WOLKITE UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF PEDIATRICS AND CHILD HEALTH

MAGNITUDE OF ADVERSE EARLY NEONATAL OUTCOMES AND IT'S ASSOCIATED FACRORS AFTER EMERGENCY CESAREAN DELIVERY AT WOLKITE UNIVERSITY SPECIALIZED HOSPITAL, WOLKITE, CERS, ETHIOPIA, 2026: RETROSPECTIVE STUDY

BY: ADANE HABTE BEREKA (PR3)

A RESEACH THESIS TO BE SUBMITTED TO DEPARTMENT OF PUBLIC HEALTH, COLLEGE OF MEDICINE AND HEALTH SCIENCES, WOLKITE UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR PEDIATRICS AND CHILD HEALTH SPECIALITY

February, 2026

WOLKITE, ETHIOPIA

MAGNITUDE OF ADVERSE EARLY NEONATAL OUTCOMES AND IT'S ASSOCIATED FACRORS AFTER EMERGENCY CESAREAN DELIVERY AT WOLKITE UNIVERSITY SPECIALIZED HOSPITAL, WOLKITE, CERS, ETHIOPIA, 2026: RETROSPECTIVE STUDY

BY: ADANE HABTE BEREKA (PR3)

MAIN ADVISOR: Mr. Abebaw Wasse (MPH, Assistant Professor in RH)

CO-ADVISOR: Dr. Fikretsion Degemu (MD, Assistant Professor In Pediatrics And Child Health)

A RESEACH THESIS TO BE SUBMITTED TO DEPARTMENT OF PUBLIC HEALTH, COLLEGE OF MEDICINE AND HEALTH SCIENCES, WOLKITE UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR PEDIATRICS AND CHILD HEALTH SPECIALITY.

February, 2026

WOLKITE, ETHIOPIA

Approval Sheet

Submitted by:

PG Candidate

Dr Adane Habte  _____ 2/6/18 E.C _____

Name Signature Date

Approved by

1. Advisor

Mr. Abebaw Wasse __  _____ 2/6/18 E.C_____

Name Signature Date

2. Co-advisor

Dr. Fikretsion Degemu __  __ __2/6/18 E,C_____

Name Signature Date

3. Examiner1

_____ _____ _____

Name Signature Date

4. Examiner 2

_____ _____ _____

Name Signature Date

5. College/Institute Dean

_____ _____ _____

Name Signature Date

6. Head, Department

_____ _____ _____

Name Signature Date

7. Director, School of Graduate studies

_____ _____ _____

Name Signature Date

February, 2026

Certification Sheet

As thesis research advisor, I hereby certify that I have read and evaluated this thesis prepared under my guidance by Dr Adane Habte entitled "Magnitude of adverse early neonatal outcomes and it's associated factors after emergency cesarean delivery at Wolkite University comprehensive specialized Hospital , wolkite town, CERS,Ethiopia,2026". I recommend that it will be submitted as fulfilling the thesis requirement.

Name of Advisors	Signature	Date
Mr. Abebaw Wasse (MPH, Assistant Professor)		_2/6/18 E.C
Dr. Fikretsion Degemu (Pediatrician, Assistant Professor)		2/6/18 E.C

As mentioned by the Board Examiners of the pediatrics and child health speciality thesis open defense examined. We certified that we have read and evaluated the thesis prepared by Dr Adane Habte and examined the candidate. We recommend being that the thesis accepted as fulfilling the thesis requirements for the Specialty degree on pediatrics and child health.

Chairperson	Signature	Date
_____	_____	_____
Internal Examiner	Signature	Date
_____	_____	_____
External Examiner	Signature	Date
_____	_____	_____

Declaration

I declare that this Research Thesis entitled "Magnitude of adverse early neonatal outcomes and it's associated factors after emergency cesarean delivery at Wolkite University comprehensive specialized Hospital , wolkite town, CERS,Ethiopia,2026" is my work that has not been addressed in the study area as far as my knowledge touched and all the sources I used have been indicated and acknowledged as a complete reference.

Name of Investigator	**Signature**	**Date**
Dr Adane Habte (MD)		2/6/18 E.C
Name of Advisors		
Mr. Abebaw Wasse (MPH, Assistant Professor)		2/6/18 E.C
Dr. Fikretsion Degemu (Pediatrician, Assistant Professor)		2/6/18 E.C

Acknowledgement

It is my sincere pleasure to acknowledge Wolkite University, College of Medicine and Health Science, for facilitation of this research proposal.

I would like to express my deep appreciation and sincerely thanks to my advisors Mr. Abebaw Wasse and Dr. Fikretsion Degemu for their technical comments and advices.

I would also like to thanks Wolkite comprehensive Hospital staffs and respective unit managers for their support.

Last but not least, my thanks go to data collectors

Acronyms & Abbreviations

ANC	Antenatal care
APH	Ante partum hemorrhage
CPD	Cephalo pelvic disproportion
CS	Cesarean section
DDI	Decision to delivery interval
END	Early neonatal death
EONS	Early onset neonatal sepsis
FHB	Fetal heart beat
GA	General Anesthesia
Hgb	Hemoglobin
IUGR	Intrauterine growth restriction
LNMP	Last normal menstrual period
MAS	Meconium aspiration syndrome
MSAF	Meconium stained amniotic fluid
NICU	Neonatal intensive care unit
PNA	Perinatal asphyxia
PPH	Postpartum hemorrhage
SNNPR	South Nations nationalities and people region
WHO	World health organization
WUCSH	Wolkite University comprehensive specialize hospital

Table of contents

List of tables

List of Figures

Abstract

Background: Neonatal morbidity and mortality after cesarean delivery varies with the type of cesarean delivery and is greater for neonates delivered by emergency cesarean delivery than elective counterparts. Early neonatal outcomes after cesarean section are influenced by preoperative and intraoperative feto-maternal factors, most of which are preventable. However, evidence from the study area is limited.

Objective: amid to assess magnitude of adverse early neonatal outcomes and associated factors after emergency cesarean delivery at Wolkite University comprehensive specialized Hospital, Central Ethiopia.

Method: Institution based retrospective study was conducted among 270 emergency cesarean deliveries. Data were collected using a structured checklist and entered to Epi data 4.2 and was exported to STATA version 17 for data analysis. Modified Poisson regression with robust SE was employed to identify factors with the outcome. Significance level was obtained using adjusted relative risk (ARR) with 95% CI and p value < 0.05.

Result: Overall, 89 (32.96%: CI; 27.6%-38.81%) of the newborns experienced early neonatal adverse outcomes. Moreover, placental-related hemorrhage (ARR = 1.09; 95% CI: 1.03–1.15; p = 0.004) and second stage of labor during C/S decision (ARR = 1.45; 95% CI: 1.22–1.70; p < 0.001) were associated with early neonatal adverse outcome related to emergency C/S.

Conclusion: In the current study, one-third of early neonatal adverse outcomes were associated with emergency cesarean section (CS). Placental-related hemorrhage and cesarean delivery performed during the second stage of labor were significantly associated with early neonatal adverse outcomes following emergency CS. These findings highlight the need for timely identification and management of placental complications and careful decision-making regarding the timing of cesarean delivery to improve neonatal outcomes.

Keywords: Neonatal outcomes, Emergency Cesarean delivery, Wolkite University Comprehensive Specialized Hospital

1. Introduction

1.1Background

Cesarean delivery is defined as the birth of a fetus via surgically created incision in the anterior uterine wall. It is called primary cesarean delivery when it is done for the “first-time” and repeat cesarean when it is done after a prior cesarean delivery. The operation can be done for maternal indication, fetal indication or both (1).

There are multiple ways of classifying cesarean delivery. A large study which systematically reviewed the available classifications and grouped them in to indication-based degree of urgency based, women based and others. According to this study women-based classification, particularly; Robson classification system was used in many centers worldwide (2). Traditionally it is classified as, Elective cesarean delivery, if the decision to perform the operation was made ahead of time and /or before onset of labor and all others are considered as emergency cesarean delivery (3).

Globally, around 22.9 million cesarean deliveries are performed every year (4). However, the rate of cesarean delivery varies in different regions of the world and highest rate was seen in Latin America and the Caribbean region (40.5%), followed by Northern America (32.3%), Oceania (31.1%), Europe (25%), Asia (19.2%) and Africa (7.3%) (5).

Cesarean delivery is a marker of access to, and availability and utilization of obstetric services (6). World health organization (WHO) sets a cesarean delivery rate of 5-15 % that is assumed to be a range which can decrease neonatal morbidity and mortality and are extremely high rates, may only indicate absence of evidence based practice (4, 6). However, It is difficult to determine optimal cesarean delivery rate because it is a function of multiple clinical factors and more importantly, it may not be a measure of perinatal outcome, rather it is considered as a measure of a specific health care process (mode of delivery) (1).

Poor neonatal outcomes after cesarean delivery has been defined as mortality, low Apgar scores or admission to the neonatal intensive care unit (7, 8). Different studies showed these poor

neonatal outcomes were more common in emergency than elective cesarean delivery and are affected by various maternal and fetal factors (9-11).

1.2 Statement of the problem

Globally, around 2.6 million newborns died in 2016, which means 7,000 neonatal deaths every day. Sub-Saharan Africa countries accounted 38 % of all newborn deaths and Ethiopia is among the five countries which contribute 50% of global neonatal deaths (12). In 2013, almost 1 million newborns died on the day they were born and another 1 million on the next six days of delivery accounting 36 % and 73% of all neonatal deaths respectively (13).

Every year, an estimated 2.6 million babies are stillborn; the vast majority of them are from low- and middle-income countries. Unfortunately, half of the babies who are stillborn are alive at the initiation of labor (14). Intrapartum related events accounted for 24% of neonatal deaths and it is possible to prevent 80% of these deaths by having accessible and quality health services, of which, access to cesarean delivery is one component (12, 14-16).

Globally, around 22.9 million cesarean procedures are performed each year, mainly to save the life of either the mother or the infant (4). However, with a neonatal death rate of 1.77 deaths per 1,000 live births, global neonatal mortality post-cesarean section is three times higher than mortality following vaginal deliveries (17).

In sub-Saharan Africa, 8.8% of all deliveries are through cesarean section (18), falling within the 5–15% range recommended by the World Health Organization (19). However, Intrapartum neonatal mortality in sub-Saharan Africa accounts for 73% of global Intrapartum neonatal deaths (20) and neonatal mortality after cesarean delivery in sub-Saharan Africa is higher than the global average (19).

Previous studies done in Ethiopian showed that, with the national population based cesarean delivery rate of 0.6%, 14% of deliveries end up neonatal death during early neonatal period (21). The cesarean delivery rate for the study area was 35.4% (22). However, information on the early neonatal outcomes after emergency cesarean delivery and factors that are linked to poor early neonatal outcomes are limited.

Different types of factors such as parity, distance between institutions before interventions, meconium-stained amniotic fluid, type of anesthesia, birth weight, indications of cesarean sections are associated with poor neonatal out come after cesarean section across the literature (18–20).

An initiative called "Every Newborn Action Plan" that was launched in 2014 to prevent newborn mortality and stillbirth, estimated that the lives of around 3 million mothers, newborns and stillborn babies could be saved each year by improving care during the time of birth and providing special care for small and sick newborns (23).

It is also well known that every newborn can get a fair chance to survive and thrive by providing access to clean and functional health facilities which have skilled health workers, accessible essential drugs and equipment during pregnancy and birth (16).

1.3 Significance of the study

Even though there were different studies which tried to identify the magnitude of post cesarean poor neonatal outcomes and their associated factors in Ethiopia, adequate data is lacking specific to emergency cesarean delivery and early neonatal outcomes at national and regional level and in the study Hospital. Therefore, it is prudent to undertake this study to see the preoperative and intra operative feto-maternal conditions which put their lever significantly in the early neonatal period.

This study tries to identify factors which affect early neonatal outcomes for neonates delivered by emergency cesarean delivery. These factors, which will be identified, might be modifiable and therefore, the finding of this study may be used as an input by health care providers and government bodies on measures needed to improve quality of care during pregnancy, labor and delivery.

2. Literature Review

2.1: Magnitude of adverse early neonatal outcomes after emergency cesarean delivery

A longitudinal study done in India showed that early neonatal outcome (morbidity and early neonatal mortality) were six times greater with emergency than elective cesarean deliveries. From those who are delivered on emergency base 94 (20%) neonates required initial resuscitation, 149 (32%) neonates were admitted to neonatal intensive care unit (NICU) and 24 (5.1%) neonates died during neonatal period (9).

A large prospective study done at Baroda, Australia showed that after emergency cesarean delivery there were 215 (14.9%) NICU admissions, 25 (1.7%) still births and 40 (2.79%) neonatal deaths (10). A cross-sectional Indian study, done at Kamineni Institute of Medical Sciences identified that after emergency cesarean delivery there were 6 (25%) NICU admissions and 1 (4.6%) perinatal asphyxia (11).

According to a five-year retrospective Nigerian study, emergency cesarean delivery accounted for 74.6% of all cesarean deliveries. 80 (23.7%) neonates had an Apgar score of < 6 at the first minute and 45 (13.3%) neonates scored an Apgar of < 6 at the fifth minute. 69 (20.5%) neonates were admitted to NICU and 26 (7.7%) neonates died during neonatal period (24). A study done in Rwanda showed that among 441 neonates delivered by emergency cesarean delivery, 40 (9.0%) neonates either died or had an Apgar score of < 7 at the 5th minute of post- operative period (25).

A study done in tertiary referral centers in London identified a lower Apgar sore (<7) after emergency cesarean section performed after a failed instrumental delivery. 18.8% and 5.6% of the newborns had low Apgar score at first and fifth minutes of life respectively (26). From an Ethiopian study done at Attat Hospital, out of 254 (90.4%) emergency cesarean deliveries there were 7 (2.5%) still births and 10 (3.6%) early neonatal deaths (27).

2.2 Factors associated with poor early neonatal outcomes after emergency cesarean delivery

2.2.1 Socio-demographic characteristics

A retrospective study done in three rural district hospitals in Rwanda showed that from the 435 neonates with mother's ages recorded, 189 (43.4%) were born to mothers between 25– 34 years old and one hundred and eighty-three neonates (41.8% of 438) were born to women with 1–3 prior pregnancies (22).

Institution based cross sectional study done in Hawasa university comprehensive specialized hospital showed that the mean age of participants was 26.4 (SD±4.8) years and ranged from 18 to 43 years and the vast majorities (98.1%) of respondents were married (28).

2.2.2 Reproductive characteristics

According to WHO global survey on maternal and perinatal health in Africa, higher proportion of primigravid women and post cesarean pregnancies at a given facility increases overall cesarean delivery rate, which intern, is associated with increased poor neonatal outcomes (fresh stillbirths, neonatal deaths , 5-minute Apgar score less than 4, referral to higher level or special care unit, admission to intensive care unit for 7 days) (18).

Rwandan study showed that neonates born to mothers with parity of four or more prior had higher odds of having a poor early neonatal outcome (mortality, low Apgar scores or admission to NICU) as compared to neonates of mothers with 1–3 prior deliveries (OR = 3.01, 95% CI: 1.23, 7.35, p = 0.015). This study also identified an association between longer ambulance travel time from health center to hospital with poor early neonatal outcomes compared to neonates of mothers coming from health centers attached to the district hospital (OR = 3.80, 95% CI: 1.07, 13.40, p = 0.038) for 30–60 minutes travel time and (OR = 5.82, 95% CI: 1.47, 23.05, p = 0.012) for more than 60 minutes travel time(25).

2.2.3 Obstetric characteristics

A retrospective study done in three rural district hospitals in Rwanda showed that from the 336 neonates with gestational age recorded, 59 (16.1%) were less than 38 weeks of gestational age. The most common indications for cesarean section included fetal distress (32.0%, 141) and prolonged labor (30.6%, 135) and for 203 (46.0%) neonates, their mothers had multiple indications for cesarean delivery (22).

According to Institution based cross sectional study done in Hawasa university comprehensive specialized hospital the mean gravidity and parity of participants was 2.4 (SD±1.5) and 1.3 (SD±1.49) respectively. Majority (84.1%) of the pregnancies were term at the time of admission. About 9%, 2.2% and 1.1% study subjects had history of abortion, stillbirth and early neonatal death respectively. Preoperatively, pre-eclampsia (39.8%), premature rupture of membranes (16.9%) and abruption placenta (12%) were the most commonly diagnosed obstetric complications among the study subjects (28).

2.2.4 Preoperative and intra operative Feto-maternal conditions

A prospective observational study done in India showed that meconium-stained amniotic fluid (MSAF) is significantly associated with neonatal morbidities like birth asphyxia, meconium aspiration syndrome (MAS) and NICU admissions regardless of mode of delivery (29).

A cross-sectional study done in Oman assessed the significance of decision to delivery interval (DDI) during emergency cesarean delivery in terms of improving fetal outcomes (Apgar score at 5th minutes and rate of admission to NICU). According to this study, with three categories of DDI (<30 minutes, 31-60 minutes and >60 minutes) there was a statistically significant relationship between number of admissions to the NICU and increased decision to delivery interval (DDI). The same observation was also seen between 5th minute Apgar scores of < 7 and increased DDI (30).

Australian study which compared the effect of anesthesia method for cesarean delivery on neonatal outcome after controlling confounder by specification of both pregnancy risk and

indication for cesarean section, showed that there is a significant excess risk attributable to general anesthesia for poor neonatal outcome (5th minute Apgar score of < 7) (31).

A study done in Kenya showed that neonates delivered after clinical fetal distress had two folds increased risk of having low Apgar score (< 7) at the first and fifth minute than those delivered without clinical fetal distress (32).

A prospective cohort study conducted in Gandhi Memorial Hospital showed that there was a significant association between type of anesthesia and first minute Apgar score. Incidence of low Apgar score in the first minute was three and half times more likely to occur in general anesthesia than spinal (33).

An institution based cross sectional study done at Gondar university hospital showed that type of anesthesia, fetal weight, uterine incision to delivery of the fetus and pre-operative fetal heart beat (FHB) were significantly associated with low Apgar score at 5th minute regardless of the type of cesarean delivery. Neonates delivered under general anesthesia were 3 times more likely to have low Apgar score (< 7) at the 5th minute than those delivered under spinal anesthesia. A neonate with birth weight 2.5 kg and above had better Apgar score at 5th minute when compared with those with birth weight less than 2.5 kg. A pre-Anesthesia fetal heart rate of greater than 160 beat per minute had shown better Apgar score at 5th minute when compared with those with a pre–Anesthesia FHR below 120 and between 120 and 160. Delivery a fetus within 3 minutes of Uterine incision had good Apgar score at 5th minute than those delivered in a time exceeding 3 minutes (34).

2.3 Conceptual frame work

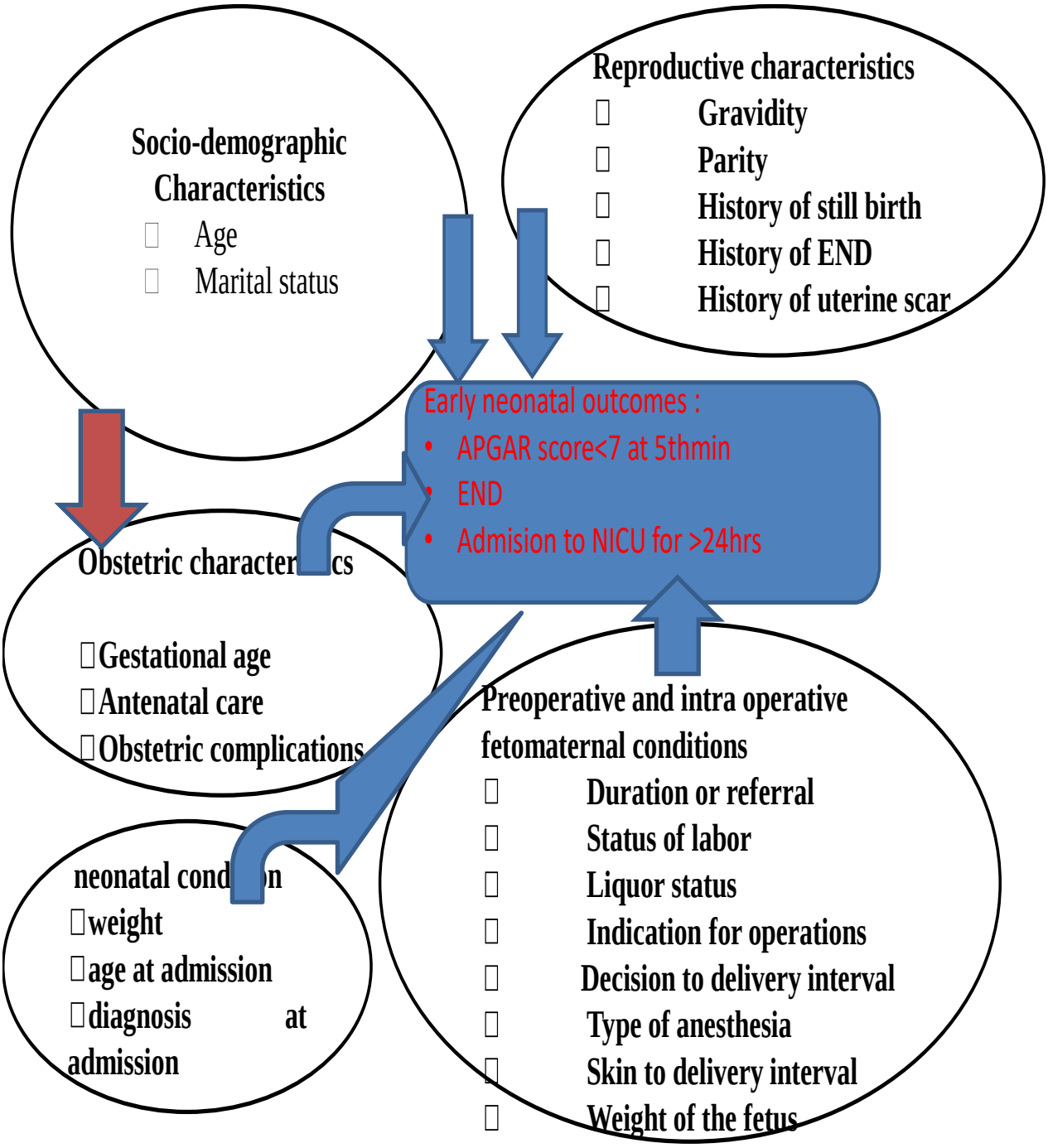

Figure 1: conceptual framework of factors associated with poor early neonatal outcomes after emergency CS adopted from different literatures (25,28,29,30,31,32,33)

3. Study Objectives

3.1 General objective

The main objective of this study was to assess magnitude of adverse early neonatal outcomes and its associated factors after emergency cesarean delivery at Wolkite University comprehensive specialized Hospital, Central Ethiopia, 2026.

3.2 Specific objectives

- To assess the magnitude of adverse early neonatal outcomes after emergency cesarean delivery at Wolkite University comprehensive specialized Hospital, Central Ethiopia, 2026.
- To identify factors associated with adverse early neonatal outcomes after emergency cesarean delivery at Wolkite University comprehensive specialized Hospital, Central Ethiopia, 2026.

4. Method and Materials

4.1 Study Area and period

This study was conducted at Wolkite university comprehensive specialized Hospital (WUCSH) in Wolkite city, Central Ethiopia regional state from November 1, 2025 to December 30, 2025.Wolkite city is the administrative center of Gurage zone in CERS, which is situated 126 km south west from country capital city, Addis Ababa. Wolkite University comprehensive specialized Hospital (WUCSH) is one of the tertiary referral hospitals directly under the federal ministry of health. It is also a teaching hospital for Wolkite University College of medical and health Sciences. The Hospital gives service to 4 million people in its catchment. It has a total bed of 350 and on average 6200 patients visit the hospital as outpatient and emergency monthly. It has 62 residents and 310 clinical staffs (64seniors, 14 general practitioner ,118 nurse and 26 midwives and 88 others). It gives service under ten departments including obstetrics and gynecology and pediatrics and child health department. Obstetrics and gynecology department has separate labor and delivery ward, maternity ward, gynecology ward and different outpatient clinics (Gender and GRC). Labor and delivery ward have one operation theaters used solely for cesarean delivery. Pediatrics and child health department has separate neonatal intensive care unit (NICU), inpatient ward, OPD and pediatrics referral clinic. NICU has a total of 39 beds.

4.2 Study Design

Institution based retrospective study design was conducted.

4.3 Population

4.3.1 Source population

The source population are all mother-neonates paired who were delivered by caesarian delivery at Wolkite university comprehensive specialized Hospital during data collection period.

4.3.2 Study population

Randomly selected mother-neonates paired who were delivered by emergency caesarian delivery at Wolkite university comprehensive specialized Hospital during data collection period.

4.4 Inclusion criteria and Exclusion criteria

4.4.1 Inclusion criteria

Mother-neonate pairs who were delivered by emergency cesarean section and had complete medical records were included in the study.

4.4.2 Exclusion criteria

Mother–neonate pairs with incomplete medical records or missing key delivery and neonatal information; neonates delivered by elective (planned) cesarean section or vaginal delivery,and neonates referred from other health facilities after delivery were excluded.

4.5 Sample Size Determination and Sampling Techniques

4.5.1 Sample Size Determination

Single population proportion formula was used to determine sample size.

$n = (Z\ \alpha/2)2 * P * (1- P) / d2$

Where,

n = gross sample population

Z α/2=Value of the standard normal distribution corresponding to a significant level of Alpha (α) 0.05

p = Proportion

d= margin of error, considered to be 5%

Based on a previous study (21), the prevalence of adverse early neonatal outcomes following emergency cesarean section was reported to be 20%, with a 95% confidence level and a 5% margin of error. Using this proportion, the calculated sample size for the first objective was 245. After adding a 10% non-response rate due to incomplete medical records, the final sample size was increased to 270. Therefore, the total required sample size for the study was 270.

4.4.2 Sampling Techniques

A simple random sampling technique using the lottery method was employed to select mother–neonate pairs delivered by emergency cesarean section between September 1, 2023, and August 30, 2024 (GC). The delivery registration book served as the sampling frame. Medical registration

numbers were recoded into three-digit numbers, and from a total of 402 emergency cesarean deliveries in the given period, 270 mother–neonate pairs were randomly selected for inclusion in the study.

4.5 study variables

4.5.1 Dependent variables:

- Early neonatal adverse outcomes related to emergency C/S

4.5.2 Independent variables

- Socio demographic Characteristics
- Reproductive Characteristics
- Chronic medical illnesses
- Obstetric complications
- preoperative and Intra operative events

4.6 Operational Definitions and definition of terms

Early neonatal outcome: Condition of a neonate in the first three days after emergency cesarean delivery, which can be favorable or adverse

Adverse early neonatal outcomes: Defined as the presence of at least one of the following: an APGAR score of less than 7 at the 5th minute, respiratory distress syndrome (RDS), admission to the neonatal intensive care unit (NICU) for more than 24 hours, or early neonatal death (within 3 days of birth).

Good/favorable early neonatal outcomes: Apgar sore of >7 at the fifth minute, absence of admission to NICU or admission to NICU for < 24 hours are considered as good/favorable early neonatal outcomes.

Fetal bradycardia: a FHB of < 120 beats per minute during labor and persisting for more than 10 minutes despite maternal position change and resuscitation with fluid and oxygen.

Fetal tachycardia: a FHB of >160 per minute during labor and persisting for more than 10 minutes despite maternal resuscitation with fluid, intranasal oxygen and positional change

Previous one cesarean scar with x factor: Cesarean scar with any other factors like mal presentation, prolonged latent phase, protracted or arrest of cervical dilatation and etc.

4.7 Data Collection Tools

Data were collected using a well-structured checklist adapted from different literature sources [25,28–34]. The checklist included maternal socio-demographic characteristics, previous obstetric history, antenatal care (ANC) follow-up, obstetric and medical complications, indications for cesarean delivery, and intraoperative factors such as type of anesthesia and incision-to-delivery time. Neonatal variables included sex, birth weight, fifth-minute Apgar score, presence of respiratory distress syndrome (RDS), need for NICU admission for more than 24 hours, and early neonatal death (within 3 days of birth).

4.8 Data Collection procedures

One trained midwife and one trained NICU nurse with prior experience in data collection were recruited for data collection. They reviewed selected medical charts and extracted relevant data from the medical records of both the mothers and neonates.

4.9 Data Quality Control

Training was provided for data collectors, and a pretest was conducted on 5% of the sample size at Wolkite Comprehensive Hospital. Data completeness and accuracy were checked daily by the supervisor (principal investigator). An operational manual was prepared to ensure uniform standards for conducting the study and to maintain good quality control.

4.10 Data Processing and analysis

Data were entered using EpiData version 4.2 and exported to STATA version 17 for data cleaning and analysis. Descriptive statistics, including tables, graphs, means, and frequency distributions, were computed.

Bivariable and multivariable modified Poisson regression with robust standard errors (SE) was employed to identify factors associated with adverse early neonatal outcomes. Regression coefficients were exponentiated to obtain crude and adjusted relative risks (CRR and ARR). The adjusted relative risk was calculated as ARR = e^{β}, with corresponding 95% confidence intervals (lower CI = e^{β}, upper CI = e^{β}) for ease of interpretation.

During bivariable analysis, variables with a p-value less than 0.25 were considered candidates and entered into the multivariable model. In the final multivariable analysis, variables with a p-value less than 0.05 were considered statistically significant at a 95% confidence level.

Multicollinearity was assessed, and all variables had variance inflation factor (VIF) values less than 2.3, indicating no significant multicollinearity. Model adequacy was evaluated using deviance and Pearson goodness-of-fit statistics, residual diagnostics, and model specification tests. The deviance and Pearson χ^2 statistics divided by their degrees of freedom were close to one, indicating an adequate model fit.

4.11 Ethical Considerations

A formal letter of approval was obtained from the college's ethical review committee. Permission to conduct the study was taken from the hospital administration. Confidentiality and anonymity were maintained during data collection, analysis and interpretation.

4.11 Dissemination of results

After completing the thesis write up it will be disseminated to WUCSH and respective school administrations. Findings will also be presented in different seminars and workshops, and finally the paper will be submitted to scientific journal for publication.

5. Result

5.1 socio-demographic characteristics

The mean age of the delivered mothers was 26.54 years (SD ± 5.4), with the 25–29-year age group being the most prevalent (99; 36.67%). The majority of participants were married (258; 95.56%) **(Table 1)**.

Table 1: **Sociodemographic characteristics of mothers of neonates delivered by cesarean section at Wolkite Comprehensive Specialized Hospital, 2026 (n=270)**

Variables	Frequency	Percent (%)
Age of mothers	Mean=26.54 yrs SD± 5.4 yrs	
15-19 year	14	5.19
20-24 year	87	32.22
25-29 year	99	36.67
30-34 year	43	15.93
35-39 year	21	7.78
40-44 year	6	2.22
Marital status		
Married	258	95.56
Single	2	0.74
Divorced	7	2.59
Widowed	3	1.11

5.2 obstetrics and pregnancy-related health experiences characteristics

The majority of participants were multiparous (169; 62.59%). Most mothers had no history of stillbirth or abortion (238; 88.15%), and 125 (46.30%) delivered at term gestation (37–42 weeks). Additionally, 233 (86.30%) had attended four or more ANC visits. Furthermore, 175 (64.81%), 221 (81.85%), and 169 (62.59%) had no history of gestational hypertension, no hemorrhage due to placental abnormality, and no PROM, respectively **(Table 2)**.

Table 2: Obstetric characteristics and pregnancy-related health experiences of mothers of neonates delivered by cesarean section at Wolkite Comprehensive Specialized Hospital, 2026 (n = 270).

Variables	Frequency	Percent (%)
Parity		
Primipara	101	37.41
Multipara	169	62.59
History of Still Birth		
Yes	32	11.85
No	238	88.15
History of Abortion		
Yes	32	11.85
No	238	88.15
History of Neonatal Death		
Yes	34	12.59
No	236	87.41
Number of uterine scars		
None	101	37.41
One time	28	10.37
Twice	113	41.85
≥3	28	10.37
Gestational age		
Preterm (<37 wk)	95	35.19
Term (37-42 wk)	125	46.30
Post term (> 42 wk)	50	18.52
ANC follow-up		
< 4 times	37	13.70
≥4 times	233	86.30
Place of ANC visit		
Health center	85	31.48
Hospital	185	68.52
Experienced Gestational HTN		
Yes	95	35.19
No	175	64.81
Experienced hemorrhage due to placental abnormality		
Yes	49	18.15
No	221	81.85
Had PROM		
Yes	101	37.41
No	169	62.59

5.3 The pre and intraoperative characteristics of emergency C/S

A total of 178 (65.93%) participants were admitted by referral. Antepartum hemorrhage was the primary reason for referral in 94 (34.81%) cases. Labor was induced in 169 (62.59%) mothers, and 192 (71.11%) experienced a labor duration of less than 12 hours. At the time of decision for cesarean section, 198 (73.33%) were in the second stage of labor, and 212 (78.52%) had clear amniotic fluid.

Regarding operative characteristics, antepartum hemorrhage was also the most common indication for cesarean section (94; 34.81%). The majority of procedures were performed under spinal anesthesia (248; 91.85%), using a Pfannenstiel skin incision, and were conducted by resident surgeons **(Table 3)**.

Table 3: The pre and intraoperative characteristics of mothers of neonates delivered by cesarean section at Wolkite Comprehensive Specialized Hospital, 2026 (n = 270).

Variables	Frequency	Percent (%)
Means of admission		
Referral	178	65.93
Direct	92	34.07
Time taken to Hospital		
Less than 30 minutes	217	80.37
More than 30 minutes	53	19.63
Reason for referral Diagnosis		
Pre/eclampsia	89	32.96
Antepartum hemorrhage	94	34.81
Fetal abnormality	9	3.33
Prolonged second stage labor	19	7.04
Malpresentations	21	7.78
Cord prolapses	20	7.41
Obstructed labor	18	6.67
Onset of labor		
Spontaneous	101	37.41
Induced	169	62.59
Duration of labour before CS operation		
Less than 12 hr.	192	71.11
More than 12 hr.	78	28.89
Stage of labor during decision for CS operation		

Second stage labor	198	73.33
Active first stage labor	57	21.11
Latent first stage labor	15	5.56
State of liquor at decision for CS operations		
Clear	212	78.52
MAS	58	21.48
Fetal presentation		
Vertex	249	92.22
Malpresentation	21	7.78
Reason for indication of CS		
Pre/eclampsia	89	32.96
Antepartum hemorrhage	94	34.81
Fetal abnormality	9	3.33
Prolonged second stage labor	19	7.04
Malpresentations	21	7.78
Cord prolapses	20	7.41
Obstructed labor	18	6.67
What was the time of operations		
Working hour	142	52.59
Duty hour	128	47.41
Type of anesthesia		
Spinal anesthesia	248	91.85
General anesthesia	22	8.15
Type of skin incision		
Pfannenstiel	248	91.85
Midline	22	8.15
Position of Surgeon		
Resident	248	91.85
Senior	22	8.15

5.4 Neonatal characteristics

Regarding newborn characteristics, a total of 125 (46.30%) had a birth weight of 2,500–3,999 g, and 181 (67.04%) had an Apgar score ≥7 at the 5th minute. Most neonates (200; 74.07%) were admitted to the NICU for less than 24 hours, while 28 (40.00%) were admitted for more than 24 hours due to respiratory distress syndrome (RDS). After three days of follow-up, 262 (97.04%) of the newborns were alive and clinically improved **(Table 4).**

Table 4: neonatal, clinical, and early days outcomes characteristics of mothers of neonates delivered by cesarean section at Wolkite Comprehensive Specialized Hospital, 2026 (n = 270).

Variable	Frequency	Percent (%)
Weight of the newborn		
Less than 2500 gm	95	35.19
2500- 3999 gm	125	46.30
≥4000 gm	50	18.52
APGAR score at 5th minutes		
<7	89	32.96
≥7	181	67.04
NICU admission		
≥24 hr.	70	25.93
<24 hr.	200	74.07
Reason for NICU admission more than 24 hr. (N=70)		
Prematurity	21	30.00
RDS	28	40.00
Asphyxia	11	15.71
others	10	14.29
Neonatal outcome after 3 days		
Improved and alive	262	97.04
Died	8	2.96
Early neonatal adverse outcome		
Yes	89	32.96
No	181	67.04

5.5 The magnitude of adverse early neonatal outcome

Overall, 89 (32.96%: CI; 27.6%-38.81%) of the newborns experienced early neonatal adverse outcomes, (**Figure2**).

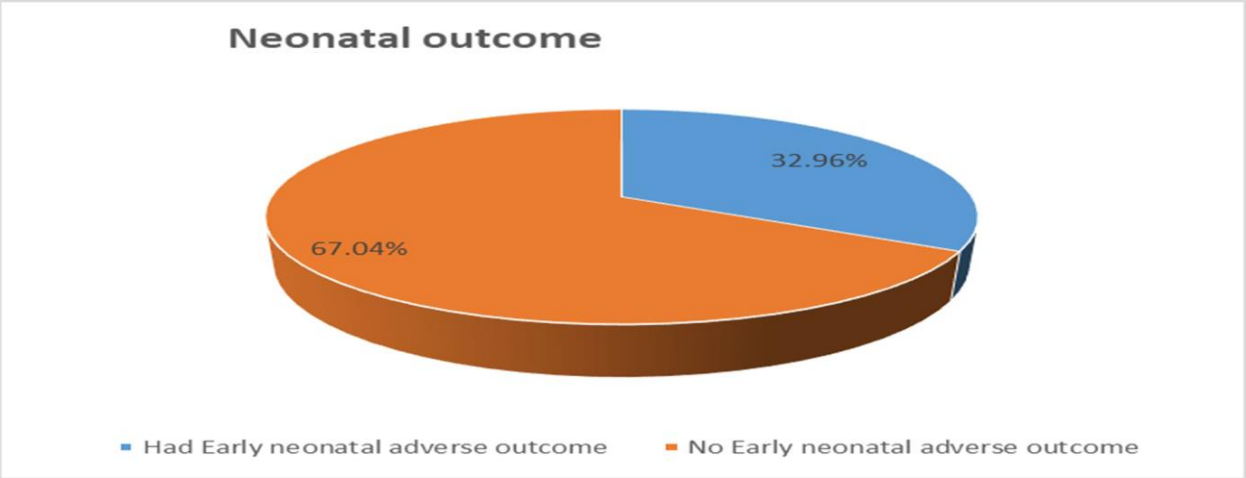

Figure2: magnitude of early neonatal adverse outcomes in neonates delivered by emergency cesarean section at Wolkite Comprehensive Specialized Hospital, 2026 (n = 270).

5.6 Factors associated with adverse early neonatal outcome

During the bivariable analysis (CRR), hemorrhage due to placental abnormalities, labor duration ≥ 12 hours before cesarean section, second stage of labor at the time of C/S decision, meconium aspiration syndrome (MAS), and malpresentation were significantly associated with adverse early neonatal outcomes following emergency C/S. In the multivariable analysis (ARR), only hemorrhage due to placental abnormalities and second stage of labor at the time of C/S decision remained significantly associated with adverse early neonatal outcomes **(Figure3)**.

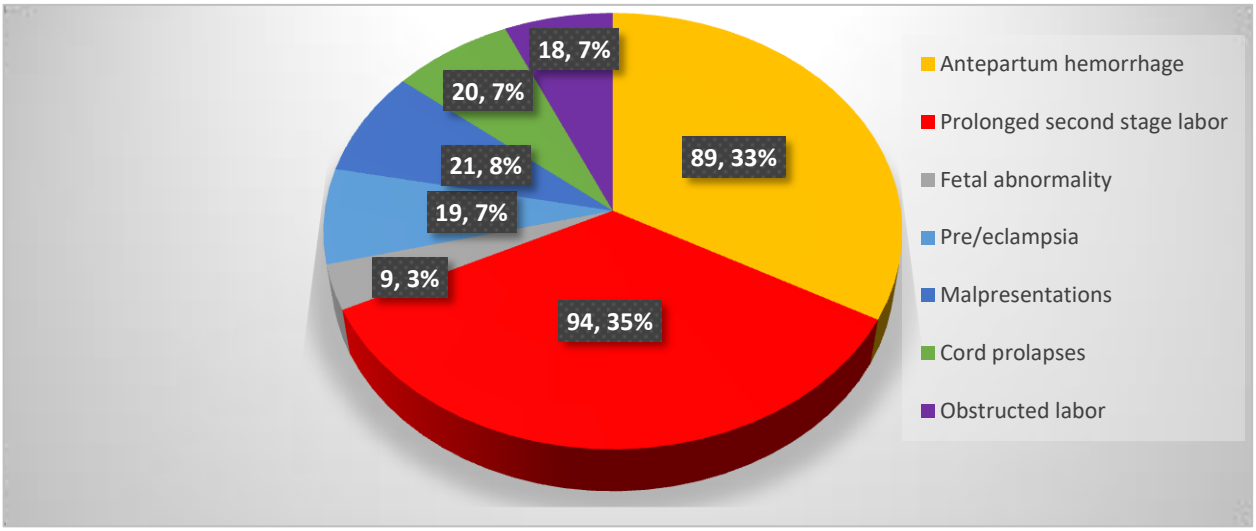

Figure3: factors associated with early neonatal adverse outcomes in neonates delivered by emergency cesarean section at Wolkite Comprehensive Specialized Hospital, 2026 (n = 270).

Accordingly, neonates born to mothers who experienced placental-related hemorrhage had a 9% higher risk of early neonatal adverse outcomes compared with those born to mothers without such complications (ARR = 1.09; 95% CI: 1.03–1.15; p = 0.004).

Neonates delivered by cesarean section in the second stage of labor had a 45% higher risk of early neonatal adverse outcomes compared with those delivered during the latent first stage of labor (ARR = 1.45; 95% CI: 1.22–1.70; p < 0.001) **(Table 5)**.

Table 5: factors associated with early neonatal adverse outcomes related to emergency C/S among mothers of neonates delivered by cesarean section at Wolkite Comprehensive Specialized Hospital, 2026 (n = 270).

Variables	CRR			P-value	ARR			P-value
		[95%, CI]				[95%, CI]		
	Coefficient	Lower CI	upper CI		Coefficient	Lower CI	upper CI	
Hemorrhage due to placental abnormality								
Yes	.17	.12	.23	**0.000**	.09	.03	.15	**0.004**
No	1	1	1	**1**	1	1	1	1
Duration of labor before CS operation								
<12 hr.	1	1	1	**1**	1	1	1	**1**
≥ 12 hr.	.15	.094	.214	**0.000**	-.02	-.13	.1	0.754
Stage of labor during CS decision								
Second stage labor	.41	.24	.60	**0.000**	.37	.20	.53	**0.000**
Active first stage labor	.11	-.09	.30	0.283	.11	-.10	.30	0.264
Latent first stage labor	1	1	1		1	1	1	1
State of liquor at decision for CS operations								
Clear	1	1	1	**1**	1	1	1	1
MAS	.18	.12	.23	**0.000**	.10	-.02	.202	0.103
Fetal presentations								
Vertex	1	1	1	1	1	1	1	1
Malpresentation	.14	.07	.22	**0.000**	.02	-.07	.12	0.606

6. Discussions

In the current study, the magnitude of early neonatal adverse outcomes following emergency cesarean section (CS) was 32.96% (95% CI: 27.6%–38.8%). This finding was comparable to reports from Malawi (32%) [35], Kenya and Uganda (37%) [36], an Ethiopian systematic review and meta-analysis (29.55% and 37.1%) [37,38], Eastern Gojjam in northwest Ethiopia (28.8%) [39], and Arbaminch in southern Ethiopia (30%) [40].

However, the magnitude observed in the present study was lower than findings from Uganda (40%) [41] and India (40%) [42]. The lower magnitude in the current study might be attributed to the fact that it was conducted in a single comprehensive hospital with adequate availability of senior specialists for emergency CS and a relatively well-equipped neonatal intensive care unit (NICU). In contrast, the aforementioned studies were conducted across multiple settings and different levels of health facilities, where the availability of senior experts and advanced NICU services was relatively limited. Differences in sociodemographic characteristics, distance to health facilities, and place of residence (urban versus rural) may also have contributed to the observed variation.

Conversely, the magnitude of early neonatal adverse outcomes in the current study was higher than findings from Hawassa Teaching Hospital (26.7%) [43], southern Ethiopia; eastern Ethiopia (24.3%) [44]; and the Harari region (22%) [45]. This discrepancy might be explained by differences in the level of health facilities, as these studies were conducted in tertiary hospitals with better-equipped human resources and advanced NICU services. Additionally, the predominantly urban setting of the comparison studies may have reduced delays in accessing care and improved service availability compared with the current study setting.

In this study neonates born to mothers who experienced placental-related hemorrhage and neonates delivered by cesarean section in the second stage of labor were associated with early neonatal adverse outcome due to emergency CS.

Accordingly, neonates born to mothers who experienced placental-related hemorrhage had a higher risk of early neonatal adverse outcomes compared with those born to mothers without such complications. This finding is consistent with studies conducted in Tigray [46], northwest Ethiopia [47], Hawassa [43], an Ethiopian systematic review and meta-analysis [37,38], and Uganda [41]. The observed increased risk of early neonatal adverse outcomes among neonates born to mothers with placental-related hemorrhage may be explained by the underlying pathophysiological mechanisms associated with this condition. Placental hemorrhage can result in compromised uteroplacental perfusion, leading to fetal hypoxia, acidosis, and preterm birth [48,49]. These complications increase the likelihood of low Apgar scores, respiratory distress, need for neonatal intensive care admission, and early neonatal morbidity and mortality. In addition, acute maternal blood loss may necessitate urgent delivery, often under suboptimal conditions, further predisposing neonates to adverse outcomes [46,47]. This finding implies that the importance of strengthening antenatal care services to ensure early identification and timely management of placental-related hemorrhagic conditions and highlight the need for heightened intrapartum and immediate postnatal surveillance for neonates born to mothers with placental hemorrhage.

In addition, Neonates delivered by cesarean section in the second stage of labor had a higher risk of early neonatal adverse outcomes compared with those delivered during the latent first stage of labor in the current study. This might be explained as the increased risk of early neonatal adverse outcomes among neonates delivered by cesarean section during the second stage of labor may be attributed to prolonged labor and delayed decision-to-delivery intervals, which increase the likelihood of fetal distress, hypoxia, and acidosis [50-53]. Second-stage cesarean sections are often performed under urgent conditions after failed descent or obstructed labor, exposing the fetus to extended periods of uteroplacental compromise and increasing the risk of low Apgar scores, birth asphyxia, and the need for neonatal intensive care [51,54,55]. This finding highlights the importance of timely labor monitoring and early identification of labor dystocia to prevent delayed second-stage interventions. Strengthening referral systems and improving access to comprehensive emergency obstetric care may reduce preventable neonatal adverse outcomes. Moreover, heightened vigilance during labor, adherence to partograph-guided monitoring, and early decision-making for operative delivery are critical.

7. Strength and limitations of the study

The current study utilized an adequate sample size, ensuring comprehensive data representation and strengthening the reliability of its findings. Despite its significant contributions, the study has some limitations. These includes; this study was conducted at a single hospital, which may limit the generalizability of the findings to other settings. Its retrospective design relied on medical records, and incomplete or inaccurate documentation could have affected data quality. Additionally, some potential confounding factors, such as maternal nutritional status, socio-economic conditions, or neonatal interventions immediately after birth, may not have been fully captured. Due to the observational nature of the study, causal relationships could not be established.

8. Conclusions

In the current study, one-third of early neonatal adverse outcomes were associated with emergency cesarean section (CS). Placental-related hemorrhage and cesarean delivery performed during the second stage of labor were significantly associated with early neonatal adverse outcomes following emergency CS.

9. Recommendations

For Hospitals:

- Ensure timely availability of senior obstetricians and anesthesiologists, particularly during labor complications and second-stage cesarean sections.
- Implement standardized protocols for the management of placental-related hemorrhage and prolonged labor to minimize adverse neonatal outcomes.

For Healthcare Providers:

- Closely monitor labor progression using partographs and identify complications early to allow timely intervention, particularly those with antepartum hemorrhage.
- Prioritize rapid decision-making for cesarean delivery when indicated, especially during the second stage of labor.

Future researchers:

- should conduct implementation research, including qualitative studies, to encourage adherence to protocols and to explore the barriers and enablers of preventing early neonatal adverse outcomes.

10. References

1. Gabbe SG, Niebyl JR, Simpson JL, Landon MB, Galan HL, Jauniaux ER, et al. Obstetrics: normal and problem pregnancies e-book: Elsevier Health Sciences; 2016.

2. Torloni MR, Betran AP, Souza JP, Widmer M, Allen T, Gulmezoglu M, et al. Classifications for cesarean section: a systematic review. PloS one. 2011;6(1):e14566.

3. Smith GC, White IR, Pell JP, Dobbie R. Predicting cesarean section and uterine rupture among women attempting vaginal birth after prior cesarean section. PLoS Medicine. 2005;2(9):e252.

4. Molina G, Weiser TG, Lipsitz SR, Esquivel MM, Uribe-Leitz T, Azad T, et al. Relationship between cesarean delivery rate and maternal and neonatal mortality. Jama. 2015;314(21):2263-70.

5. Betrán AP, Ye J, Moller A-B, 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):e0148343.

6.WHO U, Unicef. AMDD: Monitoring emergency obstetric care: a handbook. Geneva: WHO. 2009;152(4):430.

7.Yeekian C, Jesadapornchai S, Urairong K, Santibenjakul S, Suksong W, Nuchprayoon C. Comparison of maternal factors and neonatal outcomes between elective cesarean section and spontaneous vaginal delivery. Journal of the Medical Association of Thailand= Chotmaihet thangphaet. 2013;96(4):389-94.

8.Foumane P, Mando E, Mboudou ET, Sama JD, Pisoh WD, Minkande JZ. Outcome of cesarean delivery in women with excessive weight gain during pregnancy. Open Journal of Obstetrics and Gynecology. 2014;4(03):139.

9. Choudhary B, Choudhary Y, Pakhare AP, Mahto D, Chaturvedula L. Early Neonatal Outcome in Caesarean Section: A Developing Country Perspective. 2016.

10. Soren R, Maitra N, Patel PK, Sheth T. Elective Versus Emergency Caesarean Section: Maternal Complications and Neonatal Outcomes.

11. Kumari BS, Rao GV. Study on factors influencing caesarean section delivery in urban field practice area of Kamineni Institute of Medical Sciences, Narketpally, Nalgonda, India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2017;6(7):3129-33.

12. Hug L, Sharrow D, You D. Levels & trends in child mortality: report 2017. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. 2017.

13. Wardlaw T, You D, Hug L, Amouzou A, Newby H. UNICEF Report: enormous progress in child survival but greater focus on newborns urgently needed. Reproductive health. 2014;11(1):82.

14. Lawn JE, Blencowe H, Waiswa P, Amouzou A, Mathers C, Hogan D, et al. Stillbirths: rates, risk factors, and acceleration towards 2030. The Lancet. 2016;387(10018):587-603.

15. You D, Hug L, Ejdemyr S, Idele P, Hogan D, Mathers C, et al. Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Inter-agency Group for Child Mortality Estimation. The Lancet. 2015;386(10010):2275-86.

16. Organization WH. World health statistics 2016: monitoring health for the SDGs sustainable development goals: World Health Organization; 2016.

17. MacDorman MF, Declercq E, Menacker F, Malloy MH. Infant and neonatal mortality for primary cesarean and vaginal births to women with “no indicated risk,” United States, 1998–2001 birth cohorts. Birth. 2006;33(3):175-82.

18. Shah A, Fawole B, M'Imunya JM, Amokrane F, Nafiou I, Wolomby JJ, et al. Cesarean delivery outcomes from the WHO global survey on maternal and perinatal health in Africa. International Journal of Gynecology & Obstetrics. 2009;107(3):191-7.

19. Harrison MS, Goldenberg RL. Cesarean section in sub-Saharan Africa. Maternal health, neonatology and perinatology. 2016;2(1):6.

20. Cavallaro FL, Cresswell JA, França GV, Victora CG, Barros AJ, Ronsmans C. Trends in caesarean delivery by country and wealth quintile: cross-sectional surveys in southern Asia and sub- Saharan Africa. Bulletin of the World Health Organization. 2013;91:914-22D.

21. Fesseha N, Getachew A, Hiluf M, Gebrehiwot Y, Bailey P. A national review of cesarean delivery in Ethiopia. International Journal of Gynecology & Obstetrics. 2011;115(1):106-11.

22. Bago B. Prevalence and Its Associated Factors among Women Undergone Operative Delivery at Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia, 2017. Gynecol Obstet. 2018;8(461):2161-0932.1000461.

23. Organization WH, UNICEF. Reaching the every newborn national 2020 milestones: country progress, plans and moving forward. 2017.

24. Maanongun M, Ornguze A, Ojabo A, Eka P. Indications and the materno-foetal outcome of caesarean section in a secondary health facility in obudu, south-south Nigeria. Research and Reports in Gynecology and Obstetrics. 2017;1(3).

25. Nyirahabimana N, Ufashingabire CM, Lin Y, Hedt-Gauthier B, Riviello R, Odhiambo J, et al. Maternal predictors of neonatal outcomes after emergency cesarean section: a retrospective study in three rural district hospitals in Rwanda. Maternal health, neonatology and perinatology. 2017;3(1):11.

26. McDonnell S, Chandraharan E. Determinants and outcomes of emergency caesarean section following failed instrumental delivery: 5-year observational review at a tertiary referral centre in London. Journal of pregnancy. 2015;2015.

27. Moges A, Ademe BW, Akessa GM. Prevalence and Outcome of Caesarean Section in Attat Hospital, Gurage Zone, SNNPR, Ethiopia. Archives of Medicine. 2015;7(4).

28. Elias S, Wolde Z, Tantu T, Gunta M, Zewudu D. Determinants of early neonatal outcomes after emergency cesarean delivery at Hawassa University comprehensive specialised hospital, Hawassa, Ethiopia. PLoS ONE. 2022; 17(3): e0263837.

29. Mundhra R, Agarwal M. Fetal outcome in meconium stained deliveries. Journal of clinical and diagnostic research: JCDR. 2013;7(12):2874.

30. Tashfeen K, Patel M, Hamdi IM, Al-Busaidi IH, Al-Yarubi MN. Decision-to-Delivery Time Intervals in Emergency Caesarean Section Cases: Repeated cross-sectional study from Oman. Sultan Qaboos University Medical Journal. 2017;17(1):e38.

31. Algert CS, Bowen JR, Giles WB, Knoblanche GE, Lain SJ, Roberts CL. Regional block versus general anaesthesia for caesarean section and neonatal outcomes: a population-based study. BMC medicine. 2009;7(1):20.

32. Rotich S, Ndavu M, Rukaria-Kaumbutho R, Kigondu C. Early perinatal outcome in cases delivered through Caesarian section following clinical diagnosis of severe foetal distress at Kenyatta National Hospital. East African medical journal. 2006;83(5):250-8.

33. Mekonen S, Eshete A, Desta K, Molla Y. Maternal and neonatal outcomes in mothers who undergo caesarean section under general and spinal anesthesia in Gandhi Memorial Hospital, Addis Ababa. Advanced Techniques in Biology & Medicine. 2015;2015.

34. Abdissa Z, Awoke T, Belayneh T, Tefera Y. Birth outcome after caesarean section among mothers who delivered by caesarean section under general and spinal anesthesia at Gondar University teaching hospital north-west Ethiopia. J Anesth Clin Res. 2013;4(7):4-8.

35. Ayeni OM, Aboyeji AP, Ijaiya MA, Adesina KT, Fawole AA, Adeniran AS. Determinants of the decision-to-delivery interval and the effect on perinatal outcome after emergency caesarean delivery: a cross-sectional study. Malawi Medical Journal. 2021 Mar 31;33(1):28-36.

36. Ghosh R, Santos N, Butrick E, Wanyoro A, Waiswa P, Kim E, et al. Stillbirth, neonatal and maternal mortality among caesarean births in Kenya and Uganda: a register-based prospective cohort study. BMJ Open. 2022; 12:1–9.

37. Gedefaw, G., Alemnew, B., & Demis, A. (2020). Adverse fetal outcomes and its associated factors in Ethiopia: a systematic review and meta-analysis. BMC Pediatrics, 20. https://doi.org/10.1186/s12887-020-02176-9.

38. Leta, M., Assefa, N., & Tefera, M. (2022). Obstetric emergencies and adverse maternal-perinatal outcomes in Ethiopia; A systematic review and meta-analysis. Frontiers in Global Women's Health, 3. https://doi.org/10.3389/fgwh.2022.942668.

39. Ambaye M. Zegeye, Bewket B. Tesfaw, Demeke A. Alemu, (2023), Magnitude of Immediate Adverse Newborn Outcome Between Cesarean Section Versus Vaginal Delivery and Its Associated Factors at East Gojjam Zone General and Referral Hospitals, Amhara, Ethiopia, J. Women Health Care and Issues. 6(6); DOI:10.31579/2642-9756/173

40. Getie, D., Gutema, B., Haleke, W., Megersa, N., & Tessem, K. (2021). Adverse neonatal outcomes and associated factors among mothers who gave birth through cesarean section at Arba Minch General Hospital, Southern Ethiopia. International Journal of Nursing and Midwifery. https://doi.org/10.5897/ijnm2019.0390.

41. Okot G, Omara S, Kasujja M, Pebalo FP, Baruti P, Ubarnel NA. Incidence and factors associated with immediate adverse neonatal outcomes among emergency obstetric referrals in labor at a tertiary hospital in Uganda: a prospective cohort study. BMC Pregnancy Childbirth. 2024 Oct 30;24(1):715. doi: 10.1186/s12884-024-06900-6. PMID: 39478452; PMCID: PMC11523647.

42. Patel AB, Prakash AA, Raynes-Greenow C, Pusdekar YV, Hibberd PL. Description of inter-institutional referrals after admission for labor and delivery: a prospective population-based cohort study in rural Maharashtra, India. BMC Health Serv Res. 2017;17

43. Elias, S., Wolde, Z., Tantu, T., Gunta, M., & Zewudu, D. (2022). Determinants of early neonatal outcomes after emergency cesarean delivery at Hawassa University comprehensive specialised hospital, Hawassa, Ethiopia. PLoS ONE, 17. https://doi.org/10.1371/journal.pone.0263837.

44. Tefera, M., Assefa, N., Roba, K., & Gedefa, L. (2021). Adverse Neonatal Outcome are More Common among Babies Born by Cesarean Section than Naturally Born Babies at Public Hospitals in Eastern Ethiopia: A Comparative Prospective Follow-Up Study at Eastern Ethiopia. Global Pediatric Health, 8. https://doi.org/10.1177/2333794x211018350.

45. Abdullahi, Y., Assefa, N., & Roba, H. (2021). Magnitude and Determinants of Immediate Adverse Neonatal Outcomes Among Babies Born by Cesarean Section in Public Hospitals in Harari Region, Eastern Ethiopia. Research and Reports in Neonatology. https://doi.org/10.2147/rrn.s296534.

46. Gebrekidan, M., Fisseha, M., Belay, A., & Abreha, G. (2025). Effects of antepartum hemorrhage on maternal and perinatal adverse outcomes in Northern Ethiopia: a retrospective cohort study. BMC Pregnancy and Childbirth, 25. https://doi.org/10.1186/s12884-025-07829-0.

47. Damtew, B., Hailu, A., Fente, B., Workneh, T., & Abdi, H. (2024). Determinant of adverse early neonatal outcomes following emergency cesarean section in North West, Ethiopia: institutional-based case-control study. BMC Pregnancy and Childbirth, 24. https://doi.org/10.1186/s12884-024-07037-2.

48. Downes KL, Shenassa ED, Grantz KL. Neonatal Outcomes Associated With Placental Abruption. Am J Epidemiol. 2017 Dec 15;186(12):1319-1328. doi: 10.1093/aje/kwx202. PMID: 28595292; PMCID: PMC5860509.

49. Tadese M, Getachew G, Kebede TN, Yesuf TE, Tessema SD, Damesa WA, Solomon GS. Perinatal outcomes and predictors of placental abruption: a retrospective study in an Ethiopian tertiary care center. Front Public Health. 2025 Jan 7;12:1453117. doi: 10.3389/fpubh.2024.1453117. PMID: 39839380; PMCID: PMC11746074.

50. Levin G, Rottenstreich A, Tsur A, Cahan T, Rosenbloom JI, Yagel S, Meyer R. Neonatal outcome of second-stage cesarean delivery versus vacuum extraction among neonates <34 weeks. J Matern Fetal Neonatal Med. 2022 Dec;35(23):4461-4468. doi: 10.1080/14767058.2020.1852208. Epub 2020 Dec 1. PMID: 33928834.

51. Zewdu D, Tantu T, Degemu F, Abdlwehab M. Association between the stage of labour during caesarean delivery with adverse maternal and neonatal outcomes among referred mothers to tertiary centres in resource-limited settings. BMJ Open. 2023 Nov 28;13(11):e077265. doi: 10.1136/bmjopen-2023-077265. PMID: 38016797; PMCID: PMC10685916.

52. Badr DA, Carlin A, Kadji C, Kang X, Cannie MM, Jani JC. Timing of induction of labor in suspected macrosomia: retrospective cohort study, systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2024 Oct;64(4):443-452. doi: 10.1002/uog.27643. PMID: 38477187.

53. Hong J, Atkinson J, Roddy Mitchell A, Tong S, Walker SP, Middleton A, Lindquist A, Hastie R. Comparison of Maternal Labor-Related Complications and Neonatal Outcomes Following Elective Induction of Labor at 39 Weeks of Gestation vs Expectant Management: A Systematic Review and Meta-analysis. JAMA Netw Open. 2023 May 1;6(5):e2313162. doi: 10.1001/jamanetworkopen.2023.13162. PMID: 37171818; PMCID: PMC10182428.

54. Vitner D, Bleicher I, Levy E, Sloma R, Kadour-Peero E, Bart Y, Sagi S, Aviram A, Gonen R. Differences in outcomes between cesarean section in the second versus the first stages of labor. The Journal of Maternal-Fetal & Neonatal Medicine. 2019 Aug 3;32(15):2539-42.

55. Thuillier C, Roy S, Peyronnet V, Quibel T, Nlandu A, Rozenberg P. Impact of recommended changes in labor management for prevention of the primary cesarean delivery. American journal of obstetrics and gynecology. 2018 Mar 1;218(3):341-e1.

Annexes

Structured data collection form

Study title:

Reviewer name: ----------

Date of review: ----------

Patient ID/chart number: ----------

Section I- maternal Socio demographic characteristics

S. No	variable	data	Code	Skip
101	**Maternal age(years)**	----------		
102	**Current marital status**	Married----------1 Unmarried--------2 Divorced----------3 Widowed----------4		

Section II- Reproductive characteristics

S. No	Variable	data	Code	Skip

201	**Gravidity (in number)**	----------		
202	**Parity (in number)**	----------		
203	**Previous history abortion**	zero……1 one……2 two……..3 ≥ three……...4		
204	**Previous history of still birth**	zero……1 one……2 two……..3 ≥ three……...4		
205	**Previous history of early neonatal death**	zero……1 one……2 two……..3 ≥ three……...4		
206	Number of previous uterine scars **(cesarean or myomectomy)**	zero……1 one……2 two……..3 ≥ three……...4		

Section III- Obstetric characteristics and medical complications

S. No	Variable	data	Code	Skip
301	**Gestational age**	Preterm (< 37 weeks)……...1 Term (37 – 42 weeks)….....2 Post term (≥ 42 weeks)……3		
302	**Antenatal care in the current pregnancy**	zero……1 one……2 two……..3		

		≥ three……...4		
303	**Place of antenatal care**	Health center/private clinic …1 Primary hospital …….2 Referral hospital…….3		
304	**Is there any maternal and/or fetal obstetric complication diagnosed per operatively?** **If yes to question number 304 go to Q305.**	yes……1 no……2		
305	**What type of ante partum obstetric complications identified?**	Preeclampsia….1 Eclampsia…….2 Gestational hypertension….3 Ante partum hemorrhage due to placenta previa…4 Ante partum hemorrhage due to abruption placenta…5 Premature rapture of membrane……6 Intrauterine growth restriction……..7 Oligohydramnios…….8 Others (Specify----------)……..9		

Section IV- Preoperative and Intraoperative Fetal and Maternal Conditions

S. No	Variable	data	Code	Skip
401	**was she referred from other health facility before arrival to this**	yes……...1 no…....2		

	hospital labor and delivery ward? **If she is referred, go to question number 402 and 403**			
402	**How long it takes to reach this hospital from the last referring institution?**	**---------- Hrs**		
403	**What was the diagnosis put as reason for referral?**	Fetal tachycardia……1 Fetal bradycardia……2 Cordprolapse……3 Ante partum hemorrhage ……4 Preeclampsia/Eclampsia……..5 Previous cesarean scar……..6 Prolonged second stage of labor…..7 Obstructed labor…….8 CPD……..9 Malpresentation……10 Others (specify----------)….11		
404	**Was she in labor preoperatively?** **If yes to question number 304 go to Q 405, Q406, Q407, Q408, and Q409**	yes……1 no……2		

405	**How was the onset of labor?**	Spontaneous ……1 Induced……2		
406	**For how long she labored before operation?**	---------- Hours		
407	**What was the stage of labor during decision for operation?**	Latent first stage of labor…….1 Active first stage of labor…….2 Second stage of labor……3		
408	**What was the state of liquor at decision for operation?**	Clear……1 Meconium stained and Grade one……2 Meconium stained and Grade two……3 Meconium stained and Grade three……..4 Unknown……5		
409	**What was the presentation of the fetus?**	Vertex…….1 Breech …….2 Shoulder…….3 Brow…….4 Face …….5		
410	**What was the fetal heart beat at decision?**	<120 beat per minute……1 120 – 160 beats per minute …..2 > 160 beats per minute……..3		

411	**What was the indication for cesarean delivery?**	Fetal tachycardia…..1 Fetal bradycardia…..2 Obstructed labor…..3 MSAF in LFSOL…..4 Cord prolapse ……..5 CPD……..6 Failed induction…….7 Malpresentation…….8 Failled instrumental delivery…..9 Placenta previa in labor or with active bleeding...10 Abruption of placenta with active bleeding……..11 Previous uterine scar with x factor……12 More than one uterine scar in labor……..13 Others (specify----------) ……14		
412	**What was the time of operation?**	Working hours ….1 Duty hours…….2		
413	**What was the time interval between the decisions for operation to delivery of fetus?**	---------- **Minutes.**		
414	**What was the type of anesthesia?**	Spinal anesthesia……1 General anesthesia…..2		

415	**What was the type skin incision?**	Pfannenstiel ……1 Midline……..2		
416	**What was the interval between skin incision to delivery of the fetus?**	**---------- Minutes.**		
417	**What was the position of the surgeon?**	Year one resident …..1 Year two resident ……2 Year three resident…..3 Year four resident……4 Senior……..5		

Section v- Neonatal clinical Conditions

S. No	Variable	data	Code	Skip
501	**weight of the neonate**	Low birth weight (<2500 grams) …..1 Normal birth weight (2500-3999 grams) ……2 Large birth weight (≥ 4000 grams)……..3		
502	**the first minute Apgar score**	< 7 …….1 ≥7……..2		
503	**fifth minute Apgar score**	< 7 …….1 ≥7……..2		
504	**Neonatal age during referral**	-------hours		

505	**neonatal diagnosis during referral**	1. Preterm 2. sepsis 3. MAS 4. PNA 5. RDS 6. Others (----------)		
506	**Length of stay at NICU**	1. < 24 hours 2. ≥ 24 hours		
507	**condition of the neonate on the last 3rd post operation days**	1. Discharged improved 2. Alive on treatment 3. Died		
508	**If died, What was immediate cause of death?**	2. MOF 2dry to sepsis 3. respiratory failure 2dry to RDS 4. MOF 2dry PNA 6. Others (----------)		
509	**On which post operation day was the neonate died**	1. First 2. Second 3. Third		