric procedures worldwide, evidence on the specific determinants of post-bariatric anemia remains limited and fragmented. This systematic review aimed to identify risk factors for anemia after bariatric surgery. A literature search was conducted in Google Scholar, PubMed, and Elsevier following PRISMA guidelines. Cohort studies published between 2024 and 2026 involving adult patients undergoing Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy were included. Four studies met the eligibility criteria. The type of surgery was the most consistent factor associated with anemia, particularly malabsorptive procedures such as RYGB. Other factors reported as significantly associated with anemia in individual studies included older age, female sex, revision surgery, hypothyroidism, and inflammatory status. Anemia post-bariatric surgery is multifactorial and requires long-term monitoring and individualized nutritional management, especially in high-risk patients.

Keywords: bariatric surgery; anemia; risk factors; micronutrient deficiency.
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INTRODUCTION

Obesity continues to represent a significant global public health concern. Its prevalence has shown a consistent upward trend over the past decades. According to the World Health Organization (WHO), the prevalence of obesity among children and adolescents aged 5-19 years increased fourfold, rising from 2% in 1990 to 8% in 2022. Similarly, during the same period, the prevalence among adults aged 18 years and older increased from 7% to 16%. These trends highlight the escalating burden of obesity across all age groups and underscore the urgent need for effective prevention and intervention strategies.[1] Obesity is a recognized risk factor for various non-communicable diseases (NCDs), such as diabetes mellitus, hypertension, and cardiovascular conditions. The accumulation of excess adipose tissue contributes to metabolic dysregulation, insulin resistance, systemic inflammation, and endothelial dysfunction, thereby increasing the risk of cardiometabolic complications. As a result, obesity substantially elevates morbidity and mortality rates and represents a significant burden on global health systems.[2]

Before considering surgical intervention, several non-surgical weight-loss strategies are commonly recommended, including lifestyle modification, dietary interventions, behavioral therapy, and pharmacological treatment. Although these approaches may lead to modest weight reduction, their long-term effectiveness remains limited, particularly in individuals with severe obesity. Weight regain is frequently observed after lifestyle-based interventions, and pharmacological therapies may have limited effectiveness or potential adverse effects when used long-term. As a result, bariatric surgery has become the most effective and long-lasting treatment for severe obesity, leading to significant and sustained weight loss and improvements in obesity-related conditions comorbidities.[3]

Bariatric surgery entails significant changes to the morphology and physiology of the gastrointestinal tract, despite these well-established advantages. Weight reduction is achieved through restrictive, malabsorptive, or a combination of both mechanisms, depending on the method type. Bypassing the duodenum and proximal jejunum—the main sites of iron absorption in procedures like RYGB and BPD-DS can substantially decrease micronutrient intake. Moreover, decreased gastric acid production after surgery further impairs iron solubility and vitamin B12 absorption. These anatomical and physiological changes elevate the risk of postoperative deficiencies in micronutrients such as iron, vitamin B12, and folate, which are crucial for erythropoiesis.[4] As a result, anemia has emerged as one of the most frequently reported long-term complications following bariatric surgery. Recent evidence demonstrates that the prevalence of anemia increased from 14% preoperatively to 47% postoperatively. These findings highlight the potential impact of surgery-induced anatomical and physiological changes on nutrient absorption.[5]

Although several studies have reported the prevalence of anemia after bariatric surgery, most focus on describing its occurrence rather than systematically identifying its underlying determinants. As the number of bariatric procedures continues to increase globally, understanding the factors that contribute to postoperative anemia has become increasingly important. Identifying these risk factors may help clinicians recognize high-risk patients earlier and improve postoperative nutritional monitoring and management strategies. Therefore, this systematic review aims to identify and synthesize evidence on risk factors for anemia post-bariatric surgery.

METHODS

Study Design and Literature Search Strategy

This study was a systematic review in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement. The primary endpoint was to identify and evaluate risk factors for anemia following bariatric surgery. A comprehensive literature search was systematically performed using predefined search terms: ("bariatric surgery") AND ("anaemia" OR "anemia") AND ("risk factor"). Electronic databases, including Google Scholar, PubMed, and Elsevier, were searched to identify relevant studies published up to the date of the final search. To ensure methodological rigor and relevance to the study's purpose, all potentially suitable papers were assessed against predefined criteria.

Eligibility of The Study

The eligibility criteria were established a priori to ensure methodological rigor and relevance to the study's purpose. The inclusion criteria, such a: (1) adult patients involved in bariatric procedures surgery; (2) specifically included patients undergoing Roux-en-Y gastric bypass procedures or Sleeve procedures Gastrectomy; (3) reported postoperative hemoglobin assessment to evaluate the occurrence of anemia; (4) cohort study design; (5) published between 2024 and 2026; and (6) Written in either Indonesian or English.

The following criteria were used to reject studies: (1) not pertinent to the study's issue; (2) review articles, case reports, editorials, conference abstracts, or letters to the editor; and (3) involving pregnant patients.

Screening and Data Extraction

The study selection process was conducted independently by multiple reviewers using a stepwise approach consisting of title screening, abstract screening, and full-text assessment. During the identification phase, we were limited to articles published between 2024 and 2026 and written in Indonesian or English. Duplicate studies were removed prior to screening. To eliminate studies that were not pertinent to the review's focus, did not expressly evaluate Roux-en-Y gastric bypass or Sleeve Gastrectomy operations, or did not involve adult patients having bariatric surgery, titles and abstracts were reviewed during the screening phase. At this point, articles categorized as editorials, case reports, review papers, conference abstracts, or letters to the editor were not included.

Eligibility of full-text articles was then evaluated. Studies that did not provide postoperative hemoglobin measurements and included pregnant patients were disqualified. The identification, screening, eligibility evaluation, and final inclusion phases of the process were all conducted in accordance with the PRISMA framework.

The collected information includes the lead author, year of publication, country of study, and study design. Data was also collected on the type of bariatric procedure used, sample size, and participant demographics. To support a comprehensive narrative synthesis and facilitate comparisons across studies, all collected data were systematically organized. In the event of disagreement during the screening process, the final decision will be made by the majority of the authors.

Quality Assessment

Quality assessment assessed by using the Newcastle-Ottawa Scale (NOS) which include selection of study groups (maximum score: 4), comparability of cohorts (maximum score: 2), and assessment of outcomes (maximum score: 3). The overall quality score was determined by summing the assigned stars. Studies with a total of 7–9 stars were classified as high quality, those with 4–6 stars as moderate quality, and those with 3 or fewer stars as low quality.[6]

RESULT

Study Selection

In all, 32,656 publications were found using PubMed, Elsevier, and Google Scholar. 27.249 items were left for screening after 5.407 duplicates were eliminated. 27.176 records were eliminated for not meeting the predetermined criteria after title and abstract screening. After the eligibility of 73 full-text articles was assessed, 69 were eliminated. In the end, this systematic review identified four articles that satisfied all inclusion requirements. (**Figure 1**).

Risk of Bias Analysis

All included articles were deemed to have a low risk of bias based on evaluation using the NOS, with total scores ranging from 7 to 8 out of 9. Overall, the studies demonstrated good methodological quality, particularly in cohort selection, confounder adjustment, and objective outcome assessment.

Celander et al. (2025)[7] included a representative cohort with both surgical and non-surgical groups, clearly defined exposure, and baseline outcome assessment. Although major confounders were adjusted for and were laboratory-based over five years, follow-up completeness was moderate. Gorini et al. (2025)[8] analyzed a well-defined bariatric cohort with appropriate multivariable adjustment and high long-term retention.

While outcomes were largely objective, the absence of a non-exposed comparison group and the use of a non-validated satisfaction measure represent minor limitations. Karlsson et al. (2024)[9] was based on a nationwide, validated registry, ensuring strong representativeness and reliable exposure documentation, with long-term follow-up of up to 10 years. Outcomes were defined using standardized WHO criteria, although follow-up completeness varied across time points. Moreover, Soheilipour et al. (2024)[10] conducted a prospective cohort study with reliable exposure assessment but without a non-exposed comparison group and with anemia present in some participants at baseline. Nevertheless, confounding factors were appropriately controlled, and outcomes were objectively measured using WHO laboratory standards.

Study Characteristic

Across the four included studies, baseline sample characteristics indicate that the study populations were predominantly

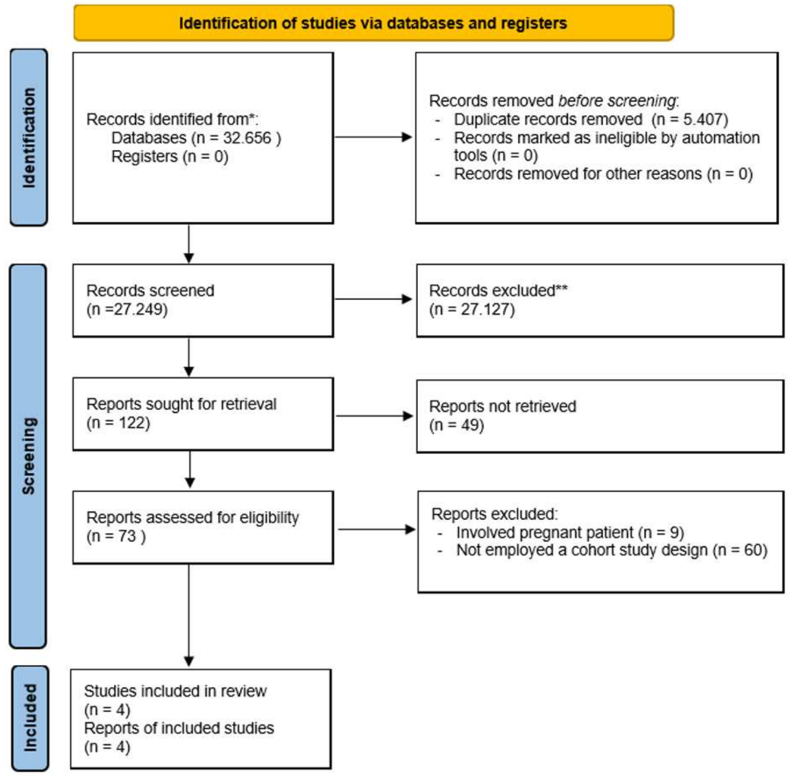

Figure 1. PRISMA flow chart

Table 1. Risk of Bias Analysis by using NOS

Study	Selection	Comparability	Outcome	Total Score	Risk of Bias
Celander et.al (2025)[7]	★★★★ Representative cohort with surgical and non-surgical groups; clear exposure and baseline assessment.	★★ Adjusted for major confounders	★★ Objective lab outcomes; moderate follow-up completeness	★★★★★★★★ (8/9)	Low
Gorini et al. (2025)[8]	★★★ Representative bariatric cohort; no non-exposed group	★★ Multivariable adjustment for key confounders	★★★ Objective lab outcomes: high retention	★★★★★★★★ (8/9)	Low
Karlsson et al. (2024)[9]	★★★ Nationwide registry cohort; documented baseline anemia; non-exposed group	★★ Adjusted for age, sex, and surgery type	★★★ WHO-based anemia assessment; long-term follow-up	★★★★★★★★ (8/9)	Low
Soheilipour et al. (2024)[10]	★★ Prospective cohort; no non-exposed group; anemia present at baseline	★★ Controlled for major confounders	★★★ WHO-based anemia assessment; longitudinal follow-up	★★★★★★★ (7/9)	Low

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Table 2. Study Characteristic

Authors, year	Study Design	Sample (n)	Duration Evaluation	Location	Age (years)	BMI (kg/m^2)
Celander et al. (2025)[7]	Prospective longitudinal cohort study	Roux-en Y Gastric Bypass: 388 samples Sleeve Gastrectomy: 201 samples	5 years	Sweden	Roux-en Y Gastric bypass: 47.6 ±14.2 Sleeve Gastrectomy: 47.6±14.2	Roux-en Y Gastric bypass: 42.6±4.1 Sleeve Gastrectomy: 42.8±4.9
Gorini et al. (2025)[8]	Prospective cohort study	Roux-en-Y gastric bypass group: 49 samples Sleeve gastrectomy group:1 sample	60 months	Italy	Roux-en-Y gastric bypass group: 39.7 ± 7.7 Patients who underwent sleeve gastrectomy were classified in the other procedures group, which had a mean age of 40.7 ± 6.5 years.	Roux-en-Y gastric bypass: 44.1 ± 4.1 Patients with the sleeve gastrectomy procedure were classified in the other procedures group, which had a mean BMI of 45.0 ± 5.5
Karlsson et al. (2024)[9]	Retrospective registry-based longitudinal cohort study	Roux-en-Y gastric bypass group: 23,453 samples Sleeve gastrectomy group: 6,248 samples	5 years and 10 years	Sweden	All groups: 41.0	All groups: 41.3
Soheilipour et al. (2024)[10]	Prospective cohort study with longitudinal analysis	Roux-en-Y gastric bypass group: 100 samples Sleeve gastrectomy group: 22 samples	3,6, and 12th months	Iran	Roux-en-Y gastric bypass group: mean 40.8, min–max 26–62. Sleeve gastrectomy group: mean 39.9, min–max 22–57.	Obesity class II, with a BMI between 35 and 39.9, and class III, with a BMI of 40 or higher,

middle-aged adults with obesity undergoing bariatric surgery, particularly RYGB and SG (Table 2). Most studies used a prospective longitudinal cohort design, while one study employed a retrospective registry-based longitudinal approach. The studies were conducted in Sweden, Italy, and Iran, with follow-up durations ranging from 3 months to 10 years. Sample sizes varied substantially, from relatively small clinical cohorts to a very large national registry, with RYGB generally contributing the larger proportion of participants, whereas SG was less represented in several studies. The mean age of participants was broadly comparable across studies, ranging from approximately 39.7 to 47.6 years, suggesting that the included populations largely reflected adults in midlife. Baseline BMI values were consistently elevated, ranging from about 41.3 to 45.0 kg/m^2, indicating that most participants who had severe obesity, including class II and class III obesity, where explicitly reported.

Factors Associated with Anemia Post-Bariatric Surgery

The hematologic profile changes following bariatric surgery demonstrate a general trend of declining hemoglobin levels and worsening iron-related parameters over time, particularly in patients undergoing RYGB. Across studies, RYGB is associated with a more pronounced and sustained reduction in hemoglobin levels compared to sleeve gastrectomy (SG), with a higher incidence and progression of anemia during follow-up. Additionally, parameters such as ferritin levels tend to decrease or show higher rates of deficiency, while transferrin saturation also declines, indicating impaired iron status. In contrast, SG shows relatively milder hematologic alterations, with smaller reductions in hemoglobin and less severe changes in iron stores. Overall, these findings suggest that malabsorptive procedures like RYGB carry a greater risk of long-term hematologic disturbances compared to restrictive procedures such as SG.

Table 3. **Factors Linked to Anemia After Bariatric Surgery**

Authors, year	Hematologic profile changes	Factors Associated with Anemia Post-Bariatric Surgery
Celander et al. (2025)[7]	Roux-en-Y gastric bypass (RYGB) group: At 5 years, the mean BMI was 30.4 ± 5.0, representing the lowest BMI among the three groups, and the mean hemoglobin reduction was −6.4 ± 12.2 g/L, which was the greatest decline across groups. Anaemia increased from 3.0% at baseline to 12.2% at 5 years, the highest prevalence of anaemia among the treatment groups. Low ferritin also rose from 3.9% to 14.9%, while low transferrin saturation decreased from 10.1% to 5.4%. Sleeve gastrectomy (SG) group: At the 5-year follow-up, the mean BMI was 32.4 ± 5.6, intermediate between the medical treatment and RYGB groups. The mean hemoglobin reduction was −2.1 ± 10.3 g/L, representing the smallest decline among the three groups. Anaemia increased from 2.6% to 8.0% over time. Low ferritin rose markedly from 2.5% at baseline to 25.7% at 5 years, which was the highest prevalence of low ferritin across all groups. Low transferrin saturation showed only a slight reduction from 9.0% to 8.0%.	• Type of surgery (p < 0,05) • Inflammation or ESR >20mm/h (p <0,05) • Folate deficiency (p < 0,001).
Gorini et al. (2025)[8]	Not reported	• Type of surgery (p=0,0039) • Revision surgery status (p=0,0019)
Karlsson et al. (2024)[9]	Roux-en-Y gastric bypass group: Mean hemoglobin decreased from 140.9 g/L prior to surgery to 131.4 g/L at the 5-year follow-up and remained relatively stable at 131.6 g/L at 10 years, indicating a marked and sustained postoperative reduction in Hb levels. Sleeve gastrectomy: Mean hemoglobin declined from 139.9 g/L before surgery to 134.8 g/L at 5 years, followed by a modest increase to approximately 137 g/L at the 10-year follow-up, suggesting a milder long-term reduction compared with the gastric bypass group.	• Type of surgery (p < 0,001) • Gender (p < 0,001) • Age (p < 0,001)
Soheilipour et al. (2024)[10]	Roux-en-Y gastric bypass group: • 3 Month (n(%)): mild baseline (22 samples (28.2%)), mild (52 samples (66.7%)), moderate (4 samples (5.1%)); moderate baseline (4 samples (18.2%)), mild (7 samples (31.8%)), moderate (11samples (50.0%)). • 6 Month (n(%)): mild baseline (62 samples (79.5%)), mild (7 samples (9.0%)), moderate (9 samples (11.5%)); moderate baseline (8 samples (36.4%)), mild (10 samples (45.5%)), moderate (4 samples (18.2%)). • 12 Month (n(%)): mild baseline (59 samples (75.6%)), mild (11 samples (14.1%)), moderate (8 samples (10.3%)); moderate baseline (7 samples (31.8%)), mild (11 samples (50.0%)), moderate (4 samples (18.2%)). Sleeve gastrectomy group: • 3 Month (n(%)): mild baseline (6 samples (33.3%)), mild (12 samples (66.7%)), moderate (0 samples (0.0%)); moderate baseline (1 sample (25.0%)), mild (0 samples (0.0%)), moderate (3 samples (75.0%)). • 6 Month (n(%)): mild baseline (17 samples (94.4%)), mild (1 sample (5.6%)), moderate (0 samples (0.0%)); moderate baseline (1 sample (25.0%)), mild (2 samples (50.0%)), moderate (1 sample (25.0%)). • 12 Month (n(%)): mild baseline (16 samples (88.9%)), mild (2 samples (11.1%)), moderate (0 samples (0.0%)); moderate baseline (1 sample (25.0%)), mild (2 samples (50.0%)), moderate (1 sample (25.0%)).	• Type of surgery – SG vs OAGB (p=0.008)) • Type of surgery – RYGB vs OAGB (p=0.026) • Sex (p=0.010) • Hypothyroidism condition (p=0.037)

Celander et al. (2025) conducted a prospective longitudinal cohort study in Sweden with a five-year follow-up. Their findings showed that the type of surgery was significantly associated with anemia ($p<0,05$). In addition, an inflammatory status, indicated by ESR >20 mm/h ($p<0,05$) and folate deficiency ($p<0,001$), was also significantly associated with anemia development. Gorini et al. (2025) conducted a prospective cohort study in Italy with a 5-year follow-up. This study reported that the type of surgery was significantly associated with nutritional deficiencies, including iron deficiency ($p=0.0039$). Furthermore, revision surgery status was also significantly associated with nutritional deficiency ($p=0.0019$), suggesting a higher risk among patients undergoing secondary surgical procedures. Karlsson et al. (2024) conducted a retrospective, registry-based longitudinal cohort study in Sweden with follow-up assessments at 5 and 10 years after surgery. The results demonstrated that type of surgery ($p<0,001$), gender ($p<0,001$), and age ($p<0,001$) were significantly associated with changes in hemoglobin levels and anemia prevalence over time. Meanwhile, Soheilipour et al. (2024) conducted a prospective cohort study with longitudinal analysis in Iran, with a 1-year follow-up. Their findings showed that the type of surgery was significantly associated with changes in anemia severity (SG vs OAGB, $p=0.008$; RYGB vs OAGB, $p=0.026$). Female sex ($p=0.010$) and hypothyroidism ($p=0.037$) were also significantly associated with anemia progression. Overall, the type of surgery was the only factor consistently identified across all four articles. The other variables, such as gender, age, revision surgery, inflammation, and hypothyroidism, were reported in separate studies (**Table 3**).

DISCUSSION

The findings of this systematic review suggest that a single factor does not cause anemia following bariatric surgery. The risk factors identified in this review were derived from statistically significant associations reported in the included cohort studies. Age and sex were identified as significant predictors in the registry-based study by Karlsson et al. (2024).[9] Revision surgery was a significant factor in the cohort study by Gorini et al. (2025).[8] In addition, Soheilipour et al. (2024)[10] reported that female sex and hypothyroidism were significantly associated with worsening anemia status. Meanwhile, Celander et al. (2025)[7] found that inflammatory status was significantly associated with the development of anemia post bariatric surgery.

All four studies reported a significant association between the type of surgery and anemia outcomes. Research by Celander et al. (2025)[7] found that Roux-en-Y gastric bypass (RYGB) was significantly associated with anemia five years after surgery ($p<0,005$). Similarly, Gorini et al. (2025)[8] reported a significant relationship between the type of surgery and long-term nutritional deficiency ($p=0.0039$), with malabsorptive procedures such as RYGB showing a greater tendency toward nutritional deficiencies. Karlsson et al. (2024)[9] also demonstrated that patients who underwent RYGB experienced a greater decline in hemoglobin levels and a higher prevalence of anemia.

Roux-en-Y gastric bypass (RYGB) is a surgical procedure that reroutes the small intestine, bypassing the duodenum and a portion of the proximal jejunum.[11] Because these segments play a central role in iron absorption, altering their normal pathway directly affects the body's ability to absorb dietary iron. The proximal jejunum works together with the duodenum, which is considered the primary site for iron uptake. When RYGB is performed, ingested iron no longer passes through these main absorption sites. As a result, iron absorption becomes significantly reduced. Over time, reduced absorption may gradually deplete iron stores, as reflected by declining ferritin levels and, eventually, a decrease in hemoglobin concentration. Therefore, patients who undergo procedures such as RYGB are more likely to develop anemia than those who undergo restrictive procedures that preserve the natural digestive tract.[12]

Previous studies have also demonstrated that anemia after Roux-en-Y gastric bypass (RYGB) is often multifactorial.[13] In addition to malabsorption caused by the surgically altered gastrointestinal anatomy, anemia may also result from inadequate oral intake, chronic occult blood loss, and reduced consumption of iron-rich foods following surgery.[14,15]

Furthermore, decreased gastric acid secretion after gastric bypass may impair the conversion of dietary ferric iron into the more absorbable ferrous form, thereby further limiting iron absorption. Although postoperative patients are routinely prescribed multivitamins and iron supplementation, iron deficiency anemia may still develop, particularly in high-risk groups such as menstruating women or patients with gastrointestinal complications such as marginal ulcers.[16,17]

The development of anemia after bariatric surgery is closely linked to several pathophysiological mechanisms associated with altered gastrointestinal anatomy. First, bypassing the duodenum and proximal jejunum reduces iron absorption because these regions represent the primary sites for iron uptake. Second, decreased gastric acid production after surgery impairs the conversion of ferric iron (Fe^{3+}) into the more absorbable ferrous form (Fe^{2+}), thereby limiting intestinal absorption. Third, vitamin B12 deficiency may occur due to reduced intrinsic factor production and decreased contact between dietary vitamin B12 and gastric secretions. Finally, reduced intake of iron-rich foods and postoperative intolerance to certain foods may further contribute to micronutrient deficiency. These mechanisms collectively impair erythropoiesis and increase the risk of long-term postoperative anemia.[18]

Age was also identified as a significant factor in the study by Karlsson et al. (2024).[9] Older patients have reduced physiological reserves, lower baseline iron stores, and a higher prevalence of comorbidities, which may increase their vulnerability to anemia after bariatric surgery.[19]

Gender differences were observed as well. Research by Karlsson et al. (2024)[9] reported that gender significantly affected hemoglobin levels over time. Similarly, research by Soheilipour et al. (2024)[10] also reported that sex was significantly associated with worsening anemia status. Women generally have lower iron stores than men and experience menstrual blood loss, which may increase their susceptibility to iron deficiency when nutrient absorption is impaired after surgery.[20]

Revision surgery was another important factor identified in research by Gorini et al. (2025).[8] Patients undergoing revision procedures may be at higher risk of anemia due to repeated anatomical alterations of the gastrointestinal tract, which further compromise micronutrient absorption. Additional surgical modifications may further reduce the effective absorptive surface area of the small intestine, thereby increasing the risk of iron and vitamin deficiencies.

Comorbid conditions may also contribute to the development of anemia. Soheilipour et al. (2024)[10] found that hypothyroidism was significantly associated with changes in anemia severity. Thyroid hormones are involved in erythropoiesis by stimulating erythropoietin production and supporting bone marrow activity.[21] Red blood cell production may decline when thyroid function is compromised, which might exacerbate surgical anemia.

Inflammatory status was also reported as a contributing factor. Research by Celander et al. (2025)[7] found that elevated ESR (>20 mm/h) was significantly associated with anemia. Chronic inflammation can elevate hepcidin levels, thereby inhibiting iron absorption.[22] This mechanism may lead to functional iron deficiency, even if total body iron stores are not severely depleted. In the postoperative period, inflammatory responses triggered by surgical tissue injury may further exacerbate anemia. Surgical trauma stimulates the release of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α), which, in turn, increase hepatic hepcidin production. Elevated hepcidin levels reduce iron availability by promoting ferroportin degradation, thereby inhibiting iron export from enterocytes and macrophages. This process leads to iron sequestration and decreased circulating iron despite adequate or increased iron stores, a condition commonly referred to as functional iron deficiency. Consequently, erythropoiesis becomes impaired, and hemoglobin recovery after surgery may be delayed. Inflammatory conditions are therefore recognized as important contributors to postoperative anemia, particularly in patients with ongoing inflammation.[23]

Although bariatric surgery carries the risk of nutritional deficiencies, it is still the most effective treatment for severe obesity. Many studies have shown that it leads to substantial and lasting weight loss, improves metabolic conditions like type 2 diabetes and hypertension, and reduces long-term mortality. Nonetheless, these positive outcomes should be weighed against possible long-term complications, such as micronutrient deficiencies, anemia, and the need for lifelong nutritional management monitoring.[16,24,25] Therefore, careful patient selection, appropriate supplementation, and long-term follow-up are essential to maximize the benefits of bariatric surgery while minimizing its potential risks.

CONCLUSION

Anemia following bariatric surgery is a multifactorial condition, with both surgical and patient-related factors. The risk factor most consistently linked to anemia post-bariatric surgery was the type of surgery, especially RYGB, which includes a malabsorptive component. In addition to surgical factors, anemia risk was shown to be increased by older age and being female. This is probably because of physiological susceptibility and lower baseline iron stores. Moreover, hypothyroidism, inflammatory condition, and revision surgery were found to be contributory variables that might worsen iron metabolism and red blood cell production. The significance of personalized dietary treatment and long-term hematological monitoring is underscored by these findings, particularly for patients who have undergone malabsorptive operations or who have additional risk factors. Bariatric patients may achieve better surgical outcomes and a reduced anemia burden.

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Conflict of Interest
None

Ethical Clearance
Not Applicable

Author Contribution
The first author was involved in conceptualizing and designing the study, conducting literature searches, preparing, and reviewing the manuscript, and acted as the study guarantor. The second author contributed to the conceptualization, design, literature search, manuscript preparation, and editing. The third author also participated in conceptualizing and designing the study, performing literature searches, editing, and reviewing the manuscript. All authors reviewed and approved the final version.

AI disclosure
The authors state that they did not use any artificial intelligence tools in preparing this manuscript.

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