Prevalence and Factors Associated with Post Cesarean Delivery Anemia at Gandhi Memorial Hospital, Addis Ababa, Ethiopia: A Cross Sectional Study; 2023GC

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Duration of study	From October 1, 2022 – July 31, 2023
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POSTGRADUATE PROGRAM

I, Dr. Semere Fisseha hereby declare that this research report entitled " Prevalence and Factors Associated with Post Cesarean Delivery Anemia at Gandhi Memorial Hospital, Addis Ababa, Ethiopia." in line with the requirement of graduate studies was fully undertaken by me under the guidance of my advisors and that I have, to the best of my knowledge and effort, avoided plagiarism or duplication of materials unless and otherwise cited and/or acknowledged and that it has not been so far submitted for any form of research application or consideration.

Dr. _____ _____ _____

Principal investigator Signature Date

We hereby certify that we have read and evaluated this research report relating to "Prevalence and Factors Associated with Post Cesarean Delivery Anemia at Gandhi Memorial Hospital, Addis Ababa, Ethiopia'' under our guidance from its inception up to in its current format and that it can be submitted for final approval for his partial fulfillment to the Degree of Specialty in Obstetrics and Gynecology.

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1. Advisor Signature Date

_____ _____ _____

2. Advisor Signature Date

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Dr. Semere Fisseha

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Abbreviations and Acronyms

AAU	Addis Ababa University
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
CBC	Complete Blood Count
CD	Cesarean Delivery
CS	Cesarean Section
CI	Confidence Interval
COR	Crude Odds Ratio
GA	Gestational Age
IFA	Iron and Folic Acid
MCV	Mean Corpuscular Volume
OR	Odds Ratio
PPA	Postpartum Anemia
PPH	Postpartum Hemorrhage
RBC	Red Blood Cells
SPSS	Statistical Package for Social Sciences
TASH	Tikur Anbessa Specialized Hospital
WHO	World Health Organization

Abstract

Background – Globally, it is estimated that 20% of maternal deaths are caused by peripartum hemorrhage and anemia. Caesarean section is one of the most common operations worldwide, with rates increasing globally and is the main risk for both intraoperative and postpartum hemorrhage which pose higher maternal morbidity and mortality compared to other modes of deliveries in many developed and developing countries.

Objectives – To determine the Prevalence and Factors Associated with Post Cesarean Delivery Anemia at Gandhi Memorial Hospital, Addis Ababa, Ethiopia.

Methods – Institutional based cross-sectional study was conducted at Gandhi memorial Hospital. A total of 420 mothers who underwent cesarean delivery were included in this study and using simple consecutive sampling technique, data was collected till required sample size was completed and the study was conducted from October 1st 2022 to July 31th 2023. Data were collected through both face-to-face interview and maternal chart review by using a pretested questionnaire. Data were cleaned, coded, and entered using Epi Data version 4.6.0.0 and then exported to SPSS version 25 for analysis. A p-value <0.05 was considered significant. Variables which were significantly associated by bivariate analysis were further processed by multivariate analysis.

Result - The prevalence of post cesarean delivery anemia was 39.8% (n= 167). interpregnancy interval of <24months [AOR=2.9; 95% CI (1.52, 5.48)], previous uterine scar [AOR=1.9; 95% CI (1.38, 3.62)], having chronic medical illness [(AOR=5.6; 95% CI (2.64, 11.73)], meal frequency of <3 times per day [(AOR=5.9; 95% CI (2.72, 12.86)], having obstetric complications [(AOR=2.1; 95% CI (1.02, 4.18)] and emergency cesarean section [(AOR=3.4; CI (1.77, 6.63)] were significantly associated with post cesarean delivery anemia.

Conclusion and recommendations - The findings of this study showed that the prevalence of post cesarean delivery anemia at Gandhi memorial Hospital was high (39.8%). Further large scale research is recommended to represent the general population, to see causal relationship and address limitations of this study.

1. Introduction

Background

Anemia is the decrease in the total count of the red blood cells (RBCs) or packed cell volume of RBCs or hemoglobin concentration below the reference values for the person's age, sex, geographical location, and physiological status, resulting into an impaired oxygen-carrying capacity of blood to the tissues **[1]**

Anemia remains a significant public health problem worldwide affecting 24.5–35.0% of women of reproductive age, especially in low-income countries. Obstetric hemorrhage is among leading causes of direct maternal mortality in obstetric practice. It is major contributor to maternal mortality in developing countries. **[1,7]**

There is a lack of consensus on definition of postpartum anemia, due to lack of prospective studies. Nevertheless, as it can be inferred from the definition given by different scholars, it is recommended that postpartum anemia should be defined by hemoglobin <110 g/L at 1 week postpartum and <120 g/L at 8 weeks postpartum **[20].** Furthermore, even if there is no clear agreement as to the right time to determine the postpartum hemoglobin level, it is usually recommended to check on the first postpartum day. **[19, 21]**

The level of hemoglobin is expected to increase in the first week postpartum as the physiological haemodilution characteristic of pregnancy disappears and, hence, the body's iron reserves become more available. However, anemia has been observed as a much commoner problem than expected because postpartum hemoglobin levels are influenced mainly by two circumstances: gestational anemia and the magnitude of per partum blood loss, where hemorrhage is the most frequently associated cause of puerperal anemia. It is estimated that up to 6% of births are complicated by loss of blood >500 ml with identifiable risk factors only in 25% of cases. For this reason, prevention programs have been set up, based on administering Uterotonic drugs in the third stage of labor given their association with less blood loss, with blood transfusions being less likely and postpartum anemia appearing. Correcting anemia antenatal is also included as a strategy to reduce the risk of hemorrhage as anemic women are less prepared to face intrapartum blood loss, and could become more quickly decompensated with minor losses. **[18]**

In healthy women after normal delivery, the prevalence of anemia (hemoglobin <110 g/L) 1 week postpartum is 14% in iron-supplemented women and 24% in non-supplemented women. As the frequency of anemia in third trimester is around 40%, the frequency of postpartum anemia is expected to be high. In consecutive series of European women, the prevalence of anemia 48 h after delivery is approximately 50%. In developing countries, the prevalence of postpartum anemia is in the range of 50-80%. **[20,22]** Repercussions are more serious in low-income countries for its association with other morbid processes, where it is also one of the main causes of maternal mortality **[18].**

Caesarean section is one of the most common operations worldwide, with rates increasing globally and is the main risk for both intraoperative and postpartum hemorrhage. Blood loss of more than 1000 mL after CD is considered as a postpartum hemorrhage. Consequently, blood transfusion following CD is not an uncommon practice in obstetrics**. [2,4]**

Pre-delivery anemia and postpartum hemorrhage are presumed to confer the greatest risks to women for postpartum anemia. Women who undergo Cesarean section may be particularly susceptible to postpartum anemia because their risk of PPH is higher than women undergoing vaginal delivery. However, there is a dearth of studies examining the frequency of anemia after Cesarean section and the relations between pre delivery anemia and PPH with postpartum anemia. **[5]**

In 90% of the cases, anemia is due to iron deficiency. It impairs cognitive capabilities and has significant association with postpartum depression. Many factors have been previously found to be associated with this complication. Of these, postpartum hemorrhage is the most important one. However, other factors such as iron deficiency, hemoglobinopathy, preeclampsia, hemolysis, and low socioeconomic status have also been found to influence the incidence of PPA. **[23]**

Statement of the problem

Globally, it is estimated that 20% of maternal deaths are caused by per partum hemorrhage and anemia. Therefore, anemia is an important health problem in terms of female and maternal health. The most common cause of maternal mortality is postpartum hemorrhage and is the most important cause of morbidity with a rate of 18% in developed and developing countries. **[6]**

Caesarean section is a common surgery, with almost 23 million procedures performed globally each year. Postpartum hemorrhage, in association with caesarean section surgery, is a leading global cause of maternal morbidity and mortality. Perioperative iron deficiency anemia is a risk factor for intraoperative bleeding. Therefore, anemia is an important and modifiable risk factor for bleeding during caesarean section surgery. **[6]**

The prevalence of anemia among postnatal mothers in developed countries ranges from 10% to 30% and in developing countries 50% to 80%. **[19,20]** In Ethiopia despite of the 2020 anemia reduction plan, postpartum anemia among lactating women increased from 18% in 2011 to 28.6% in 2016. **[24,25]**

Cesarean delivery is associated with an increased risk of postpartum blood loss and related morbidity compared with vaginal delivery. Therefore, routine hematocrit/hemoglobin testing after cesarean delivery is common and recommended by many standard textbooks, despite inadequate data to substantiate the need for it. **[8]**

Significance of the study

Anemia after caesarean section adversely affects the woman and the new-born. While prenatal anemia is extensively studied, the literature on post-caesarean section anemia is limited and characteristics of women at the highest risk of developing anemia after caesarean section are unknown.

In general, the health of women in the postpartum has been little studied and has been given little attention by both clinicians and researchers and by women themselves. Morbidity, both physical and mental, is probably underestimated and ignored, reason why it represents a serious or very serious problem to women's health, both short and long term. Postpartum anemia has been forgotten as the rest of post-partum complications; this paper will give us an objective evidence of the disease burden and possible recommendations of factors associated to it.

Since our Hospital is serving as maternity center where patients with different obstetric factors are being treated. So far there is no study done in GMH and in general little is known at country level on anemia post cesarean delivery. The aim of this study is to have data on incidence of anemia post cesarean delivery and to determine factors are associated with excessive blood loss causing anemia during cesarean delivery.

The result obtained from this study may help as a base for future research on this topic and help to improve quality of cesarean delivery practice on minimizing blood loss during the procedure to reduce maternal morbidity in this Hospital and generalization can be done to other tertiary Hospitals and alert researchers, health care providers, community and other concerned bodies to the problem.

2. Literature Review

In a study done in Turkey showed that, the mean preoperative hemoglobin of the low-risk asymptomatic women was 11.7 § 1.99 g/dl, whereas it was 11.24 § 1.99 g/dl, postoperatively (P < 0.001). In 72% of the patients, there was a drop in hemoglobin concentrations, whereas 24.5% experienced an increase and 3.5% showed no change, postoperatively. Only one woman experienced a drop of greater than 30% in hemoglobin concentration. Since the woman did not show any signs of hemodynamic instability or symptoms of anemia, she was not transfused. [8]

In another prospective observational study done in Nepal showed that, average post-cesarean drop in hemoglobin was 1.52±1.27 gm/dl and drop in hematocrit was 5.49±4.1%. Post-operative drop in hemoglobin and hematocrit had weak and positive linear relation with duration between uterine incision and repair. Cross-match to transfusion ratio was 1, transfusion probability 100% and transfusion index was 2. [7]

In one retrospective study done in South Africa maternal mortality resulting from cesarean delivery was 3.2/10,000 deliveries associated from hemorrhage during delivery. Risk factors included previous cesarean delivery, preoperative anemia and placental abruption. Uterine atony and surgical trauma were the main causes of bleeding. 41% of women had anemia preoperatively. 76% of these deaths occur within 48 hours of delivery. [9]

In a study done in Uganda showed that the prevalence of severe anemia post-caesarean section was 6.79%. Fetus with macrosomia (AOR 7.9 95%CI: 2.18–28.85, p < 0.01) and having mild or moderate anemia pre-caesarean section (AOR:9.6, 95%CI: 3.91–23.77, p < 0.01) were the factors associated with severe anemia after caesarean section. [1]

A cross-sectional study conducted in Gadarif maternity hospital, eastern Sudan, showed that The overall post-CD transfusion rate was 8.2%. Emergency CD (adjusted odds ratio [AOR]=2.57, 95% confidence interval [CI]=1.25–5.28) and antepartum hemorrhage (AOR=44.70, 95% CI=11.18–178.76) were associated with increased risk of post-CD blood transfusion. Preoperative hemoglobin (AOR=0.48, 95% CI=0.36–0.64) and rural residence (AOR=0.45, 95% CI=0.22–0.93) were associated with reduced risk for post-CD blood transfusion. [2]

Study done on maternal complications of cesarean section in Cote d'Ivoire shows Placental abruption is also a provider of postoperative anemia. Hemorrhage risk factors during C-section

are: uterine atony, prolonged labor, Placenta Previa, chorioamnionitis, previous history of postpartum hemorrhage, general anesthesia and obesity. [12]

In one study done on blood loss estimation during cesarean delivery, previous cesarean delivery, breech presentation, placenta Previa are associated with significant blood loss during cesarean delivery. [10]

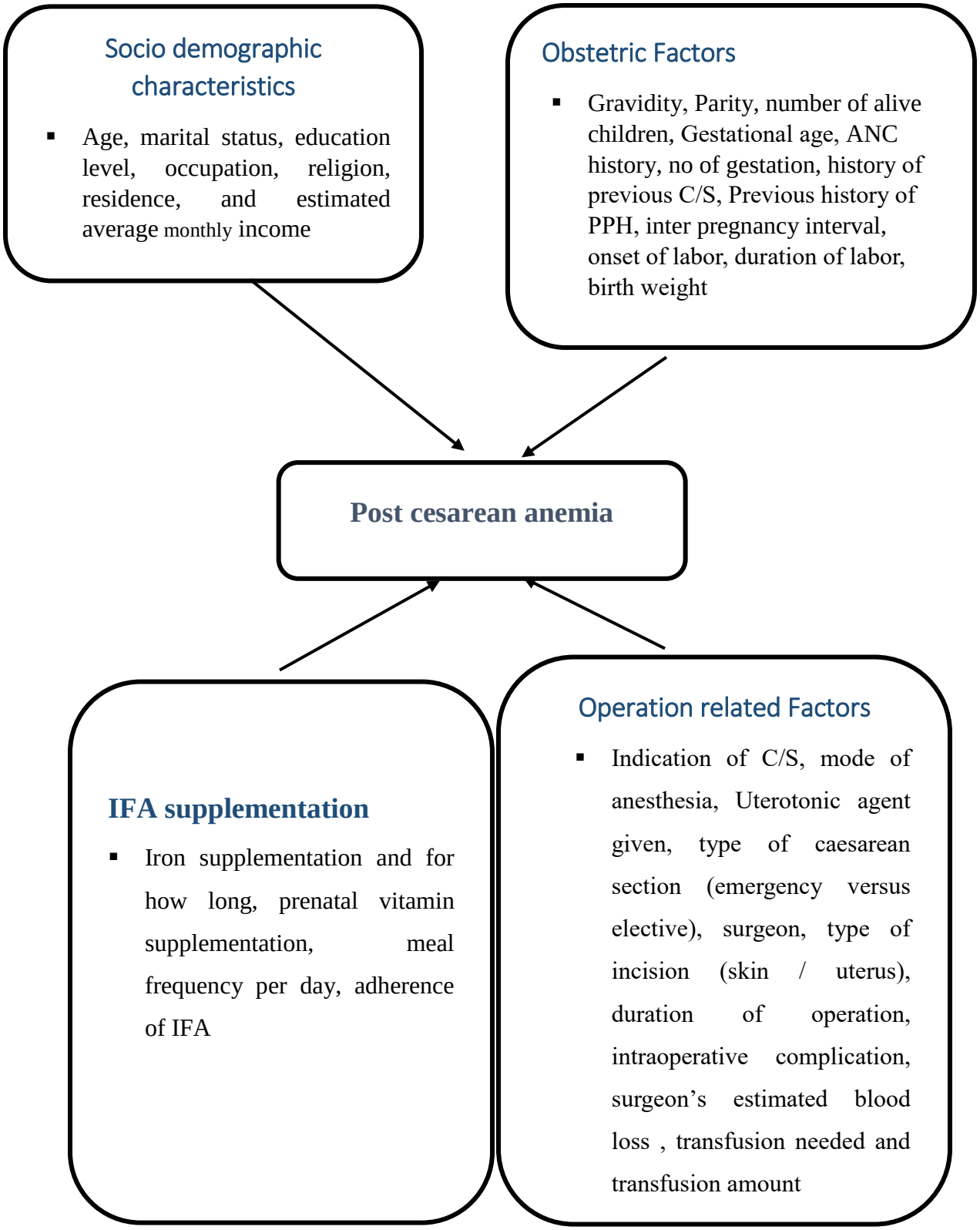
In one study in Nigeria on cesarean delivery related blood transfusion, 42.5% of cesarean delivery rate and 20.8 % of them transfused with blood. The most common indication for caesarean section was Cephalo-pelvic disproportion (25.7%).The independent risk factors for blood transfusion at caesarean section were second stage Caesarean Section (AOR = 76.14, 95% CI = 1.25–4622.06, $p = 0.04$), placenta Previa (AOR = 32.57, 95% CI = 2.22–476.26, $p = 0.01$), placental abruption (AOR = 25.35, 95% CI = 3.06–211.02, $p < 0.001$), pre-operative anemia (AOR = 12.15, 95% = CI 4.02–36.71, $p < 0.001$), prolonged operation time (AOR = 10.72 95% CI = 1.37–36.02, $p < 0.001$), co-morbidities like previous uterine scar (AOR = 7.02, 95% CI = 1.37–36.02, $p = 0.02$) and hypertensive disorders in pregnancy (AOR = 5.19, 95% CI = 1.84–14.68, $p < 0.001$). Obesity reduced the risk for blood transfusion (AOR = 0.24, 95% CI = 0.09–0.61, $p = 0.0024$). [11]

In retrospective cohort study done on maternal complication after cesarean delivery in South Ethiopia shows 28.6% of mothers with intraoperative surgical complication, among which 10% of all complication being anemia from hemorrhage. Out of cesarean delivery operations 43% of them done by Health Officers on training, 28.2% by Gynecology /obstetric specialist, 27.4% by General practitioners. Cesarean section done for mal-presentation, second stage cesarean and those done under general anesthesia are associated with maternal complications. 5.3% of women who underwent cesarean delivery were transfused with blood intraoperatively. [13]

A study done on magnitude of PPH at Dessie Hospital Ethiopia shows 5.8% of postpartum hemorrhage. Cesarean delivery was associated with PPH 5 times than spontaneous vertex delivery. [14]

In another study done on maternal complication during cesarean delivery at Yirgalem Hospital Ethiopia shows 30.1 % of overall maternal complication. Major intraoperative complication was hemorrhage (64.5%). General anesthesia and having no ANC was associated with maternal complication in this study. [15]

3. Conceptual frame work of the study



4. Objectives of the study

General Objective

To determine prevalence and associated factors of post cesarean delivery anemia at Ghandi Memorial Hospital, Addis Ababa, Ethiopia, 2022.

Specific Objective

- To assess prevalence of anemia after cesarean delivery at Ghandi Memorial Hospital, Addis Ababa, Ethiopia, 2022.
- To identify factors associated with anemia after cesarean delivery at Ghandi Memorial Hospital, Addis Ababa, Ethiopia, 2022.

5. Material and Methods

Study Design

Institutional based cross-sectional study design was conducted to assess the prevalence and factors associated with of post cesarean delivery anemia in Gandhi Memorial Hospital.

Study Area and Period

The study area was postnatal wards at Gandhi Memorial Hospital (GMH), Addis Ababa, Ethiopia. Addis Ababa is the capital city of Ethiopia, a country in the horn of Africa. The capital city holds 527 kilometers of area and is at an elevation of 2,355 meters above sea level. Addis Ababa's 2020 population is estimated at 4,793,699 according to United Nations World Urbanization Prospects. **[28]** Regarding medical service, currently the city has more than 41 hospitals, 28 health centers, 35 health posts and more than 500 clinics. There are more than 12 publics and more than 25 private hospitals in the city. Of the total 12 public hospitals, Gandhi Memorial Hospital, which is under Addis Ababa Health Bureau is selected due to high number of annual delivery (8000 deliveries per year with 40.9% cesarean section rate) and give antepartum, intrapartum and postpartum care including cesarean delivery service for 24 hrs. of a day. The Hospital is partially staffed by AAU university members, consultants, residents and partially by staff specialists, general practitioners and midwifes from ministry of health. The study was conducted from October 1st 2022 to July 31th 2023.

Source Population

All mothers who underwent caesarean delivery at Gandhi Memorial Hospital, Addis Ababa.

Study Population

All sampled mothers at postnatal wards who underwent caesarean delivery at GMH during the study period

Inclusion and Exclusion Criteria

Inclusion criteria

- All mothers who delivered by cesarean delivery (elective and emergency) during the study period.
- All mothers who delivered by cesarean delivery with gestational age above 28weeks from date or early ultrasound.
- All mothers who delivered by cesarean delivery and are willing to participate.

Exclusion criteria

- Mothers with incomplete data for the study

Sample Size Determination

The sample size was determined using single proportion formula, as described below.

$$n = \frac{(Z\alpha/2)^2 \, p \, (1-p)}{d^2}$$

Where: n = desired sample size

z = z value at 95% confidence interval (CI)

p = prevalence of immediate postpartum anemia

d = margin of error

The Z value at 95% CI is 1.96 (from significance level α = 5%). Since, there was no similar study previously done on prevalence of post-cesarean delivery anemia at country level, so with the assumption of P value 50% and tolerated margin of error of 5%, therefore;

p = 0.5 1- p = 0.5 d= 0.05

$$n = \frac{(1.96)^2 \, (0.5) \, (1-0.5)}{(0.05)^2} = 384$$

Adding 10% non-response rate, the total sample size calculated was 422 participants.

Sampling technique

Simple consecutive sampling technique was used to include study participants until the required sample size was completed.

Study Variables

Dependent Variable

- Dependent variable is post cesarean delivery anemia

Independent Variables

- **Socio demographic characteristics -** Age, marital status, education level, occupation, religion and estimated average monthly income.
- **Obstetric Factors –** Gravidity, Parity, number of alive children, Gestational age, ANC history, no of gestation, history of previous C/S, Previous history of APH, Previous history of PPH, inter pregnancy interval, onset of labor, duration of labor, birth weight.
- **IFA utilization Factors**- Iron supplementation and for how long, prenatal vitamin supplementation, hot drink (tea, coffee, or milk) when she has taken iron, meal frequency per day, adherence of IFA
- **Obstetric complications –** Preeclampsia/eclampsia, APH, PROM /chorioamnionitis, CPD, Malpresentation, cord prolapse, failed induction, uterine dehiscence or rupture
- **Surgery related Factors -** Indication of C/S, mode of anesthesia, Uterotonic agent given, type of caesarean section (emergency versus elective), surgeon, type of incision (skin / uterus), duration of operation, intraoperative complication, surgeon's estimated blood loss, transfusion needed and transfusion amount
- **Hemoglobin and RBC indices determination**

Data Collection method

The socio demographic and clinical variables were collected using the standardized pretested questionnaire. The hemoglobin and RBC indices result were collected from maternal medical record. The participants were interviewed after 24hrs of delivery when they are comfortable but before they discharged from the Hospital.

The questionnaire was developed after reviewing different pieces of literature conducted in different parts of the world **[24,26,27].** The questionnaire was validated by ten gynecologists and obstetricians. Three BSc midwives and one master midwife were recruited for data collection and supervision, respectively. After taking verbal informed consent, data was collected through both face-to-face interview and retrospective maternal chart review by using a semi- structured pretested questionnaire.

Data Quality Control Measures

Training was provided for data collectors and supervisor for data accuracy and Completeness and an appropriate modification was made after discussing with the supervisor and data collectors before starting the actual data collection process. The questionnaire was pre tested on

5% of the study population 5 days before the actual data collection to ensure clarity, wordings, logical sequence and skip patterns of the questions. Every day the filled questionnaires were checked before a respondent go from the setting by data collectors and supervisor. The principal investigator controlled the data collection procedure by supporting the supervisor and data collectors and a close supervision, honest communication and on spot decision in the data collection phase was implemented.

Data Processing and Analysis

Collected data were checked for completeness, consistency, clarity, missed values and entered into EPI-info version 4.6.0.0. Then cleaned and coded data were exported to SPSS (Statistical Package for Social Science) version 25 data management and further statistical analysis. Frequency counts were performed to assess completeness of all variables. The hemoglobin and MCV result were the major outcome variable in this study. The prevalence rates along with the 95% confidence intervals were estimated for each sub population. Correlates of post cesarean delivery anemia was assessed by multivariable logistic regression. All tests were two sided and statistical significances was set at p-value < 0.05. From these models, crude and adjusted odds ratios along with 95% confidence intervals, separately for each age group was estimated.

Operational Definitions

- **Immediate post cesarean delivery anemia** - When the hemoglobin value is less than 11 gm/dl in the first 24 hours of cesarean delivery. **[17]**
- **Good adherence of iron and folic acid supplementation -** If they took 65% or more of the supplement, equivalent to taking the supplement at least 4 days a week during one-month period of the most recent pregnancy. **[16]**

Ethical Considerations

The proposal was submitted to my advisors for feedback and approved before conducting the study. Ethical approval was obtained from TASH department of research and publication committee of Addis Ababa University. The importance of the study was explained to the participants of the study. For this a one-page consent was attached to the cover page of each questionnaire. Verbal informed consent was obtained after the objectives, benefit and risks of the study explained to study participants. Participation was voluntary, confidentiality and private information were not requested from the participants. The right of the respondent to withdraw

from the interview or not to participate was respected. The information collected from the study subjects were kept confidential and used only for the study and management of the patient. Mothers who had anemia were managed according to the protocol.

Dissemination plan and use of findings

The result of the study will be presented to TASH, department of obstetrics and gynecology. The final report will be submitted to TASH and Gandhi memorial Hospital. Moreover, efforts will be done to publish the findings of the study and disseminate through different journals and scientific publications. Copy of the article will be placed in the library of college of health sciences, AAU for the future reference.

6. Result

6.1. Sociodemographic characteristics of the study participants

In this study 420 participants were involved making a response rate of 99.5%. More than sixty percent (60.5%) of the study participants were in the age group of 20-29 years with mean and SD age of 28.4±4.6 respectively. Two-third of the study participants were orthodox and 95.5% were married. One-third of the participants attended secondary education level and 51.4% were house wife and majority of them had not their own income. Majority (39.5%) of the husbands attended secondary education level and 31.4% were a private employers and 45.2% had a monthly income of >7800 ETB seen table 1. Below.

Table 1.The sociodemographic characteristics of study participants who gave birth by cesarean section in Gandhi memorial hospital, Addis Ababa, 2023.

Variable	List of categories	Frequency	Percent
Age of the study participant	≤19	6	1.4
	20-29	254	60.5
	30-34	111	26.4
	≥35	49	11.7
Religion of the study participants	Orthodox	276	65.7
	Muslim	91	21.7
	Catholic	7	1.7
	Protestant	45	10.7
	Others	1	0.2
Marital status of the study participants	Married	401	95.5
	Unmarried	19	4.5
Education level of the study participants	Unable to read and write	25	6.0
	Not educated but able to read	53	12.6
	Primary (grade 1-8)	122	29.0
	Secondary (grade 9-12)	137	32.6
	Collage and above	83	19.8
Current occupation of the study participants	House wife	216	51.4
	Daily laborer	17	4.0
	Merchant	38	9.0
	Government employee	74	17.6
	Private employee	67	16.0
	Others	8	1.9
Education level of the husband	Unable to read and write	6	1.4
	Not educated but able to read and write	22	5.2
	Primary (grade 1-8	65	15.5
	Secondary (grade 9-12)	166	39.5

	Collage and above	161	38.3
Occupation of the husband	Daily laborer	35	8.3
	Merchant	102	24.3
	Government employee	127	30.2
	Private employee	132	31.4
	Others	24	5.7
Maternal monthly income	No income	185	44.0
	<3200	42	10.0
	3200-5250	71	16.9
	5250-7800	36	8.6
	>7800	85	20.2
Husband monthly income	No income	16	3.8
	<3200	52	12.4
	3200-5250	86	20.5
	5250-7800	76	18.1
	>7800	190	45.2

6.2 Reproductive and Obstetrics characteristics of the study participants

More than seventy-two percent (72.4%) of the participants were multigravida and 24.6% had a history of abortion. 62.8 percent of the participants had an interpregnancy interval of more than 2 years. Fifty-four percent (44%) of the participants gave birth at a gestational age of 39-40+6 and 91.4% had antenatal care follow up. Forty-seven percent of the study participants had a history of uterine scar and from those 65.2% had only one scar. 23.1%, 5%, 0.5% and 0.2% of the study participants had a history of chronic medical illness, post-partum hemorrhage, bleeding tendency and blood transfusion respectively as seen in table 2, below.

Table 2. Reproductive and Obstetrics characteristics of the study participants

Variable	List of categories	Frequency	Percent
Gravidity	Primigravid	111	26.4
	Multigravid	304	72.4
	Grand-Multigravid	5	1.2
Parity	Primiparous	75	25.2
	Multiparous	220	73.8
	Grand multiparous	3	1.0
history of abortion	Yes	76	24.6
	No	233	75.4
Inter pregnancy interval in months	<24	110	37.2
	≥24	186	62.8
Gestational age of the current	$28\text{-}33^{+6}$	6	1.4

pregnancy in wks	34-36^{+6}	31	7.4
	37-38^{+6}	73	17.4
	39-40^{+6}	227	54.0
	41-41^{+6}	46	11.0
	≥42	21	5.0
	UK	16	3.8
Antenatal care follow-up	Yes	384	91.4
	No	36	8.6
Gestational age of ANC initiated (n=384)	<12wks	80	20.8
	12-26wks	292	76.0
	26^{+1}-34wks	10	2.6
	>34wks	2	0.5
Number of ANC contact (n=384)	<8	301	78.4
	8	58	15.1
	>8	25	6.5
History of previous C/S (including any uterine scar	Yes	198	47.1
	No	222	52.9
Number of scar present per patient	One	129	65.2
	Two	65	32.8
	Three	4	2.0
History of previous PPH	Yes	21	5.0
	No	399	95.0
History of chronic medical illness	Yes	97	23.1
	No	323	76.9
History of blood transfusion	Yes	1	0.2
	No	419	99.8
Any bleeding tendency	Yes	2	0.5
	No	418	99.5

6.3 Iron and folic acid utilization characteristics of the study participants

Most of the study participants (83.6%) took IFA during pregnancy and 85.5% of them initiated at gestational age of 12.26 weeks. From those who took IFA, eight one percent of them had good adherence and 21.9% used hot drink while taking IFA. Majority (72.9%) of them eat more than three times per day.

Table 3.The study participant's characteristics on utilization of iron and folic acid.

Variable	List of categories	Frequency	Percent
IFA took during pregnancy	Yes	351	83.6
	No	69	16.4
Gestational age of iron and folic acid	<12wk	44	12.5

started (n=351)	12-26wk	300	85.5
	26^{+1}-34k	7	2.0
Adherence to IFA supplementation (n=351)	Poor adherence	66	18.8
	Good adherence	285	81.2
Hot drink while taking IFA(n=351)	Yes	77	21.9
	No	274	78.1
Frequency of meal per day	≤3 day	114	27.1
	>3 day	306	72.9

6.4 Antepartum and intrapartum pregnancy characteristics of the study participants

Almost all participants had a singleton pregnancy and 27.4% had obstetric complication and among these only one mother was diagnosed with complete HELLP syndrome. Thirty-six percent of the study participants had spontaneous labor and 10.5% had labor established by induction. From those of laboring mothers, more than two-third of them had duration of labor more than 8hours.

Table 4.The antepartum and intrapartum pregnancy characteristics.

Variable	Frequency	Percent
Number of fetuses		
Single	405	96.4
Twin	15	3.6
Obstetric complication		
Yes	115	27.4
No	305	72.6
Onset of labor		
Spontaneous	152	36.2
Induced	44	10.5
No labor	224	53.3
Labor duration		
<8hrs	60	30.8
≥8hrs	136	69.2

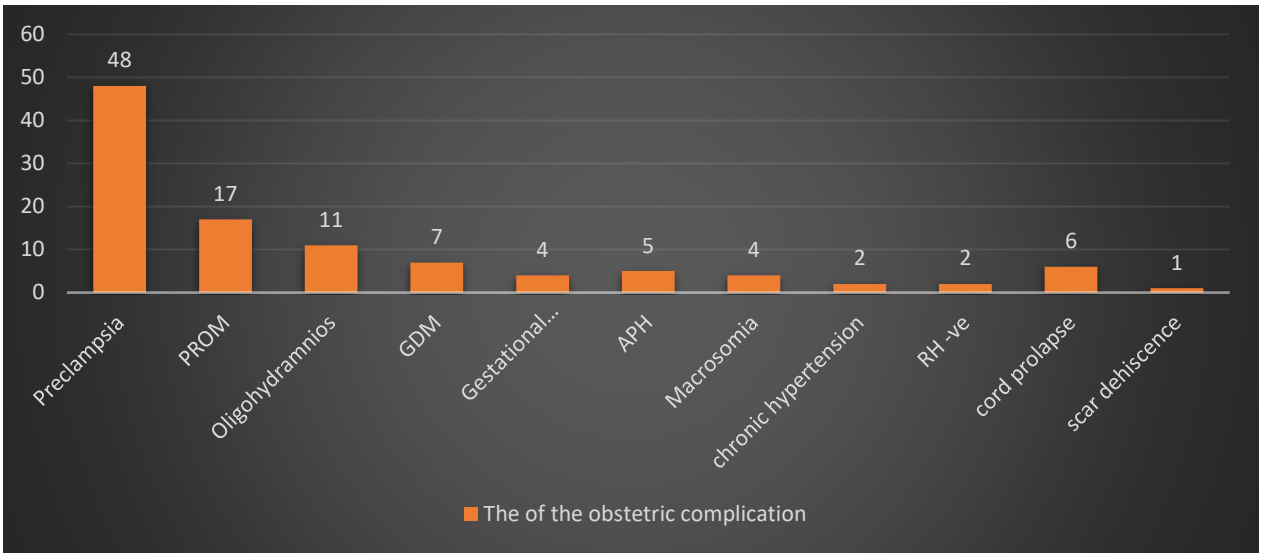


Figure 1. List of obstetric complications.

6.5 Intraoperative and post-operative characteristics of the study participants

More than half (52.4%) of them delivered by elective cesarean delivery and 98.1% took spinal anesthesia. Almost all had Pfannestiel type of skin incision and 96.4% had a single pregnancy. Eighty-six percent of the participants gave birth of a normal birth weight neonate and 84.3% of the participants use oxytocin as a uterotonic agent. 3.3% of the participants had intraoperative complications and 1% of the participants had an estimated blood loss of >1000ml. Almost eighty-nine percent of the participants took 30-60 minutes to complete the surgery and 2.9% of them had PPH diagnosed clinically.

Table 5.The intraoperative and postoperative characteristics of the study participants

Variable	Category	Frequency	Percent
Type of cesarean delivery	Elective	220	52.4
	Emergency	200	47.6
Mode of anesthesia	Spinal	412	98.1
	General	8	1.9
Type of Skin incision	Pfannestiel	413	98.3
	Midline	7	1.7
Type of uterine incision	LUST-CS	417	99.3
	Classical	1	0.2
	Others	2	0.5
Birth order	Single	411	97.9
	Twin	9	2.1
Birth weight of the first baby in grams	1000-1499	9	2.1
	1500-2499	31	7.4

	2500-3999	361	86.0
	≥4000	19	4.5
Twin B	1500-2499	1	11
	2500-3999	8	89
Uterotonic agent given	Oxytocin	354	84.3
	Misoprostol	1	0.2
	Misoprostol and oxytocin	65	15.5
Intraoperative complication	Yes	14	3.3
	No	406	96.7
Estimated blood loss	<1000ml	416	99.0
	≥1000ml	4	1.0
Transfusion needed	Yes	8	1.9
	No	412	98.1
Duration of surgery	<30min	11	2.6
	30-60min	373	88.8
	≥60min	36	8.6
PPH diagnosed clinically	Yes	12	2.9
	No	408	97.1

Majority of the cesarean sections were done by year 3 obstetrics and gynecology resident followed by year 2 resident as shown in the figure below.

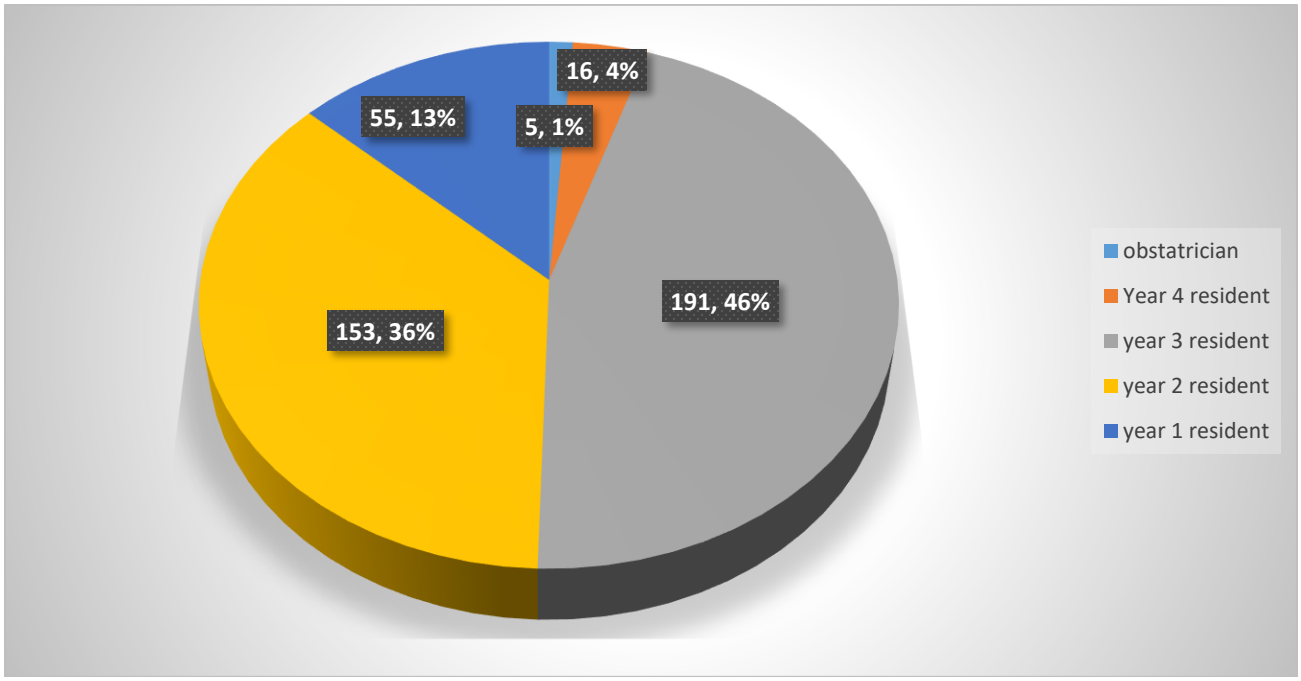


Figure 2. Cesarean deliveries by surgeon's educational level

Majority of the cesarean sections were done for an indication of previous uterine scar followed by NRFS, Malpresentation, failed induction, macrosomia, twin, CPD and cord prolapse as shown in the figure 3 below.

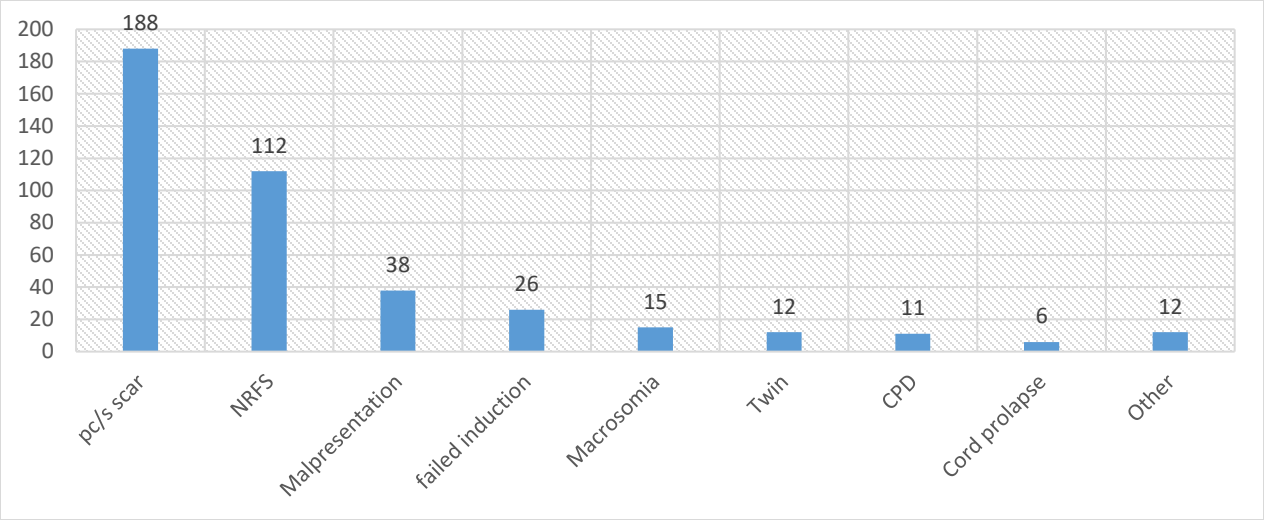


Figure 3. Lists of indications for cesarean sections

6.6 Hemoglobin and RBC indices characteristics of study participants

Almost all (94.8%) and 22(5.2%) of the study participants had hemoglobin value of ≥11gm/dl and <11 gm/dl before (with in the last 2 weeks) cesarean section respectively. From those having <11gm/dl Hgb level preoperatively, 10(45.4%) of them had mild anemia, 11(50%) had moderate anemia and 1(4.6%) had severe anemia in post-operative hemoglobin determination.

Regarding to MCV value, 82.9%, 16.4% and 0.7% of the participants had MCV value of 80-100, 80 and >100fl respectively after 24 hours of delivery. In more than half (52.4%) of the participants, post-operative hematocrit level was reduced by more than 10% from the baseline value. Among the 420 participants, 39.8% (167) had anemia (Hgb <11gm/dl) in their postoperative period with similar mean and median hemoglobin (±SD) of 11. 2gm/dl (±1.3), range from 6.5 to 14.5gm/dl as shown in the figure 4 below. Majority (63%) of the anemic mothers had mild degree followed by moderate and severe degree of anemia, as shown in the figure 5 below.

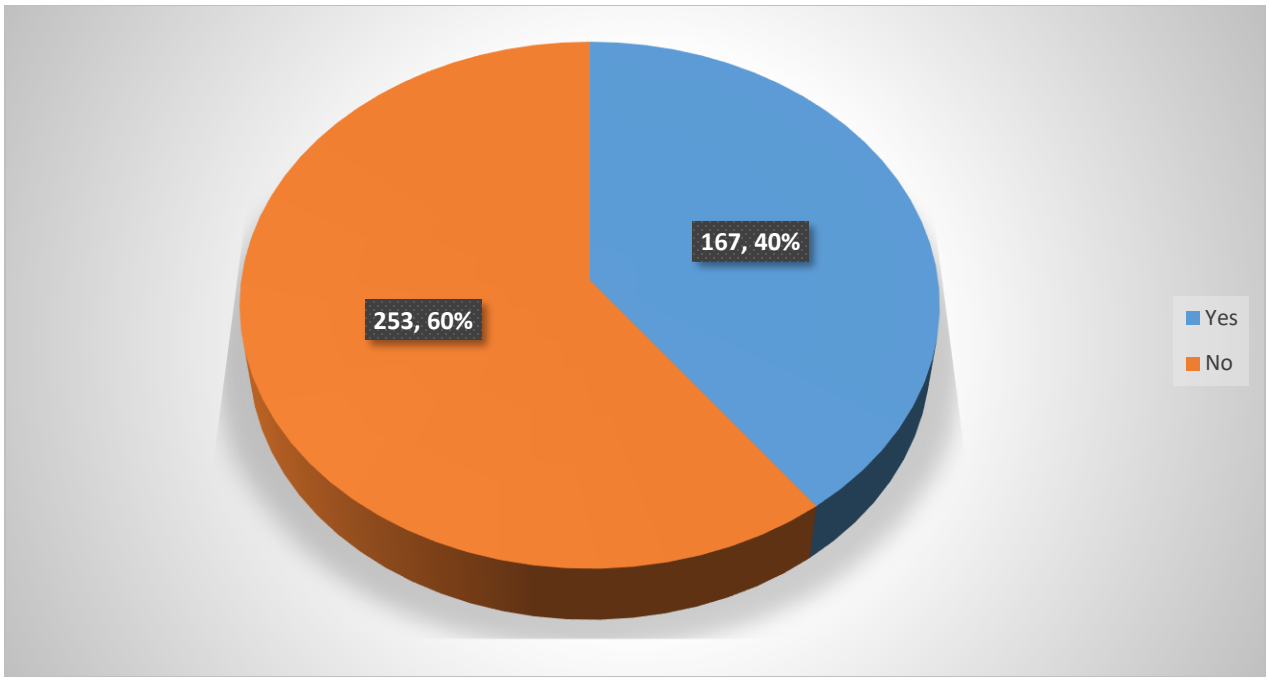


Figure 4. Prevalence of anemia in the study participants who gave birth by cesarean section in Gandhi memorial hospital.

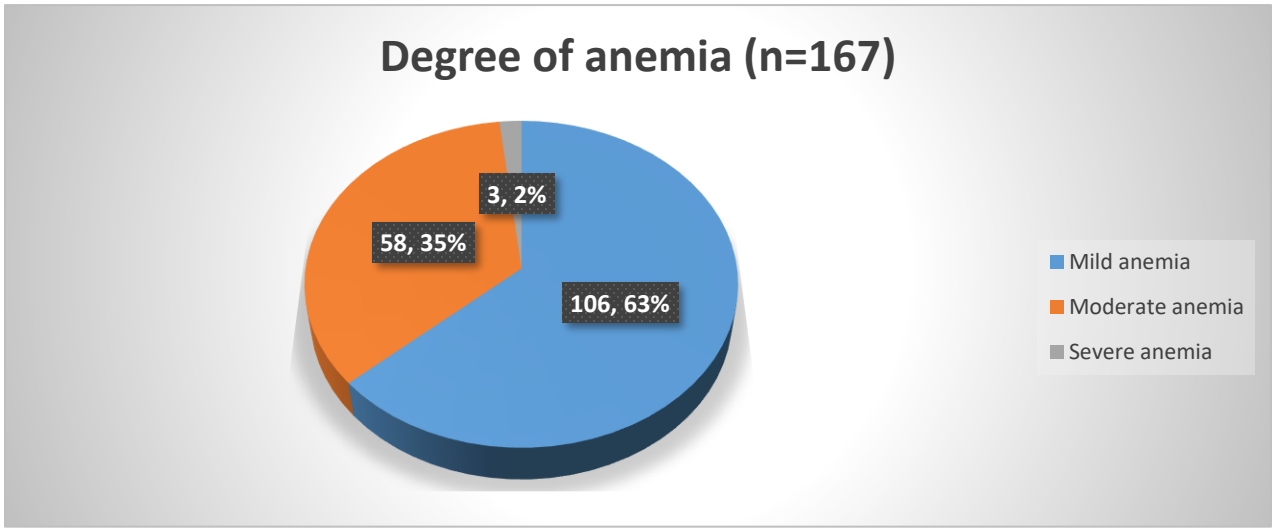


Figure 5. Degree of anemia of the study participants

6.7. Determinant factors of post cesarean delivery anemia

Participant's educational level, occupation, interpregnancy interval, history of previous uterine scar, history of chronic medical illness, utilization of IFA during pregnancy, frequency of meal, obstetric complication, type of cesarean delivery and duration of surgery had an association with the outcome variable by bivariate binary logistic regression.

The odds of multivariate logistic regression revealed that, participants whose interpregnancy interval of <24months had 2.9 odds of anemia than an interpregnancy interval of ≥ 24 months (AOR=2.9, 95%CI=1.52, 5.48) and participants having previous uterine scar had 1.9 odds of anemia compared to its counterpart (AOR=1.9, 95%=1.38, 3.62).

Participants having chronic medical illness had 5.6 times anemia than its compartment (AOR=5.6, 95%CI=2.64, 11.73) and participants whose meal frequency of <3 times per day had 5.9 odds anemia than having meal of >3 per day (AOR=5.9, 95%CI=2.72, 12.86).

Participants having obstetric complications had 2.1 odds of anemia compared to its compartment (AOR=2.1, 95%CI=1.02, 4.18) and participants who underwent emergency cesarean section had 3.4 odds of increase anemia than an elective cesarean section (AOR=3.4, CI=1.77, 6.63).

Table 6.The association of bivariate and multivariate regression between independent and dependent(anemia) variable among study participants who gave birth by cesarean section in Gandhi memorial hospital.

Variable	Anemia		p-value	COR with 95%CI	P-value	AOR with 95%CI
	Yes	No				
Educational status						
Unable to read and write	17	8	0.027	2.9(1.13, 7.51)	0.952	1.1(0.21, 5.29)
Able to read and write	27	26	0.317	1.4(0.71, 2.85)	0.668	0.78(0.23, 2.58)
Primary school	47	75	0.601	0.86(0.49, 1.52)	0.870	1.1(0.41, 2.88)
Secondary school	41	96	0.065	0.59(0.33, 1.03	0.220	0.55(0.21, 1.43)
Collage and above	35	48	1		1	
Occupation						
Employed	57	121	1		1	
Unemployed	110	132	0.006	1.8(1.18, 2.65)	0.352	1.4(0.68, 2.93)
Interpregnancy interval in month						
<24	64	46	0.000	3.8(2.29, 6.23)	0.001	**2.9(1.52, 5.48)**
≥24	50	136	1		1	
History of previous C/S (including any uterine scar)						
Yes	96	102	0.001	2(1.35, 2.98)	0.045	**1.9(1.38, 3.62)**
No	71	151	1		1	
History of chronic medical illness						
Yes	65	32	0.000	4.4(2.71, 7.14)	0.000	**5.6(2.64, 11.73)**
No	102	221	1		1	
Utilization of IFA during pregnancy						
Yes	124	231	1		1	

No	43	22	0.000	3.6(2.08, 6.36)	0.999	1(0.33, 3.01)
Frequency of meal per day						
≤3 day	81	33	0.000	6.3(3.90, 10.10)	0.000	**5.9(2.72, 12.86)**
>3day	86	220	1		1	
Obstetric complication						
Yes	68	47	0.000	3(1.93, 4.69)	0.044	**2.1(1.02, 4.18)**
No	99	206	1		1	
Type of cesarean delivery						
Elective	51	169	1		1	
Emergency	116	84	0.000	4.6(3.00, 6.97)	0.000	**3.4(1.77, 6.63)**
Intraoperative complication						
Yes	8	6	0.185	2.1(0.71, 6.08)	0.693	1.4(0.29, 6.45)
No	159	247	1		1	
Duration of surgery in minute						
<30	5	6	0.155	0.37(0.09, 1.46)	0.755	0.68(0.06, 7.91)
30-60	137	236	0.000	0.26(0.12, 0.54)	0.429	0.6(0.17, 2.12)
≥60	25	11	1		1	

7. Discussion

This study is Hospital based and assessed the prevalence and factors associated with post cesarean delivery anemia at Gandhi Memorial Hospital. The prevalence of post cesarean delivery anemia was 39.8%.

This value was in line with the study done in Mancha Centro hospital, Spain (45%) **[3]**; Uganda (30%) **[18];** and Tamil Nadu, India (47.3%) **[22].** But there was a difference in hemoglobin cutoff points to define anemia due to lack of consensus to diagnose anemia in the immediate postpartum period.

However, this proportion was higher than the study done in two teaching hospitals in Mekelle, North Ethiopia, which showed that the prevalence of immediate postpartum anemia was 24.2% **[27].** Also it is higher than the study done in Debre Markos Referral Hospital, northwest Ethiopia which showed that, the prevalence of immediate postpartum anemia was 24.3% **[26].** The possible reason for these variations might be due to use of different cutoff points to define postpartum anemia, difference in postpartum time of screening, population size and these two studies includes both post cesarean and post vaginal delivery as compared to our study which includes only post cesarean delivery.

Independent factors significantly associated with immediate post cesarean delivery anemia were interpregnancy interval of <24months during most recent pregnancy, having previous uterine scar, having chronic medical illness, participant's frequency of meal <3 times per day, having obstetric complication and emergency cesarean delivery.

More than half (62.8%) of the study participants had interpregnancy interval of > 24months.The odds of participants whose interpregnancy interval of <24months are 2.9 times higher to develop anemia than those who had interpregnancy interval of ≥ 24 months. This finding was consistent with the study conducted in Coastal Karnataka, India **[29].** The possible explanation is that maternal nutrient (particularly iron and folate) may not be replenished sufficiently between closely spaced pregnancies and this may lead to peripartum anemia.

Mothers who had previous uterine scar have 1.9 times odds of anemia compared to their counterparts. This finding was supported by study conducted in a tertiary hospital in Southwest Nigeria **[11].** The possible explanation might be due to higher risk of uterine rupture, morbidly adherence placenta, antepartum and postpartum hemorrhage, surgical management related complications in those who had previous history of uterine scar.

The odds of post cesarean delivery anemia among mothers who had chronic medical illness was 5.6 times higher than the odds of anemia among mothers with no chronic illness. This finding was similar with study conducted in Mbarar, Uganda and Bahir Dar, Ethiopia **[30, 31].** The explanation is that due to chronic infection and chronic immune activation, circulating iron levels and erythropoiesis are significantly reduced in those whose have chronic medical illness.

Increased odds of anemia were noted among participants with meal frequency of less than three times per day to those having frequency of meal greater than three times per day. This finding is not consistent with literatures I have used in this study but the possible explanation might be due to meal patterning (individual's frequency, skipping, and spacing of eating occasions) which are associated with macro- and micronutrient inadequacy are important in managing diet strategies to prevent anemia and related issues.

Presence of obstetric complications during the most recent pregnancy had also significant association with post cesarean delivery anemia, in which the odds of mothers who had obstetric complications had anemia 2.1 times higher than their counterparts. This finding is similar with

the study conducted in eastern Sudan, Nigeria, Cote d'Ivoire and Debre Markos Referral Hospital, northwest Ethiopia **[2,11,12,26].** The possible reason might be due to blood loss during peripartum period and complications associated with specific surgical interventions.

Among all study participants, 200 (47.6%) of them delivered via emergency cesarean section. In this study emergency cesarean delivery has significant association with post cesarean delivery anemia with odds of developing anemia was 3.4 times more for mothers who delivered on emergency base when compared to mothers delivered on elective base. This result was similar with the study conducted in Gadarif maternity hospital, eastern Sudan and Kathmandu Model Hospital, Nepal **[2,32].** The possible explanation might be due to the fact that emergency caesarean section is performed in unforeseen or acute obstetric emergencies in which obstetric practitioners will not have proper plan to avoid complications.

8. Limitation of the study

The study was institutional based and difficult to represent for the entire population and the interview included the past nine months' activity of mothers, recall bias was one of the limitations. Moreover, to this; since the actual time when to determine post-operative hemoglobin is not known and this may affect the result of the study.

9. Conclusion

The findings of this study showed that the prevalence of post cesarean delivery anemia at Ghandi memorial Hospital was high (39.8%) and the independent factors significantly associated with post cesarean delivery anemia were interpregnancy interval of <24months during most recent pregnancy, having previous uterine scar, having chronic medical illness, participant's frequency of meal <3 times per day, having obstetric complication and emergency cesarean delivery.

10. Recommendation

Further large scale research is recommended to represent the general population, to see causal relationship and address limitations of this study.

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12. Annexes

Annex 1: Information sheet and procedure:

Dear Sir/Madam;

Greetings, my name is Dr Semere Fisseha, who is studying for specialty of Obstetrics and Gynecology at Addis Ababa University, College of Health Sciences. I kindly request you to give me your attention to explain about the study and about you being selected as the study participant.

The Study Title: Prevalence and Factors Associated with Post Cesarean Delivery Anemia at Gandhi Memorial Hospital, Addis Ababa, Ethiopia; 2023GC

Importance and Purpose of the Study: The findings of this study will have a paramount importance for women and newborns to plan a necessary intervention programs to give attention for post cesarean delivery anemia. Moreover, the aim of this study is to write a research paper as a partial requirement for the fulfillment of a specialty program of obstetrics and gynecology for the principal investigator.

Procedure and Duration: I will be interviewing you using questionnaire, there are 29 questions to answer. I will not take more than 40 minutes of your time.

Risks and Benefits: The risk of being participated in this study is negligible, but only taking a few minutes from your time. There would not be any direct payment for participating in this study and your input has great value for the success of the study.

Confidentiality: The data you will provide us will be confidential. There will be no information that will identify you. The findings of the study will be general for the study population and will not reflect anything particular of individual person. The questionnaire will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants to the research. You have full right to refuse to take part or to interrupt the interview at any time.

Are you willing to participate in the study? 1- Yes ……. (continue to the next page)
2 – No……Thank you (skip to the next participant)

Name of Enumerator _____ Signature _____ Interview Date _____

Questionnaire Code_____

Name of the supervisor _____Signature _____Checking Date _____

Annex 2: Data Collection tool (Questionnaire)

Respondent's information sheet for face to face survey on prevalence and associated risk factors of post cesarean delivery anemia, 2022/23

Section I : Sociodemographic characteristics				
No.	**Questions**	**Answers (Circle your choices)**	**Codes**	
Q101	How old are you?	------Years (age in completed years)	<20 20-29 30-39 >or=40	1 2 3 4
Q102	What is your religion?	1. Orthodox 2. Muslim 3. Catholic 4. Protestant 5. Others (specify)……		1 2 3 4 5
Q103	What is your current marital status?	1. Married 2. Single 3. Widowed 4. Divorced 5. Non married partner		1 2 3 4 5
Q104	What is your educational status (Highest Level)?	1. Unable to read and write 2. Able to read and write without formal education 3. Primary school (Grade 1-8) 4. Secondary School (Grade 9-12) 5. Beyond Secondary School (College and above)		1 2 3 4 5
Q105	What is your current Occupation?	1. House wife 2. Daily laborer 3. Merchant 4. Government employee 5. Private employee 6. Other (specify)……..		1 2 3 4 5 6
Q106	What is your husbands educational status?	1. Unable to read and write 2. Able to read and write without formal education 3. Primary school (Grade 1-8) 4. Secondary School (Grade 9-12) 5. Beyond Secondary School (College and above)		1 2 3 4 5
Q107	What is your husband's occupation?	1. Daily laborer 2. Merchant 3. Government employee		1 2 3

		4. Private employee 5. Other (specify)……		4 5
Q108	What is your average monthly income	……... Ethiopian total birr		
Q109	What is average monthly income of your husband?	…… Ethiopian total birr	Range	

Section II : Reproductive and Obstetrics History of women				
No.	**Questions**	**Answers (Circle your choices)**	**Codes**	
Q201	Gravidity	1. Primigravid 2. Multigravid (2-5) 3. Grandmultigravid(>=6)		1 2 3
Q202	Parity	1. Primiparous 2. Multiparous (2-4) 3. Grand multiparous (>=5)		1 2 3
Q203	Number of alive birth	…….		
Q204	History of abortion	1. Yes 2. No		1 2
Q205	Inter pregnancy interval	……. Months		
Q206	Gestational age (weeks)	1. ---------- Weeks 2. Unknown		
Q207	Does she have ANC	1. Yes …. (Go to Q207 & 208) 2. No		1 2
Q208	GA when ANC visit initiated	……. Weeks		
Q209	Number of ANC visits	……. Visits		
Q210	History of previous C/S (including any uterine scar)	1. Yes 2. No		1 2
Q211	If yes to question number 4 how many scar	…… .Scars		
Q212	History of previous PPH	1. Yes 2. No		1 2
Q213	History of chronic medical illness	3. Yes (specify) …… 4. No		1 2

Q214	History of blood transfusion	1. Yes 2. No		1 2
Q215	Any bleeding tendency	1. Yes 2. No		1 2

Section III : Utilization of IFA during pregnancy				
No.	**Questions**	**Answers (Circle your choices)**	**Codes**	
Q301	IFA took during pregnancy	1. Yes 2. No		1 2
Q302	GA when IFA tablet started	…… Weeks		
Q303	Adherence to IFA supplementation	1. Poor adherence 2. Good adherence		1 2
Q304	Hot drink while taking IFA (Tea, coffee and milk)	1. Yes 2. No		1 2
Q305	Frequency of meal per day	1. ≤ 3 2. >3		1 2

Section IV : Antepartum and intrapartum obstetric Factors				
No.	**Questions**	**Answers (Circle your choices)**	**Codes**	
Q401	Number of fetuses	1. Singleton 2. Twin 3. Triplet and above		1 2 3
Q402	Obstetric complication	1. Yes (Go to Q403) 2. No		
Q403	Type of obstetric complication	1. Preeclampsia/Eclampsia 2. Antepartum Hemorrhage 3. PROM 4. Scar dehiscence 5. Uterine Rupture 6. Other ……(specify)		1 2 3 4 4 6
Q404	Onset of labor	1. Spontaneous 2. Induced 3. No labor		1 2
Q405	Duration of labor	……. Hrs		

Section V : Intraoperative and post-operative Factors				
No.	**Questions**	**Answers (Circle your choices)**	**Codes**	
Q501	Level of surgeon	1. Obstetrician /gynecologist 2. Year – 4 - Resident 3. Year - 3 - Resident 4. Year - 2 - Resident 5. Year - 1 - Resident		1 2 3 4 5
Q502	Indication for cesarean delivery	……. …….. Specify		
Q503	Type of cesarean delivery	1. Elective 2. Emergency		1 2
Q504	Mode of anesthesia	1. Spinal 2. General Anesthesia		1 2
Q505	Type of Skin incision	1. Pfannestiel 2. Midline 3. Other ……		1 2 3
Q506	Type of uterine incision	1. LUST- C/S 2. Classical 3. Other…….		1 2 3
Q507	Newborn birth weight	…….grams		
Q508	Uterotonic agent given	1. Oxytocin 2. Misoprostol 3. Misoprostol + oxytocin		1 2 3
Q509	Intraoperative complication	1. Yes (Specify …….) 2. No		1 2
Q510	Estimated Blood loss	……. ml		
Q511	Transfusion needed	1. Yes 2. No		1 2
Q512	Duration of surgery	……Minutes		
Q513	Is she diagnosed to have PPH clinically	1. Yes 2. No		1 2

Section VI : Hemoglobin and RBC indices determination				
No.	**Questions**	**Answers (Circle your choices)**	**Codes**	
Q601	Hemoglobin before surgery since 2wks (most recent)	……. g/dl		
Q602	Hemoglobin and MCV value after 24hrs of cesarean delivery)	……. g/dl		