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ORIGINAL RESEARCH

Preterm Birth Among Intrapartum Cesarean Deliveries at Public Hospitals in Southern Ethiopia: A Multicenter Retrospective Analysis of Risk Factors

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Purpose: Although the underlying causes for preterm birth are thought to be multifactorial irrespective of delivery mode, no study investigated its risk factors amongst cesarean deliveries (CD). Thus, we aimed to identify potential risk factors for the occurrence of preterm birth (PTB) among intrapartum CD.

Methods: Data from 1659 singleton intrapartum CDs were retrospectively recruited using medical records and an obstetric database. Gestational age was calculated using the last menstrual period (LMP) and ultrasound report of early onset pregnancy. A multivariable logistic regression analysis was performed to identify potential risk factors associated with PTB. Odds ratios (ORs) and 95% confidence intervals (95% CI) were used. Statistical analysis was performed using SPSS version 26.0.

Results: In this study, the prevalence of PTB among intrapartum CD was 6.1% (95% CI: 4.9, 7.2%). In the multivariable logistic regression model; grand parity ≥ 5 (adjusted odds ratio (AOR) = 2.43, 95% CI: 1.72–4.73), maternal age <20 years (AOR=2.63, 95% CI, 1.03–6.71), maternal age ≥ 35 years (AOR=3.83, 95% CI, 1.49–5.35), cesarean section scar ≥ 2 (AOR=4.86, 95% CI: 2.68–8.94), antepartum hemorrhage (AOR=4.37, 95% CI: 2.22–8.63), pregnancy-induced hypertension (AOR=2.92, 95% CI: 1.41–6.04), and premature rupture of membranes (AOR=4.56; 95% CI: 1.95–10.65) were significantly associated with PTB.

Conclusion: The current study showed an association between PTB and a multitude of obstetric variables, including grand parity ≥ 5, CS scar ≥ 2, antepartum hemorrhage, pregnancy-induced hypertension, and premature rupture of the membrane. Understanding these factors could help to implement improved quality of obstetric and neonatal care to increase survival and reduce morbidity among preterm birth.

Keywords: preterm birth, cesarean section, risk factors, cesarean section, intrapartum cesarean delivery

Introduction

Addressing the overall burden of preterm birth (delivery before completed 37 weeks of gestation) is crucial to reduce its related perinatal adverse outcomes. Globally in 2014, it is estimated that approximately 14.84 million (10.6%) neonates were born preterm, and 12 million (81.1%) occurred in Asia and sub-Saharan African countries.[1,2] Further, preterm birth (PTB) is a leading cause of mortality in children <5 years of age worldwide, contributing to an estimated 16% of all deaths and 35% of deaths among newborn babies.[3]

Because of the immature organ system, even the surviving preterm babies are at high risk of developing short-term and long-term adverse outcomes and profoundly correlated with increased expenses to health systems and significant psychological consequences to the parents of the preterm babies.[4–6]

Despite the increased understanding of mechanisms and determinant factors related to PTB and the implementation of various medical interventions to decrease its prevalence and negative impacts, PTB remains a growing public and clinical health concern.[7–9]

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In Ethiopia, the prevalence of PTB has ranged between 4.4% and 25.9%; however, these results may not represent the entire Ethiopian population because of differences in socio-demographic characteristics, the level of hospital, and the quality of healthcare.[10–13]

The alarmingly increased rate of CD observed in recent years has paralleled the scaled-up in the prevalence of PTB.[14] Several potential risk factors were reported to be associated with PTB, including extreme maternal age,[15–23] grand parity,[24–28] previous CD history,[23,29,30] antepartum hemorrhage,[18,26,31] pregnancy-induced hypertension,[10,12,20,26,32,33] and premature rupture of the membrane.[20,26,33,34]

However, the underlying causes vary between studies, and it is unclear whether the outcomes linked to PTB in vaginal deliveries are identical to CD. While some studies[35] have reported a positive correlation between CD and improved outcomes of preterm babies, others[36,37] found less risk of neonatal death in VB and no correlation between the delivery modes. Given these facts, the preferred mode of delivery for mothers to be in preterm labor is a matter of scrutiny.[35–37]

Unfortunately, in Ethiopia, there is insufficient data concerning the etiology of PTB and the impact of having the previous CD in subsequent pregnancies. The intrapartum CD might result from a failed induction to terminate the pregnancy when there are obstetric complications such as antepartum hemorrhage and pregnancy-induced hypertension during the pre-labor stage.

Identification of potential risk factors, particularly among intrapartum CD, would be even more important for low-income countries, where the burden of PTB-related neonatal morbidity and mortality is profoundly high.[38,39] In the same way, translating those findings into clinical practice offers opportunities for providing stepwise and appropriate decision-making help in decreasing the rate of PTB and its associated complications.

To our knowledge, no study examined the prevalence and risk factors of PTB amongst intrapartum CD in low-income countries, including Ethiopia. Similarly, the underlying factor that raises the likelihood of preterm CDs, such as a prior CS scar and obstetrics indications throughout labor, may be an oddity that warrants further research because it is yet unknown whether or not the PTB risk factors for CS and vaginal deliveries are comparable.[40] We therefore sought out to examine the prevalence of PTB and its associated risk factors amongst mothers who underwent intrapartum C-sections in four hospitals in Southern Ethiopia.

Methods

Study Design and Study Participants

In this hospital-based retrospective cohort study, all women who underwent intrapartum CD were studied over 2-years period, from September 2020 to August 2022 at public hospitals located in Gurage Zone, Southern Ethiopia: Wolkite University Specialized Hospital (WKUSH), Gunchure General Hospital (GGH), Atat Hospital (ATH) and Mehal Amba Hospital (MAH).

During the study period, all moms who underwent intrapartum CD for 1704 singleton live births were included. Of these, 1659 women (726 in WKUSH, 413 in GGH, 358 in ATH, and 162 in MAH) who had intrapartum CD and their newborns were subsequently examined for the study's final analysis (Supplementary Data 1). We excluded 45 study participants who had (1) multiple pregnancies (n=21), (2) insufficient documentation (n=13), and (3) mothers whose gestational ages were unknown (n=11). The four hospitals were the main obstetric centers proving cesarean deliveries in the Gurage Zone during the study period.

This study was conducted under the Declaration of Helsinki Ethical Principles for Medical Research involving human subjects protocol. The study was approved by the Ethical Review Board of Wolkite University. Because of the retrospective nature of the study design and the data being anonymized, informed written consent was exempted.

Data Collection

We retrospectively collected data from medical records and an obstetric database, which includes baseline maternal sociodemographic characteristics, obstetrics, and neonatal and intraoperative data using a standard checklist adapted from previous studies, by trained three data collectors. The data collectors received two days of training for the study before data collection. The completeness of data was checked daily by the principal investigators.

The sociodemographic characteristics included maternal age, residency area, monthly family income, maternal medical illness, antenatal care (ANC) visits, and educational level. Obstetrics variables included parity, adverse obstetric history (previous history of abortion and preterm birth), previous history of cesarean delivery, pregnancy-induced hypertension (PIH), antepartum hemorrhage (APH), premature rupture of membrane (PROM), induced/spontaneous labor, fetal presentation, and other obstetrics complications and intraoperative data included types of anesthesia, incision type, and neonatal sex.

Study Outcome

The main outcome measure was determining the prevalence of preterm birth (PTB), which was defined as intrapartum CD occurring after 28 weeks and before 37 completed weeks of gestation. We estimated the gestational age based on the last menstrual period (LMP) and the results of the earliest ultrasound assessment before 20 weeks of gestation. The secondary objectives were the identification of potential risk factors for PTB among intrapartum CD.

Statistical Analysis

Data were cleaned, coded, and transported into SPSS (Statistical Package for the Social Sciences for Windows version 26.0, SPSS Inc., Chicago, Illinois, USA) for final analysis. Results were converted into categorical data and displayed as frequency tables. Comparison of the categorical data between groups was analyzed using Pearson Chi-square or Fisher exact test. Bivariate analysis was used to check the association between potential predictors and outcome variables. We checked the outliers and multi-collinearity using standardized residual tests, and VIF and tolerance, respectively. For controlling confounding factors, multivariable logistic regression analysis was utilized among significantly associated potential independent variables by univariate analysis. The Hosmer–Lemeshow test was utilized to check model fitness. Odds ratio (OR) with a 95% confidence interval (CI) was used to check the strength of the association.

Results

Sociodemographic Characteristics of Study Participants with and without Preterm Birth Among Intrapartum Cesarean Delivery

During the study period, 1657 intrapartum cesarean deliveries were included for final analysis (Supplementary Data 1). The overall prevalence of preterm birth was 101 (6.1%) (95%: CI 4.9–7.2%). Results for sociodemographic characteristics are displayed in Table 1. Around 85% of maternal age lies between 20 and 34 years, with 6.0% (n=100) and 7.2% (n=119) being aged <20 and ≥35 years, respectively. Most study participants were urban residents (66.2%), married (97.7%), and Muslim by their religion (39.1%). Obesity was rare, with only 4.6% of the study participants having a BMI of >30 kg/m^2.

Table 1 Sociodemographic Characteristics of Study Participants with and without Preterm Birth Among Intrapartum Cesarean Delivery

Variables	Frequency	Percent (%)
Maternal age in years		
<20	100	6.0
20–34	1440	86.8
≥ 35	119	7.2
BMI in Kg/m^2		
< 25	709	42.7
25–30	873	52.6
>30	77	4.7

(Continued)

Table 1 (Continued).

Variables	Frequency	Percent (%)
Residence area		
Urban	1099	66.3
Rural	560	33.7
Religion		
Orthodox	563	33.9
Muslim	649	39.1
Protestant	438	26.4
Others	9	0.6
Marital status		
Married	1620	97.7
Unmarried	32	1.9
Divorced	7	0.4
Ever attended school		
Yes	1345	81.1
No	314	18.9
Level of education		
Elementary	626	37.7
High school	582	35.1
Diploma	186	11.2
Degree and above	265	16.0
Monthly income		
Yes	48	2.9
No	1611	97.1
ANC follow-up		
Yes	1635	98.5
No	24	1.5

Abbreviations: ANC, antenatal care; BMI, body mass index; Kg/m^2, kilogram per meter square; ANC, antenatal care.

Obstetrics and Neonatal Characteristics of Study Participants with and without Preterm Birth Among Intrapartum Cesarean Delivery

Results for obstetrics and neonatal characteristics are displayed in Table 2. According to the study, 38% of the participants were primigravida, and 34% of the women had five or more deliveries. Concerning previous delivery, 19.3% of women who had prior delivery had one CD and 8.7% had undergone at least two CDs. Premature rupture of membranes (4.2%), antepartum hemorrhage (5.1%), and pregnancy-induced hypertension (7.8%) were the most

Table 2 Obstetrics and Neonatal Characteristics of Study Participants with and without Preterm Birth Among Intrapartum Cesarean Delivery

Variables	Frequency	Percent (%)
Parity		
1	640	38.6
2–4	455	27.4
≥ 5	564	34.0
History of CD		
0	1194	72.0
1	320	19.3
≥2	145	8.7
Premature rupture of membrane		
Yes	70	4.2
No	1589	95.8
Pregnancy-induced hypertension		
Yes	129	7.8
No	1530	92.2
Antepartum hemorrhage		
Yes	84	5.1
No	1575	94.9
Oligohydroaminous		
Yes	31	1.9
No	1628	98.1
Polyhydroaminous		
Yes	22	1.3
No	1637	98.7
Previous HX of preterm birth		
Yes	39	2.3
No	1620	97.7
Previous HX of perinatal death		
Yes	25	1.5
No	1634	98.5

(*Continued*)

Table 2 (Continued).

Variables	Frequency	Percent (%)
Previous HX of abortion		
Yes	117	7.0
No	1542	93.0
Type of labor		
Spontaneous	1518	91.5
Induced	141	8.5
Fetal presentation		
Cephalic	1437	86.6
Non-cephalic	222	13.4
Prolonged labor > 24 hr.		
Yes	116	7.0
No	1543	93.0
Newborn sex		
Female	711	54.9
Male	748	45.1

Abbreviations: Hx, history; APH, antepartum hemorrhage; PIH, pregnancy-induced hypertension; PROM, premature rupture of membrane; CD, cesarean delivery; FHB, fetal heartbeat.

frequently identified obstetric problems during the preoperative period. When preterm births and abortions (spontaneous or medically induced) were compared, 2.3% of women had a record of preterm deliveries, whereas 7.0% had at least one abortion.

Multivariable Logistic Regression Analysis Showing Risk Factors Associated with PTB Among Intrapartum Cesarean Deliveries

The bivariate analysis observed that the sociodemographic variables including maternal age, residence area, and maternal medical illness, and obstetric factors including parity, previous history of CD, APH, PIH, PROM, and labor onset were significantly associated with an increased risk of PTBs. The risk factors found to be associated with PTB at bivariate analysis were further analyzed to control possible confounders.

Multivariable logistic regression analysis demonstrated that the risk of having PTB was 2.63 times (AOR=2.63, 95% CI, 1.03–6.71) and 3.83 times (AOR=3.83, 95% CI, 1.49–5.35) higher in women <20 and ≥35 years compared to women aged 20–34 years, respectively. Grand parous (≥5 parity) mothers were 2.43 times (AOR=2.43, 95% CI: 1.72–4.73) as likely to have PTB compared to mothers with less parity. Mothers who had a previous history of CD ≥ 2 were 4.86 times (AOR=4.86, 95% CI: 2.68–8.94) as likely to have PTB compared to those without a history of cesarean delivery. Women presented with APH were 4.37 times (AOR=4.37, 95% CI: 2.22–8.63) more likely to have PTB than those without APH. The likelihood of having PTB was 2.92 times (AOR=2.92, 95% CI: 1.41–6.04) higher among mothers presented with PIH compared to those without PIH. Furthermore, PROM increases the risk of having PTB > 4-fold (AOR=4.56; 95% CI: 1.95–10.65) compared to mothers presented without PROM (Table 3).

Table 3 Multivariable Logistic Regression Analysis Showing Risk Factors Associated with PTB Among Intrapartum Cesarean Deliveries

Predictors Variable	Preterm	Term	Adjusted OR	95% CI
Maternal age (n, %)				
< 20 years	16(15.84)	84(5.39)	2.63	1.03–6.71
20–34 years	63(62.38)	1377(88.38)	1	
≥35 years	22(21.78)	97(6.23)	3.83	1.49–5.35
Residence area (n, %)				
Urban	79(78.21)	1020(65.47)	1.51	0.88–2.58
Rural	22(21.79)	538(34.53)	1	
Medical illness (n, %)				
Yes	7(6.93)	41(2.63)	1.77	0.66–4.78
No	94(93.07)	1517(97.37)	1	
Parity (n, %)				
1	21(20.79)	619 (39.74)	0.66	0.31–1.37
2–4	19(18.82)	436(27.98)	1	
≥ 5	61(60.39)	503(32.28)	2.43	1.72–4.73
Previous CD scar (n, %)				
0	61(60.4)	1133(72.72)	1	
1	8(7.92)	312(20.02)	1.38	0.63–3.02
≥ 2	32(31.68)	113(7.26)	4.86	2.68–8.94
Onset of labor (n, %)				
Spontaneous	86(85.15)	1432(92.92)	1	
Induced	15(14.85)	126(8.08)	1.51	0.70–3.24
APH (n, %)				
Yes	19(18.81)	65(4.17)	4.37	2.22–8.63
No	82(81.19)	1493(95.83)	1	
PIH (n, %)				
Yes	16(15.84)	113(7.25)	2.92	1.41–6.04
No	85(84.16)	1445(92.75)	1	
PROM (n, %)				
Yes	10(9.9)	60(3.85)	4.56	1.95–10.65
No	91(90.1)	1498(96.15)	1	
Hx of PTB (n, %)				
Yes	6(5.94)	33(2.11)	2.35	0.76–7.29
No	95(94.06)	1525(97.88)	1	

(*Continued*)

Table 3 (Continued).

Predictors Variable	Preterm	Term	Adjusted OR	95% CI
Hx of abortion (n, %)				
Yes	16(15.84)	101(6.48)	0.53(0.24–1.14)	
No	85(84.16)	1457(93.52)	1	

Note: *Statistical significant at p-value <0.05.
Abbreviations: Hx, history; PTB, preterm birth; APH, antepartum hemorrhage; PIH, pregnancy-induced hypertension; PROM, premature rupture of membrane; CD, cesarean delivery; CL, confidence interval; AOR, adjusted odd ratio.

Discussion

The current study demonstrated that the overall PTB prevalence in neonates delivered by emergency cesarean section was 6.1%. This finding is similar to previous studies conducted in other parts of Ethiopia; 4.4% and 8.1% were reported in Gondar[10] and Northern Ethiopia,[11] respectively. Contrarily, other studies[12,13] conducted in Ethiopia showed the PTB rate ranging between 12.8% and 25.9%, which is significantly higher than our findings.

This significant difference is one of the manifestations showing the existing erroneous in determining the gestational age. Surprisingly, despite the reported agreement across the studies on the PTB definition (<37 weeks of complete gestation), in developing countries, the assessment procedures used to determine gestational age have not been reported in 65% of the cases.[41] Notably, an accurate estimation of gestational age is challenging in low-income countries because of poor health-seeking behavior, limited access to ultrasound, and the shortage of expertise within and across the hospitals. As a result, a higher chance of considering low birth weight as PTB might be possible, which leads to an overestimation of its prevalence rate. Certainly, predictors and interventions to reduce the prevalence of low birth weight might differ from PTB: therefore, high-quality research using standardized assessment tools for low-income countries is urgently needed. Moreover, the wide variations in the level of healthcare facilities, inclusion criteria, and management strategies between clinical setups could explain the observed difference.[10–13]

Surprisingly, there is not little that can be accomplished to lessen preterm birth using available techniques.[8,9] Standardizing the neonatal intensive care health system would be crucial to minimizing the morbidity and mortality of preterm newborns in low-income areas where expertise and medical resources are scarce and it is not realistic to adopt the modeled therapies.[24] Future research will also be necessary to create preventive interventions that can be scaled up and implemented within the current healthcare system.

In this study, the significant risk factors found to be associated with PTB were extreme maternal age (<20 and ≥35 years), premature rupture of membrane (PROM), CS scar ≥2, antepartum hemorrhage (APH), preeclampsia, and grand parity (≥5 parity).

The current study found that extreme maternal age (<20 and ≥35 years) was associated with an increased risk of PTB. Compared to mothers aged between 20 and 34 years, those mothers aged <20 and ≥35 years had a 2.63 and 3.83-fold increased risk of PTB, respectively. Our findings are consistent with previous reports[15–17] that found a U-shaped relationship between the risk of PTB and maternal age. Other studies also found that younger <20 years[18–20] and older ≥35 years mothers[21–23,28] were at a significantly increased risk of PTB. Contrarily, other studies[31,42] have observed a higher risk of PTB among mothers aged between 20 and 30 years. This difference may associate with variations in the geographical area, inclusion criteria, sociodemographic characteristics, and management protocols.

We also found that high parity ≥5 increased the risk of preterm birth. Grand parity (parity ≥5) mothers were 2.43 times more at risk of having a PTB. This finding is consistent with other studies[24–28] that demonstrate an association between PTB and high parity. This could be because grand parity mothers are more likely to have a chronic medical illness (diabetes mellitus, chronic anemia, and hypertension) and physiologic risk factors (placenta previa, abruption placenta, malpresentation, and hemorrhagic complications), which are known to impact fetal and maternal conditions, and may predispose to preterm CD.[43]

Moreover, our study upheld the hypothesis for the previous history of CD; mothers with cesarean scar ≥2 were 4.86 times more likely to have preterm CD when compared to those without a history of cesarean deliveries. Consistently,

other studies[23,29,30,40] also demonstrated the likelihood of increased risk of PTB in mothers who had previous CS scars. These indicate that giving birth by CD has been associated with an increased risk of PTB CD in subsequent pregnancies. In a systematic review of ten cohort studies involving more than 10 million participants, those with previous CD histories had a significantly increased risk of PTB in the subsequent pregnancy, even after adjusting confounding factors.[44] Thus, previous CS scars conferred a substantially increased risk of PTB CD in the following pregnancy in those mothers. Thus, efforts to minimize the possibility of a cesarean section may decrease the risk of PTB in the subsequent pregnancy.

Mothers presented with antepartum hemorrhage (APH) were associated with increased odds of PTB. The explanation is that APH, especially with active bleeding, may be indicated for intrapartum CD, irrespective of gestational age, which increases the risk of PTB. In agreement with our findings, others[18,26,31] also illustrated that APH was significantly associated with an increased risk of PTB. Depending on the type and severity of APH, women may undergo vaginal delivery/elective CS in non-emergency conditions, whereas those mothers with life-threatening bleeding promptly required immediate CD even at preterm age, which might explain the observed relationship in our study.[45,46]

PIH (pregnancy-induced hypertension) was associated with a significantly increased risk of PTB CD compared to mothers indicated without PIH. This finding is similar to previous studies conducted in Ethiopia,[10,12,20,32] and elsewhere.[26,31,33,34] PIH leads both mother and fetus at high risk. The decision to deliver babies in women with PIH needs a balancing approach between the risks of its worsening and PTB. However, in cases of fetal distress and maternal complications, the possibility of undergoing intrapartum CD increases irrespective of gestational age, which may increase the risk of PTB.[47] Thereby, proper management of HIP is imperative to reduce its negative impact on PTB.

Evidence also shows that the decision to terminate the pregnancy in PROM, whether with cesarean or vaginal delivery considering the risk/benefit ratio, is based on maternal and fetal conditions.[48,49] These indicate that despite the optimal timing and mode of delivery is controversial: pregnancy-related complications such as fetal distress in labor, maternal fever, placental abruption, and infection are common in preterm PROM, resulting in an increased risk of intrapartum CD. Consistent with previous reports,[20,26,33,34] our study also found that mothers with prolonged PROM were 4.56 times more at risk for PTB than their counterparts.

These findings suggest that it is essential to comprehend the pathogenesis of placental inflammation and the impact of pathologies related to the placenta on preterm labor to develop more efficient strategies for early detection and lowering the prevalence of PTB and its associated overall burden.[50]

This study has several strengths. First, it is the first to investigate the risk factors for PTB, particularly for intrapartum cesarean deliveries in low-income countries, using a relatively larger sample size in multiple hospitals. Second, the calculation of gestational age using either known LMP or early ultrasound reports scanned by senior obstetricians confers certain advantages over non-obstetricians. Nonetheless, it is not without some limitations. Because of the retrospective nature of the study design, some important risk factors are not included, which may explain the need for future prospective studies at the national level to extrapolate the results to the entire population.

Conclusion

One in 16 intrapartum cesarean deliveries was associated with PTB. Maternal age (<20 and ≥35 years), grand parity, CS scar ≥2, APH, PIH, and PROM were the best predictors for PTB among intrapartum CD. Clinicians who provide obstetric care must identify potential risk factors to improve the quality of antenatal, obstetric and neonatal care to increase the survival and reduce related morbidity of preterm birth. Further prospective investigations are required to extend these results and establish future clinical recommendations.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Acknowledgments

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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