

# Determinants of uterine rupture among mothers who gave birth in Jinka and Arba Minch General Hospitals, institution-based case–control study, Southern Ethiopia, Ethiopia, 2019

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## Abstract

**Background:** Uterine rupture is a major public health problem in low-income countries including Ethiopia. In Ethiopia, its prevalence is low, but it results in devastating health problems of the mother and her baby. Even though the Ethiopian government and nongovernmental organizations tried to strengthen the health care system, significant adverse maternal and fetal outcome is still associated with uterine rupture. The aim of this study was to identify determinants of uterine rupture in Jinka and Arba Minch General Hospitals.

**Methods:** The study was conducted in Jinka and Arba Minch General Hospitals, and the data collection period was 15 to 30 November 2018. A case–control study design was used with simple random sampling of 1:4. Data were collected using data extraction sheets. Variables with  $p < 0.25$  in bivariate logistic regression were entered into multivariable logistic regression. Variables with  $p < 0.05$  in multivariable logistic regression were used to determine significant association between dependent and independent variables.

**Result:** Uterine rupture occurred in 112 cases with 448 controls. Women referred from health facilities (adjusted odds ratio = 8.0, 95% confidence interval: 3.5–17.8), multiparous women (adjusted odds ratio = 12.7, 95% confidence interval: 4.2–39.0), duration of labor more than 18 h (adjusted odds ratio = 11.5, 95% confidence interval: 5.5–24.1), malpresentation (adjusted odds ratio = 3.5, 95% confidence interval: 1.0–8.0) and gestational age of  $\geq 37$  weeks (adjusted odds ratio = 5.2, 95% confidence interval: 1.4–19.3) were independent factors associated with uterine rupture.

**Conclusion:** Mothers referred from health facilities, multiparous women, duration of labor more than 18 h, gestational age of  $\geq 37$  weeks and malpresentation were significantly associated with uterine rupture. Early referral, encouraging family planning, proper use of partograph, early identification and appropriate intervention for malpresentation are recommended.

## Keywords

Arba Minch, case control, determinant factors, Jinka, uterine rupture

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## Background

Uterine rupture is tearing of the uterine wall during pregnancy or delivery. Uterine rupture can happen in mothers with a previous uterine scar and unscarred uterus. Rupture of the previously unscarred uterus can be complete or incomplete rupture.<sup>1</sup>

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In high-income countries, the problem of uterine rupture is associated with previous cesarean section (CS) whereas in low-income countries, obstructed labor is the most frequent cause of uterine rupture.<sup>2</sup>

Global median incidence of uterine rupture in population based studies was 5.3 per 10,000 births whereas in institution-based studies, the incidence was 31 per 10,000 births.<sup>3</sup> Its incidence is increasing with previous cesarean delivery. Its magnitude is higher in Asia and Africa than developed countries.<sup>4</sup> Its global prevalence among mothers with the previous CS is 0.5%, in which in high human development index countries, its prevalence is 0.2% and in low human development index countries, it is 1%.<sup>5</sup> The incidence of uterine rupture in Africa ranges from 0.5% to 9.5%.<sup>6-9</sup> In Ethiopia, its prevalence ranges from 1.2% to 9.5%.<sup>6,9,10</sup>

Although its prevalence is low, it could lead to adverse maternal and fetal outcome. In Ethiopia, it is the first leading cause of maternal mortality, accounting for 18.8% to 36% of all maternal deaths.<sup>11</sup> Uterine rupture may lead to obstetric fistula in 3% to 12.3% women, severe hemorrhage in 59.8% to 88.8% women and hysterectomy in 14% to 51.8%.<sup>7,12-14</sup> It also leads to an adverse outcome to the baby. The magnitude of fetal mortality is very high with only 1.7% to 7% of babies born alive. The risk of birth asphyxia is 137 times higher in uterine rupture.<sup>6,7,9</sup>

Most studies revealed that factors like age, mothers referred from health facilities, labor induction, parity, lack of antenatal care (ANC) follow-up, gestational age, multiple pregnancy, retained second twin, history of previous CS, pregnancy since last CS, trial of labor after CS, chorioamnionitis, preoperative hemoglobin, prolonged labor, obstructed labor, malpresentation, lack of partograph utilization, birth weight, hydrocephalus and instrumental delivery were significantly associated with uterine rupture. Some studies have contradicting results on the association between these factors and uterine rupture.<sup>2,7,10,15-18</sup>

Despite the severity of the problem, no studies were done in those mothers who have a nomadic way of life, and this study tried to identify the associated factors in these mothers. Therefore, this study will address the determinant factors of uterine rupture in Arba Minch and Jinka General Hospitals.

## Methods

### Study area and period

The study was conducted in Jinka and Arba Minch General Hospitals, Southern Nations, Nationalities and People Region (SNNPR), Ethiopia. Arba Minch town is the capital of Gamo Zone located 455 km away from Addis Ababa, the capital city of Ethiopia and 275 km away from Hawassa which is the capital city of Southern Nations, Nationalities and People region. It is located at an elevation of 1285 m

above sea level. The town had an estimated total population of 159,019 in 2017. It has two health centers, thirteen private clinics, one Marie Stopes clinic and one General Hospital. Arba Minch General Hospital obstetric and gynecologic ward has 45 midwives, one gynecologist and five Integrated Emergency Surgical Officers.<sup>19</sup>

Jinka town is the capital of South Omo zone located 691 km away from Addis Ababa and 511 km away from Hawassa. Its elevation is 1490 m above sea level. Jinka has an estimated total population of 22,475. Jinka town has one health center, three private clinics and one General Hospital. Jinka General Hospital obstetric and gynecologic ward has 14 midwives and one Integrated Emergency Surgical Officer.<sup>20</sup> Data were collected for 2 weeks from 15 to 30 November 2018.

**Study design and population.** A hospital-based case-control study design was used as follows:

**Cases:** all women who were diagnosed with uterine rupture from 1 November 2015 to 14 November 2018, in Jinka and Arba Minch General Hospitals.

**Controls:** all women who gave birth without experiencing uterine rupture from 1 November 2015 to 14 November 2018, in Jinka and Arba Minch General Hospitals.

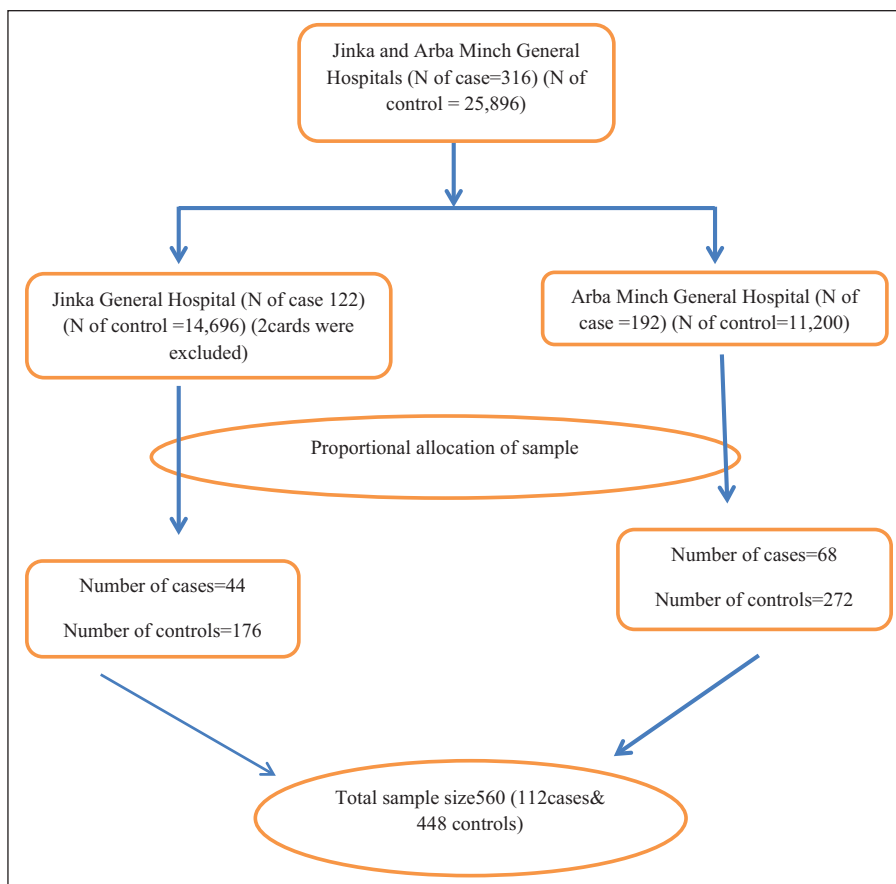
**Exclusion criterium.** If the mothers' file missed more than 20% of the variables under study.

### Sample size determination

Sample size was determined using double population proportion formula for case-control study design using Epi Info version 3.5.1 statistical software. Using significant factor (instrumental delivery) from the study done in Suhul Hospital, Shire, 95% confidence interval (CI), 80% power, proportion of control with exposure 5%, proportion of case with exposure 13.6%, odds ratio 3 (assuming this study will detect variables with odds ratio 3 and above) and four to one ratio of control to case. The final sample size becomes 560 (112 cases and 448 controls).<sup>15</sup>

### Sampling technique and procedure

Calculating the previous 4 years admission of mothers in an obstetric ward, the total case load was 192 in Arba Minch Hospital and 124 in Jinka Hospital. Proportionally allocating the sample size, 68 cases were taken from Arba Minch Hospital and 44 cases were taken from Jinka Hospital. Sampling frame was prepared for cases and controls in each Hospital. Then, a simple random sampling technique was implemented to select study participants (Figure 1).



**Figure 1.** Schematic presentation of sampling technique to identify determinants of uterine rupture among mothers who give birth in Arba Minch and Jinka General Hospitals 2018.

### Quality assurance

Data extraction sheet was adopted and pretest was done on 5% of the sample size at Nigest Eleni Mohammed Memorial Referral Hospital to check the content of the data extraction sheet. During and after data collection, each data extraction sheet was checked by principal investigator for completeness to ensure the quality of the data.

### Data collection

The data extraction sheet contained different questions including sociodemographic variables, pregnancy condition variables, and labor and delivery variables adopted from different studies.<sup>15,18,21</sup> Four diploma and two BSc midwives were recruited as data collectors and supervisors. Then, they took 2 days training on the objective of the study, data collection method, significance of the study, ethical considerations and different sections of the data extraction sheet.

### Data management and analysis

The data extraction sheet was coded and entered into Epidata version 3.1 statistical software, then exported to

Statistical Package for Social Sciences version 20 statistical packages for further analysis. Descriptive statistical analysis such as simple frequencies, crosstabs, and mean and standard deviation were used to describe sociodemographic characteristics of participants, pregnancy-related and labor and delivery-related characteristics. Binary logistic regression with 95% CI was used to explore the relationship between uterine rupture and the independent variables. Multicollinearity test was carried out to see the correlation between independent variables using variance inflation factor and no variable was dropped. Variables with  $p \leq 0.25$  in bivariate logistic regression were entered into multivariable analysis. The Hosmer–Lemeshow method was used to assess model fitness and found to be well fit. Variables with  $p \leq 0.05$  were used to determine significant associations between dependent and independent variables.

## Result

### Sociodemographic characteristics

A total of 112 women with uterine rupture and 448 controls were included from Jinka and Arba Minch General Hospitals and the response rate was 100%. Mean  $\pm$  standard deviation

**Table 1.** Sociodemographic-related characteristics of mothers who gave birth in Jinka and Arba Minch General Hospitals, SNNPR, Ethiopia, 2017/2018.

Variables	Risk factor	Case	Control	Total
		Frequency (%)	Frequency (%)	
Age	<20	11 (9.8%)	113 (25.2%)	124 (22.1%)
	21–35	90 (80.4%)	323 (72%)	413 (73.8%)
	>35	11 (9.8%)	12 (2.7%)	23 (4.1%)
Ethnicity	Ari	48 (42.9%)	209 (46.7%)	257 (45.9%)
	Gamo	29 (25.9%)	68 (15.2%)	97 (17.3%)
	Goffa	17 (15.2%)	58 (12.9%)	75 (13.4%)
	Amhara	12 (10.7%)	93 (20.8%)	105 (18.8%)
	Others <sup>a</sup>	6 (5.3%)	20 (4.5%)	26 (4.6%)
Religion	Orthodox	28 (25.0%)	158 (35.2%)	186 (33.2%)
	Protestant	70 (62.5%)	257 (57.4%)	327 (58.4%)
	Muslim	14 (12.5%)	33 (7.4%)	47 (8.4%)
Referral	Yes	98 (87.5%)	144 (32.1%)	242 (43.2%)
	No	14 (12.5%)	304 (67.9%)	318 (56.8%)

<sup>a</sup>Others (Oromo, Male, Mursi, Hamar, Bena, Tsema, Tigray, Guraghe and Basketo).

(SD) age of the mothers was  $29.23 \pm 5.44$  for cases and  $25.022 \pm 5.07$  for controls. About 30 (26.8%) cases and 209 (57.4%) controls were Ari in their ethnicity. Three-fourths of the cases and more than half of the controls were protestant religion followers. Most cases, 98 (87.5%), were referred from other health facilities as compared to only 144 (32.1%) controls (Table 1).

### Pregnancy-related characteristics

Among the cases, 81 (72.3%) had ANC follow-up and 22 (27.2%) of them had ANC visit of <4. In the majority of the controls, 436 (97.3%) had ANC follow-up and 68 (15.6%) of them had ANC visit of <4. Among the cases, 94 (93%) were term pregnant mothers and one (1%) was post-term mother. Most of the controls 367 (84.4%) were term pregnant mothers and six (1.4%) were post-term mothers. In this study, almost all women with uterine rupture were having singleton pregnancy 111 (99.1%). Among the controls, the numbers of singleton pregnancy were 423 (94.4%) and 25 (5.6%) were twin pregnancy (Table 2).

### Labor and delivery-related characteristics

Almost all women with uterine rupture 104 (92.86%) were multiparous compared to almost two-third (63.6%) of the controls. Among cases, 104 (92.86%) were followed by partograph and 66 (63.5%) of them had a duration of labor of more than 18h. Only 33 (8%) of control women had duration of labor of more than 18h. Ninety-four (83.9%) of the cases and 22 (4.9%) controls had experienced obstructed labor. Forty-two (37.5%) cases and 33 (7.4%) controls had malpresentations (Table 3).

### Determinants of uterine rupture

Determinant factors included in multiple logistic regression analysis were those variables with  $p < 0.25$  at bivariate logistic regression analysis. Multiple logistic regression analysis identified that referrals from health facilities, multiparity, duration of labor more than 18h, gestational age  $\geq 37$  weeks and malpresentation were the independent factors significantly associated with uterine rupture (Table 4).

### Discussion

This study identified that mothers referred from health facilities were eight times more likely to experience uterine rupture than women who come for care directly. This is supported by studies conducted in Mbarara, Uganda, in Referral Hospitals of Amhara Regional State and Debre Markos Hospital.<sup>9,18,22</sup> After the mothers in labor develop prolonged labor in the first unit health facility, then they referred for better management. These mothers referred from health facilities may develop uterine rupture due to the distance of health facilities from which they referred to the general hospitals in which emergency obstetric care is given. It might be also due to late referral of mothers with obstetric complication to the general hospitals with emergency obstetric care.

Multiparous women were 13 times more likely to experience uterine rupture than primiparas. This is generally known worldwide as primiparity protects against uterine rupture.<sup>3,13,23–25</sup> When parity increases, the uterine muscles become fragile and are less likely to withstand prolonged strong uterine contractions. Mothers with a duration of labor greater than 18h were about 12 times more likely to develop uterine rupture. This is supported by studies conducted in Suhul Hospital, Shire<sup>15</sup> and

**Table 2.** Pregnancy-related characteristics of mothers who gave birth in Jinka and Arba Minch General Hospitals, SNNPR, Ethiopia, 2017/2018.

Variables	Risk factors	Case	Control	Total
		Frequency (%)	Frequency (%)	
ANC follow-up (N=560)	Yes	81 (72.3%)	436 (97.3%)	517 (92.3%)
	No	31 (27.7%)	12 (2.7%)	43 (7.7%)
Number of ANC visits (N=517)	<4	22 (27.2%)	68 (15.6%)	90 (17.4%)
	≥4	59 (72.8%)	368 (84.4%)	427 (82.6%)
Gestational age (N=536)	Preterm	6 (5.9%)	62 (14.25%)	68 (12.7%)
	Term	95 (94.1%)	373 (85.75%)	468 (87.3%)
Number of fetuses (N=560)	Singleton	111 (99.1%)	423 (94.4%)	534 (95.4%)
	Twin	1 (0.9%)	25 (5.6%)	26 (4.6%)
Retained second twin (N=26)	Yes	0 (0%)	4 (16%)	4 (15.4%)
	No	1 (100%)	21 (84%)	22 (84.6%)
Previous CS (N=560)	Yes	8 (7.1%)	26 (5.8%)	34 (6%)
	No	104 (92.9%)	422 (94.2%)	526 (94%)
Polyhydramnios	Yes	1 (0.9%)	4 (8.9%)	5 (0.9%)
	No	111 (99.1%)	444 (99.1%)	555 (99.1%)
Time since last CS (N=34)	<12 months	1 (12.5%)	4 (15.4%)	5 (14.7%)
	>12 months	7 (87.5%)	22 (84.6%)	29 (85.3%)
Pre-op hemoglobin (N=560)	<7	1 (0.9%)	7 (1.6%)	8 (1.4%)
	>7	111 (99.1%)	441 (98.4%)	552 (98.6%)
Chorioamnionitis (N=560)	Yes	7 (6.2%)	10 (2.2%)	17 (3.04%)
	No	105 (93.8%)	438 (97.8%)	541 (96.6%)

ANC: antenatal care; CS: cesarean section.

**Table 3.** Labor and delivery-related characteristics among mothers who gave birth in Jinka and Arba Minch General Hospitals, SNNPR, Ethiopia, 2017/2018.

Variables	Risk factor	Case	Control	Total (%)
		Frequency (%)	Frequency (%)	
Parity	Primiparity	8 (7.14%)	163 (36.38%)	171 (30.5%)
	Multiparity	104 (92.86%)	285 (63.6%)	389 (69.5%)
Partograph use (N=560)	Yes	104 (92.86%)	414 (92.4%)	518 (92.5%)
	No	8 (7.14%)	34 (7.6%)	42 (7.5%)
Duration of labor (N=518)	<18h	38 (36.5%)	381 (92%)	419 (80.9%)
	>18h	66 (63.5%)	33 (8%)	99 (19.1%)
Obstructed labor (N=560)	Yes	94 (83.9%)	22 (4.9%)	116 (20.7%)
	No	18 (16.1%)	426 (95.1%)	444 (79.3%)
Malpresentation (N=560)	Yes	42 (37.5%)	33 (7.4%)	75 (13.4%)
	No	70 (62.5%)	415 (92.6%)	485 (86.6%)
Instrumental delivery (N=560)	Yes	3 (2.7%)	41 (9.2%)	44 (7.9%)
	No	109 (97.3%)	407 (90.8%)	516 (92.1%)
Onset of labor (N=560)	Spontaneous	107 (95.5%)	409 (91.3%)	516 (92.1%)
	Induction	5 (4.5%)	39 (8.7%)	44 (7.9%)
Trial of labor (N=34)	Yes	7 (77.8%)	15 (60%)	22 (64.7%)
	No	2 (22.2%)	10 (40%)	12 (35.3%)
Birth weight (N=560)	<2.5 kg	2 (1.8%)	20 (4.5%)	22 (3.9%)
	2.5–3.99 kg	86 (76.8%)	391 (87.3%)	477 (85.2%)
	≥4 kg	24 (21.4%)	37 (8.3%)	61 (10.9%)

**Table 4.** Determinants of uterine rupture in Jinka and Arba Minch General Hospitals.

Variables	Responses	Cases	Controls	cOR (95% CI)	aOR (95% CI)
		Frequency (%)	Frequency (%)		
Age	<20	11 (9.8%)	113 (25.2%)	0.1 (0.04–0.3)	0.2 (0.6–1.9)
	21–35	90 (80.4%)	323 (72%)	0.3 (0.1–0.7)	0.4 (0.09–1.6)
	>35	11 (9.8%)	12 (2.8%)		
Referral	Yes	98 (87%)	144 (32.1%)	14.8 (8.2–26.8)	8* (3.5–18.6)
	No	14 (12.5%)	304 (67.9%)		
Parity	Primiparity	8 (7.14%)	163 (36.4%)		
	Multiparity	104 (92.86%)	285 (63.6%)	7.4 (3.5–15.7)	12.7 (4.2–39.0)
Number of ANC visits (N=517)	<4	22 (27.2%)	68 (15.6%)	2 (1.2–3.5)	1.7 (0.8–4)
	≥4	59 (72.8%)	368 (84.4%)		
Gestational age (N=536)	Preterm	6 (5.9%)	62 (14.25%)		
	Term	95 (94.1%)	373 (85.75%)	2.6 (1.1–6.1)	5.2 (1.4–19.3)
Chorioamnionitis	Yes	7 (6.2%)	10 (2.2%)	2.9 (1.08–7.85)	1.1 (0.12–10.0)
	No	105 (93.8%)	438 (97.8%)		
Duration of labor (N=518)	Less than 18h	38 (36.5%)	381 (92%)		
	More than 18h	66 (63.5%)	33 (8%)	0.05 (0.03–0.09)	11.8* (5.5–25.3)
Malpresentation	Yes	42 (37.5%)	33 (7.4%)	7.5 (4.5–12.7)	3.3* (1.4–7.7)
	No	70 (62.5%)	415 (92.6%)		

\*indicates statistical significance.

cOR: crude odds ratio; aOR: adjusted odds ratio; CI: confidence interval; ANC: antenatal care.

Uganda.<sup>7</sup> As obstructed labor is one of the reasons for prolonged labor inappropriate use of the partograph and lack of early intervention when labor becomes prolonged may lead to uterine rupture.

Mothers with malpresentation were three times more likely to develop uterine rupture. This is supported by studies conducted in Suhul Hospital, Shire<sup>21</sup> and Bahrain.<sup>2</sup> Malpresentation is one of the reasons to obstructed labor and lack of early intervention on malpresentation result in uterine rupture.

Mothers with term pregnancy and above were five times odds of having uterine rupture. This is supported by studies done in Sweden and Norway.<sup>12,16</sup> When gestational age advances, the uterine muscles over distend and are less likely to resist strong uterine contractions. This is more likely to happen in mothers with previous CS.

## Study limitations

Since this study is the facility-based study, the finding may not be generalized to the general population. As the data were taken from patient's medical profile, some variables were missed.

## Conclusion

The finding of this study revealed that mothers referred from health facilities, multiparous mothers, grand multiparous mothers, duration of labor more than 18 h and malpresentation were significantly associated with uterine rupture.

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## Author contributions

G.G.1 contributed to the initiation of the study, design, implementation, analysis and writing up of the manuscript. T.G. participated in designing of the study, data collection, data analysis and writing up of the manuscript. G.G.2 contributed to initiation of the study, designing, data analysis and writing up of the manuscript. B.A. and G.T. participated in designing of the study, data collection, data analysis and writing up of the manuscript. All authors read and approved this manuscript.

## Availability of data and materials

The data sets used and/or analyzed during this study are available from the corresponding author on reasonable request.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

## Ethical approval and consent to participate

The study was approved by the Arba Minch University College of Medicine and Health Science Ethical Review Board. Both Gamo and South Omo zonal health offices gave permission for

data collection in Arba Minch and Jinka General Hospitals. Data were kept confidentially. There were no under 16 aged participants, and since we extracted the information from the cards, consent is taken from the hospital administrators only.

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