



Research Article

# Anemia and Associated Factors Among Women Delivered by Cesarean Section at Public Hospitals in West Hararghe Zone, Eastern Ethiopia, 2024: A Cross-Sectional Study

Teshome Ketema Sime<sup>1,\*</sup> , Yared Getahun<sup>1</sup>, Dejene Edosa<sup>1</sup>, Mukemil Awol<sup>1</sup>, Wakuma Fulea Gutema<sup>2</sup>

<sup>1</sup>Department of Midwifery, Salale University, Fitcha, Central Ethiopia

<sup>2</sup>Department of Medicine, Salale University, Fitcha, Central Ethiopia

## Abstract

**Background:** Anemia in the postpartum period remains a considerable public health problem in developing countries. It is the most common indirect cause of maternal morbidity and mortality. While prenatal anemia is extensively studied, the literature on post-caesarean section anemia is limited. Almost no study was conducted in west Hararge zone. Knowing the magnitude of post-caesarean section anemia can contribute to the scientific evidence regarding the prevalence of post-caesarean section anemia and used for policy brief. Therefore, The study aimed to assess anemia and associated factors among mothers delivered by cesarean section in public hospitals of West Hararge zone; 2024 **Methods:** A facility-based cross-sectional study was conducted among among 311 postpartum having cesarean section women admitted to six hospitals of West Hararge zone in Eastern Ethiopia. Simple random sampling technique was used to select the respondents. Data was collected using a pre-tested, structured interviewer-administered questionnaire. Both primary and secondary data were used. The collected data was entered into Epi-Data version 3.1 and analyzed using SPSS version 26. **Results:** This study revealed that the magnitude of post cesarean section anemia was 24.8%, 95% confidence interval (21.37-28.24)). factors such as hypertension history (AOR=1.90; 95% CI (1.004, 3.607)), postpartum hemorrhage (AOR=4.04; 95% CI (1.638, 9.974)), and No Adherence to IFA supplementation (AOR=3.08; 95% CI (1.224, 7.770)) were identified as the determinants of post cesarean section anemia. **Conclusion:** The current study showed high magnitude of anemia when compared with previous studies. So, action should be taken by all concerned stakes to minimize the burden of the anemia in the post cesarean section. Significant predictors of post c/s anemia includes: perineal tear, hypertension history, and postpartum hemorrhage. A more careful strategy is ideal to decrease the burden of hypertension during pregnancy, early anticipation and timely management of high index of suspicion in mothers diagnosed with postpartum hemorrhage, are recommended to tackle the burden of post cesarean section anemia.

## Keywords

Post Cesarean Section, Anemia, Ethiopia

\*Correspondence: Teshome Ketema Sime (teshomeketema4@gmail.com)

**Received:** 19 June 2026; **Accepted:** 7 July 2026; **Published:** 27 July 2026



## 1. Introduction

Anemia is a major global health problem affecting the health, quality of life, and working capacity of billions of people all over the world. There is no general agreement regarding definition and cut of point of Postpartum anemia, but so far the WHO recommended that postpartum anemia should be defined by hemoglobin <110 g/L at 1 week postpartum and <120 g/L at 8 weeks postpartum [1]. Cesarean section is an operative technique by which a fetus, placenta, and membranes are delivered through an abdominal and uterine incision. It is one of the most common surgeries around the world and it is classified into elective, necessary, and emergency caesarean sections [2].

Cesarean section rates have been rising progressively worldwide with a wide variation between countries and regions. It is globally known that Cesarean section. delivery can present several risks than a vaginal birth even if it has become now a days one of obstetric intensive cares regarding its benefits for mother and baby [3].

The significant association between anemia and cesarean delivery has important implications for the prevention and treatment of anemia among women delivered by Cesarean section [4].

Maternal mortality after caesarean delivery in Africa is 50 times higher than that of high-income countries and is driven by post-partum hemorrhage and anesthesia complications. Among many of the complication that leads to maternal mortality, one is post Cesarean section. anemia. Paradoxically, while many countries are aiming to reduce the caesarean delivery rate, increasing the rate of caesarean delivery remains a priority in Africa. In sub-Saharan Africa, the caesarean delivery rate is static at 3 5%, despite an increasing pattern in rates globally [5].

Low- and middle-income countries, wealthy women have more than five times higher C-section use than poor women. In the United States, 32% of births were by C-section in 2015, an increase from 23% in 2000, as the data showed, and in the United Kingdom, 26.2% of births were by C-section in 2015, up from 19.7% in 2000. According to the World Health Organization report, the country with the lowest C-section rate, at 0.6% in 2010, was South Sudan and the country with the highest, at 58.1% in 2014, was the Dominican Republic. Whereas, some countries where more than half of births were by C-section such as Brazil, at 55.5% in 2015; Egypt, at 55.5% in 2014; Turkey, at 53.1% in 2015) [6]. There is an evidence that In Ethiopia The overall pooled prevalence of Cesarean section is 29.55%. It is associated with both maternal and neonatal complications among which severe anemia is one of the complication [7].

Currently, The WHO addressed that Cesarean section has paramount importance on reducing maternal and prenatal mortality and morbidity, provided that there is justified medical indication. However, in the absence of clear medical justification, Cesarean section has no medical benefit, rather it is

associated with short- and long-term health risks as compared with vaginal delivery. One of the long term risks is anemia, but there is a little literature on how much of post-partum anemia is directly related to Cesarean section [8].

A facility-based cross-sectional study conducted in eastern Ethiopia revealed that Women's educational level, age, frequency of antenatal care, mode of delivery, a history of maternal blood loss, pre-delivery hemoglobin level, and iron-folate supplementation status are some of identified as immediate postpartum anemia risk factors [9].

In Ethiopia, the rate of caesarean delivery varied between regions with a range of 0.4% in Somali to 21.4% in Addis Ababa with the national pooled prevalence of 29.5%, and severe anemia is one of the complication related to Cesarean section [9].

There is limited information concerning the prevalence of anemia at immediate post caesarean section and associated factors in public hospitals of West Hararge Eastern Ethiopia. Therefore, this study aimed to assess the prevalence of anemia at post caesarean section and associated factors in public hospitals of west Hararge Eastern Ethiopia.

## 2. Methods and Materials

### 2.1. Study Setting and Period

A Cross-sectional study was conducted in west Hararge zone on the post-natal ward at six public Hospitals, Oromia region state from March 1 to May 1, 2024. West Hararge Administrative zone is one of the 21 Zone in Oromia Regional states.

### 2.2. Study Design

A facility cross-sectional based study was conducted.

### 2.3. Population

#### 2.3.1. Source Population

Women who underwent caesarean section at West Hararge public hospital were the source population of this study.

#### 2.3.2. Study Population

All women gave birth by Cesarean section at West Hararge zone.

### 2.4. Eligibility Criteria

#### 2.4.1. Inclusion Criteria

All mothers who gave births by Cesarean section. during the study period at West Hararge zone public hospitals were

included.

## 2.4.2. Exclusion Criteria

Women who received blood transfusion pre-operatively, unable to speak, and incomplete medical document.

## 2.5. Sample Size Determination

Sample size calculation was based on single population proportion formula by using the following assumption:  $p=24.35\%$  (9), Proportion of Immediate Postpartum Anemia and Associated Factors among Postnatal Mothers in North-west Ethiopia: Across-Sectional Study, 2020.), 95% confidence level, and 5% margin of error,

$$n = (Z_{(\alpha/2)}^2 \times p(1-p)) / d^2$$

And then the calculated sample size is assumed to be 283. Finally, by adding a 10% non-responsive rate, the final sample size is 311.

Where  $n$  = sample size

$Z$  = standard normal distribution corresponding to significance level at  $\alpha = 0.05$ ,  $p$  = proportion of immediate post Cesarean section anemia = 24.35%,  $d$  = margin of error 5%

## 2.6. Sampling Technique and Ischemic Representation of Sample

Simple random sampling technique was used with the following steps. Total births from March to May of 2024, at each six hospitals in similar season were identified using registration log book and births with C/s and Card number of identifying births was coded. Cards were traced and checked for completeness of the necessary information.

Accordingly six public hospitals found in west Hararge zone, namely Galamso, Mechara, Badessa, Hirna, Chiro and Asebot hospitals were selected. A total of 2536 cesarean section delivery per annum take place at similar season of last year, therefore this number is taken as  $N$  or total population of the study. Proportional allocation formula was used, as explained in the following sampling techniques frame.

## 2.7. Study Variables

### 2.7.1. Dependent Variables

Post C/s anemia.

### 2.7.2. Independent Variables

*Socio-demographic factors:* (age, residence, Occupation, educational status and income).

*Medical factors:* previous medical illness, illness during current pregnancy, HIV status, history of anemia, co-aggulation and obesity, DM, Hypertension, pervious anemia.

*Past obstetric and gynecologic factors:* (Parity, Gravidity,

obstetric complications, history of adverse pregnancy outcomes, abortion history and family planning history,).

*Current obstetric factors:* (pregnancy status, use of ANC and number of visit, TT vaccine, obstetric emergencies and drug use during pregnancy, grand multi parity).

*Current delivery related factors:* (referred mother for delivery, status of labor, Partograph use, type of C/s Number of C/s, complication during delivery and history of multiple birth).

## 2.8. Operational Definition

*Post C/s anemia:* According to this research if A post Cs Hgb. concentration of less than 10g/dl (8).

*Obstetric emergencies:* According to this research if one or more of obstetric complications like (APH, Cord prolapse, Eclampsia, fetal distress, Shoulder dystocia) happen.

*Adherence to IFA:* If a women fail to take standard dose of 60mg Iron and 400µg Folic Acid supplementation for 6months on a daily basis during pregnancy.

Preterm birth is any birth occurring between 28 - 37 weeks gestation took place.

Still birth is any fetus born at 28 weeks gestational age or more with no heartbeat or respiratory effort took place.

*Birth weight:* If first weight of the fetus or newborn obtained after birth. Measured within the first hour of life before significant postnatal weight loss has been occurred by using a standard weight scale.

*Low birth weight:* neonate birth weight less than 2,500 gm (up to and including 2,499 gm).

## 2.9. Data Collection and Quality Control Management

Under the supervision of PI, the trained midwives were collected the data using a structured questionnaire that captured study-specific variables. Daily, after the morning ward round on the postnatal ward, the data collectors were identify women on their 1st post-operative day, and explained the purpose of the study to them and invite them to participate. Women who were fulfill the study eligibility criteria were taken through an informed consenting process before enrolment into the study.

Data quality was controlled by adapting validated tools via reviewing literatures, giving training to data collectors and supervisors, conducting pretest, and language translation. Accordingly, one-day training was given to the data collectors and supervisors prior to data collection by the principal investigator on the objective of the study, method of data collection. A pretest was conducted on 5% of the sample size out of the study area to check the clarity and consistency of the questionnaire. and the checklist was done prior to the actual data collection. Relevant modifications were made as per required.

The questionnaire was primarily prepared in the English language and translated into Local language by professional who is familiar on this field and fluent in the two languages and back-translated to English language by another expert,

who is not familiar with the original questionnaires, in order to guarantee its consistency.

During the data collection time, each complete questionnaire was checked for completeness, clarity, and consistency at the site of data collection by the supervisors to take the corrective measure. on daily basis. The overall activities were also be monitored by the principal investigator.

After data collection complete, it was entered using EPI data software. After data entry, analysis was done using statistical package for social science (SPSS) and crosstab was done to check the apportionment size of the independent variables with the dependent variable to check for the assumptions.

## 2.10. Data Processing and Analysis

Data was manually checked for completeness and coded, cleaned before entering to a computer. Then, it was be entered into EPI data version 3.1 and exported into SPSS version 26 for analysis. Data exploration was conducted to assess the completeness and descriptive statistics was used to describe the data. Bivariable analysis was used to select important variables candidate for the multiple logistic regression. Variables that are found significant at p-value less than or equal to 0.25 in Bivariable analysis were selected as candidate variables for multivariable logistic regression analysis. Multi-co linearity was checked using variance inflation factor (vif) of 4.75.

Multivariable analysis was carried out to identify independent predictors of determinants of post c/s anemia by controlling for confounders. Variables with p-value less than 0.05; and with their respective 95% of ci were used to identify independent predictors for determinants of the outcome variable.

The model fitness was tested by using Hosmer and Lemeshow goodness of fit test ( $p= 0.782$ ). Finally, the results were be presented by using tables, graphs, and text.

## 3. Results

### *Sociodemographic characteristics*

A total of 311 mothers' were involved in the study making 100% response rate; the mean age of the mothers was 27.72 with Standard deviation of + 5.72; The maternal age ranges between 19 and 43 years; majority 261 (83.9%) of the mothers' ages were in the age group between 20 and 34 years, followed by above age of 34 years, respectively; in terms of where they lived, 181 (41.8%) were urban residents, whereas, 181 (58.2%) were rural residents.

The mean average monthly income of the respondents was 5526.20 with Standard deviation of + 1988.98. Regarding the marital status 16 (5.1%), 266 (85.5%), 16 (5.1%), and 13 (4.2%) were unmarried, married, widowed, and divorced respectively. Women occupation Merchant 3 (1.0%), day labor 13 (4.2%), agriculture 270 (86.8%), and 25 (8.0%) were government employee respectively. Husband occupation day labor 63 (20.3%), involved in farming 107 (34.4%), and government employee accounts about 141 (45.3%). About 166 (53.37%) had history of exposure to media. About 233 (74.9%) of women cannot read or write whereas 126 (40.5%) of husband cannot read or write. The majority 263 (84.6%) of the respondents, had a Monogamous type of marriage type whereas Polygamous accounts about 48 (15.4%) of the respondents. The socio-demographic information of the participants is summarized in (Table 1).

**Table 1.** Sociodemographic characteristics of the study participants in selected Public Hospitals of west Hararghe Zone, Ethiopia; 2024 (n = 311).

| Variables                | Category                    | Frequency | Percent (%) |
|--------------------------|-----------------------------|-----------|-------------|
| Age                      | ≤19                         | 12        | 3.9         |
|                          | 20-34                       | 261       | 83.9        |
|                          | >34                         | 38        | 12.2        |
| Place of residence       | Urban                       | 130       | 41.8        |
|                          | Rural                       | 181       | 58.2        |
| Marital status           | un married                  | 16        | 5.1         |
|                          | Married                     | 266       | 85.5        |
|                          | Widowed                     | 16        | 5.1         |
|                          | Divorced                    | 13        | 4.2         |
| Women educational status | cannot read / write         | 233       | 74.9        |
|                          | Primary education           | 67        | 21.5        |
|                          | College/university graduate | 11        | 3.5         |

| Variables                  | Category            | Frequency | Percent (%) |
|----------------------------|---------------------|-----------|-------------|
| Husband educational status | cannot read / write | 126       | 40.5        |
|                            | Primary education   | 65        | 20.9        |
|                            | Secondary education | 27        | 8.7         |
|                            | Merchant            | 3         | 1.0         |
| Women occupation           | Day labor           | 13        | 4.2         |
|                            | Agriculture         | 270       | 86.8        |
|                            | Gov. t employee     | 25        | 8.0         |
|                            | Day labor           | 63        | 20.3        |
| Husband occupation         | Agriculture         | 107       | 34.4        |
|                            | Gov. t employee     | 141       | 45.3        |
| Exposure to media          | Yes                 | 166       | 53.37       |
|                            | No                  | 145       | 46.63       |
| Marriage type              | Monogamous          | 263       | 84.6        |
|                            | Polygamous          | 48        | 15.4        |

#### Past Obstetrics related factors

Regarding the number of Parity Primiparous accounts for about 21 (6.8%) whereas; Multiparous, and Grand-multiparous accounts about 274 (88.1%), and 16 (5.1%) respectively. The Age at marriage was Less than 18 years old for 49 (15.8%) whereas Greater than 18 years old in about 262 (84.2%). Family structure Nuclear 280 (90%) but Extended 31 (10%), Majority of the Spousal age difference was Less than 5 years in

about 232 (74.6%) whereas 79 (25.4%) spousal age difference was between 6-10yrs. Regarding Previous history of still birth only 9 (2.9%) of respondents had Previous history of still birth. About 27 (8.7%) had Previous history of C/S. Almost 168 (54%) Had attended ANC follow up but only 43 (13%) of them had visited four and above. Past History of abortion accounts about 66 (21.2%), 191 (61.4%) of respondent had Inter pregnancy interval of Greater than 2 years (Table 2).

**Table 2.** Past obstetrics related characteristics of the study participants, at public hospitals in west Hararghe zone, Eastern Ethiopia; 2024 (n=311).

| Variables                       | Category                  | Frequency | Percent |
|---------------------------------|---------------------------|-----------|---------|
| Parity                          | Primiparous               | 21        | 6.8     |
|                                 | Multiparous               | 274       | 88.1    |
|                                 | Grand-multiparous         | 16        | 5.1     |
| Age at marriage                 | Less than 18 years old    | 49        | 15.8    |
|                                 | Greater than 18 years old | 262       | 84.2    |
| Family structure                | Nuclear                   | 280       | 90.0    |
|                                 | Extended                  | 31        | 10.0    |
| Spousal age difference          | Less than 5 years         | 232       | 74.6    |
|                                 | 6-10yrs                   | 79        | 25.4    |
| Previous history of still birth | Yes                       | 9         | 2.9     |
|                                 | No                        | 302       | 97.1    |
| Previous history of C/S         | Yes                       | 27        | 8.7     |

| Variables                           | Category             | Frequency | Percent |
|-------------------------------------|----------------------|-----------|---------|
| ANC follow up                       | No                   | 284       | 91.3    |
|                                     | Yes                  | 168       | 54.0    |
| Number of ANC follow ups            | No                   | 143       | 46.0    |
|                                     | One                  | 20        | 6.4     |
|                                     | Two                  | 48        | 15.4    |
|                                     | Three                | 57        | 18.3    |
|                                     | Four and above       | 43        | 13.     |
| History of abortion                 | Yes                  | 66        | 21.2    |
|                                     | No                   | 245       | 78.8    |
| Inter pregnancy interval (in years) | < two years          | 99        | 31.8    |
|                                     | Greater than 2 years | 191       | 61.4    |
| Twin px                             | Yes                  | 42        | 13.5    |
|                                     | No                   | 269       | 86.5    |

#### *Current obstetrics and gynecologic history*

In terms of their Type of the current C/S, 279 (89.7%) had emergency type of C/S and 294 (94.5%) had current indications for C/S. Of all, 42 (13.5%) had twin pregnancy, Peripartum anemia accounts 24 (7.7%), 10 (3.2%) had died fetal outcome, 42 (13.5%) had Perineal tear, Majority of the Fetal birth weight were between 2500-4000g 300 (96.5%). Postpartum hemorrhage accounts for about 59 (19%) of the respondents.

#### *Pre natal, Intra natal and cesarean section related Factor*

Out of all about 92 (29.6%) of respondents had took IFA during pregnancy, from those who took IFA during pregnancy 120 (38.6%) had adherence to IFA 120 8 (1.57%) and 44 (14.1%) took Hot drink during IFA took. Regarding Frequency of meal per day majority 279 (89.7%) had less than

meal per day.

Regarding family planning use about 109 (35%) used Family planning before the current pregnancy, from this majority of them had used Depo-Provera 62 (19.9%). Abnormal uterine bleeding history occurred in 8 (2.6%) of respondents. Regarding GA at which Iron taken about 94 (30.2%) taken b/n 13-27 weeks of GA. The time interval that was taken from incision to delivery of the baby was 77 (24.8%) of respondent was greater than 30 minutes. Regarding Type of anesthesia used about 269 (86.5%) of respondents were used General anesthesia. Regarding Type of surgeon performed the C/s about 258 (83%) of C/s were performed by Gynecologist (Table 3).

**Table 3.** Prenatal, intranatal and cesarean section related characteristics of the study participants, at public hospitals in west Hararghe zone, Eastern Ethiopia; 2024 (n=311).

| Variables                  | Category           | Frequency | Percent |
|----------------------------|--------------------|-----------|---------|
| Type of the current C/S    | Emergency          | 279       | 89.7    |
|                            | Elective           | 32        | 10.3    |
| Current indication for C/S | Yes                | 294       | 94.5    |
|                            | No                 | 17        | 5.5     |
| Fetal outcome              | Died               | 10        | 3.2     |
|                            | Alive              | 301       | 96.8    |
| Fetal birth weight         | less than 2500g    | 8         | 2.6     |
|                            | between 2500-4000g | 300       | 96.5    |
|                            | greater than 4000g | 3         | 1.0     |



| Variables                               | Category              | Frequency | Percent |
|-----------------------------------------|-----------------------|-----------|---------|
| Type of the current C/S                 | Emergency             | 279       | 89.7    |
|                                         | Elective              | 32        | 10.3    |
| GA at which Iron taken                  | up to 12 weeks of GA  | 37        | 11.9    |
|                                         | b/n 13-27 weeks of GA | 94        | 30.2    |
|                                         | B/n 28-42weeks of GA  | 38        | 12.2    |
| Adherence to IFA supplementation        | Yes                   | 42        | 13.5    |
|                                         | No                    | 269       | 86.5    |
| Postpartum haemorrhage                  | Yes                   | 59        | 19.0    |
|                                         | No                    | 252       | 81.0    |
| IFA took during pregnancy               | Yes                   | 92        | 29.6    |
|                                         | No                    | 219       | 70.4    |
| Perineal tear                           | 120                   | 38.6      | 120     |
|                                         | 191                   | 61.4      | 191     |
| Hot drink during IFA took               | Yes                   | 44        | 14.1    |
|                                         | No                    | 267       | 85.9    |
| Frequency of meal per day               | < 2                   | 279       | 89.7    |
|                                         | >2                    | 32        | 10.3    |
| Family planning use                     | Yes                   | 109       | 35.0    |
|                                         | No                    | 202       | 65.0    |
|                                         | Depo-Provera          | 62        | 19.9    |
| What types of family planning used      | Implants              | 19        | 6.1     |
|                                         | Pills                 | 26        | 8.4     |
|                                         | IUCD                  | 2         | .6      |
| AUB history                             | Yes                   | 8         | 2.6     |
|                                         | No                    | 303       | 97.4    |
| Time interval from incision to delivery | <30min                | 234       | 75.2    |
|                                         | ≥30min                | 77        | 24.8    |
| Type of anesthesia used                 | Local                 | 42        | 13.5    |
|                                         | General               | 269       | 86.5    |
| Type of surgeon                         | IESO                  | 53        | 17.0    |
|                                         | Gynecologist          | 258       | 83.0    |

#### Medical History (illness)

Different medical conditions such as Hypertension history in 100 (32.2%), Diabetes mellitus history in 60 (19.3%), Reactive HIV status in 23 (7.4%), malaria history in 16 (5.1%),

Co-aggulation history has been observed in 11 (3.5%) of the respondents (Table 4).

**Table 4.** Medical illness related characteristics of the study participants, at public hospitals in west Hararghe zone, Eastern Ethiopia; 2024 (n=311).

| Variables                 | Category     | Frequency | Percent |
|---------------------------|--------------|-----------|---------|
| Hypertension history      | Yes          | 100       | 32.2    |
|                           | No           | 211       | 67.8    |
| Diabetes mellitus history | Yes          | 60        | 19.3    |
|                           | No           | 251       | 80.7    |
| HIV status                | Reactive     | 23        | 7.4     |
|                           | Non-reactive | 288       | 92.6    |
| History of malaria        | Yes          | 16        | 5.1     |
|                           | No           | 295       | 94.9    |
| Peripartuem anemia        | Yes          | 24        | 7.7     |
|                           | No           | 144       | 46.3    |
| Co-agglutination history  | Yes          | 11        | 3.5     |
|                           | No           | 300       | 96.5    |

*Factors associated with post caesarean section anemia*

In bivariable logistic regression variables such as Previous c/s scar, co-agglutination history, Perineal tear, Postpartum hemorrhage, Adherence to IFA supplementation, Hypertension history, and History of Malaria were taken as study variables to see the outcome of dependent variable. However hypertension history (AOR=1.90; 95% CI (1.004, 3.607)), postpartum hemorrhage (AOR=4.04; 95% CI (1.638, 9.974)), and Adherence to IFA supplementation (AOR=3.08; 95% CI (1.224, 7.770)) were finally identified as factors that are significantly associated with post Cesarean section anemia in multivariable logistic regression model at p-value less than 0.05.

Those mothers who had hypertension history 1.90 (AOR=1.90; 95% CI (1.004, 3.607)), times more likely to develop post caesarean section anemia than those who had no hypertension history.

The odds of having immediate postpartum caesarean section anemia among mothers diagnosed with PPH were almost four (AOR=4.04; 95% CI (1.638, 9.974)), times more likely as compared to their counterparts. Those women who had no Adherence to IFA supplementation were three (AOR=3.08; 95% CI (1.224, 7.770)) times more likely to develop post caesarean section anemia as compared to those who had no Adherence to IFA supplementation respectively.

**Table 5.** Bivariable and multi variable association post caesarean section anemia with characteristics of the study participants, at public hospitals in west Hararghe zone, Eastern Ethiopia; 2024 (n=311).

| Variables                | Categories | Post C/S anemia |     | COR with 95% CI    | AOR with 95% C. I.   |
|--------------------------|------------|-----------------|-----|--------------------|----------------------|
|                          |            | Yes             | No  |                    |                      |
| Previous c/s scar        | Yes        | 6               | 23  | 0.77 (0.50, 3.25)  | 1.57 (0.551, 4.477)  |
|                          | No         | 71              | 211 | 1                  | 1                    |
| Co-agglutination history | Yes        | 5               | 8   | 1.96 (0.62, 6.18)  | 0.45 (0.131, 1.551)  |
|                          | No         | 72              | 226 | 1                  | 1                    |
| Adherence to IFA         | Yes        | 3               | 39  | 1                  | 1                    |
|                          | No         | 74              | 195 | 0.42 (0.17, 1.041) | 3.08 (1.224, 7.770)* |
| Postpartum hemorrhage    | Yes        | 6               | 53  | 0.28 (0.12, 0.70)  | 4.04 (1.638, 9.974)* |
|                          | No         | 71              | 181 | 1                  | 1                    |



| Variables            | Categories | Post C/S anemia |     | COR with 95% CI    | AOR with 95% C. I.   |
|----------------------|------------|-----------------|-----|--------------------|----------------------|
|                      |            | Yes             | No  |                    |                      |
| Perineal tear        | Yes        | 28              | 92  | 0.88 (0.51, 1.50)  | 1.333 (0.737, 2.410) |
|                      | No         | 49              | 142 | 1                  | 1                    |
| Hypertension history | Yes        | 21              | 82  | 0.69 (0.39, 1.22)  | 1.90 (1.004, 3.607)* |
|                      | No         | 56              | 152 | 1                  | 1                    |
| History of Malaria   | Yes        | 6               | 10  | 1.89 (0.66, 5.392) | 0.46 (0.148, 1.431)  |
|                      | No         | 71              | 224 | 1                  | 1                    |

NB: \* indicate statistically significant association at ( $p < 0.05$ ) in multivariable analysis.

## 4. Discussion

This study aimed to determine the magnitude and factors that are associated with post cesarean section anemia. The study has shown that the magnitude of post /s anemia was 24.8% with 95% confidence interval (21.37-27.84). This study has shown that the magnitude of post /s anemia was 24.8% which is slightly lower than the evidence from Harare regional state revealed that magnitude of immediate postpartum anemia was 28.1% [9].

But Consistent with Postpartum anemia among which one of the evidence from Northwest Ethiopia observed that proportion of postpartum anemia is 24.3% [10]. Similar findings were reported in Tamil Nadu [11]. Excessive bleeding after birth decreases the red blood cell component called hemoglobin. In every milliliter blood loss, a half milligram of iron will be reduced in the blood. In addition the possible explanation could be in the case of cesarean deliveries there is the probability of inadvertent injury of the anterior abdominal wall and uterine vessels and a high possibility of extension to the fundal region of the uterus and vaginal wall.

The factors that were independently associated with post caesarean section anemia were non adherence to IFA supplementations, hypertension history, and postpartum hemorrhage. Those mothers who had hypertension history 1.90 (AOR=1.90; 95% CI (1.004, 3.607)), times more likely to develop post caesarean section anemia than those who had no hypertension history. This is supported by similar study conducted in Debre markos referral hospital as APH was identified as risk factors of immediate postpartum hemorrhage and hypertensive disorders one of the most common causes of APH specifically abruption placenta [11].

The odds of having immediate postpartum caesarean section anemia among mothers diagnosed with PPH were almost four (AOR=4.04; 95% CI (1.638, 9.974)), times more likely as compared to their counterparts. This is supported by similar study conducted Gondar, and wollega respectively [11, 14]. The possible explanation could be Excessive bleeding after

birth decreases the red blood cell component called hemoglobin. In every milliliter blood loss, a half milligram of iron will be reduced in the blood.

The odds of Post cesarean section were three (AOR=3.08; 95% CI (1.224, 7.770)) fold higher among postpartum mothers who had poor adherence to IFA supplementation compared to their counterparts. This finding was in agreement with the studies carried out in Uganda, Eastern Ethiopia, and Northwest Ethiopia [10, 12, 13]. The possible explanation might be due to the depleting of stored maternal iron since physiologic requirements of iron during pregnancy and labour are high. Therefore, not taking IFA based on the right order could reduce iron store and results in anemia even with minimal blood loss during childbirth.

## 5. Conclusions

The current study showed high magnitude of anemia when compared with previous studies. So, action should be taken by all concerned stakes to minimize the burden of the anemia in the post cesarean section. Significant predictors of post c/s anemia includes: poor adherence to IFA supplementations, hypertension history, and postpartum hemorrhage. A more careful strategy is ideal to decrease the burden of hypertension during pregnancy, early anticipation and safe reduction of the occurrence of perineal tear during labour and delivery, quick and timely management of high index of suspicion in mothers diagnosed with postpartum hemorrhage, are recommended to tackle the burden of post cesarean section anemia.

## 6. Recommendations

Considering the study findings, the following recommendations are forwarded to each concerned bodies.

### *Policy makers and programmers*

Programmers are recommended to develop evidence based interventions to reduce the magnitude of post cesarean section anemia Moreover, the health policymakers should focus on

the identified factors significantly associated with post cesarean section anemia.

#### *Hospitals administrations*

The hospital is recommended to give enhancements of maternal care for mothers who presented with mothers who presented with postpartum hemorrhage, hypertension, and mothers with perineal tear. Hospitals are recommended to have standard of care to decrease the magnitude of post cesarean section anemia.

#### *Health professionals*

Increase/create public awareness about the post cesarean section anemia and factors that increase the risk of developing the post cesarean section anemia. We recommended health professionals to give close monitor for mothers who presented with postpartum hemorrhage, as well as mothers with poor adherence to IFA supplementations, and give early recognition of post cesarean section anemia. It is also better if health professionals anticipate for hypertension during pregnancy and act on it.

#### *Future researchers*

Since, future research should assess the predictors of post cesarean section anemia by prospective cohort to account all possible predictors of the outcome variable. Additionally, additional research in other geographies should be required to identify various aspects in various populations and contexts.

## Abbreviations

|      |                                             |
|------|---------------------------------------------|
| AIDS | Acquired Immune Deficiency Syndrome         |
| ANC  | Antenatal Care                              |
| AOR  | Adjusted Odds Ratio                         |
| APH  | Anti Partum Hemorrhage                      |
| CI   | Confidence Interval                         |
| CSRD | Corporate Sustainability Reporting Director |
| EDTA | Ethylene Diamine Tetra Acetic Acid          |
| HGB  | Hemoglobin                                  |
| HIV  | Human Immune Virus                          |
| MRRH | Mbarara Regional Referral Hospital          |
| PPA  | Postpartum Anemia                           |
| RCBD | Randomized Complete Block Design            |
| SD   | Standard Deviation                          |
| SPSS | Statistical Package for Social Sciences     |
| TB   | Tuberculosis                                |
| WHO  | World Health Organization                   |

## Author Contributions

**Teshome Ketema Sime:** Conceptualization, Formal Analysis, Supervision, Writing – original draft

**Yared Getahun:** Conceptualization, Formal Analysis, Methodology, Software, Writing – original draft

**Dejene Edosa:** Data curation, Project administration, Resources, Validation

**Mukemil Awol:** Funding acquisition, Supervision, Validation, Writing – original draft, Writing – review & editing

**Wakuma Fulea Gutema:** Data curation, Investigation, Visualization, Formal Analysis, Writing – original draft

## Data Availability Statement

All data supporting this manuscript are available in this published article.

## Conflicts of Interest

The authors declare no conflicts of interest.

## References

- [1] World Health Organization, Williams a L, van Drongelen W, Lasky RE, Sanderson M, Lai D, et al. Guideline : Daily iron and folic acid supplementation in pregnant women. World Heal Organ. 2012; 46: 323-9.
- [2] Betran AP, Torloni MR, Zhang JJ, Gülmezoglu AM. WHO statement on caesarean section rates. BJOG An Int J Obstet Gynaecol. 2016; 123(5): 667-70.
- [3] Bragg F, Cromwell DA, Edozien LC, Gurol-Urganci I, Mahmood TA, Templeton A, et al. Variation in rates of caesarean section among English NHS trusts after accounting for maternal and clinical risk: Cross sectional study. BMJ. 2010; 341(7777): 818.
- [4] Adam I, Salih Y, Hamdan HZ. Association of Maternal Anemia and Cesarean Delivery: A Systematic Review and Meta-Analysis. J Clin Med. 2023; 12(2): 4-15.
- [5] 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; 11(2): 1-12.
- [6] Taylor CJG. Caesarean section. Br Med J. 1922; 1(3206): 909-11.
- [7] Gedefaw G, Demis A, Alemnew B, Wondmienieh A, Getie A, Waltengus F. Prevalence, indications, and outcomes of caesarean section deliveries in Ethiopia: A systematic review and meta-analysis. Patient Saf Surg. 2020; 14(1): 1-10.
- [8] WHO. Anaemia Policy Brief. 2012;(6): 1-7. Available from: [http://www.who.int/iris/bitstream/10665/148556/1/WHO\\_NMH\\_NHD\\_14.4\\_eng.pdf](http://www.who.int/iris/bitstream/10665/148556/1/WHO_NMH_NHD_14.4_eng.pdf)
- [9] Abebe GT, Kure MA, Yadeta TA, Roba KT, Amante TD. Immediate postpartum anemia and associated factors among women admitted to maternity ward at public hospitals in Harari Regional State, Eastern Ethiopia: A facility-based cross-sectional study. Front Glob Women's Heal. 2022; 3.
- [10] cozy A, gEDA W, Kelkay B. Proportion of Immediate Postpartum Anaemia and Associated Factors among Postnatal Mothers in Eastern Ethiopia: A Cross-Sectional Study. Anemia. 2023.

- [11] Hsia K-CC, Stavropoulos P, Blobel G, Hoelz A, Sudha G, Nussinov R, et al. Title. *Proc Natl Acad Sci*. 2015; 3(1): 1-10. Available from: <http://dx.doi.org/10.1038/srep22311%0A>
- [12] Abebaw A, Gudayu TW, Kelkay B. Proportion of Immediate Postpartum Anaemia and Associated Factors among Postnatal Mothers in Northwest Ethiopia: A Cross-Sectional Study. *Anemia*. 2020.
- [13] Obai G, Odongo P, Wanyama R. Prevalence of anaemia and associated risk factors among pregnant women attending antenatal care in Gulu and Hoima Regional Hospitals in Uganda: A cross sectional study. *BMC Pregnancy Childbirth*. 2016; 16(1): 1-7. Available from: <http://dx.doi.org/10.1186/s12884-016-0865-4>
- [14] Aschale, A. A., Alemu, H. A. and Abneh, A. A. (2025) "Post-partum anemia and associated factors among caesarean section women in Wollega zone Ethiopia 2023", pp. 1-11.