E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.869

Original Research Article

Prevalence and Influencing Factors of Post-Caesarean Section Anemia at a Tertiary Care Hospital in Pakistan: A Retrospective Observational Study

Syeda Mahrukh Fatima Zaidi[1], Samra Kashif Lone[2], Sarwat Laqa[2], Saeeda Begum[2], Abdul Rahman Qureshi[2], Syeda Abiha Rabab[1]

[1]Registrar, Department of Gyne & Obs, Memon Medical Institute Hospital, Karachi, Pakistan.
[2]Consultant, Department of Gyne & Obs, Memon Medical Institute Hospital, Karachi, Pakistan.

Corresponding Author
Syeda Mahrukh Fatima Zaidi, Registrar, Department of Gyne & Obs, Memon Medical Institute Hospital, Karachi, Pakistan.
Email: mahrukhfatima2010@live.com

Received: 14-08-2026 Revised: 26-10-2026 Accepted: 10-11-2026 Published: 10-11-2026

ABSTRACT

Background: The prevalence of cesarean sections (CS) in Pakistan has risen alongside global trends, driven by medical necessity and patient preference. This increase raises concerns about maternal health, particularly the risk of postpartum anemia exacerbated by intraoperative blood loss. Pre-existing anemia, compounded by iron deficiency and childbirth-related factors, significantly heightens this risk. Despite global research on CS-related complications, specific studies on severe post-cesarean anemia in Pakistan are lacking. This study aims to fill this gap by exploring the prevalence and contributing factors of severe postpartum anemia following CS, which is essential for targeted interventions to enhance maternal health outcomes in Pakistan.

Methods: This retrospective observational study at Memon Medical Institute Hospital (MMIH) Karachi from January to April 2024 aimed to assess the influence of maternal blood group, parity, and previous cesarean sections on postoperative hemoglobin levels in women undergoing Lower Segment Cesarean Section (LSCS).

Results: The study included 204 patients, among whom 75.9% of the women had postoperative anemia. The analysis revealed a risk of developing anemia after a caesarean section was 17.22 times higher in females who had anemia before the procedure compared to those who did not (aOR 17.224, 95% CI: 5.137-57.744, p<0.05). Factors such as a history of multiple cesarean sections, emergency cesarean sections, and multiple parity were identified as the most common factors influencing postoperative anemia in the study.

Conclusion: Cesarean section rates are increasing globally, leading to high rates of postoperative anemia, especially in low- and middle-income countries. Our study found a 75.9% prevalence of anemia linked to preoperative hemoglobin levels, prior C-sections, and emergency procedures, highlighting the need for improved nutritional interventions and counseling.

Keywords: Anemia during pregnancy; Cesarean delivery; Postpartum anemia; Postpartum hemorrhage; Women.

INTRODUCTION

Cesarean section (CS) is one of the most common surgical procedures performed globally, including in Pakistan, often necessitated by various obstetric complications or maternal health concerns. In 2018, more than half of all deliveries were cesarean sections in Brazil, Egypt, and Turkey. Data from the United States of America, Australia, and Germany reveal that almost one in every three pregnant women has a cesarean section delivery[1]. Similarly, a rising trend of cesarean section deliveries has been documented in South Asian countries including Pakistan, where it increased from 3.2% (1990) to 20% (2018) [1,2]. The request of the mother for a cesarean section can also be considered as

a non-medical reason that has contributed to the upsurge of the cesarean rate[3]. This continuing rise in the CS rate is of debatable benefit worldwide, but alarmingly high maternal morbidity and mortality associated with operative delivery in developing countries such as Pakistan makes it a matter of concern (Najmi, 2000) [4]

Cesarean section has been shown to increase the risk of postpartum anemia (hemoglobin level of less than 11g/dl) by twofold[5]. Many factors would be implicated to affect intraoperative blood loss during CS e.g. maternal causes; weight, parity, previous CS, fetal causes; multiple gestations, poly-hydramnios, malpresentation, technical causes; operative time, type of incision, placental separation technique, placental position and the type of anesthesia[6]. The main risk factor for postpartum anemia is pre-existing anemia—especially due to iron deficiency combined with blood loss during delivery[7,8]. Sivahikyako et al (2021) also stated the factors independently associated with severe anemia post cesarean section were: having mild or moderate anemia pre-caesarean section and a macrosomic birth > 400 g[9]. The rate of post-CD blood transfusion varies from 0.36% in developed countries[10] to 25.2% in developing countries[11]. One of the measurements of blood loss during cesarean section is a calculation based on postoperative decrement of hemoglobin (Hb). Given limited resources, most women are discharged after cesarean section with an unknown hemoglobin concentration. To skilfully identify women who are vulnerable to severe anemia after cesarean section for appropriate intervention before hospital discharge, the prevalence of postpartum anemia in each setting must be monitored, and factors associated with anemia after cesarean delivery evaluated.

This study addresses the prevalence and factors associated with severe anemia following cesarean section (CS) in Pakistan. While existing research in the region has examined maternal morbidity in CS patients including anesthesia-related complications and inadequate iron intake during pregnancy, and comparison of outcomes in patients undergoing elective and emergency cesarean section, there is a notable gap in studies specifically focusing on the prevalence of post-cesarean anemia and its underlying causes[12,13,14]. However, an Ethiopian study by Zewdu et al (2023), has shed light on the prevalence and predictors of postpartum anemia (PPA) following CS such as grand parity, placenta previa, prepartum anemia, and postpartum hemorrhage (PPH)[15]. However, these findings need to be contextualized within the Pakistani healthcare system to effectively inform strategies for reducing the prevalence of severe anemia after CS and improving maternal health outcomes[15].

METHODS

An observational retrospective study was conducted at Memon Medical Institute Hospital (MMIH) in Karachi from January 2024 to April 2024. The study aimed to analyze various factors affecting postoperative hemoglobin levels in women who underwent Lower Segment Cesarean Section (LSCS). Data were extracted from the hospital's electronic health records and patient's surgical operation records following approval from the Institutional Review Board (IRB) (Date 21-05-2024 / No IRB/MMIH/2024/32 and informed consent from the participants. The study involved postpartum women aged 18 and older who had undergone elective or emergency LSCS, excluding those who had received transfusions before the operation or had pre-existing medical conditions affecting hemoglobin levels. The data encompassed demographic details, obstetric history, prepartum anemia status, parity, presence of placenta previa, estimated blood loss, occurrence of postpartum hemorrhage, and postpartum management details. Additionally, information regarding the baby's characteristics, such as blood group, weight, and gender, was also documented.

Quantitative variables, such as age, will be presented as mean, while qualitative variables, such as parity and type of c-section, will be reported as frequency and percentage. Regression analysis was utilized to identify predictors influencing postoperative hemoglobin levels, with statistical significance set at $p < 0.05$.

RESULTS

We obtained a total of 204 medical records for women who underwent cesarean sections from the Hospital Information Management System (HIMS) and patient's surgical operation records. The mean age

of the women was 29±4.72 years, and notably, 75.9% (n=155) of them experienced postoperative anemia. Our analysis revealed that women with two cesarean sections were significantly more susceptible to post-operative anemia (52.3%, n=81) compared to those with a single cesarean section (33.5%, n=52) (p<0.05). Furthermore, post-operative anemia was markedly more common in multigravida women (74.8%, n=116) than in primigravida women (25.2%, n=39), **(Table 1)**.

Out of 204 women who underwent cesarean delivery, the most common indication for it was a previous scar followed by non-progression of labor. Among these women, those who had undergone a previous cesarean delivery were more likely to develop postoperative anemia. (p<0.05), **(Table 2)**

The likelihood of developing anemia after a caesarian section is 17.22 times higher in females who had anemia before the procedure than those who did not (aOR 17.224, 95% CI: 5.137-57.744, p<0.05). Other factors which independently associated with post-operative anemia included gestation (aOR 2.424, 95% CI: 1.241-4.735, p<0.05) and the type of caesarian section (aOR 2.994, 95% CI: 1.539-5.827, p<0.05), **(Table 3)**.

To increase postoperative hemoglobin levels, various interventions were implemented. The most common interventions were oral iron sulfate, administered to 59.31% (n=121) of patients, and ferricit injections, given to 32.35% (n=66) of patients. The remaining 7.35% (n=15) received blood transfusions.

Characteristics	Post op Anemia			P-value
	Overall (N=204)	Yes (N=155)	No (N=49)	
Age in years, Mean±S.D	29±4.72	29.15±4.58	28.51±5.17	0.412
Age Category (years), n(%)				
19-25	48(23.5)	35(22.6)	13(26.5)	0.831
26-35	137(67.2)	105(67.7)	32(65.3)	
35+	19(19.3)	15(19.7)	4(8.2)	
Weight category (Kg), n(%)				
31-60	17(8.3)	14(9)	3(6.1)	0.703
61-90	174(85.3)	132(85.2)	42(85.7)	
90+	13(6.4)	9(5.8)	4(8.2)	
Pre Op Anemia (g/dL), n(%)				
≥ 11 No	119(58.3)	73(47.1)	46(93.9)	0.001
< 11 Yes	85(41.7)	82(52.9)	3(6.1)	
No. of Caesarian section, n(%)				
1st	82(40.2)	52(33.5)	30(61.2)	0.002
2nd	95(46.6)	81(52.3)	14(28.6)	
3rd or more	27(13.2)	22(14.2)	5(10.2)	
Gestation, n(%)				
Primigravida	61(29.9)	39(25.2)	22(44.9)	0.012
Multigravida	143(70.1)	116(74.8)	27(55.1)	
Caesarian Section Type, n(%)				
Emergency	**65(31.9)**	**40(25.8)**	**25(51)**	**0.001**
Elective	**139(68.1)**	**115(74.2)**	**24(49)**	

Table 1: Baseline characteristics of women with postpartum anemia

Indications of C-section	N (%)	Post-Op Anemia		
		Yes	No	P-value
Malpresentation	16(7.8)	12(7.7)	4(8.2)	
Maternal wish	6(2.9)	4(2.6)	2(4.1)	
Non-progression of labour	43(21.1)	26(16.8)	17(34.7)	0.016
Placenta previa	10(4.9)	8(5.2)	2(4.1)	
Previous scar	118(57.8)	99(63.9)	19(38.8)	
Reactive CTG	11(5.4)	6(3.9)	5(10.2)	

Table 2: Cesarean Delivery and post operative anemia

Factors	*cOR(95% C.I)*	*p-value*	*aOR(95% C.I)*	*p-value*
Pre Op Anemia (g/dL)				
≥ 11	**Reference**			
< 11	17.224(5.137-57.744)	0.001	16.990(4.978-57.984)	0.001
Gestation				
Primigravida	**Reference**			
Multigravida	2.424(1.241-4.735)	0.010	0.953(0.301-3.108)	0.935
Caesarian Section Type				
Emergency	**Reference**			
Elective	2.995(1.539-5.827)	0.001	2.159(0.831-5.611)	0.114
No. of Caesarian Section				
1st	**Reference**			
2nd	3.338(1.619-6.883)	0.001	1.955(0.560-6.824)	0.293
3rd or more	2.538(0.871-7.400)	0.088	1.431(0.303-6.754)	0.651
Age (years)				
19-25	**Reference**			
26-35	1.219(0.576-2.579)	0.605		
35+	1.393(0.390-4.977)	0.610		
Weight (Kg)				
31-60	**Reference**			
61-90	0.673(0.185-2.457)	0.549		
90+	0.482(0.087-2.680)	0.405		
Macrosomia (Kg)				
< 4	**Reference**			
≥ 4	2.612(0.319-21.423)	0.371		
Indication of C section				
Malpresentation	**Reference**			
Maternal wish	0.667(0.087-5.127)	0.697		
Non progression of labour	0.510(0.141-1.845)	0.305		
Placenta Previa	1.333(0.196-9.083)	0.769		
Previous Scar	1.737(0.506-5.963)	0.380		
Reactive CTG	0.400(0.078-2.062)	0.273		

Table 3: Factors influency post operative anemia

DISCUSSION

Cesarean section rates are high and rising globally, with one in five women delivering via Cesarean and an average global rate of 18.6%, ranging from 6.0% in the least developed to 27.2% in the most developed regions[16]. Annually, over 23 million Cesarean sections are performed, accounting for nearly one-third of all surgical procedures in low-income countries[17]. This rise has significant implications for maternal health, especially in regions like Pakistan. Anemia, prevalent among women globally due to factors such as micronutrient deficiencies and various diseases[18], presents symptoms like fatigue and dizziness and increases risks of premature delivery, low-birthweight infants, and postpartum depression. In 2019, nearly 37% of pregnant women worldwide were anemic[19], and despite the global focus, no country is on track to reduce maternal anemia by 50% by 2025[20]. In the UK, iron deficiency anemia in pregnancy reached up to 30.4%, rising to 41.3% postpartum[21]. In Pakistan, anemia is a major public health issue, with prevalence rates of 26% in urban and 47% in rural areas among reproductive-aged women[33]. Pregnant women in urban areas face anemia rates from 29% to 50%[34,35]. Our study highlights that lower preoperative hemoglobin levels are linked to a higher likelihood of postoperative anemia in Cesarean section patients, indicating that pre-existing anemia may worsen due to surgical blood loss, and

underscores the need for further research into this association.

In our study, the most prevalent indication for cesarean section associated with postoperative anemia was a previous scar, affecting 63.9% of women with anemia. While a prior cesarean section does not always necessitate a cesarean in future pregnancies, the perceived safety for both physicians and mothers often leads to repeated cesarean deliveries[23]. Non-progression of labor was the second most common indication, seen in 16.8% of cases with anemia **(Table 2).** Maternal wish was a less frequent indication, noted in 2.6% of women with postoperative anemia. Although the overall p-value of 0.016 suggests variability among indications, individual odds ratios did not show a statistically significant association with anemia. Maternal wish was the least common indication for cesarean sections and did not show a significant association with postoperative anemia (OR = 0.667, p = 0.697). However, counseling should emphasize the potential risks associated with elective cesareans, including increased postoperative anemia and neonatal risks such as higher mortality, respiratory diseases, and type 1 diabetes compared to vaginal delivery[24]. Thorough preoperative preparation and informed decision-making are crucial to optimize outcomes.

Our retrospective observational study at Memon Medical Institute Hospital (MMIH) in Karachi found that 75.9% of women who underwent Cesarean sections experienced postoperative anemia **(Table 1).** This aligns with global data, highlighting the challenge of postpartum anemia, particularly in low- and middle-income countries (LMICs) where nutritional deficiencies and limited access to comprehensive maternal healthcare are common[9,22]. The study aimed to assess the prevalence and factors influencing anemia following C-sections, addressing the lack of research on the risk factors and health outcomes associated with post-C-section anemia. By investigating contributors such as perioperative hemoglobin levels, gestational age, type of C-section, history of previous C-sections, maternal age, weight at delivery, macrosomia, and reasons for the procedure, we hope to enhance maternal care and health outcomes after cesarean delivery.

In examining the baseline characteristics of our study population, we found no significant differences in age and weight categories between women with and without postoperative anemia. However, preoperative anemia emerged as a critical predictor. Women with preoperative hemoglobin levels below 11 g/dL were significantly more likely to develop postoperative anemia (aOR: 16.990, 95% CI: 4.978-57.984, p<0.01). Among those with preoperative anemia, 96.5% developed postoperative anemia, compared to 61.3% with normal preoperative hemoglobin levels. Similar findings were observed in Southwest Nigeria, where pre-caesarean anemia increased the odds of requiring blood transfusions twelvefold[25], and in Egypt, where hemoglobin levels below 11.0 g/dL increased the risk of primary postpartum hemorrhage sevenfold, leading to severe postpartum anemia[26]. Low preoperative hemoglobin impairs oxygen transport to the uterus, affecting myometrial contractility and leading to uterine atony and postpartum hemorrhage, which exacerbates pre-existing anemia. This underscores the importance of addressing anemia before delivery, as preoperative hemoglobin status is a modifiable risk factor significantly impacting postoperative outcomes.

Our study also identified that women undergoing multiple Cesarean sections are at a higher risk of developing postoperative anemia. Our study revealed that 63.4% of women with their first C-section developed postoperative anemia, while 85.3% of those with a second C-section and 81.5% of those with a third or more C-sections experienced anemia. This indicates that the risk of anemia increases with the number of C-sections. Specifically, women with a second C-section had the highest prevalence of anemia at 85.3%. Although the crude odds ratio for a second C-section was significant (OR = 3.338, p = 0.001), the association was not significant after adjustment (aOR = 1.955, p = 0.293) **(Table 3)**. This trend is consistent with other studies that have shown repeated surgical interventions increase the likelihood of blood loss and subsequent anemia. A study by *Park et al.* (2017) found that repetitive cesarean delivery (RCD) is independently associated with increased anemia and iron deficiency, with odds ratios of 1.47 (95%

CI: 1.21–1.79, p < 0.001) and 1.42 (95% CI: 1.21–1.67, p < 0.001), respectively, compared to vaginal delivery only, highlighting the elevated risk of anemia associated with multiple C-sections[27]. The cumulative effect of multiple surgeries on maternal health necessitates careful monitoring and management strategies to mitigate the risks.

Multigravida women demonstrated a higher rate of postoperative anemia compared to primigravida women, with 116 out of 143 multigravida women (74.8%) affected, versus 39 out of 61 primigravida women (25.2%). This correlation may be due to increased physiological demands and potential nutritional deficiencies with multiple pregnancies[28]. Baig et al. similarly found that multigravida women were more prone to anemia[29], and a study by Ali et al. in Tanzania reported higher anemia rates in women with greater parity[30]. Conversely, Chikwendu et al. in Nigeria found higher anemia rates in primigravida women, which could be due to differences in study methodology, population characteristics, or healthcare practices[31]. In our study, the crude odds ratio (cOR) for multigravida women was 2.424 (95% CI: 1.241-4.735, p = 0.010), but this significance diminished after adjusting for other variables, with the adjusted odds ratio (aOR) being 0.953 (95% CI: 0.301-3.108, p = 0.935), suggesting that the initial correlation may be influenced by additional factors.

Emergency cesarean sections are a significant risk factor for postoperative anemia due to greater blood loss and less optimal conditions. In our study, 25.8% of women undergoing emergency C-sections developed anemia, compared to 74.2% of those with elective C-sections. This is consistent with Raees et al., who reported higher postpartum anemia rates in emergency (70%) versus elective C-sections (40%)[12]. The crude odds ratio for emergency C-sections was 2.995 (95% CI: 1.539-5.827, p < 0.01), though it decreased to 2.159 (95% CI: 0.831-5.611, p = 0.114) after adjustment, indicating other factors also contribute. These findings are supported by research in LMICs, where preoperative anemia, multiple pregnancies, and emergency C-sections are associated with increased postpartum anemia risks[12,29-30]. For instance, a study in Nigeria reported a postpartum anemia prevalence of 58%, significantly associated with preoperative anemia and emergency C-sections[32].

Increased iron demand and enhanced maternal iron absorption during pregnancy are well-documented [**36**], but simple hemoglobin concentration alone cannot accurately reflect maternal iron status due to plasma volume expansion, which dilutes hemoglobin levels. This dilution effect is more pronounced in women with multiple gestations or large babies [**37**]. Fetal macrosomia, which can lead to prolonged labor, operative delivery, and postpartum hemorrhage, may exacerbate postpartum anemia due to increased uterine vascularity and surgical trauma. Our study found a positive association between macrosomia and postpartum anemia; however, macrosomia (defined as birth weight ≥ 4 kg) was not statistically significant in our analysis (p = 0.371), likely due to the small number of macrosomic cases (3 or 4). Nevertheless, the crude odds ratio (cOR) for postpartum anemia in mothers with macrosomic babies was 2.612, indicating twice the risk of developing anemia compared to those with normal birth weight babies. This aligns with other studies **(9, 26, 38)**, which report a significant association between macrosomia and increased postpartum anemia risk. Despite the lack of robust statistical evidence, our findings suggest that further research with larger sample sizes is necessary better to understand the impact of macrosomia on postoperative anemia.

To mitigate the risk of postoperative anemia, interventions such as oral iron sulfate and Ferricit injections were administered to 59.31% and 32.35% of women, respectively, while 7.35% received blood transfusions (Hb < 7 g/dL). Although effective, these measures reflect a reactive rather than preventive approach. Addressing anemia preoperatively through nutritional supplementation and antenatal care could reduce postoperative anemia and its associated morbidities. A multidisciplinary panel, including FIGO and EBCOG experts, recommends daily oral iron (30–60 mg) and folic acid (400 µg) supplementation during pregnancy in high anemia prevalence areas to lower maternal anemia, iron deficiency, and low birth weight[39]. Healthcare providers should counsel women on the risks associated with multiple cesarean sections and

emphasize optimizing maternal health before surgery. While emergency cesarean sections are sometimes unavoidable, proper counseling on their indications and risks can help women make informed delivery choices. In Pakistan, where anemia rates are notably high, especially in rural areas, targeted interventions and public health campaigns are crucial for improving maternal outcomes. Early diagnosis and treatment of severe anemia are essential, and screening women with low preoperative hemoglobin and macrosomic fetuses for hemoglobin optimization before and during cesarean sections can help address this issue[9].

Limitations

Our study has several limitations. The retrospective design inherently limits causal inferences, and potential confounding variables may not be fully accounted for. Additionally, it may also be subjected to recall bias or incomplete data. The relatively small sample size, particularly the low number of macrosomic cases, restricts the generalizability of our findings and the power to detect statistically significant associations. Our study was conducted at a single tertiary care hospital, which may not reflect the broader population or different healthcare settings. The lack of standardized perioperative care and varying practices in managing anemia and cesarean sections could also influence the outcomes. The exclusion of patients with pre-existing conditions affecting hemoglobin levels may also limit the generalizability of our findings to all postpartum women. Future research should aim to include larger, multicenter studies with prospective designs to better understand the risk factors and mechanisms underlying post-Caesarean section anemia and to develop effective preventive strategies.

CONCLUSION

Cesarean section rates are rising globally, with substantial regional variation. This trend poses significant risks for postoperative anemia, particularly in low- and middle-income countries such as Pakistan. Our study at Memon Medical Institute Hospital revealed that 75.9% of women experienced postoperative anemia, closely associated with low preoperative hemoglobin levels, a history of previous C-sections, and emergency procedures. Factors like preoperative deficiencies and the cumulative effects of multiple surgeries exacerbate anemia. Addressing this issue requires preoperative nutritional interventions to improve maternal hemoglobin levels, including iron and folic acid supplementation. Additionally, comprehensive counseling on the risks associated with multiple cesarean sections is crucial for informed decision-making. Strengthening public health strategies and antenatal care can significantly reduce anemia and enhance maternal health outcomes. Effective management and targeted interventions are essential to mitigate the risks and improve overall care for women undergoing cesarean deliveries.

DECLARATIONS

1. **Ethics approval and consent to participate:** This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University of Ulm (Date 21-05-2024 / No IRB/MMIH/2024/32..
2. **Consent for publication:** For this type of study, formal consent is not required.
3. **Availability of data and materials:** Data and materials used for the preparation of this manuscript can be available upon request.
4. **Conflict of interests:** The authors declare that they have no conflict of interests.
5. **Funding:** The authors received no extramural funding for this study.

REFERENCES

1. Niino Y. The increasing cesarean rate globally and what we can do about it. Biosci Trends. 2018;5(4):139–50.
2. Boatin AA, Schlotheuber A, Betran AP, Moller AB, Barros AJ, Boerma T, et al. Within country inequalities in cesarean section rates: an observational study of 72 low- and middle-income countries. BMJ. 2018;360:k55.
3. Hildingsson I, Rådestad I, Rubertsson C, Waldenström U. Few women wish to be delivered by cesarean section. BJOG Int J Obstet Gynaecol. 2002;109(6):618–23.
4. Ansari A, Baqai S, Imran R. An Audit of Cesarean Section Rate Using Modified Robson Criteria at a Tertiary Care Hospital. J Coll Physicians Surg Pak.

2019 Aug;29(8):768-770. doi: 10.29271/jcpsp.2019.08.768. PMID: 31358101.
5. Bergmann RL, Richter R, Bergmann KE, Dudenhausen JW. Prevalence and risk factors for early postpartum anemia. Eur J Obstet Gynecol Reprod Biol. 2010 Jun;150(2):126-31. doi: 10.1016/j.ejogrb.2010.02.030. Epub 2010 Mar 29. PMID: 20303210.
6. Ashraf Aly H, Ramadani HM. Assessment of blood loss during cesarean section under general anesthesia and epidural analgesia using different methods. AJAIC. 2006;9(1):25-34.
7. Butwick AJ, Walsh EM, Kuzniewicz M, Li SX, Escobar GJ. Patterns and predictors of severe postpartum anemia after Cesarean section. Transfusion. 2017 Jan;57(1):36-44. doi: 10.1111/trf.13815. Epub 2016 Sep 13. PMID: 27618767; PMCID: PMC5243180.
8. Milman N. Postpartum anemia I: definition, prevalence, causes, and consequences. Ann Hematol. 2011 Nov;90(11):1247-53. doi: 10.1007/s00277-011-1279-z. Epub 2011 Jun 28. PMID: 21710167.
9. Sivahikyako, S.A., Owaraganise, A., Tibaijuka, L. *et al.* Prevalence and factors associated with severe anemia post-caesarean section at a tertiary Hospital in Southwestern Uganda. *BMC Pregnancy Childbirth* **21**, 674 (2021). https://doi.org/10.1186/s12884-021-04157-x
10. Chua SC, Joung SJ, Aziz R. Incidence and risk factors predicting blood transfusion in caesarean section: original article. *Aust NZ J Obstet Gynaecol*. 2009;49(5):490–493. doi:10.1111/j.1479-828X.2009.01042.x
11. Ozumba BC, Ezegwui HU. Blood transfusion and cesarean section in a developing country. *J Obstet Gynaecol*. 2006;26(8):746–748. doi:10.1080/01443610600955792.
12. Raees M, Yasmeen S, Jabeen S, Utman N, Karim R. Maternal morbidity associated with emergency versus elective cesarean section. Journal of Postgraduate Medical Institute. 2013;27(1). Google Scholar
13. Rabia S, Jalil N, Feroze S, Iqbal M. Frequency and determinants of maternal anemia in early postpartum period. ANNALS OF ABBASI SHAHEED HOSPITAL AND KARACHI MEDICAL & DENTAL COLLEGE. 2018 Mar 31;23(1):15-20. DOI: https://doi.org/10.58397/ashkmdc.v23i1.46
14. Zahid N, Munawar I, Aslam A, Mirza SA. Comparison of outcome in patients undergoing elective and emergency cesarean section. Journal of Rawalpindi Medical College. 2016 Mar 30;20(1). Google Scholar
15. Zewdu D, Tantu T, Ali R, et al. Prevalence and predictors of postpartum anemia after cesarean delivery in Ethiopia: a retrospective analysis of risk factors. Midwifery 2023;123. doi:10.1016/j.midw.2023.103707 Google Scholar
16. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990-2014. PLoS One. 2016 Feb 5;11(2):e0148343. doi: 10.1371/journal.pone.0148343. PMID: 26849801; PMCID: PMC4743929.
17. Dennis A, Ferguson M, Jackson S. The prevalence of perioperative iron deficiency anaemia in women undergoing caesarean section—a retrospective cohort study. Perioper Med. (2022) 11:36. 10.1186/s13741-022-00268-x
18. Chaparro CM, Suchdev PS. Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. Ann N Y Acad Sci. 2019 Aug;1450(1):15-31. doi: 10.1111/nyas.14092. Epub 2019 Apr 22. PMID: 31008520; PMCID: PMC6697587.
19. WHO. Anaemia in women and children. 2022. https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children#:~:text=In%202019%2C%20global%20anaemia%20prevalence,39.1%25)%20in%20pregnant%20women. Accessed 31 Jul 2022.
20. NHS England. Saving Babies Lives. Accessed April 2021. Available at: www.england.nhs.uk/?s=saving+babies+lives

21. Royal College of Obstetricians and Gynaecologists. Each Baby Counts 2019 Progress Report. Accessed April 2021. Available at: www.rcog.org.uk/en/guidelines-research-services/audit-quality-improvement/each-baby-counts/reports-updates/
22. Lakew G, Yirsaw AN, Berhie AY, Belayneh AG, Bogale SK, Getachew E, Andarge GA, Seid K, Bogale EK. Prevalence and associated factors of anemia among postpartum mothers in public health facilities in Ethiopia, 2024: a systematic review and meta-analysis. BMC Pregnancy Childbirth. 2024 Apr 27;24(1):327. doi: 10.1186/s12884-024-06525-9. PMID: 38678183; PMCID: PMC11055361
23. Deutsches IVF Register (D.I.R.). Available from: www.deutsches-ivf-register.de/ [accessed 10 September 2014].
24. Signore C, Klebanoff M. Neonatal morbidity and mortality after elective cesarean delivery. Clin Perinatol. 2008 Jun;35(2):361-71, vi. doi: 10.1016/j.clp.2008.03.009.' PMID: 18456074; PMCID: PMC2475575.
25. Akinlusi FM, Rabiu KA, Durojaiye IA, Adewunmi AA, Ottun TA, Oshodi YA. Caesarean delivery-related blood transfusion: correlates in a tertiary hospital in Southwest Nigeria. *BMC Pregnancy Childbirth.* 2018;18(1):24. doi: 10.1186/s12884-017-1643-7.
26. El Badawy A, Waly E, Zaitoun N, Abo-Elwan Y. Assessment of risk factors for primary postpartum hemorrhage at Zagazig university hospitals. *Zagazig Univ Med J.* 2017;23(2):1–9. doi: 10.21608/zumj.2017.4684.
27. Park JY, Lee SW. A history of repetitive cesarean section is a risk factor of anemia in healthy perimenopausal women: The Korea National Health and Nutrition Examination Survey 2010-2012. PLoS One. 2017 Nov 30;12(11):e0188903. doi: 10.1371/journal.pone.0188903. PMID: 29190715; PMCID: PMC5708789.
28. Leflamme EM. Maternal haemoglobin concentration & pregnancy outcome: a study of the effects of elevation in EL ALTO, Bolivia. Mcgill J Med 2011; 13(1): 47-55.PMCID: PMC3296152 https://doi.org/10.26443/mjm.v13i1.244
29. Baig JA, Jamal MM, Jamal J, Musarrat M. To determine the association of maternal anemia with perinatal outcome in tertiary care hospital. Pakistan Armed Forces Medical Journal. 2020 Apr 30;70(2):302-07.
30. Ali MM, Ngowi AF, Gibore NS. Prevalence and obstetric factors associated with anaemia among pregnant women, attending antenatal care in Unguja island, Tanzania: Int J Community Med Public Health 2019; 6(3): 950-95. Doi: https://doi.org/10.18203/2394-6040.ijcmph20190577
31. Chikwendu MC, Nkemena B, Udigwe GO, Obiechina NJA, Nnaji GA. Risk factors for anaemia in pregnancy at the first antenatal clinic visit at Nnamdi Azikiwe university teaching hospital, Nnewi. Tropical J Obstetrics Gynaecol 2015; 32(1): 14- 26.
32. The World Bank. Prevalence of anemia among pregnant women (%) - Nigeria | Data. 2016 [cited 2 February 2021]. Available from: https://data.worldbank.org/indicator/SH.PRG.ANEM?locations=NG
33. Federal Bureau of Statistics (Pakistan), Government of Pakistan, National Center for Health Statistics, Centers for Disease Control and Prevention, Pakistan Medical Research Council. Pakistan national health survey 1990-1994. [cited 2024]. Available from: https://ghdx.healthdata.org/record/pakistan-national-health-survey-1990-1994
34. Aziz-Karim S, Khursheed M, Rizvi JH, Jafarey SN, Siddiqui RI. Anaemia in pregnancy--a study of 709 women in Karachi. Trop Doct. 1990 Oct;20(4):184-5. doi: 10.1177/004947559002000421. PMID: 2284682.
35. Lone FW, Qureshi RN, Emanuel F. Maternal anaemia and its impact on perinatal outcome. Trop Med Int Health. 2004 Apr;9(4):486-90. doi: 10.1111/j.1365-3156.2004.01222.x. PMID: 15078267.
36. Georgieff MK. Iron deficiency in pregnancy. Am J Obstet Gynecol. 2020 Oct;223(4):516-524. doi: 10.1016/j.ajog.2020.03.006. Epub

2020 Mar 14. PMID: 32184147; PMCID: PMC7492370.

37. Steer PJ. Maternal hemoglobin concentration and birth weight. Am J Clin Nutr. 2000 May;71(5 Suppl):1285S-7S. doi: 10.1093/ajcn/71.5.1285s. PMID: 10799403.
38. Madoue GB, Sile SN, Lhagadang F. Foetal macrosomia: risk factors, maternal and foetal outcomes in N'Djamena mother and child hospital. *Chad South Sudan Med J.* 2018;**11**(2):40–43.
39. Muñoz M, Peña-Rosas JP, Robinson S, Milman N, Holzgreve W, Breymann C, Goffinet F, Nizard J, Christory F, Samama CM, Hardy JF. Patient blood management in obstetrics: management of anaemia and haematinic deficiencies in pregnancy and in the post-partum period: NATA consensus statement. Transfus Med. 2018 Feb;28(1):22-39. doi: 10.1111/tme.12443. Epub 2017 Jul 19. PMID: 28722245.