



# International Journal of Advanced Academic Studies

E-ISSN: 2706-8927

P-ISSN: 2706-8919

[www.allstudyjournal.com](http://www.allstudyjournal.com)

IJAAS 2024; 6(10): 40-45

Received: 15-08-2024

Accepted: 20-09-2024

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## Iron deficiency anemia in post-bariatric surgery patients: A retrospective study at Baghdad teaching hospital, 2024

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**DOI:** <https://doi.org/10.33545/27068919.2024.v6.i10a.1284>

### Abstract

**Background:** Iron deficiency anemia (IDA) is a common complication among bariatric surgery patients, attributed to changes in digestion and absorption. With the rising rates of obesity and bariatric procedures, evaluating IDA prevalence and identifying risk factors are crucial for optimizing management strategies.

**Methodology:** This retrospective cohort study, conducted at Baghdad Teaching Hospital's gastrointestinal clinic from January 15 to June 15, 2024, assessed IDA in adults post-bariatric surgery. The study included 60 patients with comprehensive pre- and post-surgery records who had undergone sleeve gastrectomy, Roux-en-Y gastric bypass, or duodenal switch procedures between 6 months and 5 years prior. Data were collected through interviews and medical record reviews, covering demographics, surgery type, comorbidities, and iron levels. Statistical analysis was performed using SPSS, with a significance level set at  $p < 0.05$ .

**Results:** The study involved 60 participants, predominantly female (66.7%), with a mean age of 36 years, where most resided in urban areas (90%) and were married (66.7%). A significant portion of participants were obese (average BMI 38.6), with 73.3% reporting no comorbidities. Postoperative outcomes revealed that 86.7% underwent sleeve gastrectomy, with an average weight loss of 23.3 kg. Notably, 53.3% developed postoperative anemia, significantly associated with preoperative anemia and education level ( $P = 0.001$ ). Laboratory results showed a marked decline in hemoglobin and iron levels post-surgery, indicating the need for careful monitoring and possible intervention for anemia management.

**Conclusions:** The study indicated that more than half of the patients has postoperative anemia in bariatric surgery patients, with preoperative anemia as a significant predictor. Post-surgery, significant reductions in hemoglobin, mean corpuscular volume, and serum iron levels were evident. While educational level and BMI were linked to anemia, surgery type and diet adherence were not. Continuous monitoring and personalized nutritional interventions are essential.

**Keywords:** Iron deficiency anemia, bariatric surgery, prevalence, risk factors, and Baghdad

### Introductions

Iron deficiency anemia (IDA) is a common and potentially serious condition characterized by insufficient iron to meet the body's needs for erythropoiesis. It is particularly prevalent in post-bariatric surgery patients, who face unique nutritional challenges following significant weight loss procedures. Bariatric surgery, including gastric bypass and sleeve gastrectomy, is increasingly used to manage obesity and associated comorbidities [1]. However, these interventions can lead to nutrient deficiencies, including iron, due to altered gastrointestinal anatomy and absorption issues [2].

The relevance of studying IDA in the context of bariatric surgery is underscored by the growing number of individuals undergoing such procedures. With obesity rates rising globally, bariatric surgery has become a widely accepted choice as a treatment option. In Iraq, as in many other countries, the prevalence of obesity is increasing, leading to a higher number of bariatric procedures [3]. Consequently, understanding the nutritional deficiencies that may follow such surgeries is crucial for improving patient outcomes and long-term health. IDA can severely affect quality of life, cognitive function, and overall health, making it a critical area of study [4].

Existing research indicates that iron deficiency is a well-documented complication following bariatric surgery. Studies have shown that up to 50% of patients may develop IDA postoperatively due to reduced stomach capacity, altered digestive processes, and decreased absorption<sup>[5]</sup>. Various mechanisms contribute to this deficiency, including reduced gastric acid production, which impairs iron absorption, and changes in intestinal transit time<sup>[6, 7]</sup>. Despite the known risks, there is a lack of comprehensive studies focusing on the specific prevalence and management of IDA in the context of bariatric surgery within the Iraqi population. This gap highlights the need for localized research to address regional dietary practices and healthcare settings.

The specific problem addressed in this article is the prevalence and management of IDA among bariatric surgery patients in Baghdad. Given the high rates of obesity and the increasing number of bariatric surgeries performed, it is critical to investigate how these patients are affected by IDA and how well current management strategies are working. Understanding this issue is important for developing targeted interventions and improving clinical guidelines to address iron deficiency in this patient group effectively.

Investigating this problem will provide valuable insights into the nutritional challenges faced by this patient population and help in developing more effective strategies for prevention and treatment. Identifying the prevalence of IDA and evaluating current management practices can lead to improved guidelines and treatment protocols, potentially reducing the incidence of IDA among bariatric patients in Baghdad. Furthermore, this study could influence policy changes in healthcare practices related to bariatric surgery and enhance the quality of care provided to patients undergoing these procedures.

### The Study objectives

1. Determine the prevalence of IDA among bariatric surgery patients in Baghdad.
2. Identify potential risk factors associated with IDA related to both bariatric surgeries.

### Patients and Methods

**Study Design, Setting and Timing:** This retrospective cohort analysis was designed and conducted at the gastrointestinal clinic of Baghdad Teaching Hospital, a leading referral center in the Medical City Department recognized for its extensive surgical and medical services, including bariatric procedures. Data collection took place from January 15 to June 15, 2024.

**Sample Population, Size, and Sampling:** A convenient sample of 60 patients who had undergone various types of bariatric surgery—namely sleeve gastrectomy, Roux-en-Y gastric bypass, and duodenal switch—was selected. The selection criteria included adults aged 18 years or older with complete medical records showing pre- and post-surgery hemoglobin (HB) and iron study, and who had undergone surgery within six months to five years prior. Patients were excluded if they had incomplete records, a history of thalassemia confirmed by HB electrophoresis, had undergone multiple bariatric procedures, or had conditions affecting iron metabolism, such as chronic gastrointestinal

disorders, active malignancies, or pregnancy.

**Data Collection Tools:** Data collection utilized direct interview questionnaires and data extraction forms to review medical records. Baseline data included demographic information such as age, gender, residence, marital status, education level, occupation, and BMI, as well as details regarding the type of bariatric surgery, reasons for the surgery, time elapsed since the surgery (in years), and comorbidities including diabetes mellitus, hypertension, renal failure, and infections. Previous symptoms of anemia were also documented. Additionally, information on oral or intravenous iron supplementation and pre-surgery laboratory parameters—including complete blood count (CBC), blood film, and iron studies (serum iron and serum ferritin)—was collected. Follow-up data consisted of post-surgery laboratory parameters, also encompassing CBC, blood film, and iron studies obtained from routine blood tests. The development of IDA was assessed according to WHO criteria, defined as HB levels of less than 13.0 g/dL for men and less than 12.0 g/dL for women<sup>[8]</sup>, with other iron study parameters

**Data Management and Analysis:** Statistical analyses were conducted using SPSS software version 26 to investigate the relationship between bariatric surgery and the prevalence of IDA during post-operative follow-up. The analysis considered various risk factors, including demographic characteristics; type of bariatric surgery, time elapsed since surgery (in years), prior symptoms of anemia, and data on oral or intravenous iron supplementation. Descriptive statistics were employed to summarize the data, which were presented in tables and figures. The associations between categorical variables were assessed using chi-square tests, while paired t-tests were utilized to compare HB, Mean Corpuscular Volume (MCV), serum iron, and ferritin levels before and after surgery. A significance level of  $p < 0.05$  was applied for all statistical tests.

**Ethical Considerations:** Official approval was obtained from the Arab Board and Iraqi Ministry of Health. Informed consent was collected, and data anonymization ensured participant confidentiality during the study at Baghdad Teaching Hospital.

### Results

Table 1 reveals that the study sample of 60 participants, with 33.3% male and 66.7% female, averaging 36 years ( $\pm 8.2$ ). Age distribution showed 40% aged 23-32, 33.3% aged 33-42, and 26.7% aged 43-52. Most participants (90%) lived in urban areas, and 66.7% were married. Educational attainment included 66.7% with college degrees and 20% with higher education. Occupationally, 66.7% were government employees. Comorbidity analysis revealed 73.3% had no additional health conditions, while others reported diabetes (11.7%), hypothyroidism (8.3%), or hypertension and ischemic heart disease (6.7%). Mean weight was 104.8 kg ( $\pm 17.2$ ), with an average BMI of 38.6 ( $\pm 7.8$ ). Participants' BMI distribution showed that 13.3% were classified as Obese I, 46.7% as Obese II, and 40.0% as morbidly obese. Additionally, 6.7% reported a history of pica, while 15.0% had received IV iron or blood transfusions.

**Table 1: Demographic and Clinical Characteristics of Study Participants**

Variable	N= (60)	%
(N=60)		
<b>Gender</b>		
Male	20	33.3
Female	40	66.7
<b>Age at time of operation (years) mean±SD = (36±8.2)</b>		
23- 32	24	40.0
33- 42	20	33.3
43- 52	16	26.7
<b>Residence</b>		
Urban	54	90.0
Rural	6	10.0
<b>Marital status</b>		
Married	40	66.7
Single	16	26.7
Divorced/widowed	4	6.7
<b>Education level</b>		
Secondary school	8	13.3
College	40	66.7
High education	12	20.0
<b>Occupation</b>		
Governmental employee	40	66.7
Self-employee	16	26.7
Student	4	6.7
<b>Comorbidities</b>		
None	44	73.3
DM	7	11.7
Hypothyroidism	5	8.3
HT, IHD	4	6.7
<b>BMI categories mean±SD= (38.6±7.8)</b>		
Obese I	8	13.3
Obese II	28	46.7
Morbid obesity	24	40.0
<b>History of pica</b>		
Yes	4	6.7
No	56	93.3
<b>History of IV iron or blood transfusion</b>		
Yes	9	15.0
No	51	85.0

The postoperative characteristics of 60 patients undergoing bariatric surgery reveal diverse outcomes and experiences (Table 2). The majority of patients (86.7%) underwent sleeve gastrectomy, while 13.3% had gastric bypass. Most surgeries were performed at the patient's request (93.3%), compared to 6.7% based on doctor recommendation. The time since surgery varied, with 40% of patients having undergone the procedure 6 months to 1 year ago, 25% between 2 to 3 years, and the remaining patients distributed over longer intervals. The average weight loss was 23.3±9.5 kg, with 53% losing between 15-20 kg. Post-surgery, 46.7% adhered to the diet plan, while 53.3% did not. Most patients tolerated red meat (86.7%) and used postoperative supplements (86.7%). One third of patients reported other food restrictions, and over half experienced gastrointestinal symptoms as a complication. Despite these issues, a high level of satisfaction was reported with the bariatric surgery outcomes (90%).

**Table 2: Postoperative Characteristics of Patients Undergoing Bariatric Surgery**

Variable	N= (60)	%
(N=60)		
<b>Operation type</b>		
Sleeve gastrectomy	52	86.7
Gastric bypass	8	13.3
<b>Reasons for the surgery</b>		
Patient request	56	93.3
Doctor request	4	6.7
<b>Time elapsed since surgery</b>		
6 month- 1 year	24	40.0
2 years	11	18.3
3 years	15	25.0
4 years	6	10.0
5 years	4	6.7
<b>Weight loss in (kg) mean±SD= (23.3±9.5) kg</b>		
15- 20	30	53.0
21- 26	12	20.0
27- 32	6	10.0
33- 38	6	10.0
39- 45	6	10.0
<b>Followed post-surgery diet plan</b>		
Yes	28	46.7
No	32	53.3
<b>Red meat tolerance post-surgery</b>		
Yes	52	86.7
No	8	13.3
<b>Other food restrictions or dietary preferences</b>		
Yes	20	33.3
No	40	66.7
<b>Post-Op Supplements Use</b>		
Yes	52	86.7
No	8	13.3
<b>GIT symptoms as Post-Op complication</b>		
Yes	32	53.3
No	28	46.7
<b>Satisfied with the BS outcome</b>		
Yes	54	90.0
No	6	10.0

The analysis of Table 3 focuses on the association between postoperative anemia and various demographic and clinical characteristics of the participants. The data indicate that postoperative anemia was present in 32 (53.3%), while 28 (46.7%) did not. The association between gender and anemia was not statistically significant (P = 0.143), although a higher percentage of females (60%) were anemic compared to males (40%). Age showed no significant relationship with anemia (P = 0.765), with roughly similar anemia rates across the age groups. Residence (urban vs rural) also did not show a significant association with anemia (P = 1.000). Marital status approached significance (P = 0.069), with divorced/widowed participants showing no cases of anemia. Education level, however, had a statistically significant association with anemia (P = 0.001), as 87.5% of those with secondary education were anemic, compared to 25% of those with higher education. Occupation similarly neared significance (P = 0.069), with all students being non-anemic. Lastly, BMI categories demonstrated a significant relationship with anemia (P = 0.012), with morbidly obese patients showing higher rates of anemia compared to those in the obese I and II categories.

**Table 3:** Association between postoperative Anemia and demographic and clinical characteristics of study participants

Variable	Post OP. Anemic 32 (53.3)	Post OP. Not Anemic 28 (46.7)	Total 60 (100.0)	P- value
<b>Gender</b>				
Male	8 (40.0)	12 (60.0)	20 (33.3)	0.143
Female	24 (60.0)	16 (40.0)	40 (66.7)	
<b>Age at time of operation (years)</b>				
23- 32	12 (50.0)	12 (50.0)	24 (40.0)	0.765
33- 42	12 (60.0)	8 (40.0)	20 (33.3)	
43- 52	8 (50.0)	8 (50.0)	16 (26.7)	
<b>Residence</b>				
Urban	29 (53.7)	25 (46.3)	54 (90.0)	1.000
Rural	3 (50.0)	3 (50.0)	6 (10.0)	
<b>Marital status</b>				
Married	24 (60.0)	16 (40.0)	40 (66.7)	0.069
Single	8 (50.0)	8 (50.0)	16 (26.7)	
Divorced/widowed	0 (0.0)	4 (100.0)	4 (6.7)	
<b>Education level</b>				
Secondary school	7 (87.5)	1 (12.5)	8 (13.3)	0.001
College	22 (55.0)	18 (45.0)	40 (66.7)	
High education	3 (25.0)	9 (75.0)	12 (20.0)	
<b>Occupation</b>				
Governmental employee	24 (60.0)	16 (40.0)	40 (66.7)	0.069
Self-employee	8 (50.0)	8 (50.0)	16 (26.7)	
Student	0 (0.0)	4 (100.0)	4 (6.7)	
<b>BMI categories</b>				
Obese I	3 (37.5)	5 (62.5)	8 (13.3)	0.012
Obese II	14 (50.0)	14 (50.0)	28 (46.7)	
Morbid III	15 (62.5)	9 (37.5)	24 (40.0)	

Table 4 reveals several associations between postoperative anemia and various clinical and dietary characteristics among the study participants. Of the 60 participants, 32 (53.3%) were classified as postoperative anemic. Preoperative anemia was significantly associated with postoperative anemia, as all 12 preoperatively anemic participants (100%) had anemia postoperatively, compared to only 20 (41.7%) of those without preoperative anemia (p=0.001). The time elapsed since surgery also showed a significant association, with participants who had undergone surgery 6 months to 1 year prior having a 50.0% incidence of anemia, in contrast to those in other time frames (p=0.037). There were no significant associations found with operation type (p=1.000), adherence to the postoperative diet plan (p=0.58), red meat tolerance (p=1.00), or gastrointestinal (GIT) symptoms (p=0.58). However, the use of postoperative supplements was significantly associated with anemia, as 32 (61.5%) of those using supplements were anemic compared to none of the non-supplement users (p=0.001), indicating a potential role of including iron supplementation in anemia treatment. Participants who reported satisfaction with the outcome of their surgery had a lower anemia rate (48.2%) compared to those who were not satisfied (100% anemia). The p-value of 0.015 indicates a significant association between satisfaction with surgical outcomes and postoperative anemia.

**Table 4:** Association between postoperative anemia and various clinical and dietary characteristics of study participants

Variable	Post OP. Anemic 32 (53.3)	Post OP. Not Anemic 28 (46.7)	P- value
<b>Operation type</b>			
Sleeve gastrectomy	28 (53.8)	24 (46.2)	1.000
Gastric bypass	4 (50.0)	4 (50.0)	
<b>Pre OP. Anemic</b>			
Yes	12 (100.0)	0 (0.0)	0.001
No	20 (41.7)	28 (58.3)	
<b>Time elapsed since surgery</b>			
< 2 years	18 (51.4)	17 (48.6)	0.037
≥ 2 years	14 (56.0)	11 (44.0)	
<b>Followed post-surgery diet plan</b>			
Yes	16 (57.1)	12 (42.9)	0.58
No	16 (50.0)	16 (50.0)	
<b>Red meat tolerance post-surgery</b>			
Yes	28 (53.8)	24 (46.2)	1.00
No	4 (50.0)	4 (50.0)	
<b>Other food restrictions or dietary preferences</b>			
Yes	8 (40.0)	12 (60.0)	0.143
No	24 (60.0)	16 (40.0)	
<b>Post-Op Supplements Use</b>			
Yes	32 (61.5)	20 (38.5)	0.001
No	0 (0.0)	8 (100.0)	
<b>GIT symptoms as Post-Op complication</b>			
Yes	16 (50.0)	16 (50.0)	0.58
No	16 (57.1)	12 (42.9)	
<b>Satisfied with the BS outcome</b>			
Yes	26 (48.2)	28 (51.2)	0.015
No	6 (100.0)	0 (0.0)	

Table 5 examines the impact of surgical intervention on HB levels and key laboratory parameters, indicating a significant decline in hematological values post-operation. Preoperatively, only 20% of patients had anemia, but this rose to 53.3% postoperatively (P = 0.002), suggesting that surgery exacerbated the anemia rate. Mean HB levels, which were within the normal range preoperatively (12.8±1.5 g/dL), dropped significantly to 10.8±1.9 g/dL after surgery (P = 0.001), indicating a substantial reduction. Similarly, mean corpuscular volume (MCV) decreased from 81.8±4.6 fL to 76.5±5.5 fL (P = 0.002), showing a shift toward microcytic anemia. Serum iron levels fell from 72.4±37.3 µg/dL preoperatively to 55.3±24.6 µg/dL postoperatively (P = 0.001), alongside a significant reduction in ferritin levels, from 93.4±30.5 µg/mL to 35.6±21.2 µg/mL (P = 0.001). These findings indicate that surgical intervention significantly impacts patients' iron stores and red blood cell parameters, necessitating close postoperative monitoring to address potential anemia and related complications.

**Table 5:** Impact of surgical intervention on HB levels and laboratory parameters

Variables	Preoperative HB (g/dL) 60 (100.0)	Postoperative HB (g/dL) 60 (100.0)	P-value
Anemia Men: Hb < 13.0 g/dL Women: < 12.0 g/dL	12 (20.0)	32 (53.3)	0.002
No Anemia	48 (80.0)	28(47.7)	
Laboratory Parameters & normal range	Pre-Operation Mean±SD	Post-Operation Mean±SD	* P-value
HB (g/dL) Men: 13.0 - 17.0 g/dL Women: 12.0 - 15.0 g/dL	12.8±1.5	10.8±1.9	0.001
MCV (80 - 100 fL)	81.8±4.6	76.5±5.5	0.002
Iron (60 - 170 µg/dL)	72.4±37.3	55.3±24.6	0.001
Ferritin (µg/mL) Men: 20 - 500 µg/mL Women: 20 - 200 µg/mL	93.4±30.5	35.6±21.2	0.001
* Significant difference between two independent means using Students-t-test at 0.05 level			

## Discussion

In the presence of different complications associated with bariatric surgery, many healthcare professionals still face low hemoglobin levels postoperatively. The key findings of this study indicate that a significant proportion (53.3%) of participants experienced anemia postoperatively. Notably, preoperative anemia was a strong predictor of postoperative anemia, with all preoperatively anemic patients developing anemia after surgery. The average weight loss among participants was 23.3 kg, and while most adhered to the diet plan and tolerated red meat, a significant portion faced gastrointestinal symptoms and other food restrictions. Laboratory analyses revealed substantial declines in HB, MCV, serum iron, and serum ferritin levels post-surgery. Additionally, educational level and BMI category showed significant associations with anemia, while factors such as operation type, adherence to diet, and gastrointestinal symptoms did not. These results underscore the need for targeted nutritional interventions and educational programs to improve outcomes for bariatric patients, particularly those with preoperative anemia, to mitigate the risk of postoperative anemia.

Previous research in Iraq on bariatric surgery and anemia is relatively limited. However, studies such as those by Al-Jumaili *et al.* (2021) and Mohammed *et al.* (2022) provide insights into similar populations. Al-Jumaili *et al.* observed that postoperative anemia was a common complication among bariatric patients in Iraq, with a prevalence of approximately 50% [9]. This study's finding of 53.3% aligns closely with local findings; supporting the notion that postoperative anemia is a significant issue in the Iraqi context.

Mohammed *et al.* (2022) explored the impact of different bariatric procedures on nutritional deficiencies, highlighting that sleeve gastrectomy often led to deficiencies in iron and vitamin B12, similar to the results observed in this study [10]. These deficiencies are primarily due to altered digestive anatomy and reduced gastric volume from bariatric procedures, impairing nutrient absorption. This study links anemia to declines in HB and iron levels, highlighting the need for careful nutritional monitoring and supplementation, especially for iron and vitamin B12 in patient's post-sleeve gastrectomy.

Globally, research supports the association between bariatric surgery and increased risk of postoperative anemia. A comprehensive review by Schindler *et al.* (2023) indicated that anemia is a frequent postoperative complication, particularly among patients who have undergone sleeve gastrectomy or gastric bypass [11]. This study's results corroborate these global findings, with significant postoperative declines in HB, MCV, and serum iron levels. In contrast, the study by Cummings *et al.* (2023) reported a slightly lower prevalence of postoperative anemia in a sample of bariatric surgery patients in Europe, where the rate was approximately 40% [12]. This discrepancy might be attributed to differences in dietary supplementation practices or variations in the types of bariatric procedures performed. The significant link observed between lower educational levels and a higher prevalence of anemia in this study. Research by Liang *et al.* (2023) has similarly found that lower education levels often correlate with poorer nutritional outcomes and higher rates of anemia among postoperative bariatric patients [13]. This suggests that education may influence adherence to dietary recommendations and supplement use.

The association between higher BMI categories and increased prevalence of anemia observed in this study aligns with the findings of Adams *et al.* (2023), who reported that patients with higher preoperative BMI are at greater risk for postoperative anemia [14]. This could be due to the greater extent of weight loss and subsequent nutritional deficiencies experienced by individuals with higher BMI.

The significant relationship between the use of postoperative supplements and anemia is particularly intriguing. Studies by Kwon *et al.* (2022) have suggested that while supplementation is intended to prevent anemia, inappropriate or insufficient supplementation might contribute to persistent anemia [15]. This study's findings suggest that the type and adequacy of postoperative supplements may require further evaluation to optimize anemia management.

The association between the time elapsed since surgery and anemia observed in this study reflects similar findings by Klink *et al.* (2023), who noted that anemia often develops or worsens over time post-surgery due to progressive nutrient deficiencies [16]. This underscores the need for ongoing

monitoring and adjustment of nutritional interventions long after the initial surgery.

The significant declines in HB, MCV, serum iron, and serum ferritin levels observed postoperatively are consistent with the results reported by Hsu *et al.* (2023), who documented similar declines in laboratory parameters among bariatric surgery patients [17]. These changes highlight the need for vigilant monitoring of nutritional status and timely intervention to address deficiencies.

### Conclusion

The study indicated that more than half of the patients who underwent bariatric surgery experienced significant postoperative iron deficiency anemia, with significant declines noted in HB, MCV, and serum iron levels after the procedure. Associations were identified between preoperative anemia, educational level, and BMI and the occurrence of anemia. Conversely, the type of surgical procedure and adherence to dietary guidelines did not demonstrate a significant relationship with anemia. Continuous monitoring and tailored nutritional interventions are essential for effectively addressing these issues.

### Recommendation

The study underscores the high prevalence of IDA after bariatric surgery, highlighting the need for regular anemia screening, personalized iron supplementation, dietary counseling, and research into long-term prevention strategies.

### Acknowledgments

The researcher expresses deep gratitude to Dr. Bassam Francis Matti and Dr. Besmah Mohammed Ali Ibrahim for their exceptional guidance and support throughout the study. Special thanks are also given to the Supervising Committee of the Arab Board of Health Specializations for their approval and commitment to ethical standards, ensuring the study's integrity. Finally, heartfelt appreciation is extended to the study participants, whose cooperation was vital to the research's success and achievement of its objectives.

### Conflict of Interest

All contributing authors declare no conflict of interest with regards to the publication of this article.

### Financial support

This study was entirely self-funded by the researcher and did not receive any financial support from any institution or organization.

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