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Original article

Determinants of preterm birth among mothers who gave birth at Shiek Hassan Yabare Referral Hospital in Jigjiga town, Eastern Ethiopia: Unmatched case-control study

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Abstract

Background: *: Complications of prematurity are one of the leading causes of death in children under the age of five across the world. Preterm delivery can cause cognitive impairment, attention deficit hyperactivity disorder, hypoxic-ischemic encephalopathy, neurocognitive deficits, and poor academic performance in children. All of these problems lead to poor quality of life and long-term health effects. Despite significant reductions in neonatal mortality in Ethiopia, preterm birth rates remain high. The objective of the study is to identify the determinants of preterm birth among mothers who gave birth at Sheik-Hassen Yebere Jigjiga University Referral Hospital from June 1 to July 30, 2021 .*

Methods : *An unmatched case-control study design was employed among 381 mothers (127 cases and 254 controls) who delivered at Sheik-Hassen Yebere Jigjiga University Referral Hospital in Jigjiga Town between January 1, 2018, and December 31, 2019. The medical records of eligible participants were randomly selected using a computer-generated simple random sampling method. Both bivariate and multivariable logistic regression models were used, and independent determinants were determined based on adjusted odds ratios with 95% confidence intervals and a p-value of less than 0.05 .*

Results: *A total of 381 charts were reviewed, 127 cases, and 254 controls. The mean gestational age was 32.5+2.57SD and 39+2.57SD weeks for preterm and term respectively. History of less than or equal to 4 ANC visits (AOR 6.43 CI 3.1-13.20), male fetus (AOR 2.04, 95% CI 1.2-5.2), reside in rural areas (AOR 2.51, 95% CI 1.4-6.74), maternal hemoglobin level <11mg/dL (AOR 3.32, 95% CI 1.4- 13.2), neonates who had congenital birth defects (AOR 3.49 CI 1.4.4-8.68) were significantly associated with preterm birth.*

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Conclusion: *Based on the factors that contribute to preterm birth, it is important to encourage pregnant women to regularly take iron and folic acid supplements and to attend their scheduled antenatal care visits. In addition, improving healthcare accessibility in rural regions is crucial.*

Keywords: Preterm birth, Jigjiga town, Determinants, Neonates, Prematurity

Background

Preterm delivery is defined as giving birth before 37 weeks of gestation or fewer than 259 days from the first date of the maternal last menstrual period (1). Every year, 15 million newborns are born prematurely, with over 80% of births occurring between 32 and 37 weeks of gestation. In 2020, 13.4 million preterm births occurred, with over 1 million premature complications resulting in death(2).

The World Health Organization (WHO) has reported that the prevalence of preterm birth in 2020 varies from 4% to 16 % among different regions. However, the burden of preterm birth is significantly higher in low- and middle-income countries, particularly in Sub-Saharan Africa and Asia(3). In these regions, the rate of preterm birth exceeds 10%, which is twice as high as the rate in developed countries. In Ethiopia alone, there are 320,000 premature births each year, resulting in the death of 24,000 children under the age of five due to complications related to preterm delivery(4).

Premature birth is a major contributor to child mortality worldwide, accounting for more than 1 in 5 of all deaths among children under the age of five(1). It can result in various complications such as cognitive impairment, attention deficit hyperactivity disorder, difficulty in feeding, poor body temperature regulation, hypoxic-ischemic encephalopathy, neurocognitive deficits, and academic underachievement in children(5-7). These issues ultimately lead to a diminished quality of life and long-lasting health consequences(8).

Numerous studies conducted globally have identified several risk factors for preterm birth. These include substance use during pregnancy, being pregnant with multiples, short gaps between pregnancies, previous preterm births, short cervixes, pregnancy-related complications like diabetes and hypertension, as well as lifestyle factors like low pre-pregnancy maternal weight(3, 4, 7, 9). However, in many cases, the exact cause remains idiopathic(2).

Despite the World Health Organization (WHO) releasing new recommendations for the care of premature infants, the rates of preterm birth and the mortality rates associated with complications from preterm birth remain elevated. Consequently, it is crucial to prioritize understanding the underlying causes of preterm birth to improve health outcomes for both mothers and infants. There is a lack of research in this field, particularly in the study area, regarding the factors that contribute to preterm birth. Additionally, most studies conducted in Ethiopia have utilized a cross-sectional study design, whereas our study employed a case-control study design. Thus, this

study aimed to identify the determinants of preterm births in Jigjiga, town, eastern Ethiopia.

Methods

Study setting, period, and design

The study was conducted in public hospitals in the of Jigjiga town. Jigjiga is the capital city of the Somali Region and is located 631.4 kilometers from Addis Abeba, Ethiopia's capital. The town has a total of sixteen health facilities, including one regular public hospital, one referral hospital, and 14 health posts. The Jigjiga University Shiek Hassan Yabare Referral Hospital, which is affiliated with the university, serves the populations of the Somali Region and nearby areas. This hospital has 282 beds and provides a wide range of services, including outpatient care, hospitalization, delivery services, and emergency care. An institution-based unmatched case-control study design was employed from June 1 to July 30, 2021.

Population and Eligibility criteria

The study population were women who gave birth at the hospital from January 1, 2018, to December 31, 2019. Cases were defined as women who delivered before 37 weeks of gestation, while controls were defined as women who delivered at or after 37 weeks of gestation. To identify these women, data from various sources such as the Operation Theater, admission and discharge logbooks, and delivery registers was utilized. Only those women whose hospital records contained complete information about their obstetric conditions were included in the study, while charts with incomplete information and women who delivered before 28 weeks of gestation were excluded.

Sample size and Sampling Technique

The sample size was calculated using EPI Info version 7 statistical software for the double population proportion formula by considering multiple pregnancies as an exposure variable with the following assumptions. The proportion of outcome among cases (P= 23.4%), the proportion of outcome among controls (P= 8.4%), 95% confidence level, 80% power, and the ratio of a case to control 1:2(10).After considering 10% non-retrieved cards, the total sample size was 381, with 127 cases and 254 controls.

Between January 1st, 2018, and December 31, 2019, Shek-Hassen Yebere Jigjiga University Referral Hospital undergone 6249 childbirths. Out of these, 601 neonates were born prematurely during this period. To conduct the study, a sample of 381 medical records was chosen, comprising 127 cases and 254 controls. This sample size was allocated proportionally based on the number of preterm births in each of the two years. The selection of all medical records was done through computer-generated random sampling.

Data Collection Tools and Procedures

In this study, data was gathered by reviewing the medical records of the participants. A structured checklist, which was adapted from previous studies [8, 24, 27], was used to collect data on various factors such as maternal socio- demographics , obstetric history,

gynecologic information, medical factors, and infant characteristics. Prior to data collection, a pretest was conducted at Deghabur hospital on 5% of the medical records to identify any variables that were not recorded and these variables were subsequently excluded from the checklist. The data was collected by 5 trained BSc professional midwives who work at private hospitals.

Operational Definition

Preterm birth: refers to the delivery of a baby between 28 and 37 weeks of gestation.

Full-term birth: refers to newborns who are delivered after completing more than 37 weeks of gestation.

Data quality control

A pretest of the questionnaire was carried out on samples (5% of the total sample size) prior to the real data collection. The study's objectives, data collection methods, and data management strategies were covered in a two-day training session for the supervisors and data collectors. The data collectors were closely supervised on a daily basis. The supervisors and the principal investigator ensured that the collected data was consistent and complete.

Data processing and analysis

The collected data were organized, cleaned, and entered into Epi-data version 3.1. They were then exported to SPSS version 23 for further analysis. Descriptive statistics, such as frequency tables, mean with standard deviation, and percentages, were used to present the data. Bivariable logistic regression analysis was conducted to select candidate variables for the multivariable analysis. Variables with a p-value less than 0.25 were considered for the final model. The multivariable analysis aimed to identify the true effects of the predictor variables on preterm birth. Multi-collinearity was assessed using the variance inflation factor (VIF) and tolerance, but no collinearity effect was found. The Hosmer-Lemeshow goodness of fitness test was used to evaluate the model's fit, and the result ($p = 0.63$) indicated that the model was a good fit. Finally, the strength of the relationships between PTB and predictor factors was evaluated using Adjusted Odds Ratios (AOR) with 95% Confidence Intervals. A p-value less than 0.05 was considered statistically significant.

Results

Socio-demographic characteristics

A total of 381 medical records of mothers were reviewed, with 127 being cases and 254 being controls. The mean maternal age was 25.28, with a standard deviation of $\pm$5 years. The majority of participants in both groups were between the ages of 20 and 34. Most of the respondents, 286 (75.1%), lived in urban areas. The mean gestational age was 32.5 weeks with a standard deviation of $\pm$5 2.57 for cases, The majority of the babies were male, with 195 (51.2%) in total, including 70 (55.1%) in the cases group. The mean weight of the neonates was 3063 grams with a standard deviation of $\pm$831.84 for both cases and controls. The minimum weight recorded was 1000 grams, while the maximum was 5000 grams.

For the controle the mean gestational age was 39 weeks with a standard deviation of ±2.57. The majority of the babies among control were also male 125 (44.9%) (Table 1).

Table 1: Socio-demographic factors among mothers and their neonates at Sh. Hassen Yebere Referral hospital between January 1, 2018, and December 31, 2019 in Jigjiga town, Eastern Ethiopia 2021

Variables	Category	Case N (%)	Control N (%)	Total N (%)
Age Group	<19	14(11%)	38(15%)	52(13.6%)
	20-34	99(78%)	198(78%)	297(78%)
	>35	14(11%)	18(7.1%)	32(8.4%)
Place of residence	Rural	38(29.9%)	25(11.4%)	63(24.9%)
	Urban	89(70.1%)	225(88.6%)	314(75.1%)
Sex of neonate	Male	50(39.4%)	35(13.8%)	195(51.2%)
	Female	77(60.6%)	219(86.2%)	186(48.8%)
weight of the neonate	< 2500gm	70(55.1%)	33(13.0%)	103(27%)
	>2500	57(44.9%)	221(87.0%)	278(73%)

Maternal obstetric and medical factors

Approximately 76 (59.8%) of the case group mothers received ANC follow-up. Among them, 39 (30.7%) of the cases had less than 4 ANC visits. Approximately 95 (74.8%) of the case group mothers were multigravida, and a total of 12 (9.4%) had a history of abortion.

Among the participants, 8 individuals (8.25%) were found to have HIV/AIDS, with 5 (9.26%) from the case group. Furthermore, 24 cases (18.9%) had urinary tract infections during their current pregnancy. Regarding the mode of delivery for mothers, 88 (63.9%) of the cases were delivered through spontaneous vaginal delivery (SVD), while 32 (25.5%) underwent cesarean section (C/S). Additionally, 12 (9.4%) of the cases had a history of previous cesarean section.

Among controls, 117 (46.1%) mothers received ANC follow-up, of which 91 (35.8%) had less than 4 ANC visits, and 187 (73.6%) of the control group were multigravida. Only 6 (2.4%) of the control group mothers had a history of abortion.

Additionally, 3 (6.98%) from the control group were found to have HIV/AIDS, and 13 controls (5.1%) experienced urinary tract infections during their current pregnancy. Moreover, 200 (78.7%) of the control group were delivered through spontaneous vaginal delivery (SVD), while 39 (15.4%) underwent cesarean section (C/S), and 27 (10.6%) had a history of previous cesarean section (Table 2).

Table 2 -Maternal obstetric and medical factors among mothers who gave birth at Sh. Hassen Yebere Jigjiga university referral hospital between January 1, 2018, and December 31, 2019 in Jigjiga town, Eastern Ethiopia 2021.

Variables	Category	Case N(%)	Controls N(%)	Total n (%)
ANC visit	Yes	76(59.8%)	117(46.1%)	193(50.7%)
	No	51(40.2%)	137(53.9%)	188(49.3%)
Number of ANC visits	<4 ANC visit	39(30.7%)	91(35.8%)	130(67.4%)
	> 4 ANC visit	37(29.1%)	26(10.2%)	63(32.6%)
Gravidity	Primigravida	32(25.2%)	67(26.4%)	99(26%)
	Multigravida	95(74.8%)	187(73.6%)	282(74%)
Parity	Primipara	41(32.3%)	69(27.2%)	110(28.9%)
	Multipara	86(67.7%)	185(72.8%)	271(71.1%)
Hemoglobin level	<11d/dl	28(22%)	23(9.1%)	51(25.9%)
	≥11d/dl	99(78%)	231(90.9%)	330(74.1%)
History of previous abortion	Yes	12(9.4%)	6(2.4%)	18(4.7%)
	No	115(90.6%)	248(97.6%)	366(96.1%)
Multiple pregnancies	Yes	16(12.6%)	17(6.7%)	33(8.7%)
	No	111(87.4%)	237(93.2%)	348(91.3%)
Current pregnancy complication	Premature Rupture of Membranes	38(38.0%)	29(29.59%)	67(33.84%)
	Preeclampsia	34(34.0%)	40(40.82%)	74(37.37%)
	APH	19(19.0%)	15(15.31%)	34(17.17%)
	Placenta previa	9(9.0%)	14(14.29%)	23(11.62%)
Maternal medical problem	Hypertension	15(27.78%)	10(23.26%)	25(25.77%)
	Diabetes Mellitus	10(18.52%)	17(39.53%)	27(27.83%)
	HIV seropositive	5(9.26%)	3(6.98%)	8(8.25%)
	Urinary tract infection	24(44.44%)	13(30.23%)	37(38.14%)
Mode of delivery	Spontaneous vaginal delivery	88(63.9%)	200(78.7%)	292(76.6%)
	C-section	32(25.5%)	39(15.4%)	71(18.6%)
	Instrumental	7(5.5%)	15(5.9%)	18(4.7%)
Previous C-section	Yes	12(9.4%)	27(10.6%)	39(10.2%)
	No	115(90.6%)	227(89.4%)	342(89.8%)
PROM	Yes	38(29.9%)	57(22.4%)	95(24.9%)
	No	89(70.1%)	197(77.6%)	286(75.1%)

Neonatal outcome factors

Out of all the neonates that were delivered, 57 (44.9%) of the cases and 29(11.4%) of the control neonates experienced fetal distress. Approximately 23(18.1%) of the cases and 18 (7.1%) of the controls had congenital defects. Additionally, about 12 (9.4%) of the cases and 5 (2.0%) of the controls were deliveries with intrauterine growth restriction (IUGR) (Table 3).

Table 3: Fetal factors among mothers who gave birth at Sh. Hassen Yebere Jigjiga university referral hospital between January 1, 2018, and December 31, 2019in Jigjiga town, Eastern Ethiopia 2021

Variables	Category	Case N (%)	Controls N(%)	Total N(%)
Fetal distress	Yes	57(44.9%)	29(11.4%)	86(22.6 %)
	No	70(55.1%)	225(88.6%)	295(77.4%)
Congenital birth defect	Yes	23(18.1%)	18(7.1%)	41(10.8%)
	No	104(81.9%)	236(92.9%)	340(89.2%)
Intrauterine growth re-	Yes	12(9.4%)	5(2.0%)	17(4.5%)
	No	115(90.6%)	249(98.0%)	364(95.5%)

Determinants of Preterm Birth

All variables that had a p-value of less than 0.25 in the bivariate analysis were included in the final model of the multivariable analysis. In the bivariable logistic regression, factors such as congenital birth defects, antenatal care of less than or equal to four visits, rural dwellers, hemoglobin <11mg/dL, antepartum hemorrhage, hypertension, fetal sex, and weight of the neonate were found to be significantly associated with preterm birth.

In the final model of multivariable analysis, variables such as hemoglobin <11mg/dL, being male fetus, having congenital birth defects, antenatal care of less than or equal to four visits, and rural dwellers remained statistically significantly associated with PTB. Accordingly, mothers living in rural areas were twice as likely to have PTB compared to mothers living in urban areas (AOR; 2.512, 95% CI: 1.11, 5.684). Mothers who received ≤ 4 antenatal care visits were six times more likely to have a preterm delivery than mothers who had four or more ANC visits (AOR; 6.426, 95% CI: 3.128, 13.202). Neonates who had congenital birth defects were three times more likely to be delivered prematurely than those who had no congenital birth defects (AOR; 3.491, 95%CI: 1.44, 8.681). Mothers with a hemoglobin level below 11mg/dL were three times more likely to give birth prematurely compared to those with a hemoglobin level of 11mg/dL or higher (AOR; 3.328, 95% CI: 1.459, 7.589). Male newborns were twice as likely to be born prematurely compared to female newborns (AOR; 2.045, 95% CI: 1.042, 4.015) (Table 4).

Table 4: Binary and multivariable logistic analysis of determinates of preterm birth cases and controls in Sh. Hassen Yebere Jigjiga university referral hospital.

Variables	Cases	Controls	Crude OR(95% CI)	Adjusted OR(95% CI)
Congenital birth defects				
Yes	23(18.1%)	18(7.1%)	2.900(1.501,5.602)	3.491(1.4.4, 8.681)**
No	104(81.9%)	236(92.9%)		1
Number of ANC visits				
≥ 4	37(29.1%)	26(10.2%)		1
< 4	90(70.9%)	228(89.8%)	3.605(2.064,6.297)	6.426(3.128,13.20)*
Place of residency				
Rural	38(29.9%)	25(11.4%)	3.313(1.927,5.696)	2.512(1.110,5.684)*
Urban	89(28.3%)	225(88.6%)		1
Hemoglobin Level				
<11 mg/dL	28(22%)	23(9.1%)	2.841(1.595,5.174)	3.328(1.459,7.589)*
≥11 mg/dL	99(78%)	231(90.9%)		1
Antepartum haemorrhage				
Yes	19(15%)	15(5.9%)	2.803(1.372,5.725)	4.154(0.708,10.105)
No	108(85%)	239(94.1%)		1
Chronic hypertension				
Yes	15(11.8%)	10(3.9%)	3.268(1.424,7.500)	4.0 (0.459,7.589)
No	112(88.2%)	244(96.1%)		1
Fetal Sex				
Male	50(39.4%)	35(13.8%)	4.063(2.455,6.726)	2.045(1.042, 5.015) **
Female	77(60.6%)	219(86.2%)		1
Weight of the neonate				
≤ 2500gm	70(55.1%)	33(13.0%)	8.224 (4.958,13.642)	10.624(0.395,20.922)
>2500gm	57(44.9%)	221(87.0%)		1

***Key**: 1= Reference category* *=p-value<0.05, **=p-value<0.001, ***=p-value<0.0001, COR= Crude odds Ratio, AOR= Adjusted Odds Ratio

Discussion

This study identified residing in rural areas, having a maternal hemoglobin level below 11mg/dL, being male, having congenital birth defects, receiving antenatal care of fewer than four visits as a determinant of preterm delivery.

The findings of this study indicate that mothers who were rural dwellers have twice the risk of preterm birth compared to mothers who were urban dwellers. This aligns with previous study conducted in Australia(11). This can be explained by the fact that rural areas have limited availability and access to health services, resulting in delayed initiation of antenatal care during pregnancy. Additionally, women living in rural areas may have inadequate maternal nutrition due to limited access to information about the benefit of dietary diversification during pregnancy.

Mothers whose most recent hemoglobin level below 11gm/dl had a three times higher chance of giving birth prematurely compared to those with a hemoglobin level of 11gm/dl or higher. This finding is in line with similar studies conducted in Tigray, debremarkos , Indonesia, and Malawi(12-16). This could be due to the fact that when a pregnant woman has low levels of hemoglobin, it can induce stress for both the mother and the fetus. This stress can then lead to the release of the cortisol hormone, which can trigger premature birth.

Neonates who had congenital birth defects were three times more likely to be delivered prematurely than those who had no congenital birth defects. This is inline with a study done in the US(17). This could be a result of certain birth defects that impact the structure of the uterus, causing it to be incapable of sustaining a pregnancy until full term. Furthermore, some birth defects can result in pregnancy complications like preeclampsia or abnormalities in the placenta, which can increase the likelihood of premature birth.

Mothers who had less than four antenatal care (ANC) follow-up visits were found to be six times more likely to give birth prematurely. This finding aligns with similar studies conducted in Ghana, Jimma, Debretabor, and Tigray(10, 18-20). The reason for this increased risk may be that mothers with inadequate ANC follow-up miss out on important information, early detection, diagnosis, and treatment that could prevent preterm birth.

Neonatal sex is one factor predisposing to preterm birth. This study revealed that being male neonatal has two times risk to be born preterm than those of females. Our find is consistent with a review conducted by Månsson, Johanna, et al.(21). This could be due to the difference in hormone levels between male and female newborns. Male fetuses tend to have higher levels of testosterone, which may create an unfavorable environment in the uterus and increase the risk of preterm birth.

Conclusion

This study found that factors such as having less than or equal to 4 ANC visits, maternal

hemoglobin level <11mg/dL, being male fetus, having congenital birth defects, living in rural areas, were found to contribute to preterm birth. So, it is important to encourage pregnant women to regularly take iron and folic acid supplements and to attend their scheduled antenatal care visits. In addition, improving healthcare accessibility in rural regions is also crucial.

Declaration

Ethical Approval

The Institutional Health Research Ethics Review Committee (IHRERC) of Jigjiga University granted ethical clearance for the study. Additionally, a permission letter was obtained from the medical director of Shek Hassen Yebere Jigjiga University Referral Hospital to access medical records. To ensure confidentiality, all names and personal identification information were excluded from the data collection record.

Contribution of author

SM conceived the idea for this study, developed the proposal, supervised fieldwork, and was involved with the analysis, interpretation, and writing. SM, EL,ML and DA contributed to the conceptualization of the study, methodology, writing final draft, writing - review & editing of the manuscript.

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Availability of data and materials

All relevant data are included in this study. However, additional data is available from the corresponding author upon reasonable request.

Conflict of interest

There is no conflict of interest

Funding : No funding

Abbreviations

Abbreviations: ANC, Antenatal Care; AOR, Adjusted Odds Ratio; CI, Confidence Interval; COR, Crude Odds Ratio; HIV, human immunodeficiency virus ; PTB, Preterm Birth; PROM, Premature Rupture of Membranes; SPSS, Statistical Package for Social Science; SVD, Spontaneous vaginal delivery ;WHO, World Health Organization.

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