COLLEGE OF MEDICINE AND HEALTH SCIENCE

SCHOOL OF PUBLIC HEALTH

PREVALENCE AND FACTORS ASSOCIATED WITH ADVERSE NEONATAL OUTCOMES AMONG CESAREAN DELIVERIES AT PUBLIC HOSPITALS IN HAWASSA CITY, SIDAMA REGION, ETHIOPIA

BY: TAMIRU RIKIBA (BSc)

A THESIS SUBMITTED TO HAWASSA UNIVERSITY, COLLEGE OF MEDICINE AND HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH IN REPRODUCTIVE HEALTH

HAWASSA, ETHIOPIA

JUNE, 2024

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JUNE, 2024

Declaration

I hereby declare that this MSc thesis is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis / dissertation have been duly acknowledged.

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This MSc thesis has been submitted for examination with my approval as thesis advisor.
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Examiner's approval sheet

School of graduate studies

Hawassa university examiners' approval sheet

We, the undersigned, members of the board of examiners of the final open defense by Tamiru Rikiba have read and evaluated his thesis entitled' 'prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in Hawassa city, Sidama region '' examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the Master's degree.

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Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the school of graduate studies (SGS) through the department/school graduate committee (DGC/SGC) of the candidate department.

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List of acronyms and abbreviation

ANC	Antennal Care
ANO	Adverse Neonatal Outcomes
APGAR	Appearance, Pulse, Grimace, Activity and Respiration
CD	Cesarean Delivery
CS	Cesarean Section
DM	Diabetes Mellitus
FHR	Fetal Heart Rate
GA	General Anesthesia
HUCSH	Hawassa University Comprehensive Specialized Hospital
IRB	Institutional Review Board
LBW	Low Birth Weight
MAS	Meconium Aspiration Syndrome
MSAF	Meconium Stained Amniotic Fluid
NICU	Neonatal Intensive Care Unit
OR	Operation Room
SA	Spinal Anesthesia
SPSS	Statistical Package for Social Science
TCD	Total Cesarean Delivery
WHO	World Health Organization

Abstract

Background: Cesarean deliveries are linked to higher risks of adverse neonatal outcomes compared to spontaneous vaginal births. In Ethiopia, comprehensive data on these outcomes and associated factors is lacking. Understanding these issues in hospitals is crucial for improving maternal and neonatal care.

Objective: This study aimed to assess prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in Hawassa city, Sidama region, Ethiopia.

Method and material: a facility based retrospective cross-sectional study was conducted at two public hospitals in Hawassa city from April 1 to 30, 2024, analyzing 522 hospital medical records of mothers who delivered by CS from Jan 2023 to Aug 2024. Data were collected using a structured data extraction checklist via kobocollect 4.0, and Simple random sampling technique was employed to select study participants. Data were analyzed using SPSS version 27, employing Binary and Multiple Logistic regressions to identify factors associated with adverse neonatal outcomes. Statistical significance was stated at p-value<0.05, with adjusted odds ratio (AOR) and 95% confidence interval (CI) reported.

Result: nearly one-third of newborns delivered through cesarean section developed adverse outcome. Women who had preeclampsia and abruptio-placenta were 2.9 (AOR: 2.9; 95% CI; 1.104, 3.38 and 3.3 times (AOR: 3.3; 95% CI; 1.36, 8.21) more likely to develop an adverse neonatal outcomes compared with those women who did not have the condition respectively. Similarly women who delivered by midline cesarean section were 2.9 times (AOR: 2.9; 95% CI; 1.125, 7.4) more likely to develop adverse neonatal outcomes compared with those women who delivered by lower transverse cesarean section. Women who referred from other facility were 2.8 times (AOR: 2.8; 95% CI; 1.82, 4.4) more likely to develop adverse neonatal outcomes compared with those women who were not referred.

Conclusion: prevalence of adverse neonatal outcomes was high in the study area. Preeclampsia, abruptio-placenta, being referred from other health facility, and delivery via midline cesarean section were factors associated with adverse neonatal outcomes. Timely intervention for high-risk pregnancies could help reduce adverse neonatal outcomes.

Key words: cesarean section, adverse neonatal outcomes, Ethiopia

1. Introduction

1.1. Background

Cesarean section is the delivery of the fetus (es), placenta and membranes through an incision on the abdominal and uterine wall at or after 28 weeks of gestation(1). It's usually done when a vaginal birth would be risky for mothers or baby's life or health. In some cases, it can also be chosen even if there's no medical reason (2).

In recent years, cesarean-sections are becoming much more common around the world. In China, the rate has hit a high of 46%, and many other countries in Asia, Europe, Latin America, and even the US are seeing similar increases (3,4). According to recent study from WHO, encompassing 154 countries and 94.5% of global births (2010–2018) revealed that 21.1% of women delivered via C-section. This trend is expected to continue, with a projected global rate of 29% by 2030 , raising concerns about their potential impact on newborn health (2,5). Although cesarean delivery is generally a life- saving procedure, it may lead to increased maternal and neonatal complications and healthcare expenses. Babies born via caesarean delivery face more risks than babies born vaginally, they are more likely to have respiratory problems in the neonatal period, more likely to have difficulties establishing breastfeeding, and more likely to experience asthma in childhood and adulthood(6–8).

The number of women giving birth by CS is rapidly growing in a continuous manner in both the developed and developing countries, with prevalence ranging from 5% in sub-Saharan Africa to 29% in Latin America and Caribbean countries(4,9,10). There is a double neonatal mortality rate among newborns in Africa after cesarean section compared to the global average. According to a prospective observational study conducted across 22 African countries, one in 20 babies die in the early neonatal period after elective cesarean delivery (11).

Cesarean sections are on the rise in Ethiopia, with rates nearly tripling between 2016 (2%) and 2019 (5%). This increase is uneven across the country, with some regions like Addis Ababa having much higher rates (24.1%) compared to others like Somali (1.1%). However the actual number of Cesarean section performed in hospitals will be much higher; Estimates suggest the overall rate could be as high as 30% (6). In our study area nearly half (49.3%) of

the births were cesarean deliveries (12). Increasing rate and number of cesarean deliveries are known to be associated with fetal risks prematurity, low APGAR score, perinatal asphyxia, stillbirth and early neonatal death (7,8,13–17). Important contributing factors include not having antenatal care, gestational age , the baby's birth weight, the presence of meconium in the amniotic fluid, the type of anesthesia used, and any pre-existing medical or pregnancy complications the mother had before pregnancy (14,18–23).Even though adverse neonatal outcomes in Ethiopia are high little is known about comprehensive prevalence and factors associated with this adverse neonatal outcomes, most of existing studies often employ a limited number of outcome measures, potentially overlooking the more comprehensive spectrum of potential complications impacting newborns after CS (16,19). In country, where healthcare challenges and high neonatal mortality rates persist, understanding prevalence and factors associated with adverse neonatal outcomes following CS holds significant importance. This study addresses this critical gap by focusing on comprehensive outcome measures commonly observed in Ethiopia.

1.2. Statement of the problem

In Ethiopia, the prevalence of cesarean section (CS) deliveries remains low compared to global averages, with significant regional variability. The national rate of CS was around 5% as of the latest reports, which is below the World Health Organization's recommended threshold of 10-15% for optimal maternal and neonatal health outcomes(24). However, Cesarean-sections are much more higher in hospitals (6). A hospital based cross sectional study done among women who gave birth at public and private hospitals in Hawassa city found out the cesarean section rate was 49.3% (12).

Cesarean deliveries are associated with an increased risk of adverse neonatal outcomes, which are a major public health concern and the leading cause of newborn illness and death (7,8,17,25). A systematic review and meta-analysis reported that the pooled prevalence of adverse birth outcomes in Ethiopia was 26.88%, with specific outcomes including low birth weight (10.06%), preterm birth (8.76%), stillbirth (7.09%), and congenital anomalies (2.55%) Another study in the Harari region found that 22% of babies born by cesarean section experienced immediate adverse outcomes, including death, NICU admission, and absence of neonatal reflexes. (26–28). In this study area a research specifically focusing on emergency cesarean deliveries found that 26.7% of newborns experienced adverse early neonatal outcomes after cesarean deliveries (22). Furthermore, Ethiopia faces a particularly alarming challenge with neonatal mortality. The rate has risen from 29 deaths per 1,000 live births in 2016 to 33 deaths in 2019, indicating a worsening situation (24,29).

Research suggests many factors contribute to newborn complications after C-sections, including mother's age, prenatal care, and obstetric and medical conditions (15,22,23,28,30,31)**.** However, in Ethiopia, despite a high rate of C-sections and newborn problems, there's a lack of understanding about the full range of these complications. Existing studies focus on Cesarean-section prevalence or just a few specific newborn issues (14,18,20,21,31,32), neglecting the broader picture of newborn health after CS. This lack of comprehensive understanding may hinder efforts to optimize obstetric practices and reduce neonatal mortality and morbidity in Ethiopia. Therefore this study aimed to assess prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in Hawassa city, Sidama region, Ethiopia.

1.3. Significance of the study

Adverse neonatal outcomes, particularly those associated with cesarean deliveries; pose a significant public health burden in Ethiopia, with high prevalence rates of complications such as birth asphyxia, MAS, low birth weight, and prematurity indicating a pressing need for intervention to improve maternal and neonatal health outcomes. The rising neonatal mortality rate in Ethiopia, coupled with the identified risk factors associated with cesarean deliveries, suggests that efforts to mitigate adverse outcomes are urgently needed. Failure to address these issues could lead to further increases in neonatal mortality rates, exacerbating an already critical situation.

Given the potential association between cesarean section (CS) and increased adverse maternal and neonatal outcomes, knowing prevalence and identifying factors behind this condition after CS is key to identifying high-risk pregnancies and implementing preventive measures through education and early intervention.

Little information exists about the extent and contributing factors of adverse neonatal outcomes following Caesarean deliveries in Sidama region Ethiopia, including Hawassa. This study extends beyond the limited outcome measures typically used, providing a more comprehensive picture of potential risks associated with CS in the Ethiopian context.

Understanding the full range of adverse outcomes, including the specific complications most commonly linked to Cesarean sections, allow healthcare providers to be better equipped to handle these situations. The findings also offer a valuable reference point for future research endeavors.

2. Literature review

2.1. Overview of cesarean section

The World Health Organization (WHO) recommends a cesarean section rate of between 10-15%. However, rates vary considerably around the world. In high-income countries, the Cesarean section rate is often much higher, exceeding 20% in some regions. In contrast, Cesarean-section rates in low-income countries are often much lower, sometimes below 5%(29).

According recent study from the WHO, encompassing 154 countries and 94.5% of global births (2010–2018) revealed that 21.1% of women delivered via C-section, with averages ranging from 5% in sub-Saharan Africa to 42.8% in Latin America and the Caribbean(33) These variations in C-section rates stem from a complex interplay of factors, including medical considerations like access to emergency obstetric care and fetal monitoring, alongside socioeconomic influences like a mother's education and cultural preferences, and finally the healthcare system itself, including its organization, financing, and availability of skilled birth attendants.

The first 28 days of life are a critical time for a child's health and survival. While global progress has been made, disparities in neonatal mortality remain significant. In 2021, an estimated 2.3 million children died in their first month, with the highest rates in sub-Saharan Africa. Compared to high-income countries, a child born in sub-Saharan Africa faces a much higher risk of not reaching their first birthday(34).

Nearly one in four Ethiopian babies (26.8%) experience complications during their first month of life. The two most common issues are low birth weight (10%) and prematurity (8.7%). Rural in residence, lack of antenatal care follow up and having current complication of pregnancy were the factors associated with adverse birth outcomes(13).

2.2. Prevalence of adverse neonatal outcomes following caesarean delivery

Adverse Neonatal outcomes vary widely around the world, influenced by diverse factors. While some countries report relatively low rates of adverse outcomes, others face significantly higher challenges. a six-year registry study by Wilmink found 12% of newborns experienced adverse outcomes in Netherlands (35). In contrast, a systematic review from Iran found that 30% of babies delivered via cesarean section encounter difficulties, most

commonly transient tachypnea (36).A Spanish study using two years of national data by Costa-Ram et al. concluded that 14% of newborns required admission after C-section (37).

A large international study across 22 African countries found that 4.4% of babies born via cesarean section died within their first week of life(11). In another study from Cameroon, nearly 26% of babies born through C-section experienced complications, with respiratory distress being the most common(38).Similarly, a study in Rwanda reported that 9% of newborns delivered by C-section had immediate health problems(39).

Ethiopia faces a significant challenge with adverse neonatal outcomes after cesarean sections (CS). In Harar, a study by Abdullah et al. found that 22% of newborns delivered via CS experienced immediate complications(19). This equates to roughly 1 in 5 babies facing health challenges in their first crucial moments. Similarly, Tefera et al.'s research reported an even higher rate, with 24.3% of babies born through CS experiencing adverse neonatal outcomes(7)

A retrospective study in Gurage Zone found that nearly 20% of pregnancies resulted in poor fetal outcomes(16). In my study area a research specifically focusing on emergency cesarean deliveries found that 26.7% of newborns experienced adverse early neonatal outcomes after CD(22).

2.3. Factors affecting neonatal outcomes after cesarean delivery

2.3.1. Socio-demographic factors

According to a two-year national prospective perinatal study in Jordan mothers who were employed during pregnancy had 1.84 times higher adjusted odds ratio of having their newborn admitted to the NICU compared to mothers who were not employed(40).

Distance can be a matter of life and death for newborns in need of emergency care. Studies have shown that longer travel time between health centers and district hospitals are associated with higher odds of neonatal death or low APGAR scores. Neonates whose mothers had to travel for 30-60 minutes by ambulance to reach the district hospital were 3.8 times more likely to experience poor outcomes compared to those with shorter travel times. For travel times exceeding 60 minutes, the odds further increased to 5.8 times higher(39,41).

A study in southwest Ethiopia found that women living in rural areas were 1.29 times more likely to experience unfavorable feto-maternal outcomes after a cesarean section compared to women from urban areas(14).In another study, Babies born to mothers with an estimated monthly income below 5200 Ethiopian Birr had a 3.38 times higher risk of immediate adverse outcomes after a cesarean delivery compared to babies from wealthier families(19).

2.3.2. Obstetric and medical factors

Having two or more children significantly increases the risk of pregnancy complications for mothers compared to those with one child or none**.** Women who have had two or more children (multiparous and grand multiparous) are nearly 9 times more likely to ANO compared to women with one child or none (primipara and nulliparous**)**(42).

Delivering in the second stages of labor by C-section can be risky for both mothers and babies. Study done in India and Kenya reported that babies born through C-sections in the second-stage faced a significantly higher risk of complications like cord blood acidosis, low Apgar scores, and the need for resuscitation. The rate of perinatal deaths was also found to be higher in the second-stage group(43,44).

A study in Ethiopia by Zewudu et al. found the similar finding reporting, performing cesarean sections during the second stage of labor, when the baby is already descending into the birth canal, doubles the risk of adverse neonatal outcomes compared to CS done in the first stage of labor(45).

Urgency and underlying health concerns play a significant role in newborn health after CS. Studies in India, Cameroon, and Rwanda all found that emergency cesarean sections were associated with more negative neonatal outcomes than elective cesarean sections(38,39,46).

Studies conducted in our country show mixed findings**,** Babies born through CS performed for absolute indications, like obstructed labor and Eclampsia were 8.3 and 9.8 times more likely to develop unfavorable fetal management outcome than with indications as mal-presentation(19,31). However, a study by Belay et al. suggests Mothers with underlying medical conditions or suspected cephalopelvic disproportion (CPD) who underwent CS had reduced risks of poor fetal outcomes(16).

The risk of adverse neonatal outcome (ANO) increases for babies born to mothers who have had multiple pregnancies, no prenatal care, prolonged rupture of membranes, and a longer

labor. Mothers who did not receive prenatal care during their pregnancy were 3.16 times more likely to experience fetal death than mothers who did (OR 3.159, P-value=0.000)(14,19,21,40).A study conducted in Jordan reported a 92% increased likelihood of adverse neonatal outcomes among babies born to mothers with DM compared to those born to mothers without DM(40).

A study in Ethiopia revealed that babies born via CS to mothers with pre-existing medical or obstetrical conditions were three times more likely to experience adverse outcomes compared to those born to mothers without such conditions. Mothers with anemia were 2.5 times more likely to experience fetal death compared to mothers with normal hemoglobin levels(19,21)

Babies born to mothers whose water broke (membrane ruptured) more than 12 hours before a cesarean section were over 3 times more likely to have complications compared to babies born to mothers whose membrane is intact(32).Mothers who labored for more than 24 hours were more likely to have babies with poor neonatal outcomes compared to those who delivered after shorter labors(47)**.**

Choosing the right anesthesia for a cesarean section (CS) is a crucial decision, as it impacts both the mother's and baby's well-being. A Korean study found that newborns delivered via CS under GA had a higher proportion of low 5-minute Apgar scores compared to those born under SA(48). Similarly, a study by Metogo et al. in Cameroon linked general anesthesia to lower Apgar scores in the first, third, and fifth minutes after birth, as well as increased risks of infant resuscitation(49).

a study in northwest Ethiopia found that babies born via general anesthesia during cesarean sections were nearly 3 times more likely to have a low Apgar score at 5 minutes compared to those born via spinal anesthesia(50).

2.3.3. Neonatal factors

Newborns with meconium-stained amniotic fluid, low birth weight, prematurity and multiple pregnancy face a significantly higher risk of serious health complications, low APGAR score, NICU admission, and even death(50–52).

babies with a pre-anesthetic fetal heart rate above 160 beats per minute tend to have higher APGAR scores at 5 minutes after birth compared to babies with heart rates between 120 and 160 beats per minute or below 120 beats per minute(50).

Conceptual frame work

Studies indicate that multiple factors are associated with increased risks of complications following cesarean sections for newborns. These factors encompass the mother's age, rural residence, lack of antenatal care, parity, general anesthesia, existing obstetric or medical complications, stage of labor, emergency CS, prolonged rupture of membrane, low birth weight, meconium stained amniotic fluid , multiple pregnancy, pre-anesthetic fetal heart rate (6,15,22,32,36,53). This study aimed to assess prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries, therefore the conceptual framework below shows these interrelated factors associated with adverse neonatal outcomes. For this study the conceptual framework is adapted and modified after reviewing different studies.

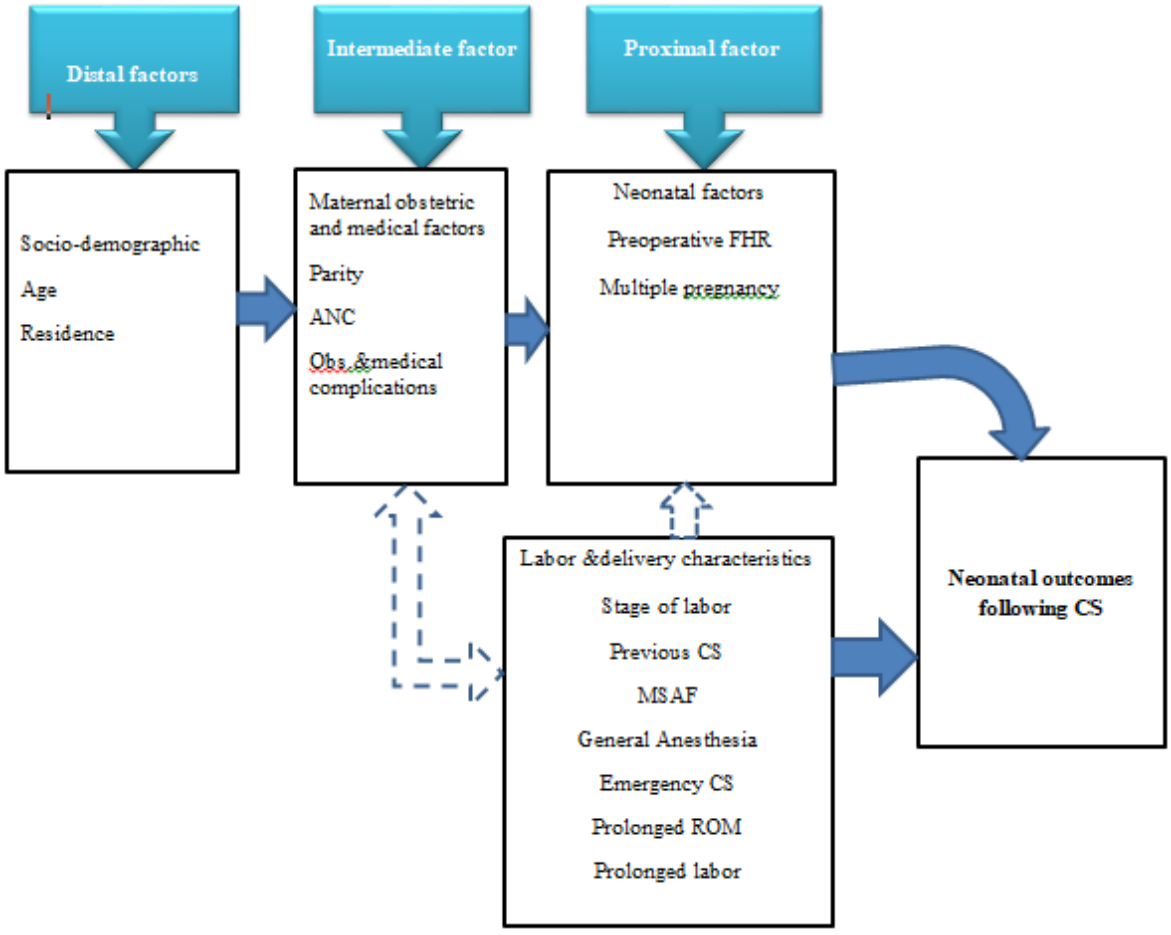

Figure 1: A conceptual frame work of prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in Hawassa city, Sidama region

3. Objectives

3.1. General objective

The general aim of this study was to assess prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in Hawassa city, Sidama region.

3.2. Specific objectives

To determine prevalence of adverse neonatal-outcome among cesarean deliveries at public hospitals in Hawassa city, Sidama region.

To identify factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in Hawassa city, Sidama region.

4. Method and Material

4.1. Study area

The study was conducted in Hawassa city which is found 275 km far from Addis Ababa, the capital of Ethiopia. Its administration divided into 8 sub-cities with a total population 577,075 in 2023 which is projected based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia(54). There are four public hospitals namely Hawella Tula General Hospital, Adare general hospital, Motite Furra Primary Hospital and Hawassa comprehensive specialized hospital and ten health centers in city. We randomly selected two hospitals Adare general hospital and Hawassa comprehensive specialized hospital. Adare general hospital provides maternal and child care services by four obstetricians, six emergency surgeons, nine general practitioner, forty four midwives and nine nurses and had 1213 total cesarean deliveries last year. While Hawassa University comprehensive specialized hospital gave the same services by 7 obstetricians, 104 midwives and 32 OB/Gyn residents and done 1450 cesarean deliveries last year.

4.2 Study Design and Period

Facility based retrospective cross sectional study was conducted from April 1-30, 2024.

4.3. Population

4.3.1. Source population

All mothers who delivered by cesarean section from January 1, 2023 to August 30, 2024, at public hospitals in Hawassa city, Sidama region

4.3.2. Study population

All randomly selected mothers who delivered by cesarean section from January 2023 to August 2024 at selected public hospitals in Hawassa city, Sidama region.

4.4. Eligibility criteria

4.4.1. Inclusion criteria

All records of women who delivered by cesarean section (CS) from January 1, 2023, to August 30, 2024, at selected public hospitals in Hawassa city, Sidama region.

4.4.2. Exclusion criteria

Records of mothers with incomplete data were excluded.

4.5. Sample size determination

For objective one

Sample size was calculated using single population proportion formula taking overall prevalence of adverse neonatal outcomes among women who delivered by cesarean section 22% (19), 5% margin of error and 95% confidence interval as follow

n= (Zα/2) 2 p (1-p)/d2 where n=sample size

z = statistic for level of confidence

p= prevalence ANO among CD

d= precision

n= (1.96)2 (0.22)(1-0.22)/(0.05)2

= (3.8416)(0.1716)/0.0025

=264, adding 10% for incomplete records final sample size become 290.

For second objective

By using double population proportion formula using results from previous studies on the most important variables, the sample size was determined as shown below using EpiInfo 7.2.5.0.

Table 1. Sample size determination for factors associated with adverse neonatal outcomes among women who delivered by CS at public hospitals in Hawassa city, sidama region

Associated factors	CI	power	% of outcome in Unexposed	AOR	Sample size	Reference
LBW	95%	80%	2.5	3.5	532	(55)
Meconium	>>	>>	14.4	6.37	58	(22)
Gestational age	>>	>>	11.7	2.64	264	(47)
ANC	>>	>>	32	3.16	114	(21)

Taking the largest of all, the final sample size became **532.**

4.6 .Sampling technique and sampling procedure

A total of 522 study participants were selected using computer generated random sampling technique after preparation of sampling frame using OR registry logbook, which has the list

of all mothers who underwent CS for delivery in each hospital. The total calculated sample size was distributed to each selected health facilities using proportional allocation according to the number of cesarean deliveries from the previous year. In 2023 Hawassa university comprehensive and specialized hospital performed 1450 cesarean sections and Adare general 1213 according to last year hospitals report. Consequently 290 records of mothers who were delivered by cesarean section were selected from Hawassa University comprehensive specialized hospital and 242 records of mothers who were delivered by cesarean section were selected from Adare general hospital.

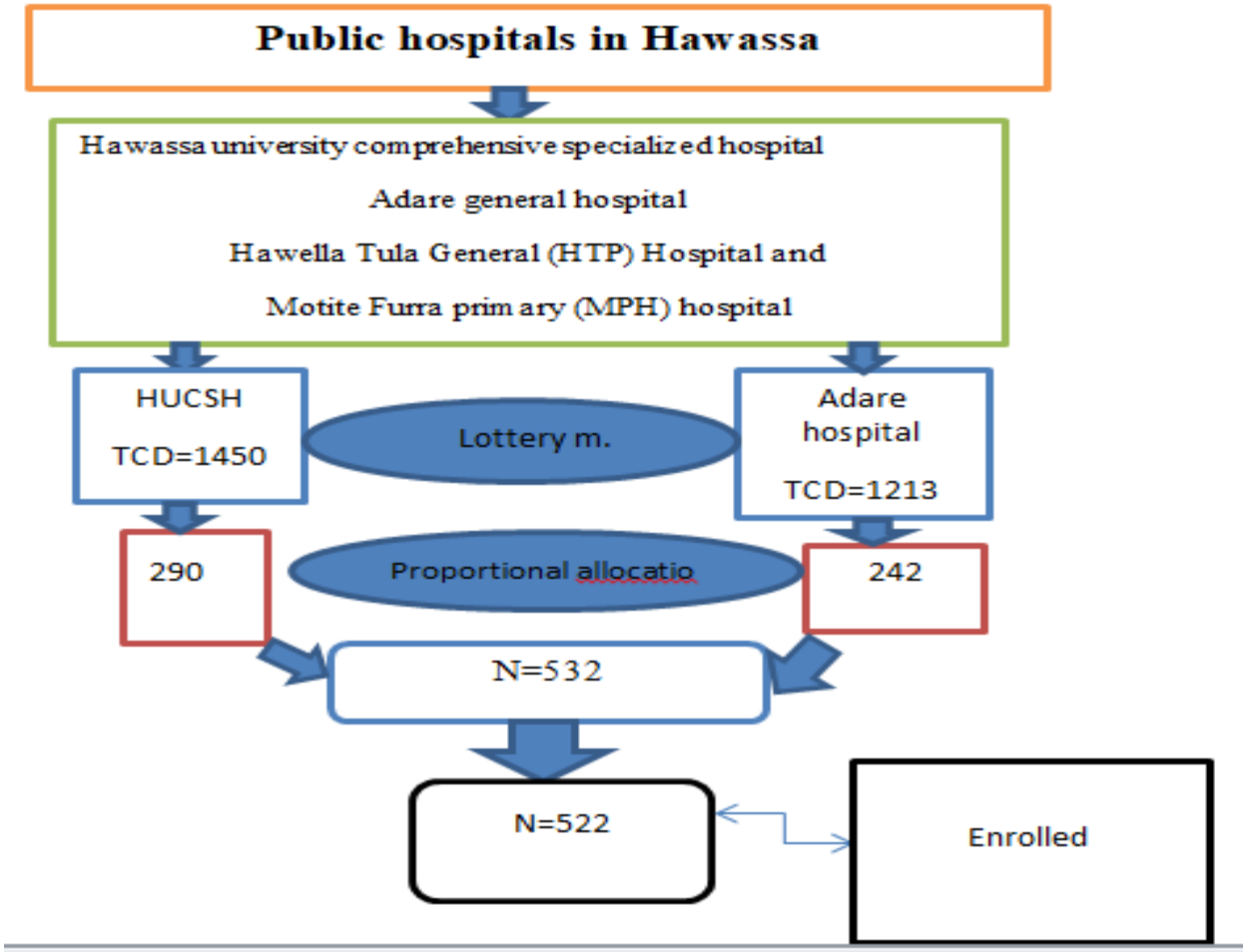

Figure 2: sampling procedure for prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in Hawassa city Sidama region.

4.7. Variables

4.7.1. Dependent variable

Neonatal outcomes: are first and fifth minute Apgar score, birth weight, meconium aspiration syndrome, preterm birth and NICU admission.

Adverse neonatal outcomes: considered when the neonate has at least one or more of the following, low APGAR score, LBW, meconium aspiration syndrome, preterm birth or NICU admission.

4.7.2. Independent variables

Socio-demographic: Age, Rural residence

Obstetric and medical Characteristics: null Parity, absence of ANC follow-up presence Medical or obstetric complications

Labor and delivery characteristics: being referred, presence of labor, General anesthesia, Emergency CD, midline CS, Second stage of labor

Neonatal factors: NRFHR, Meconium stained amniotic fluid

4.8. Operational definition

Low birth weight: birth weight <2.5kg delivery(28)

Preterm birth: babies born alive before 37 completed weeks of pregnancy(24)

Low First and fifth minute APGAR score: APGAR<7(1).

NICU admission: if newborn was admitted to NICU wit in 24hrs of delivery.

Neonatal death: death of a baby within 24 hours of delivery(24)

MAS: diagnosed based on clinical features by a pediatrician (presence of meconium, tachypnea, respiratory grunting, nasal flaring, and chest retractions) and radiographic signs on chest x rays (patchy infiltrates, hyper expansion) (56)

4.9. Data collection

Trained nurses and midwives collected data after taking two day training on the study objectives, eligibility criteria and mastering the use of KoboCollect 4.0. Data was gathered using KoboCollect 4.0 from medical records of mothers who gave birth by Cesarean section using data extraction format which was adapted and specifically tailored for this study after records were reviewed and cesarean delivered mother's card were identified by their medical registration number. The checklist was prepared in English and It consists four parts; socio-demographic information, maternal obstetric and medical conditions, labor and delivery characteristics and neonatal outcomes. The completeness of the data was checked by filtering submissions with missing information with in Kobocollect itself and by exporting the submitted data in to SPSS on daily basis.

4.10. Data quality control

Two day training was given for data collectors and supervisor concerning the data abstraction tool and data collection process. During the actual data collection phase, close supervision and monitoring was done. The submitted data was checked for completeness by supervisors and the principal investigator on a daily basis.

4.11. Data processing and analysis

The collected data was exported to SPSS 27 software for cleaning, coding and statistical analysis. Descriptive summary measures (mean, maximum, minimum, range and standard deviation) were used to present continuous variables. For categorical variables frequency tables, bar and pie charts were used.

To explore the relationships between dependent and independent variables, chi-square tests were performed initially. Subsequently, binary logistic regression was used to model the relationships and identify significant predictors of the outcome variable. Variables with a p-value less than 0.25 in the Bivariable logistic regression analysis were considered as candidate for further exploration in the multivariable logistic regression model. Multicollinearity was checked using variance inflation factor (VIF<10) and tolerance >0.1 indicating non-existence of multicollinearity. Hosmer-Lemeshow goodness-of-fit test with p-value > 0.05 was used suggesting good fit. Statistical significance was stated at $p<0.05$ and adjusted odds ratio (AOR) with a 95% confidence interval (CI) were presented.

4.12. Ethical consideration

Ethical clearance from the Institutional Review Board (IRB) of Hawassa University College of Medicine and Health Sciences (HUCMHS) was taken and we obtained a letter of permission from the hospital managers to access the de-identified data for this analysis. The retrieved data was kept confidential. We used Medical record number and personally identifiable information was not included in any analysis or reporting to protect individual privacy.

5. Results

5.1. Socio-demographic characteristics

From the total selected records of mothers, 522(98%) were reviewed. Ten (2%) were excluded due to incomplete recording. Mean age of women was 26.5 (SD±4.7) years and the minimum and maximum ages were 18 and 40 years, respectively. Four hundred fifty four (87%) of the mothers were in the age group of 20–34 years. Majority of the mothers, 375 (72%) were urban residents (see Table 2)

Table 2. Socio-demographic Characteristics of women who delivered by CS at public hospitals in Hawassa city, sidama region, 2024(n=522)

Variables	Category	Frequency	Percentage
Age	<20	36	6.9
	20-34	454	87
	>=35	32	6.1
Marital status	Married	517	99
	Single	2	0.4
	Divorced	3	0.6
Residence	Urban	375	72
	Rural	147	28

5.2. Obstetric and medical characteristics

Out of 522 mothers, 174(33%) had not given birth before (nulliparous), while the majority 348(67%) had already had one or more children. Nearly all the mothers 510(97.7%) received antenatal care. Most pregnancies were singleton (96.6%) and about 9.2% were preterm. More than half (53%) of the mothers had current pregnancy complications, and almost a third (29%) had complications in past pregnancies. Additionally, a small number of mothers (6.5%) had other medical conditions. The most common complications during pregnancy were Malpresentation (19.6%), pre-eclampsia (19.3%), and antepartum hemorrhage (10.2%) (See table3)

Table 3. Obstetric and medical Characteristics of women who delivered by CS at public hospitals in Hawassa city, Sidama region, 2024(n=522)

Variables	Category	Frequency(N)	Percentage (%)
Parity	Null	174	33.3
	1-4	320	61.3
	Grandmult	28	5.4
Type of pregnancy	Singleton	504	96.6
	Multiple	18	3.4
ANC	Yes	510	97.7
	No	12	2.3
Malpresentation	Yes	70	13.4
	No	452	86.6
Current obstetric complications	Yes	276	53
	No	246	43
Past obstetric complications	Yes	151	28.9
	No	371	71.1

Medical complications	Yes	34	6.5
	No	488	93.5
Gestational age	Term	448	85.8
	Preterm	48	9.2
	Post term	26	5

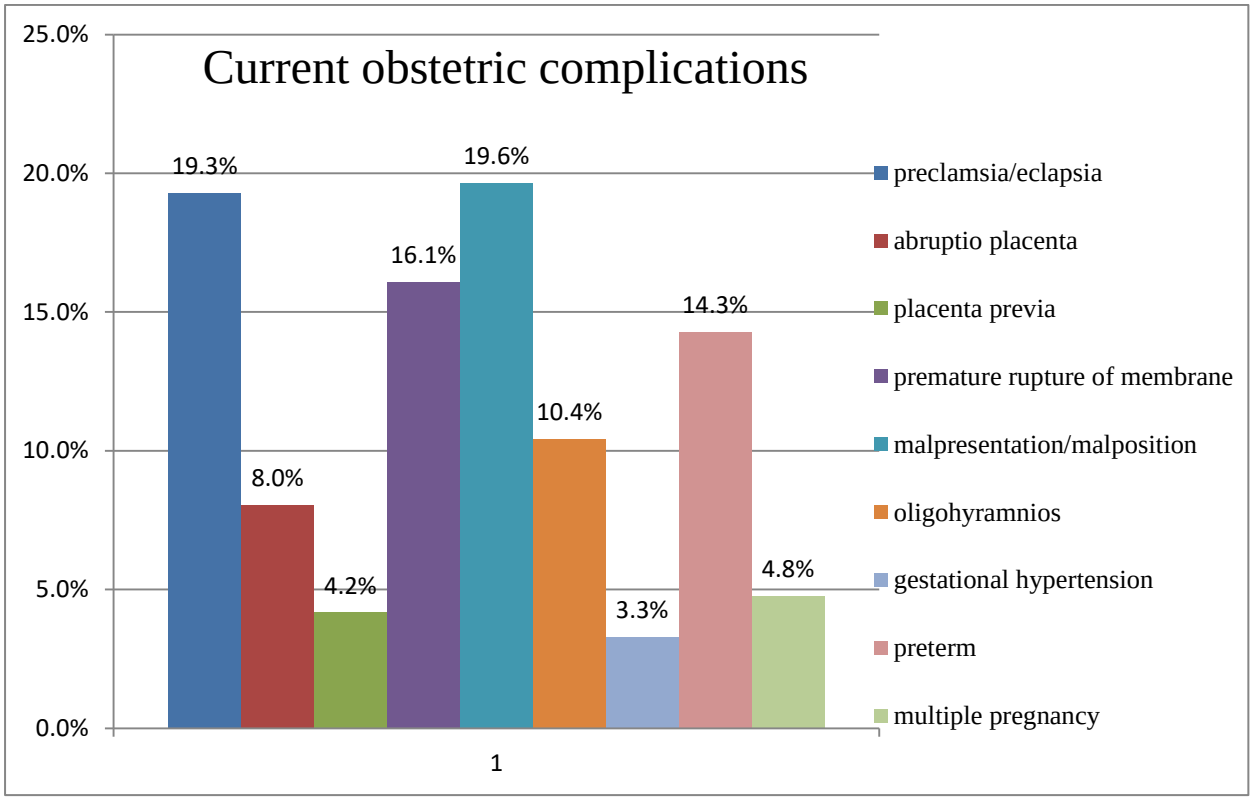

Figure 3**.**frequency of current obstetric complications among women who delivered by CS at public hospitals in Hawassa city, Sidama region, 2024(n=522).

5.3. Labor and delivery characteristics

From the total records reviewed, more than half (58.8%) of the mothers were referred from other institutions. Most mothers went into labor before surgery (83%), and a significant majority of those labors were spontaneous (95%). Cesarean deliveries were typically emergent in most of the cases (84.7), with the most common reasons being fetal distress, prior cesarean scar, and abnormal positioning of the baby (see table 4 and fig 4).

Table 4.labor and delivery Characteristics of women who delivered by CS at public hospitals in Hawassa city, Sidama region, 2024(n=522).

Variables	Category	Frequency(N)	Percentage (%)
Referral	Yes	307	58.8
	No	215	41.2
Labor	no	86	16.5
	latent	384	74.1
	active	33	6.3
	second	16	3.1
Type of CS	Emergency	442	84.7
	Elective	80	15.3
FHR	Normal	295	56.5
	Bradycardia	117	22.4
	Tachycardia	110	21.1
Membrane	Intact	405	77.6
	Ruptured <=12hrs	37	7.1
	>12hr	80	15.3
Color of liquor	Clear	30	30.8
	blood stained	10	8.5
	meconium stained	71	60.7
Previous CS	no	378	72.4
	one	74	14.2
	2 and above	70	13.3

Variables	Category	Frequency(N)	Percentage (%)
Skin incision	Pfannenstiel	501	96
	Midline	21	4
Incision to delivery time	<=5min	282	56
	>5min	240	46
Anesthesia	Spinal	504	96.6
	General	18	3.4

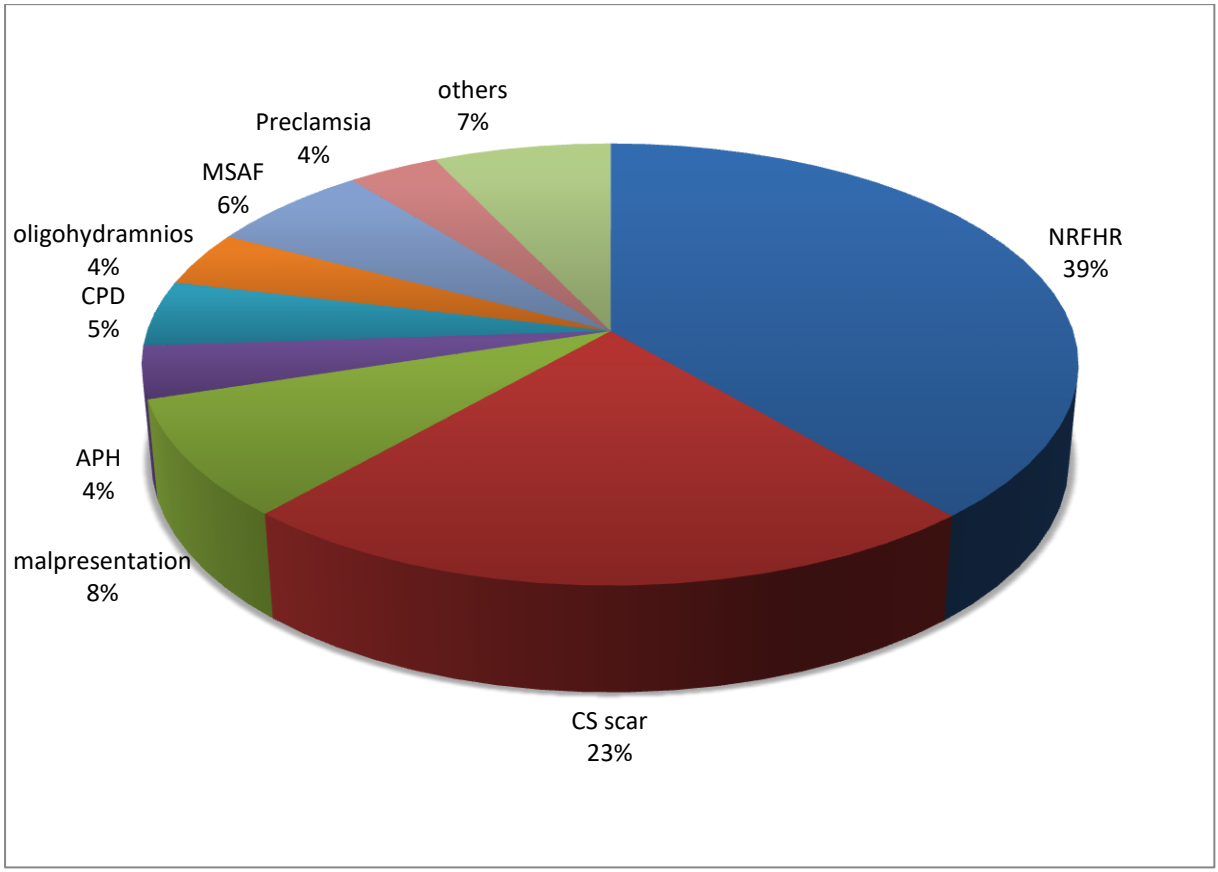

Figure 4: Indications for cesarean delivery among women who delivered by CS at public hospitals in Hawassa city, Sidama region, 2024(n=522)

5.4. Neonatal outcomes

Out of 522 total cesarean delivery records reviewed, nearly all (98.5%) resulted in live births, However 29% of the newborns experienced at least one adverse outcome. Specifically, 12.6% low birth weight, 23.4% low first-minute APGAR score and 10.3% had a low fifth-minute APGAR score. Additionally, 9.2% of the babies were born prematurely, 3% had meconium aspiration syndrome(MAS) and 22.6% were admitted to the NICU(see table5)

Table 5. Neonatal outcomes of women who delivered by cesarean section at public hospitals in Hawassa city, Sidama region, 2024(n=522).

Variables	**Category**	**Frequency(N)**	**Percentage (%)**
Neonatal status	Alive	514	98.5
	Dead	8	1.5
Sex	Male	264	50.6
	Female	258	49.4
Weight	Normal	444	85.1
	LBW	59	12.6
	Macrosomia	19	3.6
1st minute APGAR	Normal	400	76.6
	Low	122	23.4
5th minute APGAR	Normal	468	89.7
	Low	54	10.3
Preterm birth	Yes	48	9.2
	No	474	90.8
MSAF	Yes	19	3.6
	No	503	96.4
NICU	Yes	118	22.6
	No	404	77.4

5.5. Factors associated with adverse neonatal outcomes

In the binary logistic regression analysis, abruptio placenta, oligohyramnios, type of cesarean section, preoperative fetal heart rate, preeclampsia, type of anesthesia, type of skin incision and referral status had p-value less than 0.25.

In the multi-variable logistic regression analysis preeclampsia, abruptio-placenta, skin incision type and referral status remained as statistically significant predictors of immediate adverse neonatal outcomes. Mothers diagnosed with preeclampsia were about 2.9 times (AOR: 2.93; 95% CI 1.12, 3.38) more likely to have adverse neonatal outcomes compared to mothers without this condition. Similarly mothers diagnosed with abruptio placenta were 3.3 times (AOR: 3.35; 95% CI 1.36, 8.21) more likely to develop adverse neonatal outcome compared to those without the condition. Mothers who delivered through midline type of cesarean section had 2.89 (AOR: 2.89; 95% CI 1.13, 7.4) times odds of developing adverse neonatal outcome compared to mothers who underwent lower transverse cesarean section. Likewise mothers who were referred from other health facilities were 2.8(AOR: 2.84; 95%CI 1.82, 4.4) more likely to develop adverse neonatal outcomes compared to those who were not referred (see table 6)

Table 6. Bi-variable and multivariable logistic regression analysis of factors associated adverse neonatal outcomes among women who delivered by Cesarean section at public hospitals in Hawassa city, sidama region, 2024(n=522).

Variable	Neonatal outcomes			
	favorable	adverse	COR (95%CI)	AOR (95%CI)
Preeclampsia				
Yes	33(8.9%)	32(21.1%)	2 (1.184,3.42)	2(1.104,3.38)*
No	337(91.1%)	120(78.9%)	1	1
Abruptio-placenta				
Yes	10(2.7%)	17(11.2%)	4.5 (2,10)	3.3(1.364,8.2)*
No	360(97.3%)	13588.8%)	1	1
Referral				
Yes	19552.7%	112(73.7%)	3.2(2.091,493)	2.8(1.82,4.4)*
No	175(47.3%)	40(26.3)	1	1
Middle line				
Yes	8(2.2%)	13(8.2)	3.4(1.083,3.42)	2.89(1.125,7.4)*
No	362(97.8)	139(91.8)	1	1
General anesthesia				
Yes	4 (1.1%)	14(9.2%)	4(1.52,10.5)	1.65(0.546,4.97)
No	366(98.9)	138(90.8)	1	1
FHR				
Normal	218(58.9%)	77(56.5%)	1	1
Bradycardia	69(18.6)	48(31.6)	1.43(0.85,2.395)	1.34(0.765,2.36
Tachycardia	83(22.45	27(17.8)	2.24(1.246,4)	1.56(0.84,2.9)
Emergency CS				
Yes	306(82.7%)	136(89.5)	2(1.083,357)	1.8(0.95,3.56)
No	64(17.3%)	16(10.5)	1	1
Oligohyramnios				
Yes	18(4.9%)	17(11.2%)	2.5(1.2,4.9)	1.7(0.76,4.0)
no	352(95.1)	135(88.8)	1	1

‘*” significant variables, COR=crude odds ratio AOR=adjusted odds ratio

6. Discussion

The prevalence of adverse neonatal outcomes following cesarean delivery at public hospitals in Hawassa city was found to be 29%. Preeclampsia, abruptio-placenta, being referred from other health facilities and delivering via middle line cesarean section were associated factors with adverse neonatal outcomes.

Prevalence of adverse neonatal outcomes among cesarean delivered mothers at public hospitals in Hawassa city was found to be 29%. This was significantly higher than the 19.7% observed in a study conducted in the Gurage zone 2022. This variation could be linked to the Gurage zone study included fewer adverse neonatal outcome measuring parameters. Our finding is in line with other studies done in Harar 2021 and south west Oromia 2021 where 22% and 24% of newborns delivered via cesarean section experienced adverse outcomes respectively (15,57).

The findings of this study regarding factors associated with adverse neonatal outcomes are consistent with previous research highlighting current obstetric complications in the form of preeclampsia and abruptio-placenta, being referred from another facility, and delivering via midline cesarean section are all important factors linked to adverse neonatal outcomes(15,58,59).

In this study current obstetric complications as a form of preeclampsia and abruptio placenta were associated with adverse neonatal outcomes. Mothers with preeclampsia were nearly three times more likely to experience adverse neonatal outcomes compared to those without the condition, while mothers with abruptio placenta had over three times(3.3) higher odds of adverse neonatal outcomes. This finding is in line with a study conducted in Tigray 2019 and Gurage 2022(15,60). This might be these conditions can necessitate early delivery, increasing the risk of preterm birth and related neonatal complications such as respiratory distress syndrome and low birth weight. Furthermore Preeclampsia can impair placental blood flow, reducing oxygen and nutrient delivery to the fetus, which may result in fetal distress during delivery and increase the risk of neonatal hypoxia and acidosis(61,62).

Our study revealed that Mothers who were referred from other health facilities were 2.8 times more likely to develop adverse neonatal outcomes compared to those mothers who were not referred. This is in line with study done in Tanzania where Women referred for delivery had higher CS rates and poorer neonatal outcomes(58). This might be due to Mothers referred

from other health facilities might have more complex pregnancies or existing health conditions that necessitated transfer(63). These underlying conditions could increase the risk of complications for the newborn. Additionally delays in getting referred or receiving appropriate care at referral facilities and trouble with transport could contribute to adverse outcomes(64,65). Studies show longer ambulance rides are linked to poorer health outcomes in newborns(39,41).

In this study midline cesarean section type was associated with adverse neonatal outcomes. Mothers who delivered via midline cesarean section had 2.89 times odds of developing adverse neonatal outcomes compared to mothers who delivered through lower transfer cesarean section. While midline cesarean sections are sometimes necessary to improve outcomes for both mother and baby, research on their overall effectiveness compared to other techniques is inconclusive. Study done in US 2011, found faster delivery times with a transverse incision, but no difference in baby health. In contrast, another study from the same country 2021 showed slower delivery and better outcomes with a transverse incision(66,67). Our findings align with the second US study. However, our result might be influenced by other pre-existing conditions since we lacked data on why midline cesarean sections were performed.

6.1. Limitation

The findings are specific to Hawassa City public hospitals and may not be generalizable to other regions of Ethiopia or different healthcare settings.

Although the study attempts to control for various factors through statistical analysis, there is possibility that variables which are not included (like labor duration, decision-to-delivery time, referral-to-arrival time) or unknown factors that were not considered in the analysis may have influenced the adverse neonatal outcomes.

7. Conclusion and recommendations

7.1. Conclusion

Nearly a third (29%) of newborns delivered by cesarean section in this study experienced immediate complications. We identified the following significant factors with adverse neonatal outcomes such as: Preeclampsia, abruptio-placenta, referral status and midline cesarean sections were associated with adverse neonatal outcomes.

7.2. Recommendation

For Health organization

Establish protocols for routine prenatal screenings for all pregnant women to identify preeclampsia and placental abnormalities early.

Develop and implement educational programs to inform expectant mothers about the importance of regular prenatal check-ups and the signs and symptoms of preeclampsia and placental abnormalities.

Develop and disseminate clinical guidelines for choosing the type of cesarean incision, focusing on optimizing outcomes based on individual patient conditions.

Establish a robust referral coordination system to ensure timely and efficient transfer of mothers with high-risk pregnancies.

Establish specialized teams in hospitals to manage and coordinate care for referred mothers, ensuring they receive immediate and appropriate attention upon arrival.

For researchers

Undertake well-controlled studies to investigate the link between midline cesarean sections and adverse neonatal outcomes, considering factors beyond just the timing of the incision.

Explore the underlying reasons behind the increased risks associated with referral status to better understand and mitigate these risks.

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Annexes

Annex-I: Permission Letter for Public Hospitals in Hawassa City to Participate in Research

This document is intended to inform the leadership of hawassa university comprehensive specialized hospital and Adare general hospital about a research study titled" prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals in hawassa city,sidama region" and ask your voluntary participation. This research study aims to investigate adverse neonatal outcomes and associated factors among cesarean deliveries involving medical records of mothers who have undergone cesarean section at public hospitals in Hawassa City. This information will be used to identify high-risk pregnancies and implementing preventive measures through education and early intervention. Your hospital's participation will involve granting access to the medical records of mothers who have undergone cesarean deliveries from January 1, 2023 to august 30, 2024. All information obtained from your hospital will be anonymzed and treated confidentially. Access to the data will be restricted to authorized researchers only. We will ensure data is stored securely and destroyed confidentially after the study is completed. Participation in this study is entirely voluntary. You have the right to refuse to participate or withdraw your hospital's involvement at any time without any penalty. There are no direct benefits to your hospital for participating in this study. However, the findings may contribute to advancements in identifying high-risk pregnancies and implementing preventive measures through education and early intervention. If you have any questions about this study or your hospital's involvement, please do not hesitate to contact the principal investigator, [tamiru rikiba], at [tame81rike@gmail.com] or [0934754381]. By signing this document, you confirm that you have read and understood the information provided and agree to allow your hospital to participate in this research study.

Thank you!

Hospital manager: ----------

Principal investigator: ----------

Annex-II: Data extraction checklist

Title: prevalence and factors associated with adverse neonatal outcomes among cesarean deliveries at public hospitals Hawassa city, sidama region.

This tool is developed for the collection of data that are essential for the assessment of adverse neonatal outcomes and associated factors among neonates of cesarean deliveries in selected public hospitals in Hawassa, Ethiopia. All relevant information to the study was retrieved from the client's chart without stating their name. Health care professionals (BSc midwifes and Nurses) working in the delivery, obstetric and gynecology surgical ward will collect this data and was kept confidential.

The data extraction form contains four sections with socio demographic, obstetric and medical and neonatal factors. The form guides you through relevant questions about mothers who underwent cesarean delivery. The choice will use checkboxes for pre-defined options and text boxes to fill in open-ended questions directly within designated text boxes.

MRN……Name of facility…….

Name of data collector……date……Signature ……

Name of supervisor ……date……signature ……

Available data: 1.complete……. 2. Incomplete……3.excluded…….

Part 1: socio-demographic information

Sn	Variables	Response categories	Skip pattern
101	Age in years	_____Years old	
102	Residence	1.rural 2.urban	
103	Marital status	1. Married 2. Unmarried 3. Divorced 4. Widowed	
104	Referral status	1.yes 2.no	If yes,#107
Part II: maternal obstetric and medical characteristics			
201	Gravida (number of times she has been pregnant)	……write in numbers	
202	Para(number of times she has given birth)	……write in numbers	
203	Type of current pregnancy	1.Singleton 2.Multiple	
204	ANC follow-up	1.Yes 2.No	If yes proceed to #205
205	how many times	1.Once 2.Twice 3. three 4. More than three	
206	Current obstetric complications	1.yes 2.no	If yes, proceed #207
207	what is the complication	_____	
208	Current medical complications	1.yes 2.no	If yes,#209
209	what was the	_____	

	complication		
210	obstetric complications in the past	1.yes 2.no	If yes, proceed #211
211	what was the complication	_____	
212	Medical complications in the past	1.yes 2.no	If yes,#212
213	Gestational age	1. Preterm (< 37 weeks) 2. Term (37 – 40 weeks) 3. Post term (> 42 weeks)	
Part-III labor and delivery characteristics			
302	Have labor before CS	1.Yes 2.No	If yes, proceed to #303
303	type of labor	1. Spontaneous 2. Induced	
304	Duration of labor	……..	Write hrs
305	Type of CS	1.Emergency 2.Elective	If **2** proceed to #306
306	If the answer is emergency at what stage	1.Latent First stage 2. Active First stage 3.Second stage	
307	Pre-operative FHR	----------	Write in number
308	state of liquor	1.not ruptured 2. Ruptured 3. Unknown	If ruptured proceed to #310 and #311

309	Duration of ROM	----------ago	Write hrs
310		1.Ruptured with Clear liquor 2. Grade 1 Meconium stained 3. Grade 2 Meconium stained 4.Grade 3 meconium stained	
311	current CD	1. Primary 2.Repeat	
312	Type of anesthesia	1.General Anesthesia 2.Spinal Anesthesia	
313	Indication for current CD	1.fetal Bradycardia or tachycardia 2. obstructed labor 3.APH with active bleeding 4. Malpresetation &malposition 5. pre-eclampsia/ eclampsia 6.failure of labor progress 7. Failed Induction 8.cord prolapse 9.failed instrumental delivery 10.Previous uterine scar with x factor 11.More than one uterine scar in labor 13.CPD 12.Specify----------	
Part iv: Neonatal outcomes			
401	Newborn status	1. Alive 2. Dead	
402	Sex of the bay	1.male 2.female	
403	Weight of the baby	1.1000-1499gm 2.1500-2499gm 3. 2500-3999gm 4. ≥4000gm	

404	1st minute APGAR score		
405	5^{th} minute APGAR score		
406	NICU admission	1. Yes 2.No	
407	If yes for the above, specify reason	1. Preterm 2. PNA 3. Low birth weight 4. RDS 5. MAS 6. Others (----------)	Write the reason
409	Birth asphyxia	1.yes 2.no	