CESEAREAN SECTION RATES AND ADVERSE PERINATAL OUTCOMES AMONG ROBSONS TEN GROUPS OF WOMEN: A step towards a multidimensional audit

A prospective cross-sectional

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Declaration

I attest that, to the best of my knowledge and belief, this work does not contain any content that has been recognized for the awarding of any other degree in my name at any university or other postsecondary institution, nor does it contain any content that has been previously published or written by another individual, with the exception of instances where appropriate citation has been provided within the text. It seems to include everything I would like to include in my research proposal.

Signature: …….

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I attest to having read this research thesis entitled "CESEAREAN SECTION RATES AND ADVERSE PERINATAL OUTCOMES AMONG ROBSONS TEN GROUPS OF WOMEN" and endorsing its acceptance to Addis Ababa University.

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Abbreviation and Acronyms

CD- Cesarean Delivery CS-Cesarean Section

APO-Adverse Perinatal Outcome

WHO-World Health Organization

RTGCS- Robson's Ten Group Classification System

FIGO-International Federation of Gynecology and Obstetrics

TAH-Tikur Anbessa Hospital

GMH-Gandhi Memorial Hospital

ZMH-Zewditu Memorial Hospital

OVD-Operative Vaginal Delivery

OASIS-Obstetric Anal Sphincter Injury

PPH-Post Partum Hemorrhage

NRFHRP- Non-Reassuring Fetal Heart Rate Pattern

GDM-Gestational Diabetes Mellitus

PIH- Pregnancy Induced Hypertension

APH-Antepartum Hemorrhage

PROM-Premature Rapture of Members

IUFD-Intrauterine Fetal Death

NICU-Neonatal Intensive Care Unit

END- Early Neonatal Death

CPD- Cephalopelvic proportion

HDP-Hypertensive Disease of pregnancy

IUGR- Intrauterine Growth Restriction

Abstract

Background

Cesarean section (CS) rates are rising globally, with wide variation across populations. The World Health Organization recommends the Robson classification system for standardized monitoring. However, little is known about its association with maternal morbidity and adverse perinatal outcomes (APO) in Ethiopian referral hospitals.

Methods

We conducted a hospital-based cross-sectional study among 1,100 deliveries across three referral hospitals in Addis Ababa. Deliveries were classified into the ten Robson groups. Maternal morbidity and APO (including low Apgar score, NICU admission, advanced resuscitation, stillbirth, and early neonatal death) were assessed. Logistic regression was applied to identify independent predictors of APO.

Results

Of the 1,100 deliveries, 566 (51.5%) were by CS. Groups 5 (32.2%), 1 (18.9%), 2 (10.6%), 3(9.4) and 10 (8.8%) were the largest contributors. Maternal morbidity occurred in 25.8% of CS deliveries, highest in Group 10 (68.0%) and Group 4 (55.9%). The overall APO rate was 19.3%, with Group 10 (56.0%), Group 6 (47.6%), and Group 8 (36.7%) most affected. In multivariable regression, gestational age was protective (AOR 0.83 per week, 95% CI 0.75–0.92, $p<0.001$), while hypertensive disorders with intrauterine growth restriction (HDP with IUGR) (AOR 6.19, 95% CI 2.34–16.38, $p<0.001$) and residence outside Addis Ababa (AOR 4.51, 95% CI 1.35–15.07, $p=0.02$) were significant predictors of APO.

Conclusion

The study demonstrates that high CS rates alone do not equate to poor or good outcomes. Instead, prematurity, HDP with IUGR, and delayed referral drive adverse results. Robson Groups 10, 6, and 8 carried the greatest perinatal risks, while Groups 4 and 10 had the highest maternal morbidity. Implementing Robson-based CS audits, strengthening antenatal surveillance for HDP and IUGR, and improving neonatal care and referral systems are critical to reducing adverse outcomes.

Keywords: Cesarean section, Robson classification, maternal morbidity, perinatal outcomes, Ethiopia

Contents

Introduction

Background

After the fetus reaches the age of viability, a cesarean section (CS), a potentially life-saving obstetric treatment, is performed to deliver the baby by making an incision on the mother's abdomen and uterus. This procedure is medically recommended to reduce maternal and newborn mortality during childbirth. (2, 19)

One significant global measure for assessing access to obstetric services is the rate of crude cesarean sections. The number of cesarean sections performed has been continuously rising over the past three decades in many nations, particularly high-income ones. The average global CS rate, according to a survey of 150 nations, was 18.6%, with the least and most developed countries having CS rates ranging from 6% to 27.2%. Africa has the lowest population-level CS rate (7.3%) in the globe, whereas Latin America and the Caribbean have the highest prevalence (40.5%). (2, 19, 29)

Despite the fact that CS is a safe procedure when carried out by qualified medical professionals, the rise in the global CS rate over the past three decades has raised concerns about the possible harm to the health of mothers and newborns among governments, policymakers, and healthcare professionals. Both immediate and long-term dangers that could impact the health of mothers and newborns may be linked to CS. (2, 5, 24)

A higher risk of newborn respiratory distress, thromboembolism, stillbirth, postpartum hemorrhage, anesthetic accidents, retained placenta, postpartum infections, greater need for blood transfusions, and even mortality are some of these problems. Placenta previa, a morbidly attached placenta, and uterine rupture with the potential for postpartum hysterectomy are long-term dangers that endanger future reproductive life and increase the risk of childhood obesity and asthma. For women living in environments with minimal resources and limited access to comprehensive obstetric care, these risks are higher. (2, 3)

An absence of international consensus regarding a universal cesarean section classification system has complicated understanding of these drivers across countries. The 1985 WHO statement, which was based on evidence available at the time, stated that regional cesarean section rates should not exceed 10–15%. Rising global cesarean section patterns are influenced by a variety of factors, with some authors arguing that the increase is largely driven by the rising

use of the non-medically indicated cesarean section, which can pose unnecessary risks to mothers and neonates.(6, 12, 29)

A group of specialists was gathered by WHO in October 2014 to talk about this matter. In order to create a consistent point of comparison for maternal and perinatal data both inside and between facilities over time, the panel suggested the Robson classification as an international standard. In order to create a common baseline for comparing maternal and perinatal data both inside and between facilities throughout time, the panel examined the evidence and then suggested the Robson classification as an international standard. Additionally, 31 nations adopted the Robson categorization in approximately 33 million pregnancies in accordance with the WHO's guideline. (24, 30)

Robson's system categorizes all deliveries into one of ten categories based on five parameters: obstetric history (parity and previous cesarean section), onset of labor (spontaneous, induced, or cesarean section before onset of labor), fetal presentation or lie (cephalic, breech, or transverse), number of neonates, and gestational age (preterm or term). (29)

This system allows for institution-specific monitoring and auditing and offers a standardized comparison method across institutions, countries, and time periods. The ten Robson categories are mutually exclusive, completely inclusive, and applicable prospectively, as each woman admitted for delivery can be classified immediately based on a few variables that are typically routinely recorded. (1,29)

A valuable clinical method that allows standardized comparison of data and time points, the RTGCS offers an easy way to gather information about the CS rate, and it identifies the groups driving changes in CS rates. The reported crude rates of CS performed in different countries and regions are highly variable, and there are often significant differences between hospitals within a single region. When the number of CS cases increases, it is crucial to improve the database for benchmarking by implementing valid classifications. (25, 28)

A popular method for assessing cesarean section (CS) rates is the Robson Ten Group Classification System. However, CS rates by themselves are not a good indicator of quality and should be taken into account in conjunction with other obstetric outcomes. Comparisons, trend analyses, and subgroup analyses are made possible by this method's simultaneous assessment of several outcomes, which supports a methodical and multifaceted examination that is advantageous to families and healthcare practitioners. (20)

Statement of problem

The rates of caesarian sections (CS) have risen dramatically over the years, from approximately 7% in 1990 to 21% in 2023, and are predicted to continue rising over the next ten years as both unmet needs and overuse are predicted to coexist, with a projected global rate of 29% by 2030. CS use has important public health implications for both mother and child. When carried out under the right indications, CS can significantly reduce maternal and neonatal morbidity and mortality, but it can also have negative effects on the mother and child, ranging from short-term health outcomes to long-term problems. (3, 5)

Many nations deal with the dual burden of unmet CS needs and unsafe CS delivery. Other people bear a triple burden, with the double burden that affects a portion of the population being made worse by excessive CS use. Reducing mother and newborn morbidity and mortality is one of the 2030 World Health Organization's goals. Avoiding clinically unnecessary cesarean sections is one of the recommended strategies for achieving this goal. However, sustaining low CS rates while ensuring safe outcomes for moms and newborns is a challenge. (5)

The cesarean section rate in Ethiopia stands at approximately 2%, although there are significant differences across administrative regions, indicating disparities in access. There was a notable difference in the trend of cesarean section (CS) rates observed between urban and rural areas across five DHS datasets. The report indicates that the incidence of CS in urban settings increased over the five-year periods of the surveys, starting from 5.1% in 2000, rising to 9.4% in 2005, reaching 8.1% in 2011, climbing to 10.6% in 2016, and slightly decreasing to 10.1% in 2019. Similarly, the rate of CS in rural areas also saw an increase, moving from 0.2% in 2000, to 0.3% in 2005, to 0.5% in 2011, to 0.9% in 2016, and then significantly rising to 3.9% in 2019. In 2019, Addis Ababa recorded the highest percentage of CS at 24.1%, reflecting the greatest growth since 2000, which was 7.9 %.(31, 38)

While lowering the rate of CS is desired, it is crucial to remember that one of the most important ways to lower maternal and perinatal morbidity and death is to provide access to medically justified CS. Therefore, it is crucial to research the traits of the woman undergoing the surgery and whether it is being performed for legitimate reasons. Examining the causes of the CS trend in various healthcare facilities and among female populations is equally crucial. An internationally recognized classification approach that has been shown to improve the analysis and comparison of CS rates in diverse situations consistently and turn this data into actionable

information must be adopted and consistently used in order to do this. The International Federation of Gynecology and Obstetrics (FIGO) and the World Health Organization currently suggest the Ten-Group Robson classification system as an effective monitoring tool for evaluating CS rates within and within different obstetric units over time. (2, 28)

After adjusting for socioeconomic variables, a global research that examined data at the national level found no correlation between a CSR above 10% and appreciable drops in maternal and newborn mortality. The numbers of CS deliveries per 100 births, or CS rates, and newborn death have a negative and statistically significant linear association, according to another ecological study. (36, 38).

The Robson Ten Group Classification System provides a framework for assessing important obstetric outcomes outside of cesarean sections (CS) in all Robson groups in a methodical manner. While some attempts have been made to apply the Robson classification to the analysis of individual outcomes, including postpartum hemorrhage (PPH), obstetric anal sphincter injury (OASIS), and operative vaginal delivery (OVD), thorough analyses of several outcomes at the same time using Robson groups are rare. With the results presented and analyzed in a meaningful way, this study intends to determine the prevalence of cesarean sections and investigate the relationship between adverse perinatal outcomes classified using the Robson Ten Group Classification System in three teaching hospitals in Ethiopia. (20)

Significance of the study

The quality and accessibility of maternal health services are significantly influenced by cesarean sections. A dependable and practical instrument for the predetermined and structured analysis of complicated real-world data, ideally prospectively collected must be developed in order to enable genuine assessment and improvement of obstetric care at any level. The Robson ten group classifications is a global standard for evaluating, tracking, and comparing CS rates at all levels, according to the World Health Organization.

A framework for evaluating maternal and perinatal outcomes can be derived from the classification. It is a useful tool for determining which population should receive the most attention in order to lower the rates of cesarean sections. Examine the particular group for successful tactics or measures aimed at maximizing the use of cesarean sections. However, it is uncommon to use Robson groups to assess multiple outcomes side by side in parallel. The prevalence of cesarean sections and their associations with unfavorable perinatal outcomes will be shown in this study for each of the ten groups of women in Robinsons. Understanding which group is more likely to experience perinatal adverse outcomes also helps us put policies in place to lessen their incidence and effects. Any alterations in perinatal outcomes brought about by modifications to clinical practice can be proposed.

This research will contribute new insight in to the feasibility and effectiveness of using the Robson Ten Group Classification System in analyzing other outcomes rather than only cesarean section. By providing robust quantitative data on Cesarean section prevalence and relationships with adverse perinatal outcomes among Robinsons ten groups of women, this study will set foundation for future researches and recommends using the Robson Ten Group Classification System as a standard auditing tool in Ethiopia based on the study results.

Literature Review

Introduction

The most used surgical delivery method worldwide is caesarean section. Following embryonic viability, the fetus, membrane, and placenta are delivered via abdominal and uterine incisions during cesarean procedures. Due to disparities in socioeconomic level and access to both public and private healthcare services, the rates of Caesarean sections vary by nation, even between urban and rural areas. (10)

This study describes current CS rates globally by including 154 nations with CS rate records from 2010 or later. 94.5% of all live births worldwide in 2018 were represented by this. In the least, less, and more developed regions, the average CS rate was 8.2%, 24.2%, and 27.2%, respectively, while the global CS rate was 21.1%. The regions with the greatest birth rates are Latin America and the Caribbean (42.8%, 23 nations, 91.2% birth coverage), whereas sub-Saharan Africa has the lowest (5.0%, 39 countries, 88.6% birth coverage). (5)

The countries with the highest CS rates worldwide include the Dominican Republic (58.1%), Brazil (55.7%), Cyprus (55.3%), Egypt (51.8%), and Turkey (50.8%), according to Betran et al.'s (2021) trend research. The countries with the lowest CS rates worldwide include Madagascar (2%), Cameroon (2%) Ethiopia (1.9%), Niger (1.4%), and Chad (1.4%). Other nations with the lowest CS rates were Haiti (5.4%) in Latin America, the Netherlands (14.9%) in Europe, Papua New Guinea (3.1%) in Oceania, and Timor-Leste (3.5%) in Asia. According to the forecasts, if current trends continue, 28.5% of women globally will give birth by cesarean section (CS) by 2030, meaning that 38 million CS deliveries will occur each year. (5)

It is noteworthy that women are having fewer children, maternal age is increasing, electronic fetal monitoring is widely used, mal-presentation, especially breech presentation, frequency of forceps and vacuum delivery is decreasing, rate of labor induction is increasing, obesity is significantly increasing, and vaginal birth after Caesarean is decreasing, even though the reasons for the persistent rise in Caesarean rates are not fully understood. Women who are educated (at least a secondary level), live in urban regions, or have affluent socioeconomic status have relatively high CS rates. These are some potential reasons. (10, 15)

In Ethiopia, seven of the eleven administrative regions saw an increase in the rate of cesarean sections, which rose from 0.7% in 2000 to 1.9% in 2016. In 2016, the greatest rate of cesarean sections (21.4%) occurred in Addis Ababa, indicating unequal access. This suggests

that some women might not get the CS they require, while others would be subjected to needless CS. (27, 31)

The WHO determined at a meeting in Geneva in October 2014 that there was no justification for altering the 1985 guideline, which stated that, at the population level, CS rates greater than 10% were not linked to lower rates of maternal and newborn mortality as long as the fetus was still alive at the start of labor. (7, 24)

Robson's Ten Group Cesarean section Classification System

According to a 2011 systematic review by Torloni and colleagues, which included 73 publications from 31 countries that reported on the use of the Robson Classification between 2000-2013, synthesized user experience on implementing the Robson classification, and suggested adaptations, the Robson ten-group classification system was found to be the most appropriate for comparing surgery rates. The review also found that the Robson ten-group classification system was the most appropriate for comparing cesarean rates at a facility and national level. (15, 29, 30)

The Robson Classification System, also known as the Robson Ten Group Classification System (RTGCS), has been advocated by the World Health Organization (WHO) since 2015 as the most dependable method for meeting the current perinatal and CS monitoring needs on a local and global level. "The Robson Classification system is proposed by WHO as a global standard for evaluating, tracking, and comparing cesarean section rates within and between healthcare facilities over time." Additionally, the European Board and College of Obstetrics and Gynecology (EBCOG) and the International Federation of Gynecology and Obstetrics (FIGOS) both recommended the RTGCS. (21)

Using the Robson classification consistently will allow for the identification of target groups where interventions aiming at lowering CS rates will be most successful, according to Akadri and colleagues (2022). (2, 13)

The Robson Ten Group Classification System is an international classification system that Nantume et al. suggested be used because of its therapeutic significance, prospective categorization of women, simplicity, robustness, reproducibility, and flexibility. This facilitates the execution and assessment of focused treatments within particular populations. Making sure

that every hospital's Cesarean Section rate (CSR) falls between the 10 to 15% range that the World Health Organization recommends is crucial. (13)

The Robson classification is straightforward, reliable, repeatable, and adaptable. Analyzing rising trends in cesarean deliveries and the factors influencing this rising rate has been done using it. Standardized data comparisons are made possible by the Robson criteria, which also pinpoint the clinical situations influencing variations in cesarean rates. This makes it easier to quickly evaluate each institution's results and compare them objectively. (5, 11, 14, 16)

According to the findings of Tontus and Nebioglu (2020), Robson's grouping is the most suitable choice to meet present local, regional, and worldwide objectives. To expand on this approach, an internationally applicable C-Section categorization would be a suitable endeavor. It will be easier to evaluate, screen, audit, and compare cesarean rates across various hospitals, nations, or regions if Robson categorization is used as a universal system for classifying cesarean sections. Additionally, it will assist in developing and putting into practice efficient plans designed to achieve the WHO-recommended rates of cesarean sections. (24)

The Robson TGCS is a helpful tool that is openly accessible to all healthcare facilities to help with the analysis of cesarean delivery rates, according to Hehir et al. All medical facilities have access to it in order to make the analysis of cesarean delivery rates easier. It allows non-evidence-based activities to be called out if they are judged improper and promotes consistent practice patterns. Widespread adoption of the system could clarify any confusion surrounding the comparison of crude overall cesarean rates and improve transparency and understanding of the quality of healthcare delivery at individual institutions. Although numerous commendable efforts have been made to try to lower the overall number of cesarean sections, this inexpensive and simple-to-understand technology may help with this ongoing public health concern. (11)

The WHO has recognized Robson classification as the best global standard for researching the CS rate trend, and Strambi et al. (2020) think that using it to monitor the CS incidence and indications could lower the CS rate. However, because it only takes into account clinical factors, it has several limitations. According to a recent Cochrane review, interventions that focus on non-clinical characteristics are effective in lowering the frequency of needless CSs. (22)

Poor data collecting still prevents many countries and institutions from publishing their findings. Determining the quality of the data has been one of the many unanticipated advantages of using the RTGCS. As clinical practice changes, it is simple to track any resulting changes in other perinatal outcomes. Adopting the RTGCS as standard practice will allow doctors to learn from one another and fully fulfill its potential. (17)

Perinatal Adverse Outcome

Of the 3 to 4 million stillbirths and 3 million neonatal fatalities that occur annually, 97% to 99% occur in low- and middle-income countries. Better monitoring and prompt access to emergency obstetric care when needed could have prevented over 40% of stillbirths that happen during labor. With around one-third occurring on the day of birth and nearly three-quarters dying within the first week of life, 47% of all deaths among children under five in 2019 occurred within the first seven days following birth. (34)

According to the 2016 Ethiopian Demographic and Health Survey (EDHS) report, the neonatal mortality rate was 29 deaths per 1,000 live births, which is still among the highest in the world. Ethiopia also has one of the highest perinatal mortality rates in Africa, with 46 deaths per 1,000 pregnancies. Reducing neonatal, baby, and under-five mortality rates is a top objective worldwide. By 2030, Ethiopia aims to lower newborn mortality to less than 12 per 1,000 live births, which is the Sustainable Development Goal (SDG). (35,42)

When evaluated by year, the connections between NMRs and CSRs were primarily positive, despite a minor reduction in the trend of NMR over time. This finding is consistent with the results of the WHO worldwide survey on maternal and perinatal health conducted in Latin America in 2005, as well as the findings of the 2007–2008 study conducted in Asia on antepartum and intrapartum CS with indications. (43)

In contrast to a secondary analysis of two WHO surveys that found no significant correlation between rising CS rates and neonatal morbidity and mortality, Liabsuetrakul et al. (2019) found that rates of birth asphyxia were significantly higher and associated with rising CSRs. (36)

According to Tognon et al. (2019), women at low risk who rely too much on non-essential technology may not be significantly improving maternal and newborn outcomes despite an increase in surgical procedures. (23)

According to Savchenko et al. (2022), the Robson Ten Group Classification System offers a helpful framework for examining rates of OVD, OASIS, PPH, and Apgar score in addition to CS rates. in the first and fifth minutes. A multifaceted approach to risk assessment based on real-world data is made possible by the collective interpretation of these results. This approach may benefit both families and healthcare professionals by identifying high-risk groups, modifying preconceived notions about risk levels, and identifying the main contributors to the overall burden of adverse events. This approach allows for systematic investigation beyond the sole parameter of CS rates and is also appropriate for comparisons between hospitals and across international borders. (20, 41)

Guida and Costa (2022) strongly advise any researchers looking at the Robson Classification to look into outcomes other than caesarean section rates. Additionally, identifying the groups where adverse outcomes are more common makes them easier to understand and enables us to take action to lessen their impact and prevalence.

Conclusion

The Robson categorization is a popular beginning point for a perinatal categorization system that can be further improved, according to the World Health Organization (WHO). It could be necessary to split each of the ten groupings into separate groups or combine certain groups. Furthermore, extra information can be added and examined within other groups, such as indications for caesarean sections or newborn morbidity. The panel may also examine other labor and delivery-related incidents and results. (17, 18, 30)

Today's societies are continuously advancing towards the medicalization and over-medicalization of delivery, according to current patterns and estimates of CS use worldwide. The complicated situation of women's delivery in Southern Asia and sub-Saharan Africa is characterized by morbidity and mortality linked to unmet needs, unsafe CS provision, and instances of overuse of the surgical procedure, which depletes resources and adds avoidable morbidity and mortality. Comprehensively resolving the CS issue is a worldwide priority if the Sustainable Development Goals are to be accomplished within the next ten years. (5)

Improving obstetric care quality is a top goal in low-income nations where maternal and perinatal morbidity and mortality rates are still high. One method for raising the standard of care is clinical auditing. There are various benefits of using the RTGCS effectively. This makes it easier to find Robson groups that significantly impact the overall CS rate. Furthermore, by

examining patterns in overall and group-specific CS rates over time, RTGCS can serve as a baseline for interventions at the institutional and national levels. (1, 9)

This classification's drawback is that it ignores some other obstetric characteristics. For example, some of the women in this category may have experienced an iatrogenic birth due to a co-existing sickness that may not have been preventable. (17, 18)

Objectives

General Objective

- To determine prevalence of Cesarean Section (CS) & adverse perinatal outcomes (APO) among Robinsons ten groups of women

Specific Objective

- **Specific Objective 1**: To estimate the prevalence of cesarean sections among Robinsons ten groups of women
    - Sub objective 1.1 To determine Robinsons ten group specific *CS* rate
    - Sub objective 1.2 To determine absolute group contribution to overall *CS* rate
    - Sub objective 1.3 To determine relative group contribution to overall *CS* rate
    - Sub objective 1.4 To describe the *size & characteristics* of study population
- **Specific Objective 2** To explore whether a relationship exist between Robinsons group specific CSRs & adverse perinatal outcomes
    - Sub objective 2.1 Describe APO rate of sample by Robinson's ten groups
    - Sub objective 2.2 Describe CSRs by APO status among Robinson's ten groups
    - Sub objective 2.3 Compare GS-CSR between women with and without APOs

Research Methods, materials, and Procedure

Study area period

The study was conducted in Addis Ababa; the capital city of Ethiopia in the selected Hospitals (Three teaching hospitals- Black Lion Hospital (BLH), Gandhi Memorial Hospital (GMH), and Zewditu Memorial Hospital (ZMH)).GMH has fifteen catchment health centers with average monthly delivery of 500-600 babies, ZMC has 13 catchment health centers with monthly delivery of 400-500babies and BLH has 12 catchment Health centers with monthly delivery of 300-400. It was conducted from Jun1, 2025 until March 30/25.

Study design

Cross-sectional descriptive correlational study design

Pregnant women who delivered via SVD or Cesarean delivery were participants of the study. Are selected if they fulfill the inclusion criteria and the data will be collected on their 1st post-operative day and 6hrs post-partum until sample size is met. Additional data were collected for Neonatal outcomes for mothers delivered via Cesarean section. The study describes the prevalence of cesarean section based on the Robison's ten group classification system and also assesses the relationships between adverse perinatal outcomes based on each groups.

Study population

Population: Pregnant women came for delivery service in the three hospitals.

Study population: Mothers who gave birth in the selected hospitals in the study period fulfill the inclusion criteria from Jun1, 2025 until April 30/25.

Analytic Population: Mothers who gave birth in the selected hospitals and neonates delivered by cesarean section in the study period fulfill the inclusion criteria from Jun1, 2025 until April 30/25.

Inclusion Criteria- All women who gave birth at BLH, GMH and ZMH and neonates delivered via cesarean section from Jun1, 2025 until April 30/25.

Exclusion criteria- Laparotomy done for uterine rupture deliveries before fetal viability and those with missing records.

Sample Size Determination and procedure

Computed sample size for both objectives separately

Objective 1: Method: proportion based method = 384

The sample size (n) is calculated according to the formula: n = z2 * p * (1 - p) / e2

Where: z = 1.96 for a confidence level (α) of 95%, p = proportion (expressed as a decimal), e = margin of error.

The Caesarean Section rate was 34.8% in public Addis Ababa hospital

z = 1.96, p = 0.348, e = 0.05

n = 1.962 * 0.348 * (1 - 0.348) / 0.052

n = 0.8716 / 0.0025 = 348.657

n ≈ 349

The sample size is equal to 349 with 10% Non-response Rate sample size will be 384

Objective 2: For logistic regression estimated = 1100

Method: EPV rule-of-thumb based sample size estimation

EPV of 50 and formula; n = 100 + 50i (50 is integer and i represents number of independent variable in the final model)

For 20 independent variables (10 primary factors and 10 covariates) the formula gives us = 1100

Next we estimated effect size using G-power software: entered the following values: Probability of type I error (significance level) α = 0.05, power of the test taken as 1-β = 0.95, and sample size of 1100. Estimated ES = 0.11

Operational definition

The Robson's Ten Group Cesarean Classification System classifies all deliveries into one of the ten groups based on six variables (30)

Parity: Number of previous deliveries upon admission for delivery- Nullipara: No previous delivery/ Multipara At least one previous delivery.

Previous CS: Number of previous CS upon admission for delivery-None: All previous deliveries were vaginal/ One or more: At least one previous delivery by CS but may have one or more vaginal deliveries in addition.

Onset of labor: How labor and delivery started in the current pregnancy, regardless of how delivery was planned originally- Spontaneous: Prior to delivery, the woman was in spontaneous labor/ Induced: Upon admission to the labor ward, the woman was not in labor and was then induced/ Pre-labor CS Woman not in labor when admitted for delivery and a decision was taken to deliver by CS.

Number of fetuses: Number of fetuses upon admission for delivery-Singleton: One fetus/ Multiple: More than one fetus.

Gestational age: Gestational age upon admission for current delivery-Term 37 weeks or more/ Preterm Less than 37 weeks.

Fetal lie and presentation: The final fetal lie/presentation before a decision for delivery or before a diagnosis of labor is made- Cephalic: Fetal head is the presenting part/ Breech: Fetal buttocks or one foot or two feet are the presenting part/ Transverse or Oblique lie: Fetal long axis is perpendicular or oblique in relation to the mother´s long axis.

Fetal Viability is considered when birth weight ≥ 1000 g and gestational age ≥ 28 weeks.

Explanatory or background variables: Gestational Age (GA), onset of labor, Urgency of CS, birth weight, Non-Reassuring fetal heart rate pattern (NRFHRP), Meconium stained Amniotic fluid(MSL), IUGR with Doppler abnormality , Uterine scar, Dystocia (CPD/POP/, breech, abnormal lie, failed induction), Others/ pregnancy complications (Preeclampsia, Antepartum Hemorrhage)

Gestational Age (GA): The age of the pregnancy calculated from the first day of the last normal menstrual period (LMP).

Onset of labor: The onset of regular, painful uterine contractions that result in progressive effacement and dilation of the cervix.

Urgency of CS: The urgency of cesarean delivery is determined by the maternal and/or fetal condition that necessitates prompt delivery, and it ranges from immediate life-threatening emergencies to elective procedures

Birth weight: The first weight of the newborn obtained after birth.

Non-Reassuring fetal heart rate pattern (NRFHRP): Non-reassuring fetal heart rate patterns are those that suggest fetal hypoxemia, acidosis, or other compromise and require evaluation and possible intervention to prevent fetal injury.

Meconium stained Amniotic fluid (MSL): The presence of meconium in the amniotic fluid, which gives the fluid a greenish or yellowish discoloration.

Uterine Scar: A uterine scar is the area of the uterine wall that has healed following a prior surgical incision or injury to the uterus.

Abnormal Lie: Any fetal lie other than longitudinal

Breech Presentation: Breech presentation is one in which the fetal buttocks, with or without the feet, present at the maternal pelvic inlet.

Failed induction: Failed induction of labor is diagnosed when adequate uterine contractions cannot be achieved and the active phase of labor is not reached after an adequate attempt at induction.

Preeclampsia: Preeclampsia is a pregnancy-specific syndrome characterized by the new onset of hypertension and proteinuria, usually after 20 weeks of gestation.

Antepartum Hemorrhage: Bleeding from the genital tract occurring after fetal viability and before the onset of labor.

Cephalo-pelvic Disproportion (CPD): A condition in which the fetal head is of such a size, or the maternal pelvis of such dimensions, that vaginal delivery is unlikely or impossible.

Averse perinatal outcome (APO) is operationally defined as one of the following adverse neonatal outcomes: Birth weight < 1750gms, Apgar score 5th minute <7, Gestational age below 33 weeks, Perinatal mortality (Corresponds to a composite variable including intra-partum fetal death, or neonatal death within 24 hours of delivery), Neonatal Near Miss (Corresponds to a composite variable including birth weight below 1750 g, or 5th minute Apgar score <7, or gestational age below 33 weeks). (33, 37)

Maternal Preference for CS- Mother who are candidate for Trial of labor but Opted for CD.

Table 1. The Robson Classification with subdivisions (30)

(1) Nulliparous, singleton, cephalic, term (≥37+0 weeks) births in spontaneous labor;
(2) Nulliparous, singleton, cephalic, term births with (2a) induced labor or (2b) pre-labor caesarean section;
(3) Multiparous, singleton, cephalic, term births without previous caesarean section in spontaneous labor;
(4) Multiparous, singleton, cephalic, term births without previous caesarean section with (4a) induced labor or (4b) pre-labor caesarean section;
(5) Previous caesarean section, singleton, cephalic, term births;(5.1) With one previous CS , (5.2) With two or more previous CSs
(6) Nulliparous singleton breech births;
(7) Multiparous singleton breech births, including previous caesarean section;
(8) Multiple pregnancies, including previous caesarean section;
(9) Transverse and oblique lies, including previous caesarean section;
(10) Preterm (<37+0 weeks), singleton, cephalic births, including previous caesarean section.

Data collection tool

A systematic questionnaire and questionnaire checklist were used to gather data by looking through the client chart, log book, and electronic medical record. The English language was used to create the questionnaire. By examining various types of literature and earlier research of a similar nature, the questionnaire and checklists were modified. Maternal and perinatal outcomes and related complications are included in the second section of the tool, whereas the first section is used to evaluate the obstetric features of respondents. After explaining the informational sheet, the data collector obtained verbal agreement. If the mother consented to participate in the study and the data collector signed the consent form, secondary data collection was allowed to start. Every piece of information that may be used to identify participants was kept completely private. It was safeguarded in a password-protected computer that was safely secured in the researcher's personal cabinet to prevent unauthorized access, usage, alteration, theft, or loss.

Data collection procedure and quality control

Structured questionnaires were used to gather data, and logbooks, client charts, and electronic medical records were examined. One general practitioner, a supervisor from a different location outside the study site, and three midwives were enlisted to gather the data. For each questioner, the data collector received 50 Birr. Prior to data collection, supervisors and data collectors received one day of training on the purpose, advantages, and methods of data extraction. The questionnaire was pre-tested on ten percent of the sample before the actual data collecting began in order to guarantee the quality of the data. Following pre-testing, the data collection tool has undergone additional modifications to enhance the messages' comprehensibility, simplicity, and clarity.

Before, during, and after the data collection period, every questionnaire was examined for accuracy and completeness. Data collectors were monitored during the data collecting process, and the lead investigator and data collectors met on a regular basis to discuss concerns that arose during data gathering and errors discovered during editing. Prior to data entry, the gathered information was once more reviewed and verified for accuracy.

Data analysis and interpretation

Data entry, cleaning, and analysis was done using IBM SPSS Statistics version 26 after the accuracy and completeness of the data were confirmed. Both descriptive and inferential statistical methods were used. Descriptive statistics used to compile the socio demographic, obstetric, and clinical traits of research participants

Continuous variables were displayed as means and ranges, while frequencies and percentages were used to summarize categorical variables. The distribution of cesarean sections among groups was ascertained by classifying each birth using the Robson Ten Group Classification System (RTGCS).

For each Robson group, the following indices were computed:

1. Group size = Number of women in the group
2. Group CS rate (%) = (Number of CS in the group / Total deliveries in the group) × 100
3. Absolute contribution (%) = (Number of CS in the group / Total deliveries) × 100
4. Relative contribution (%) = (Number of CS in the group / Total CS) × 100

The overall and group-specific contributions of each Robson category to the overall cesarean section rate were measured by this formula.

The Robson group assessed also adverse perinatal outcomes (APO) and maternal morbidity for cesarean deliveries. HELLP syndrome, eclampsia, pulmonary edema, antepartum hemorrhage (APH), and hypertensive disorders of pregnancy (HDP) were among the maternal morbidities. NICU admission, birth weight <1750 g, stillbirth, early neonatal mortality, or a 5-minute Apgar score <7 were all considered components of the composite outcome known as APO.

APO rates and group-specific morbidity were compared using Fisher's exact test when cell counts were less than five or the Chi-square test (χ^2). 95% confidence intervals (CIs) and odds ratios (ORs) were used to summarize the associations.

Possible predictors of worse prenatal outcomes were found Using bivariate logistic regression,. Maternal age ≥35 years, parity, gestational age, hypertensive disorders, HDP with IUGR, severe maternal complications, timing of cesarean section, and residence were all independently put into the model. P-values and their accompanying 95% CIs were computed along with Crude Odds Ratios (CORs). Statistical significance was established at a p-value of less than 0.05. , variables with significant clinical relevance or p <0.25 in the bivariate analysis

were added to a multivariable logistic regression model account for potential confounders. The Adjusted Odds Ratios (AORs) with 95% CIs were calculated In order to determine independent predictors of unfavorable perinatal outcomes. To evaluate the model's fitness, Hosmer–Lemeshow goodness-of-fit test was used and variance inflation factor (VIF) was used to verify multicollinearity .

P <0.05, associations were considered statistically significant. While an OR <1 suggested a protective effect, an OR >1 indicated higher likelihood of APO. Confidence intervals that did not include 1 were considered significant.

Ethical Consideration

The researcher has taken into account the ethical guidelines that should be followed when carrying out the research. We ensured that the participants received the highest level of respect, their right to privacy, and the confidentiality of the data we collected. The Department Research and Publication Committee (DRPC) of Addis Ababa University's College of Health Sciences, Department of Obstetrics and Gynecology, granted ethical approval for the study, and the medical director of the respective hospital granted permission.

Before actually taking part in the study, potential participants were informed about its goals, methods, and expected benefits. They were also informed about their right to voluntary participation, their right to withdraw, the confidentiality of the data, and how to give their complete consent. The data collector signed verbal informed permission after obtaining participants' verbal consent, and we did not use any kind of coercion or enticement to urge participation in the study. The researcher stresses that participation is entirely voluntary and guarantees the participants' freedom to leave at any time without facing any repercussions.

To protect the confidentiality of the participants' identities in any report or publication, we have used anonymous codes rather than their personal information. Other than giving participants 15 minutes to get explanation about the study and provide informed consent to participate in the study, there were no known risks associated with the data collection process. Lastly, we made sure the work appropriately represented the study outcomes and was free of plagiarism or research misconduct during result communication.

Results

Study Population

The study included 1,100 deliveries in total. The vast majority of births were delivered at Gandhi Memorial Hospital (GMH) (712; 64.7%), followed by Zewditu Memorial Hospital (ZMH) (297; 27.0%) and Tikur Anbessa Specialized Hospital (TASH) (91; 8.3%). Maternal age ranged from 15 to 44 years, with a mean of 27.7 years. Of the participants, 972 (88.3%) were between the ages of 20 and 34, 78 (7.1%) were over 35, and 50 (4.5%) were under 20. Out of the women, 524 (47.6%) were nulliparous and 576 (52.4%) were multiparous. The majority of women (963; 87.5%) gave birth at term, while 137 (12.5%) delivered preterm. 88 (8.0%) of the preterm births were late preterm (34–36 weeks), and 49 (4.5%) were early preterm (less than 34 weeks). The majority of women (1,074; 97.6%) lived in Addis Ababa, while 26 (2.4%) were from nearby areas. In terms of antenatal care (ANC), 445 (40.5%) attended ANC at outside institutions, whereas 655 (59.5%) had their most recent ANC visit at the study health facilities.

Table 2. Maternal Sociodemographic and Obstetric Characteristics of Study Participants

Variable	Frequency (n)	Percent (%)
Maternal age (years)		
15–19	50	4.5
20–34	972	88.3
≥35	78	7.1
Parity		
Nulliparous	394	35.8
Primiparous	339	30.8
Multiparous	367	33.4

Number of fetuses		
Singleton	1057	96.1
Multiple	43	3.9
Presentation		
Cephalic	1018	92.5
Breech	77	7.0
Transverse/oblique	5	0.5
Gestational age		
Preterm (<37 wks)	137	12.4
Term (≥37 wks)	963	87.6

Robson Group 1: Nulliparous, Term, Singleton, Cephalic, Spontaneous Labor

There were 251 women in total. The majority lived in Addis Ababa (245; 97.6%), and all were nulliparous. Maternal ages ranged from 18 to 34, with a mean of 26. At delivery, the average gestational age was 39.6 weeks. Meconium-stained amniotic fluid, persistent tachycardia and suspected fetal distress were the main reasons for the 107 (42.6%) caesarean deliveries. There were 15 cases of maternal morbidity (14.0%), primarily hypertensive disorders (13; 13.1%) and antepartum hemorrhage (2; 3.7%) . There were no stillbirths, two (1.9%) early neonatal deaths, and nine (9.3%) NICU admissions, one (0.9%) low 5-min Apgar, and ten (10.3%) composite adverse perinatal outcomes, indicating overall positive perinatal outcomes.

Robson Group 2: Nulliparous, Term, Singleton, Cephalic, Induced or Pre-labor Cesarean

Included were 96 nulliparous women, the majority of whom lived in Addis Ababa (90; 93.8%). The average gestational age was 39.2 weeks, and the average maternal age was 27 years (range: 19–35). The CS rate was 60 (62.5%) overall. 43 (54.4%) CS were reported in Group 2A (induced labor, n=79), primarily for Failed induction 19 women(44.2%) and fetal distress12 women (28%) . Ten cases (12.7%) had maternal morbidity, and six cases (7.6%) had adverse perinatal outcomes. There were 16 (100%) CS for high-risk indications (placental abruption, IUGR with complications, and severe maternal diseases) in Group 2B (pre-labor CS, n=16). Negative perinatal outcomes were 4 (25.0%) and maternal morbidity was 8 (50.0%).

Robson Group 3: Multiparous, Term, Singleton, Cephalic, Spontaneous Labor

There were 272 women in total. Age distribution: ≥35 years old (23; 8.5%), 15–19 years old (3; 1.1%), and 20–34 years old (246; 90.4%). Addis Ababa was home to the majority (265; 97.4%). Parity: ≥5 (6; 2.2%), 2–4 deliveries (99; 36.4%), and 1 prior delivery (136; 50%). Preterm 37–38 weeks (59; 21.7%), full term 39–40 weeks (137; 50.4%), and late term 41 weeks (64; 23.5%) are the gestational ages. 53 (19.5%) had CS, primarily due to fetal distress. Maternal morbidity: 6 (11.3%), primarily antepartum hemorrhage (1; 1.9%) and hypertensive disorders (4; 7.5%). Perinatal outcomes include one (1.9%) early neonatal death and one (1.9%) Intrapartum stillbirth.

Robson Group 4: Multiparous, Term, Singleton, Cephalic, Induced or Pre-labor Cesarean

79 women across all categories were involved. Maternal age range: 21–38 years, with a mean of 29. The majority (75; 94.9%) were residents of Addis Ababa. In group 4a (induced labor, n=57), there were 11 (19.3%) CS, primarily due to unsuccessful induction (5; 45.5%) and fetal distress (4; 36.4%) . There were eight cases of maternal morbidity (72.7%). Perinatal outcomes include two composite adverse perinatal outcomes (18.2%), one NICU admission (9.1%), and no deaths. Group 4b (pre-labor CS, n=21) had CS (100%): for high-risk indications; 11 cases of maternal morbidity (52.4%), 5 NICU admission (23.8%), and 5 composite adverse perinatal outcomes (23.8%).

Robson Group 5: Previous Cesarean, Singleton, Cephalic, ≥37 Weeks

There were 201 women in total. 20–34 years old (163; 81%) with a mean age of 30. 198 (98.5%) are residents of Addis Ababa. Parity 1 (82; 41%), 2–4 (100; 49.7%) and ≥5 (19; 9.5%). CS was done for 182 (90.5%) and 19 (42.2%) of the 45 TOLAC attempts were successful. There was 35 (19.2%) maternal morbidity, primarily hypertensive diseases (31; 15.4%). Perinatal outcomes: 1 (0.5%) stillbirth, 2 (1.0%) antepartum IUFD, 13 (7.1%) NICU Admission, and 20 (11%), composite adverse perinatal outcomes.

Robson Group 6: Nulliparous, Singleton, Breech

There were 24 women in all. Mean age of 25.5, ages 23–28 on average. 22 (91.7%) are residents of Addis Ababa. CS was done for 21 (87.5%) mothers, Intrapartum 6 (28.6%), and pre-labor 15 (71.4%). Maternal Morbidity was seen in 7(33.3%) cases. Perinatal outcome; 3 (12.5%) early neonatal deaths, 9(37.5%) NICU admissions and 10 (41.7%) composite adverse perinatal outcomes were the neonatal outcomes.

Robson Group 7: Multiparous, Singleton, Breech

There were thirty-three women in all. Maternal age on average: 29 years (21–39). All inhabitants of Addis Ababa. The parity was 2–3 in 27 (81.8%). CS was done for 26 (78.8%), 10 (30.3%) Intrapartum, and 16 (48.5%) pre-labor. The maternal morbidity occurs in 4(12.1%) mothers. Perinatal outcomes: 3 (9.1%) NICU Admission and 3 (9.1%) composite adverse perinatal outcomes.

Robson Group 8: Multiple Pregnancies

Included were 37 women in all. The average mother is 29.6 years old (20–37). Resident of Addis Ababa was 36 (97.3%). Parity;1 (10; 27.0%), 0 (6; 16.0%), and 2–4 (20; 54.0%). Mean birth weight of 2400 g (range: 1600–3100) and 4 (10.8%) were under 1750 g. CS was done for 30 (81.1%), and 18 (48.6%) pre-labor, and 12 (32.4%) Intrapartum CS. Maternal morbidity 7 (18.9%). Perinatal outcome: 10 (27.0%) NICU admission and 11 (29.7%) composite adverse outcomes.

Robson Group 9: Transverse or Oblique Lie

Five women in all, with an average age of 29, were included. All resident of Addis Ababa. CS was done for 5 (100%) mothers. Pre-labor 4 (80%), Intrapartum 1 (20%). No maternal Morbidity. Perinatal outcome: 1 (20.0%) low Apgar; no early neonatal deaths or stillbirths.

Robson Group 10: Preterm Cephalic

There were 102 women in all. Mothers are 28.5 years old on average. CS was done for 50 (49.0%) mothers. Pre-labor: 32 (64.0%), Intrapartum: 18 (36.0%). 34.2 weeks is the mean gestational age (28–36). 11 (22.0%) were under 1750 g, with a mean birth weight of 2342 g (1000–3000). Maternal morbidity occurred in 34 (68.0%) mothers, primarily hypertensive

disorders (23; 46.0%) and antepartum hemorrhage (13; 26.0%). Perinatal outcomes included 28 (56.0%) NICU admissions,1 (2.0%) stillbirth, and 28 (56.0%) composite adverse outcomes.

Cesarean Section Profile

566 (51.5%) of the 1,100 deliveries were caesarean sections. Group 5 (prior CS) is the largest contributor, making up 32.2% of all caesarean sections, suggesting a high frequency of repeat CS. Together, Groups 1 and 2 (nulliparous, term, and cephalic) make up about 30% of all CS. In line with established obstetric practice, groups 6, 7, 8, and 9 (breech, multiple, or Abnormal lie) exhibit suitably high CS rates (80–100%). In keeping with the difficulties of preterm care, Group 10 (preterm, cephalic) again exhibits a comparatively high CS rate (49%).

Table 3: Robson group distribution and contribution to overall CS

Robson Group	Deliveries	CS Count	CS Rate (%)	Absolute Contribution (%)	Relative Contribution (%)
G1(Nulliparas, single, cephalic, ≥37 wks, spontaneous labor)	251	107	42.6	9.7	18.9
G2 (Nulliparas, single, cephalic, ≥37 wks, induced or CS before labor)	96	60	62.5	5.5	10.6
G3 (Multiparas, single, cephalic, ≥37 wks, spontaneous labor)	272	53	19.5	4.8	9.4

G4 (Multiparas, single, cephalic, ≥37 wks, induced or CS before labor)	79	32	40.5	2.9	5.7
G5 (Previous CS, single, cephalic, ≥37 wks)	201	182	90.5	16.5	32.2
G6 (All nulliparas, single breech)	24	21	87.5	1.9	3.7
G7 (All multiparas, single breech)	33	26	78.8	2.4	4.6
G8 (Multiple pregnancies)	37	30	81.1	2.7	5.3
G9 (All abnormal lies transverse/oblique)	5	5	100.0	0.5	0.9
G10 (All single cephalic, <37wks - preterm)	102	50	49	4.5	8.8

Indications for Cesarean Section

Prior caesarean section was the most frequent indication for caesarean birth (176, 31.0%).Non-reassuring fetal heart rate pattern (109 cases, 19.2%), Obstructed labor and Cephalopelvic disproportion (81 cases, 14.3%) and hypertensive disorders of pregnancy with intrauterine growth restriction (72 cases, 12.8%) were among the other main indications.

Table 4: Indications for cesarean section

Indication	N	% (of all CS)
Fetal	331	58.5
Maternal	106	18.7
Both fetal & maternal	105	18.6
Maternal preference	24	4.2

Maternal morbidity and adverse perinatal outcomes (APO) were examined in women who had caesarean births since these outcomes show the combined burden of hazards on both mothers and babies. Robson group presents the results to show group-specific differences.

Maternal Morbidity

146(25.8%) was the overall maternal morbidity rate. Group 10 had the highest percentages (68%) followed by Group 4 (55.9%) and Group 6 (33.3%). HDP 115 (78.7%), APH 34 (23.2%), HDP+IUGR 24 (16.4%), HELLP/Eclampsia 13 (8.9%), and PAS 1 (0.68%) were among the frequent consequences.

Table 5: Maternal morbidity by Robson group

Robson Group	Total Cases	Maternal Morbidity (No)	Maternal Morbidity (Yes)	Morbidity %
G1	109	93	16	14.7%
G2	60	42	18	30.0%
G3	56	50	6	10.7%
G4	34	15	19	55.9%
G5	184	149	35	19.0%
G6	21	14	7	33.3%
G7	26	22	4	15.4%
G8	30	23	7	23.3%
G9	5	5	0	0.0%
G10	50	16	34	68.0%

Table 6: Types of maternal complications

Group	HDP (n, %)	HDP+IUGR (n, %)	HELLP/Eclampsia (n, %)	APH (n, %)	Placenta accreta (n, %)
G1	14 (13.1%)	2 (1.9%)	0 (0.0%)	4 (3.7%)	0 (0.0%)
G2	16 (26.7%)	4 (6.7%)	1 (1.7%)	4 (6.7%)	0 (0.0%)
G3	4 (7.5%)	2 (3.8%)	0 (0.0%)	1 (1.9%)	0 (0.0%)
G4	12 (37.5%)	3 (9.4%)	1 (3.1%)	5 (15.6%)	0 (0.0%)
G5	31 (17.0%)	3 (1.6%)	1 (0.5%)	4 (2.2%)	1 (0.5%)
G6	6 (28.6%)	2 (9.5%)	2 (9.5%)	0 (0.0%)	0 (0.0%)
G7	3 (11.5%)	1 (3.8%)	0 (0.0%)	2 (7.7%)	0 (0.0%)
G8	6 (20.0%)	0 (0.0%)	0 (0.0%)	1 (3.3%)	0 (0.0%)
G9	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
G10	23 (46.0%)	7 (14.0%)	5 (10.0%)	13 (26.0%)	0 (0.0%)

There was a 25.8% overall maternal morbidity rate among caesarean deliveries. The highest rate (68.0%) was seen in Group 10 (preterm cephalic), which was followed by Group 4 (56.2%) and Group 6 (33.3%). Group 1 (14.0%) and Group 3 (11.3%) had the lowest rates. Although there were no cases of maternal illness in Group 9 (abnormal lie), the sample size was somewhat small (n=5). These results suggest that the maternal risk is especially significant for breech presentations, inductions, and premature deliveries.

Adverse Perinatal Outcomes (APO)

A total of 109(19.3%) of newborns experienced adverse perinatal outcomes. Groups 10 (56.0%) ,6 (47.6%), and 8 (36.7%) had the greatest percentages. The APOs of Groups 1 (10.3%) and 5 (11.0%) were considerably lower. The most common adverse outcomes were NICU admission (15.9%), advanced neonatal resuscitation (6.1%), Birth Weight <1750gm (3.5%) and low Apgar score at 5 minutes (2.1%)

Table 7: Adverse perinatal outcomes (overall)

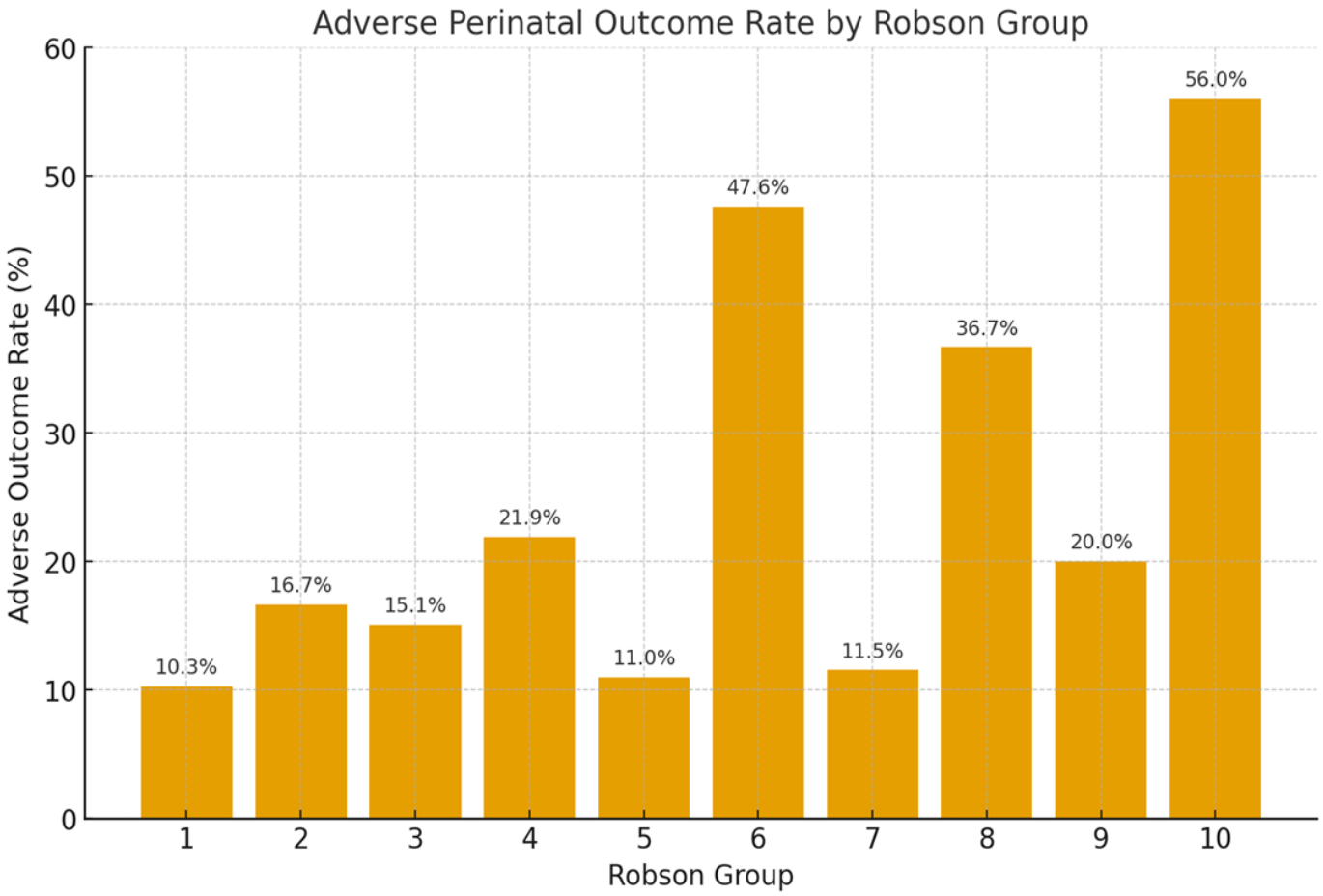
Outcome	N	%
NICU admission	90	15.9
Advanced resuscitation	35	6.1
Birth Weight <1750gm	20	3.5
Stillbirth (antepartum + intrapartum)	4	0.7
Early neonatal death	6	1
APGAR 1 min <7	12	2.1
APGAR 5 min <7	6	1
Adverse perinatal outcome	109	19.25

Table 8: Adverse perinatal outcomes by Robson group

Robson Group	Total CS deliveries (with data)	Adverse Perinatal outcomes (no)	Adverse Perinatal outcomes (Yes)	Adverse outcome rate (%)
G1	107	96	11	10.3%
G2	60	50	10	16.7%
G3	53	45	8	15.1%
G4	32	25	7	21.9%
G5	182	162	20	11.0%
G6	21	11	10	47.6%
G7	26	23	3	11.5%
G8	30	19	11	36.7%
G9	5	4	1	20.0%
G10	50	22	28	56.0%

According to this study, adverse perinatal outcome was linked to almost 1 in 5 caesarean deliveries (19.3%). The effects of prematurity, malpresentation, and multiple gestations were reflected in the greatest risk groups, which were Group 10 (preterm cephalic, 56.0%), Group 6 (nulliparous breech, 47.6%), and Group 8 (multiple pregnancies, 36.7%). On the other hand, Groups 1 (10.3%) and 5 (11.0%) had the lowest APO rates

Figure 1: Adverse perinatal outcome rate By Robson Group



All things considered, these results underscore the need for focused perinatal treatment approaches in these high-risk groups by highlighting the disproportionate burden of poor newborn outcomes among preterm, breech, and multiple pregnancies.

Table 9: Adverse perinatal outcomes by Robson group to Overall analysis

Robson Group	N (CS)	APO rate (%)	OR vs Overall	95% CI	Interpretation
G1	107	10.3%	0.48	0.26 – 0.90	Significantly

					lower risk
G2	60	16.7%	0.84	0.43 – 1.65	Similar to overall
G3	53	15.1%	0.75	0.35 – 1.58	Similar to overall
G4	32	21.9%	1.17	0.51 – 2.71	Similar to overall
G5	182	11.0%	0.52	0.33 – 0.82	Significantly lower risk
G6	21	47.6%	3.81	1.62 – 8.97	Significantly higher risk
G7	26	11.5%	0.55	0.16 – 1.82	Similar to overall
G8	30	36.7%	2.43	1.16 – 5.10	Significantly higher risk
G9	5	20.0%	1.05	0.12 – 9.38	Wide CI, not significant
G10	50	56.0%	5.34	3.05 – 9.33	Significantly higher risk

Robson group analysis showed higher odds of APO in Groups 6, 8, and 10, while Groups 1 and 5 had significantly lower odds.

Combined Adverse Outcomes

In total, 2.9% of cases had both poor perinatal outcomes and maternal morbidity. Group 10 exhibited the greatest overlap (8.2%), with Group 6 falling in second (2.3%).

Table 10: Combined maternal morbidity and adverse perinatal outcomes

Robson Group	No Maternal Morbidity /APO	Maternal Morbidity +APO	Maternal Morbidity only	APO only
G1	82	1	14	10
G2	36	4	14	6
G3	41	2	4	6
G4	12	5	13	2
G5	133	6	29	14
G6	9	5	2	5
G7	19	0	4	3
G8	14	2	5	9
G9	—	—	—	—
G10	9	21	13	7

Women with maternal morbidity had significantly higher risk of APO compared to those without morbidity (OR 2.67, 95% CI 1.84–3.88, $p < 0.001$), confirming a strong relationship between maternal complications and neonatal compromise.

Bivariate Analysis

Crude logistic regression showed that the following were significantly associated with APO: Gestational age (per week) protective (COR 0.79, 95% CI 0.72–0.87, $p < 0.001$), HDP with IUGR increased risk (COR 5.81, 95% CI 2.90–11.64, $p < 0.001$), Hypertensive disorders (any) (COR 2.11, 95% CI 1.21–3.67, $p = 0.007$), CS timing (pre-labor vs intrapartum) higher risk (COR 1.95, 95% CI 1.18–3.21, $p = 0.01$), severe maternal complications (HELLP, eclampsia, pulmonary edema) higher risk (COR 2.94, 95% CI 1.07–8.08, $p = 0.04$), and residence outside Addis Ababa higher risk (COR 3.82, 95% CI 1.36–7.22, $p = 0.01$).

Table 11: Bivariate logistic regression analysis of predictors of APO

Predictor	COR	95% CI	p-value
Maternal age ≥35 years	1.42	0.78–2.57	0.25
Multiparity	0.89	0.55–1.44	0.62
Gestational age (per week)	0.79	0.72–0.87	<0.001*
Hypertensive disorders (any)	2.11	1.21–3.67	0.007*
HDP with IUGR	5.81	2.90–11.64	<0.001*
Severe maternal complications (HELLP, eclampsia, pulmonary edema)	2.94	1.07–8.08	0.04*
CS timing (pre-labor vs. intrapartum)	1.95	1.18–3.21	0.01*
Residence outside Addis Ababa	3.82	1.36–7.22	0.01*

Multivariable Analysis

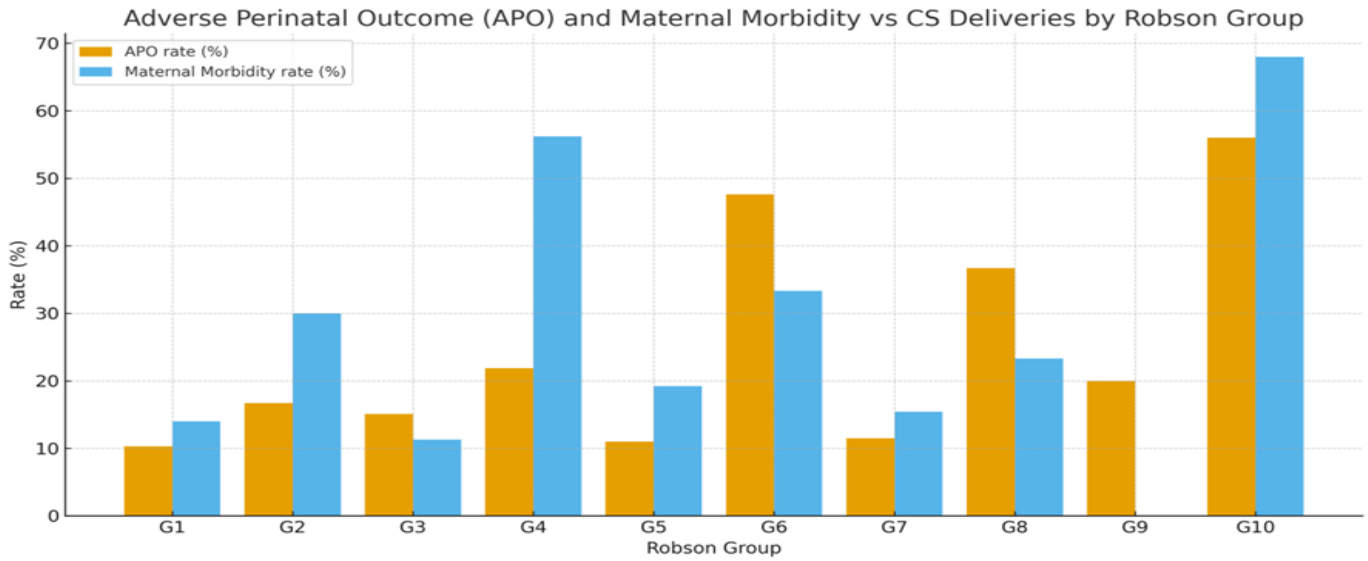
After adjusting for confounders, three variables remained independent predictors of APO: Gestational age (AOR 0.83, 95% CI 0.75–0.92, $p < 0.001$), HDP with IUGR (AOR 6.19, 95% CI 2.34–16.38, $p < 0.001$), and residence outside Addis Ababa (AOR 4.51, 95% CI 1.35–15.07, $p = 0.02$). Hypertensive disorders, CS timing and severe maternal complications were significant only in bivariate analysis. Maternal age and parity were not significant predictors.

Table 12: Multivariable logistic regression analysis of predictors of APO

Predictor	AOR	95% CI	p-value
Maternal age ≥35 years	1.21	0.61–2.39	0.59
Multiparity	0.94	0.57–1.55	0.82
Gestational age (per week)	0.83	0.75–0.92	<0.001*
Hypertensive disorders (any)	1.26	0.74–2.15	0.40
HDP with IUGR	6.19	2.34–16.38	<0.001*
Severe maternal complications (HELLP, eclampsia, pulmonary edema)	2.37	0.61–9.20	0.2
CS timing (pre-labor vs. intrapartum)	1.27	0.74–2.19	0.39
Residence outside Addis Ababa	4.51	1.35–15.07	0.02*

Taken together, these findings indicate that adverse outcomes are not directly linked to the frequency of cesarean section itself but are primarily driven by obstetric risk factors.

Figure2: Comparison of adverse perinatal outcomes and maternal morbidity rates across Robson groups



Discussion

This prospective study evaluated cesarean section (CS) births in referral hospitals using the Robson Ten group classification and also assed maternal morbidity and adverse perinatal outcomes (APO for Cesarean deliveries. 566 (51.5%) of the 1,100 births were cesarean sections, which is consistent with the growing CS rates in many low- and middle-income nations. Group 5 (prior CS), Group 1 (nulliparous, term cephalic, spontaneous labor), and Group 2 (nulliparous with induction or pre-labor CS) were the Robson groups that contributed the most of Cesarean deliveries.

Group 1+2 (nulliparous, term, and cephalic) accounted for almost one-third of births compared to the Robsons group. These groups account high CS rates (42.6% in Group 1 and 62.5% in Group 2). These values above WHO guidelines and indicate excessive usage of CS in low-risk nulliparas. To reduce unnecessary CS, experts advise concentrating audits and interventions on these nulliparous groups (2). The Robson method allows identification of target groups where actions aiming at reducing CS rates will be most effective according to Akadri et al.

A comparable percentage (32%) was made up of multiparas without prior CS (Robson Groups 3 and 4). As anticipated for this low-risk grouping, Group 3 (spontaneous labor multiparas) had a comparatively low CS rate (19.5%). In contrast, the CS rate for Group 4 (induced or pre-labor multiparas) was much higher (40.5%), indicating that labor induction significantly increased the number of surgical births in multiparous women. According to published audits (such as those conducted in Ethiopian hospitals), Group 4 exhibits a significant increase in CS when inductions are carried out intensely, while Group 3 likely to contribute less to the CS caseload. These results support WHO's belief that primary CS in multiparas or needless inductions can increase CS rates without enhancing results.

A significant portion of CS in our study was accounted for by Group 5 (multiparas with a prior CS); 182 CS (90.5% CS rate) were present in 201 women (18.3% of all births). This is consistent with global experience, since multiple studies show that Group 5 is the main cause of high hospital CS rates. According to Tura et al. (Ethiopia), Group 5 made a disproportionately large contribution to their total CS (27). Similarly, if VBAC is not encouraged, growing prior-CS populations result in increasing CS burdens, according to Vogel et al. (WHO multi-country analysis) (29). Therefore, while our result of an almost universal CS in Group 5 is in line with

these reports, it differs from WHO and FIGO guidelines, which promote safe VBAC in order to prevent the "cascade" of repeat procedures.

As anticipated, abnormal presentations and multiple gestations (Groups 6–9) also displayed extremely high CS rates. Twins/triplets (G8) had an 81.1% CS, multiparous breech (G7) a 78.8% CS, nulliparous breech (G6) an 87.5% CS, and all malpresentations (G9) a 100% CS. These findings are consistent with global practice, which states that CS delivers the majority of breech pregnancies in various settings, particularly in nulliparas. Previous audits from Tanzania and Ethiopia also show that >80% of breech groups had CS, which is indicative of the difficulty of vaginal breech birth and the propensity for surgery. Our nearly universal CS in groups 6–9 is consistent with other published findings, as WHO expert evaluations recognize that these groups naturally have a high CS incidence (23).

With a CS rate of 49.0%, Group 10 (all preterm cephalic) accounted for 9.3% of our births (102 women). This indicates a low threshold for CS in preterm instances and is higher than what might be observed if many preterm labors were permitted to progress vaginally. Although WHO guidelines suggest that preterm newborns should be handled to minimize perinatal risk, global data do not identify a "ideal" Group 10 CS rate. Zwart et al. (based on WHO data) and others have noted that preterm fetuses frequently result in more interventions, and our over 50% CS rate in preterm is commensurate with tertiary care populations. It might also indicate that CS had to deliver the baby early due to serious maternal/fetal problems (such as IUGR or preeclampsia).

Adverse outcomes were not correlated with total CS rates and differed significantly between groups. Maternal morbidity was seen in 25.7% of CS births, whereas APO occurred in 19.3%. Group 10 (preterm cephalic) had the highest burden, with two-thirds of mothers developing morbidity and almost half of neonates experiencing APO. Groups 6 (nulliparous with breech) and 8 (multiple pregnancies) similarly displayed extremely high neonatal risk lining with global data indicating malpresentation and twin pregnancies are significant causes of poor perinatal outcomes.(36)

Maternal morbidity was seen in Group 10 (preterm cephalic) which had the greatest contribution (68.0%), followed by Group 4 (56.2%) and Group 6 (33.3%). The lowest rates were found in Group 1 (14.0%) and Group 3 (11.3%). These findings imply that mothers are more at risk in groups with preterm births, inductions, and breech presentations.

While induction and pre-labor CS (Groups 2 and 4) were linked to increase APO, Groups

1–4 displayed moderate CS rates and comparatively less unfavorable effects. The need for targeted audits on repeat CS is indicated by Group 5's moderate morbidity and APO, despite their biggest share of CS contributions. Group 7 (multiparous breech) fared better than Group 6 (nulliparous breech), which had a relatively high APO burden. Because of prematurity, Group 8 (multiple pregnancies) had a high APO. CS was done for all mothers in Group 9 (abnormal lie) with no maternal morbidity

The combined results demonstrate that risk is not directly correlated with the overall CS rate, but rather varies by group-specific factors. Together, these findings demonstrate that maternal morbidity and neonatal adverse outcomes are disproportionately prevalent in some Robson groups. While Groups 6, 8, and 10 had the highest rates of unfavorable perinatal outcomes, Groups 4 and 10 had the highest rates of maternal morbidity.

Given that underlying obstetric risk factors had a larger impact on adverse outcomes than cesarean delivery rates alone, these findings underscore the need for targeted interventions for high-risk groups. And this study highlights the overall surgical rate has less of an impact on cesarean section outcomes than clinical and demographic risk factors. Better perinatal outcomes are not necessarily correlated with high CS usage; this is mostly dependent on the group's preexisting risk.

According to Tognon et al. (2019), maternal outcomes in Tanzania were not improved by merely raising CS among low-risk mothers. Similarly, the WHO's focus on the 10% rule is based on data showing that maternal mortality plateaus after a sharp decline up to roughly 10–15% CS. The very high CSR did not seem to reduce obstetric problems, and our data support that finding. It may even indicate an excess of iatrogenic risk. The Robson classification can assist in auditing these non-CS results by group, as suggested by Savchenko et al. In reality, a large portion of the repeat-surgery morbidity was probably caused by our Group 5 patients (previous CS). (23)

Gestational age, hypertensive disorders of pregnancy (HDP) with intrauterine growth restriction (IUGR), and living outside of Addis Ababa were found to be significant independent predictors of APO by regression analysis. The odds of APO decreased by 17% for every extra week of gestation, highlighting prematurity as a major factor in neonatal survival. Mothers who had HDP with IUGR were six times more likely to have APO. The risk of APO was four to five times higher for women, most likely as a result of referral delays.

The decision to perform a cesarean before or during labor is frequently complicated by underlying maternal or fetal risk factors, as evidenced by the fact that the multivariable model did not support the association between HDP, cesarean timing (pre-labor vs. intrapartum), and APO that was suggested by crude analysis. Although severe maternal complications (eclampsia, pulmonary edema, and HELLP syndrome) also shown increased crude risk, adjusted analysis revealed that the severity of hypertensive disease, not the cesarean section, is primarily responsible for their influence on newborn outcomes.

Conclusion

According to this study's use of Robson's Ten Group Classification, certain groups are disproportionately responsible for both CS deliveries and unfavorable perinatal outcomes. To lessen these difficulties, targeted approaches emphasizing improved preterm care, VBAC promotion, and primary avoidance of CS are crucial. The results support the usefulness of Robson classification in guiding more comprehensive perinatal health policies and treatments as well as in auditing CS rates. These results support the widespread data that outcome is not only determined by CS rate. Therefore, clinical and demographic risk variables have a greater influence on cesarean section outcomes than the overall CS rate.

Recommendations

strengthening the management of hypertension diseases during pregnancy, detecting them early, and acting quickly will improve the health systems of expectant mothers and newborns. Preventing preterm births and improving neonatal care capabilities should be the main priorities. Improved referral systems are required to provide continuity of care for mothers residing outside of Addis Ababa. Standardized protocols are crucial for handling breech and multiple pregnancies. Monitoring and assessment will be enhanced by bolstering data collection using the Robson categorization as a standard audit tool. Furthermore, carrying out targeted research and prospective multicenter studies on the management of hypertension disorders and preterm birth would yield data to direct future interventions in Ethiopia and comparable contexts.

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Annex I: Information Sheet and informed consent

Dear Madam: Hello my name is----------. I am working as data collector for the study being conducted in this hospital by Dr. Berhan Habtom who is studying for specialty of Obstetrics and Gynecology at Addis Ababa University, College of health sciences. I kindly request you to give me your attention to explain about the study and you being selected as study participant. Taking part in the research or not is entirely your choice. There will be no impact on the services you receive.

The study title: Cesarean section prevalence and relationships with adverse perinatal outcomes among Robinson's ten groups of women

Importance and purpose of the study: The finding of this study will have paramount importance for knowing the Cesarean section prevalence and relationship with adverse perinatal outcomes based on the Robinson's ten groups classification system and to recommend possible interventions based on the findings. Moreover, the aim of this study is to write a research paper as a partial requirement for the fulfillment of a specialty program of Obstetrics and gynecology for the principal investigator.

Procedure and duration: Data will be extracted from your clinical records and there will be no interview. I will take not more than 10min of your time. I don't envisage any negative consequences for you in taking part. Participating in the study will not benefit you directly, but we hope to learn things that will benefit others.

Confidentiality: The data you will provide will be confidential. There will be no information that will identify you. The finding of the study will be general for study population and will not reflect anything particular of individual person. The questioner will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants to the research

The results will be presented in the thesis. They will be seen by my supervisors, and the Department of Research and Publication Committee (DRPC). The thesis may be read by future students on the course. The study may be published in a research journal.

Are you willing to participate in the study? 1- Yes------Continue to Next part (Data collection)

2. No …….Skip to Next Participant

Data Collector Name: ……..

Signature: ……

If you need any further information, you can contact me: [Dr. Berhan Habtom, 0929050770, berhanhabtom16@gmail.com

Annex II: Data Collection tool

Data Collection: Date and Start Time	
Hospital Name/Code	
Case Card Number	

Part 1 to 4 data should be filled for all deliveries, while data on part 5 and 7 are only for sub-sample of women who gave birth by Cesarean Section

Part I: Epidemiological And obstetric Characteristics of the study population

Variable	Response Options	Response	Codebook
Maternal Age	Age in Complete Year		
Maternal Age group	15-19		
	20-34		
	35and above		
Residence	Addis Ababa		
	Around AA		
	Other regions		
Gravidity	1 to any		

Parity	0		
	1		
	2-4		
	5 and above		
Abortion	0		
	1-2		
	>2		
Ectopic	0/1/2		
Current Pregnancy			
ANC place of last visit	Study health facility		
	Not in Study health facility		
GA at birth in Weeks & Days	28 Weeks and Above		Use Point between weeks & days e.g. 35.5
GA at birth in Completed Weeks	28wks and above		Fill only Weeks
GA at birth	Pre-Viable		1,2,3,4,5,6,7
	Early Preterm		
	Late Preterm		
	Early Term		
	Full Term		
	Late Term		
	Post Term		

Exclude if GA is <28weeks

Part II: Classification and sub-sample sector variable

Variables	Response choice	Response	Code book
II.A Robinsons grouping variables			
Parity	Nulliparous		1, 2
	Multiparous		
GA at birth 37	GA>= 37 or GA <37		1,2
Number of Fetuses	Single		1,2
	Multiple		
Presentation/lie(T1)	Cephalic		1,2,3
	Breech		
	Transverse or Oblique lie		
Previous Cesarean Section for Multiparous	0		0,1,2,3(for Multiparous only) or 999 for nulliparous)
	1		
	2		
	>=3		
Onset of Labor	Induction		1,2,3
	Spontaneous		
	Pre-Labor CS		
IIB. Sub-sample sector			
Mode of Delivery	SVD		1,2,3,4,5

	Instrumental		
	Assisted breech delivery		
	Laparotomy		
	CS		

Exclude subject if No data on any of the above variables is missed

Part III Previous 1 CS cases study variables

Variable	Response Choices	Response	Coding
Onset Of Labor	Pre-labor elective CS-indicated		1,2,3,4
	Opted for elective CS		
	Opted for TOLAC-Spontaneous		
	Intention unknown		
Mode of Delivery for 1previous CS Cases by plan			
Intension TOLAC	Vaginal Successful/CS for Failed TOLAC		1/0
Planned indicated Elective CS	CS/Vaginal/Laparotomy		
Opted for Elective CS	CS/Vaginal/Laparotomy		1,2,3
Intention Unknown	CS/Vaginal/Laparotomy		

Part IV. Robson's CS Group Population Category

Assign a group to this case based on the algorism also if appropriate assign a sub-group

Variables	Response Option	Response	Codebook
RGTS Group	R1 to R10		Numbers only
RGT Sub-group	Various		Use point format
Was the mode of delivery CS	Yes/No		1,0

Continue with additional data collection for women who gave birth by CS: For Perinatal Outcome Study

Part V: Cesarean Section Indication

variables	Response Option	Response	Code
CS timing	Pre-Labor CS		1,0
	Intrapartum CS		
Indication for CS	As written in EMR		
	Category per ICD 9 &10		Recode in to four categories
	Category as per ACOG		
Indication for CS F/M	Fetal		1,2,3,4
	Maternal		
	Maternal Preference		
	Combined		

Indication for previous 1 CS Scar	Previous 1 CS Scar Indicated		1,2,3
	Previous 1 CS Scar - Opted		
	Previous 1 CS Scar – Failed TOLAC		

Part VI Covariates

Variables	Response	Response	Codebook
HDP any	Yes/No		Yes=1, No=0
HDP with IUGR	Yes/No		
HEELP/Pulmonary Edema/Eclampsia	Yes/No		
APH without HDP	Yes/No		
Placenta accrete Spectrum	Yes/No		
Chorioamnionites	Yes/No		
Sever Maternal Morbidity Composite	Yes/No		
Medical Illness(specify)	Yes/No		

Severe Maternal Morbidity includes any of variables in the list

Part VII Neonatal Outcome Variables

Outcome Variables	Response	Response	Codebook
Birth Weight actual in grams	In grams		4 digit Continuous
APGAR Score -1st min	Number 1-10		Digit Continuous
APGAR Score -5th min	Number 1-10		
Still Birth	Yes/No		Yes=1, No= 0
Birth Weight -<1750	Yes/No		
<7 APGAR at 5th Min	Yes/No		
Advanced neonatal resuscitation	Yes/No		
NICU Admission	Yes/No		
Intrapartum Still birth	Yes/No		
Early Neonatal Death	Yes/No		
Adverse Perinatal outcome Composite*	Yes/No		
Control Variables			
Sex	Male/Female		Female=1, Male=0

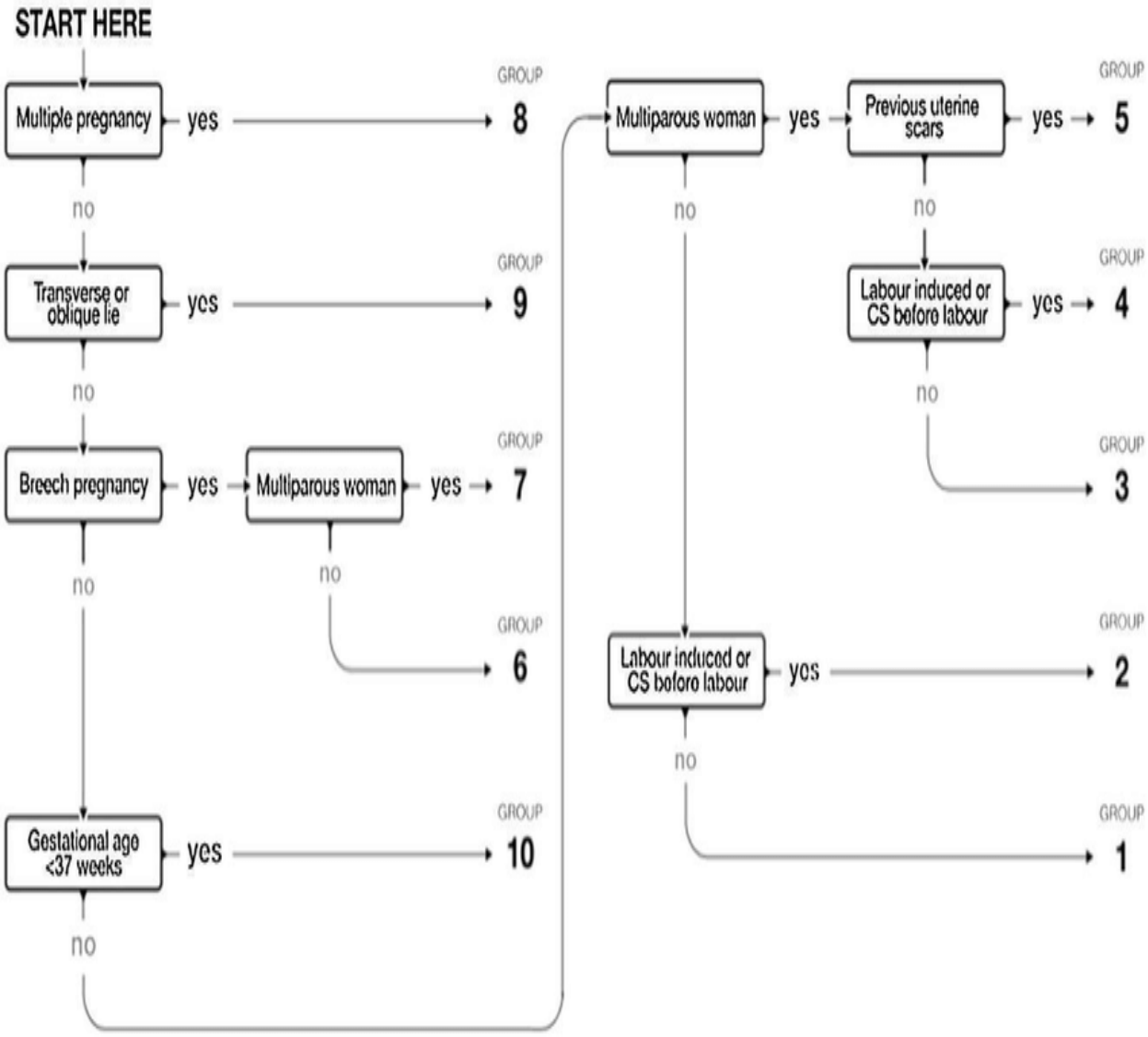
IUFD Antepartum	Yes/No		Yes=1, No=0
Congenital Anomaly	Yes/No		
Early preterm birth 37-38	Yes/No		

*= Includes intrapartum still birth or neonatal death, admission to a neonatal unit, resuscitation, requiring drug and /or intubation or an APGAR score <7 at 5 min, or birth weight <1750.

Data Collection Verifications

Variables	Response
Data collection End period	Date: Time:
Data collector Name	Name: Signature:

Annex III: Flow chart for the Robson ten group classification systems


START HERE
Multiple pregnancy
yes
GROUP 8
no
Transverse or oblique lie
yes
GROUP 9
no
Breech pregnancy
yes
Multiparous woman
yes
GROUP 7
no
GROUP 6
no
Gestational age <37 weeks
yes
GROUP 10
no
Multiparous woman
yes
Previous uterine scars
yes
GROUP 5
no
Labour induced or CS before labour
yes
GROUP 4
no
GROUP 3
no
Labour induced or CS before labour
yes
GROUP 2
no
GROUP 1