ORIGINAL ARTICLE

Determinants of Uterine Rupture among Women Who Gave Birth in Hiwot Fana Comprehensive Specialized University Hospital, Eastern Ethiopia: A Case-Control Study

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ABSTRACT

BACKGROUND: *Uterine rupture is a leading cause of maternal morbidity and mortality in Ethiopia and is associated with a high risk of perinatal death. This study aimed to identify the determinants of uterine rupture among women who gave birth at Hiwot Fana Comprehensive Specialized University Hospital (HFCSUH).*

METHODS: *An unmatched case-control study was conducted among randomly selected women who gave birth at HFCSUH between December 1, 2018, and November 30, 2022. Women who experienced uterine rupture were included as cases, while women without uterine rupture served as controls. For each case, three controls who gave birth on the same day (one preceding and two succeeding deliveries) were selected. Data were analyzed using multivariable logistic regression in SPSS version 26. Variables with a p-value < 0.05 were considered statistically significant. Associations were reported using adjusted odds ratios (AORs) with 95% confidence intervals (CIs).*

RESULTS: *A total of 206 women (51 cases and 155 controls) with a mean age of 25.9 years were included. Grand multiparity (AOR = 2.9, 95% CI: 1.12–7.62), prolonged labor (AOR = 3.1, 95% CI: 1.06–8.89), referral from another health facility (AOR = 4.2, 95% CI: 1.04–17.05), and fetal malpresentation (AOR = 5.3, 95% CI: 1.78–15.85) were independently associated with uterine rupture.*

CONCLUSION: *Grand multiparity, prolonged labor, referral from another health facility, and fetal malpresentation were significant independent determinants of uterine rupture. Reducing the incidence of uterine rupture and its complications requires strengthening family planning services for multiparous women, ensuring timely management of prolonged labor through appropriate labor monitoring (e.g., partograph use), improving emergency referral systems, and enhancing the early detection and management of fetal malpresentation during antenatal and intrapartum care.*

KEYWORDS: *uterine rupture, determinants, maternal mortality, hysterectomy, Ethiopia*

INTRODUCTION

Uterine rupture, a complete or partial tear of the uterine wall, is a serious obstetric emergency and a major public health problem worldwide (1,2). The incidence of uterine rupture varies considerably between high- and low-income countries. In high-income countries, the incidence is low (0.01–0.05% of deliveries) and primarily affects women attempting vaginal birth after a previous cesarean section. In contrast, low-income countries bear a disproportionate burden, with prevalence estimates ranging from 0.1% to 3.0% (2–5). Beyond maternal mortality, uterine rupture can result in hysterectomy, obstetric fistula, and infertility. It is also associated with near-total perinatal mortality, while surviving infants are at increased risk of birth asphyxia and long-term neurodevelopmental impairment (3,5–8). In Sub-Saharan Africa, where access to emergency obstetric care is often limited, uterine rupture remains a leading cause of maternal death. The prevalence ranges from 0.3% to 3.5%, and case fatality rates exceed 10%. Contributing factors include high fertility rates, shortages of skilled birth attendants, weak referral systems, and the "three delays" in seeking, reaching, and receiving appropriate care (3,9–12).

Ethiopia faces a particularly high burden of uterine rupture, with prevalence estimates ranging from 1.4% to 16.68% across different regions. In some Ethiopian studies, uterine rupture accounted for up to 20% of maternal deaths. Unlike the pattern observed in high-income countries, the condition is particularly common among women without a previous cesarean section. Ethiopian studies have also documented serious consequences of uterine rupture, including hysterectomy in 30–60% of cases, obstetric fistula, prolonged hospitalization, and near-complete perinatal loss. Although the psychological consequences, including grief, stigma, and fear of future pregnancy, are substantial, they remain understudied (13–18).

Several global and national initiatives have been implemented to reduce the burden of uterine rupture. The World Health Organization (WHO) has developed guidelines on partograph use, timely referral, emergency obstetric care, and safe vaginal birth after cesarean section (VBAC). It also promotes the Emergency Obstetric and Newborn Care (EmONC) framework, which requires comprehensive facilities to provide cesarean section and blood transfusion services. The United Nations Children's Fund (UNICEF) has supported the training of skilled birth attendants, supplied essential equipment, and promoted community-based maternal health education. At the national level, the Ethiopian government has implemented the Health Extension Program (HEP) to improve antenatal care and facilitate referrals in rural communities. It has also adopted the Maternal Death Surveillance and Response (MDSR) system, expanded EmONC services, and trained non-physician clinicians to perform cesarean sections. Despite these efforts, the burden of uterine rupture remains unacceptably high in many parts of Ethiopia, highlighting the need for context-specific research to identify persistent determinants and inform targeted interventions (19,19–21).

Factors associated with uterine rupture vary across settings and are commonly classified as maternal, fetal, obstetric, and health system-related. Maternal factors include low socioeconomic status, advanced maternal age, and rural residence. Fetal factors include macrosomia, malpresentation, and male sex. Obstetric factors include multiparity, previous cesarean scar, prolonged labor, and obstetric interventions. Health system-related factors include inadequate antenatal care (ANC) and failure to use partographs for labor monitoring (22–27). However, the relative contribution of these factors differs across regions because of variations in healthcare infrastructure, referral systems, and obstetric practices.

Effective prevention of uterine rupture requires a clear understanding of its determinants and their relative contribution to guide context-specific interventions. Because uterine rupture is largely preventable through appropriate labor monitoring and timely obstetric care, identifying these determinants is essential (3). Although previous studies have shown that the determinants of uterine rupture vary across settings due to differences in healthcare systems, referral pathways, and obstetric practices (13), no recent study has identified the context-specific determinants of uterine rupture at Hiwot Fana

Comprehensive Specialized University Hospital in eastern Ethiopia. Therefore, this study aimed to identify the independent determinants of uterine rupture at this hospital to inform targeted, evidence-based prevention strategies.

METHODS

Study design: An institution-based unmatched case-control study was conducted at Hiwot Fana Comprehensive Specialized University Hospital (HFCSUH) in eastern Ethiopia.

Study setting

HFCSUH is a tertiary care hospital that serves as the primary referral center for more than 20 million people in the Harari Region, Oromia Region, Somali Region, and Dire Dawa City Administration. During the data collection period (January 15 to February 15, 2023), the Department of Obstetrics and Gynecology was staffed by 22 consultants, 35 residents, 50 midwives, and 4 general practitioners and managed approximately 4,500 deliveries annually.

Population and sampling: Medical record numbers (MRNs) of women diagnosed with uterine rupture between December 1, 2018, and November 30, 2022, were obtained from delivery logbooks, operation registers, and admission and discharge registers to establish the sampling frame. Cases were selected using simple random sampling. For each case, three controls who delivered on the same day without uterine rupture were selected: one woman who delivered immediately before the case and two who delivered immediately afterward.

Women with incomplete medical records, defined as records missing five or more variables or lacking essential information on uterine rupture, were excluded. Among cases, uterine rupture was diagnosed by the attending clinician during delivery, confirmed intraoperatively, and documented in the operative note. Among controls, the absence of uterine rupture was confirmed through medical record review, with no documented diagnosis or clinical suspicion of uterine rupture. In both groups, case classification was based exclusively on the clinician's documented diagnosis.

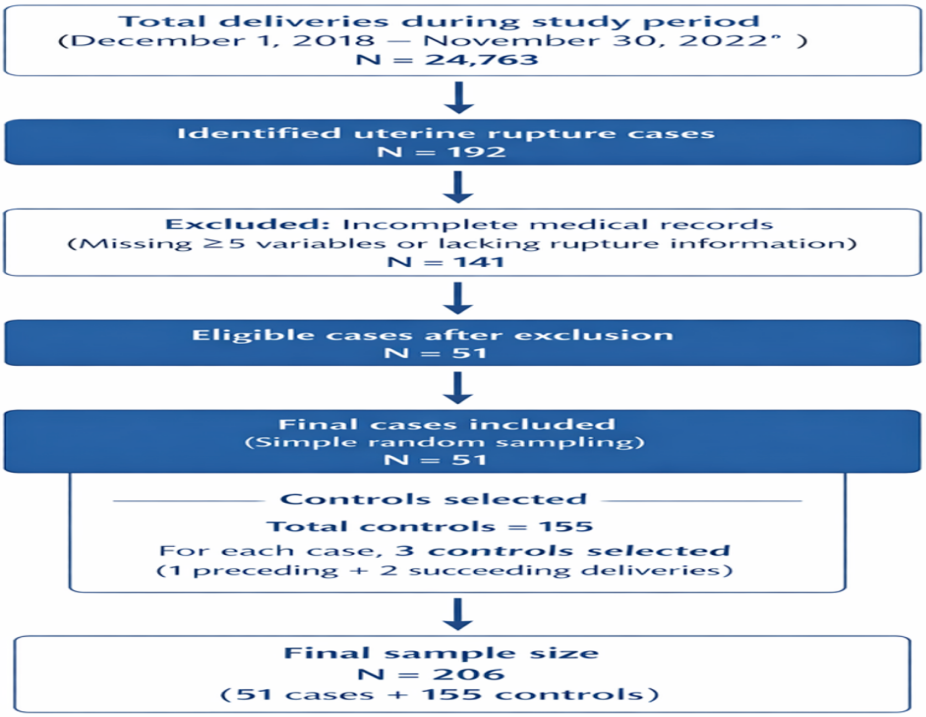

***Figure** 1: Schematic diagram of the sampling procedure.*

The sample size was calculated using Epi Info version 7 for an unmatched case-control study, assuming a 95% confidence level, 80% statistical power, and a case-to-control ratio of 1:3. The largest required sample size was obtained after considering several determinants of uterine rupture reported in previous studies. Previous cesarean section, identified as a determinant in a study conducted in eastern Ethiopia, yielded the largest sample size (n = 187) and was therefore used for sample size determination (28). After adding a 10% allowance for incomplete medical records, the final sample size was 206 participants, comprising 51 cases and 155 controls. The sampling procedure is illustrated in Figure 1. This study is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for case-control studies. The completed STROBE checklist is provided as supplementary material.

Data collection and processing: Data on sociodemographic, obstetric, medical, health system, and fetal factors were collected by two trained obstetrics and gynecology residents through a review of women's medical records. The questionnaire was pre-tested on 5% of the sample (3 cases and 9 controls) using records of women who gave birth at Jugal General Hospital. The first author reviewed the completed data daily to ensure completeness, accuracy, and consistency.

Data were analyzed using SPSS version 26. Bivariable analysis was performed to identify potential determinants. Subsequently, variables with a p-value < 0.25 were entered into a multivariable logistic regression model after multicollinearity was assessed. Variance inflation factor (VIF) values ranged from 1.12 to 1.98, while tolerance values ranged from 0.505 to 0.893. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were then computed, and statistical significance was declared at p < 0.05. The assumptions of logistic regression, including the goodness of fit of the final model, were assessed using the Hosmer-Lemeshow test, with a p-value > 0.05 indicating a good model fit.

Ethical considerations: This study was conducted in accordance with the Declaration of Helsinki. Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee (IHRERC) of Haramaya University College of Health and Medical Sciences (reference number IHRERC/004/2023) before data collection. Written permission was obtained from the Chief Clinical Director and the Heads of the Gynecology and Obstetrics Department. Official permission was also secured from the HFSUH administration. All information obtained from medical records was kept anonymous and confidential.

RESULTS

Sociodemographic characteristics: Of the 24,763 deliveries during the study period, 192 resulted in uterine rupture, corresponding to an incidence of 7.8 per 1,000 deliveries. A total of 206 women (51 cases and 155 controls) were included in the study. The mean age was 26 years (range: 15–44 years; standard deviation: 6.2 years). The majority of women (96.1% of cases and 80.6% of controls) were between 18 and 35 years of age. Most cases (90.2%) and controls (66.5%) resided in rural areas (Table 1).

Table 1: Maternal sociodemographic characteristics of women who gave birth at HFCSUH from December 1 to November 30, 2023.

Variables	Categories	Cases (n=51) (%)	Controls(n=155)	X^2, P-value
Age (in years)	<18	0(0)	20(12.9)	8.08(0.018)
	18-35	49(96.1)	125(80.6%)	
	>35	2(3.9)	10(6.5)	
Residence	Rural	46(90.2)	103(66.5)	10.8(0.001)
	Urban	5(9.8)	52(33.5)	
Distance from healthy facility	<10km	12(23.5)	76(49.0)	10.2(0.001)
	>=10km	39(76.5)	79(51.0)	

Obstetric characteristics: Compared with controls, a higher proportion of cases were grand multiparous (35.3% vs. 19.2%), anemic (62.8% vs. 31.0%), and had a history of cesarean section

(31.4% vs. 35.0%). Approximately two-thirds of women with uterine rupture received 1–2 units of blood, compared with 4.0% of the controls (Table 2).

Table 2: Obstetrics characteristics of the women who gave birth at HFCSUH from December 1 to November 30, 2023 (n=206).

Variables	Categories	Cases (n=51) (%)	Controls (n=155) (%)
Malpresentation	Yes	34(66.7)	43(27.7)
	No	21(33.3)	112(72.3)
Gravidity	1-4	24(47.1)	118(76.1)
	>=5	27(52.9)	37(23.9)
Parity	<=4	33(64.7)	125(80.6)
	>4	18(35.3)	30(19.4)
Use of uterotonics	Yes	5(9.8)	28(18.1)
	No	46(90.2)	137(81.9)
Interpregnancy interval	<24 months	23(45.1)	50(32.3)
	>=24 months	28(54.9)	105(67.7)
Obstructed labor	Yes	15(29.4)	15(4.9)
	No	36(70.6)	140(95.1)
Is she referred	Yes	46(90.2)	93(60)
	No	5(9.8)	62(40)
Predelivery Hgb	<=7mg/dl	12(23.5)	9(5.8)
	7.1-11mg/dl	20(39.3)	39(25.2)
	>=11mg/dl	19(37.2)	94(60.6)
	Not determined	0(0)	13(8.4)
Number of transfusions	0	9 (17.6)	148(95.5)
	1-2	33(64.7)	6(3.9)
	3-4	9(17.6)	1(0.6)

Determinants of uterine rupture: In the multivariable logistic regression analysis, parity, duration of labor, referral status, and malpresentation were significantly associated with uterine rupture. Grand multiparous women had three times higher odds of uterine rupture than women who had given birth fewer than five times (AOR = 2.92; 95% CI: 1.12, 7.62). Women with prolonged labor had three times higher odds of uterine rupture than those without prolonged labor (AOR = 3.08; 95% CI: 1.06, 8.89). Women referred from other health facilities were four times more likely to experience uterine rupture than those who were not referred (AOR = 4.20; 95% CI: 1.04, 17.05). Finally, women with fetal malpresentation had five times higher odds of uterine rupture than those with a vertex presentation (AOR = 5.31; 95% CI: 1.78, 15.85) (Table 3).

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Table 3: Factors associated with uterine rupture among women who gave birth in HFCSUH, 2023 (n=206).

Variables	Categories	Cases (n=51)	Controls (n=155)	COR(CI)	P-value	AOR(CI)	P-value
Residence	Rural	46	103	4.64(1.74, 12.4)	0.002	2.05(0.32,13.44)	0.450
	Urban	5	52	1			
Parity	≥5	18	30	2.27(1.13,4.57)	0.021	2.92(1.12,7.62)	0.028
	≤4	33	125	1			
Duration of labor	≥24hours	19	27	2.81(1.84,8.90)	0.001	3.08(1.06,8.89)	0.038
	<24 hours	32	128	1			
Is she referred	Yes	46	93	6.13(2.31,16.30)	0.000	4.22(1.04,17.05)	0.043
	No	5	62	1			
Malpresentation	Yes	34	43	4.22(2.15,13.68)	0.000	5.31(1.78, 15.85)	0.003
	No	21	112	1			
Distance from healthy facility	≥10km	39	79	3.13(1.52, 6.42)	0.002	2.99(0.62, 14.62)	0.174
	<10km	12	76	1			

DISCUSSION

This study identified the determinants of uterine rupture in a major referral hospital in eastern Ethiopia. We found that malpresentation, grand multiparity, prolonged labor, and referral from other health facilities were independently associated with uterine rupture. These findings have important clinical and theoretical implications for improving maternal survival in low-resource settings.

As expected, malpresentation was significantly associated with uterine rupture. Similar findings have been reported in studies conducted at Ayder Comprehensive Specialized Hospital, Tigray (29), Suhul General Hospital, Tigray (30), and other hospitals in southern Ethiopia (31). Malpresentation (e.g., transverse lie or breech presentation) creates a mechanical mismatch between the fetus and the birth canal, preventing fetal engagement. The uterus then contracts against this obstruction, leading to progressive thinning of the lower uterine segment until rupture occurs. Clinically, early detection requires careful abdominal examination or intrapartum ultrasound. Health facilities should document fetal presentation on the partograph and establish protocols for timely cesarean section or external cephalic version when appropriate (32).

Grand multiparous women were more likely to experience uterine rupture than women with lower parity. This finding is consistent with studies conducted in Ethiopia, including a systematic review and meta-analysis (33), studies from referral hospitals in the Amhara Region (34), Adama City (35), Suhul General Hospital (30), and hospitals in Jinka and Arba Minch (31). This increased risk may be attributed to several factors. Repeated childbirth may lead to cumulative collagen remodeling and thinning of the uterine myometrium, reducing its tensile strength and increasing susceptibility to uterine rupture. Additionally, high parity is often associated with increased uterine sensitivity to endogenous and exogenous oxytocin, resulting in hypertonic contractions and elevated intrauterine pressure, both of which may contribute to uterine rupture (36,37). Clinically, these findings highlight the importance of prioritizing grand multiparous women in family planning programs, particularly those living in rural areas with limited access to emergency obstetric care.

Consistent with previous studies, prolonged labor was significantly associated with uterine rupture (34,38). Prolonged labor may result from abnormalities in any of the three Ps: passage, passenger, or power. The progress of labor depends on the interaction among these three factors; therefore, a mismatch between them can result in prolonged labor. If the obstruction is not relieved through interventions such as cesarean section, uterine rupture may occur (39–42). Clinically, this finding reinforces the critical importance of routine partograph use in all delivery settings. Crossing the action line on the partograph should prompt timely

intervention, including referral for cesarean section when indicated, well before uterine rupture becomes imminent.

We also found that uterine rupture was more likely among women referred from other health facilities. This association can be explained by the "three delays" model: delay in deciding to seek care, delay in reaching a healthcare facility, and delay in receiving appropriate care after arrival. Referred women often experience all three delays. They may labor for prolonged periods at primary health facilities where cesarean section is unavailable, encounter transportation barriers, and subsequently experience additional delays at referral hospitals because of overcrowding, limited bed availability, or delays in accessing surgical teams. Our findings suggest that the referral system itself is a modifiable risk factor. This association is also expected because uterine rupture is one of the indications for referral (31,43–45). Factors contributing to these delays include poor communication, inadequate transportation, and weaknesses within the healthcare system (46). Strengthening the capacity of lower-level health facilities to promptly identify and refer women requiring higher-level care, or to provide appropriate care when feasible, could substantially reduce these delays (47).

Our study reviewed uterine rupture cases over a five-year period to identify key determinants over time. However, because this was a retrospective study, information on variables such as body mass index, educational status, household income, and health-seeking behavior was not available.

In conclusion, theoretically, our findings support an integrated model of uterine rupture that incorporates mechanical factors (malpresentation and prolonged labor), obstetric history factors (grand multiparity), and health system factors (referral delays). Clinically, interventions should target multiple levels: (1) community-level family planning to reduce grand multiparity; (2) routine partograph use and early detection of malpresentation and prolonged labor at primary health facilities; and (3) improvements in referral systems through better communication, transportation, and surgical capacity. Future research should prospectively quantify the three delays and evaluate whether strengthening cesarean delivery services provided by non-physician clinicians at primary health facilities reduces the incidence of uterine rupture.

A major strength of this study is its five-year study period, which yielded a robust sample of 192 uterine rupture cases from more than 24,000 deliveries, allowing stable estimation of multiple determinants. In addition, the case-control design, with a 1:3 case-to-control ratio and selection of controls by delivery date, helped minimize selection bias.

However, several limitations should be acknowledged. First, because this was a retrospective review of medical records, information on potentially important variables, including body mass index, educational status, household income, health-seeking behavior, and women's decision-making autonomy, was unavailable. These unmeasured factors may have confounded the observed associations. Second, we were unable to assess the quality of care provided at referring facilities or determine the duration of each delay within the referral pathway. Third, the study was conducted at a single referral hospital, limiting the generalizability of the findings to primary health centers or community settings. Finally, the exclusion of some eligible cases because of incomplete medical records (missing five or more variables) may have introduced selection bias if the excluded women differed systematically from those included in the analysis.

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