Magnitude of spontaneous preterm birth and its associated factors among preterm birth in NICU wards in Asella Teaching and Referral Hospital, Asella, Oromia, Ethiopia

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Abstract

Objective: To assess the prevalence of spontaneous preterm births and to identify the associated risk factors.

Methods: This single-centre cross-sectional study enrolled women that experienced a preterm birth as registered on the neonatal log-book between 30 December 2019 and 30 December 2020. A pre-tested structured checklist was used to collect data (sociodemographic characteristics; obstetric-related factors; medical history; and pregnancy-related factors). Bivariate logistic regression analyses were applied to identify factors associated with spontaneous preterm birth. A multivariate model identified significant independent risk factors.

Results: A total of 310 patients participated in the study. The prevalence of spontaneous preterm birth in this population was 67.1% (208 of 310; 95% confidence interval [CI] 61.5, 71.9).

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Patients without a partner (adjusted odds ratio [AOR] = 1.470, 95% CI 1.23, 4.42), patients residing in a rural area (AOR = 2.51, 95% CI 1.123, 5.513) and those with a history of PIH during their current pregnancy (AOR = 0.104, 95% CI 0.053, 0.014) were significantly more likely to have a spontaneous preterm birth.

Conclusion: The prevalence of spontaneous preterm birth in in this study was high. Healthcare providers and all stakeholders should focus on screening pregnant women at the risk of spontaneous preterm birth.

Introduction

Preterm birth is defined by the World Health Organization (WHO) as all viable births before 37 completed weeks of gestation since the first day of woman's last menstrual period.[1] Preterm birth can be classified as spontaneous or provider initiated (induced) based on the onset of labour.[1] Spontaneous preterm birth is defined as beginning labour with an intact or pre-labour rapture of the membrane and birth before 37 weeks of gestational age.[1]

Globally, from among 12.9 million of all preterm births, approximately 0.5 million were in each of Europe and North America and 0.9 million in Latin America and the Caribbean.[2] Approximately 85% of all global preterm births occur in Africa and Asia.[2] Preterm birth-related mortality is high particularly in low- and middle-income countries, particularly in Southeast Asia and sub-Saharan Africa.[3] The rates of preterm birth are increasing in many countries.[3] Preterm birth is a major public health problem with 28% of the 4 million annual early neonatal deaths being due to preterm birth.[4]

According to the WHO, the estimated prevalence of spontaneous preterm birth ranges from 5% to 18% across 184 countries.[5] From those 184 countries, Brazil, USA, India and Nigeria are among the top ten countries with the highest numbers of spontaneous preterm births.[5]

In 2016, the under-five mortality rate in low-income countries was 76 deaths per 1000 live births whereas it was only 7 deaths per 1000 live births in high-income countries.[6] preterm birth has many long- and short-term consequences, including cerebral palsy, mental retardation, visual and hearing impairments, behaviour and social-emotional concerns, learning difficulties, poor health and poor growth.[7] In addition, neurosensory deficits (blindness, deafness), intraventricular haemorrhage, necrotizing enterocolitis and delay in physical and mental development are among its consequences.[7] Furthermore, spontaneous preterm birth also leads to prolonged hospital stays after birth, frequent hospital admissions that lead to increased risks of chronic illnesses and social and financial burdens for the parents.[8]

According to the Ethiopian Demographic Health Survey, neonatal mortality in Ethiopia showed a prevalence of 77% to 48% from 2005 to 2016,

respectively.[9–11] From 35.5% of neonatal mortality, approximately 11.1% were due to preterm birth in Jimma, southeastern Ethiopia.[12] Moreover, Ethiopia is working towards ending preventable deaths of newborns and under-fives by 2030.[13] The survival rates of spontaneous preterm birth around the world are vary.[5] In low-income settings, half of the babies born ≤32 weeks die due to a lack of feasible, cost-effective care, such as warmth, breast feeding support and basic care for infection and breathing difficulties.[5]

Even though the complications of spontaneous preterm are a huge problem globally,[5] only a single study has been conducted on the prevalence of spontaneous preterm birth and its associated factors in Ethiopia.[14] Therefore, this current study aimed to assess the magnitude of spontaneous preterm births and to identify the associated risk factors in the neonatal intensive care unit (NICU) at Asella Teaching and Referral Hospital, Asella, Ethiopia in order to provide up-to-date information to pregnant mothers, researchers, healthcare workers, government officials and relevant stakeholders.

Patients and methods

Study population and study design

This retrospective cross-sectional study enrolled women that experienced a preterm birth as registered on the neonatal log-book in the NICU at Asella Teaching and Referral Hospital, Asella, Ethiopia between 30 December 2019 and 30 December 2020 using systematic random sampling. The inclusion criteria were as follows: (i) preterm birth registered on the neonatal log-book with complete information recorded; (ii) preterm birth registered on the neonatal log-book from 30 December 2019 to 30 December 2020.

The study was conducted at Asella Teaching and Referral Hospital, in the town of Asella, Arsi zone, Oromia regional state, which is approximately 175 km southeast of the capital city Addis Ababa. Asella is located at a latitude and longitude of 7057 I N/3907I E with an elevation of 2430 m. Based on an Asella town health office annual report in 2011, it had an estimated total population of 97 652 of which 49 104 (50.3%) were males and 48 548 (49.7%) were females. An institutional-based cross-sectional study was carried out in the four wards (intensive care unit ward, premature ward, sepsis ward and Kangaroo mother care ward) of the NICU at Asella Teaching and Referral Hospital.

The study protocol was approved by Ethics Committee of Arsi University, Asella, Oromia, Ethiopia (no. AU/H/S/CN/035/12). The identified patient data were recorded by coding rather than the patients name in order to maintained patient confidentiality. Patients were not required to provide informed consent as this was a review of their anonymized data.

Sample size determination

The sample size was calculated using a single population proportion formula with the proportion of spontaneous preterm birth being 66.1%, which was taken from a study conducted in Addis Ababa;[14] and a 95% confidence interval and margin of error of 5%, using the following formula:

$$n = \frac{(Za/2)2xP(1-P)}{d2},$$

Where:
n = desire sample size
Zα/₂ = confidence interval of 95% (1.96)
p = proportion 66.1%
d = margin of error 5%

$$n = \frac{(Za/2)2xP(1-P)}{d2} =$$
$$n = \frac{(1.96)2 * 0.661 * 0.339}{(0.05)2} = 344$$

Since the source population of preterm neonates admitted in Asella Referral and Teaching Hospital were 2072, which were less than 10 000, then the following correction formula was used:

$$nf = \frac{no}{1 + no/N}$$

Where nf = final sample size, no = sample size from above formula (344) = total population (2072)

$$nf = \frac{344}{1 + 344/2072} = 344/1.166 = 295$$

Then a 10% non-response rate was added. This gave a final sample size of 325.

Sampling technique and procedure

Systematic random sampling was employed to review the log-book of neonate registration. During this random sampling, the value of K was calculated using the formula of K = N/n, where N = 2072 (the total of number of preterm neonates registered in the log-book of neonates or study population) and nf = 325 (calculated sample size). Then K = 2072/325 = 6.37, which was rounded up to 7. After this, the first participant was selected by simple random sampling from number 1 to 7 in which number 3 was selected. Then, every seventh medical record from the preterm neonate log-book was reviewed.

Study variables

The dependent variable was spontaneous preterm birth. The independent variables were as follows: (i) sociodemographic characteristics (maternal age, residence and marital status); (ii) mother's healthcare service (antenatal care [ANC] follow-up status, number of ANC visits, Venereal Disease Research Laboratory Test [VDRL], urinary tract infection [UTI]; (iii) obstetric-related factors (parity, gravida, inter-pregnancy interval, onset of labour, gestational age, pregnancy-induced hypertension [PIH], antepartum haemorrhage [APH], premature rupture of membrane [PROM]); (iv) medical-related factors (maternal HIV status, malaria during pregnancy, anaemia [haemoglobin level] during pregnancy, cardiac problems, diabetes mellites [DM], asthma, hypertension).

Operational definitions and data collection

Spontaneous preterm birth was the commencement of labour with an intact or pre-labour rapture of the membrane and birth before 37 weeks of gestational age.[1] The birth interval was defined as the number of months since the previous birth. It was considered as either being short or optimal if the birth interval was <24 months or ≥24 months, respectively.[10]

To ensure the quality of the data, a structured checklist adapted from previous studies was used to collect the data from chart reviews.[14–17] The checklist was structured into four sections: sociodemographic characteristics; obstetric-related factors; medical history; and pregnancy-related factors. A preliminary structured checklist was initially developed in English and translated into the local language (Afan Oromo version); followed by retranslation back into English. Data were collected by four nurses that had Bachelor of Science degrees in nursing and a supervisor with a Master of Science degree in paediatrics and child health nursing. The data collectors received half a day of training on the checklist instruments, method of data collection,

ethical issues and purpose of the study. Completeness and accuracy of data were checked on a daily basis.

Statistical analyses

Data were entered into Epi-data version 4.4.2.1 (EpiData Association, Odense, Denmark) and then exported to IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA) for analysis. The outcome variables were dichotomized and coded as 0 and 1, representing those that did not have a spontaneous preterm birth and those that had a spontaneous preterm birth, respectively. Descriptive statistics like frequency, percentage, and measures of central tendency with the corresponding measure of dispersion (e.g. mean $\pm$ SD) were used for the presentation of sociodemographic and other characteristics. The reporting of this study follows to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.[18]

Binary logistic regression analysis was applied to identify factors associated with spontaneous preterm birth. Then variables with a P-value < 0.25 in the bivariate analysis were entered into the multivariate model to control the effects of confounder/s and to identify independent variables.[19,20] Model fitness was checked using the Hosmer–Lemeshow's goodness-of-fit test ($P = 0.217$), which is the model of goodness of fit. Finally, the variables that had independent correlations with spontaneous preterm birth were identified on the basis of adjusted odds ratio (AOR). A P-value < 0.05 was considered statistically significant.

Results

This study enrolled 310 preterm neonates that were admitted to the NICU wards, which was 95.4% of the target number of 325. The mean $\pm$ SD age of the mothers was 27.77 $\pm$ 11.11 years (Table 1). With regard to maternal age, 215 of 310 (69.4%) were between 20–34 years of age. A total of 261 of 310 (84.2%) patients lived in a rural area. A total of 264 of 310 (85.2%) patients were married and lived with their partner.

A total of 299 of 310 (96.5%) patients had an ANC follow-up for their recent pregnancy. With regard to VDRL testing, 81 of 310 (26.1%) had a positive result (Table 2). A total of 189 of 310 (61.0%) patients had a history of PROM. Regarding birth interval, 157 of 310 (50.6%) patients had a short birth interval. The majority of the pregnancies were planned (234 of 310 patients; 75.5%). A total of 151 of 310 (48.7%) patients had a gestational age between 32–36 weeks (Table 3).

The proportion of spontaneous preterm birth in this study was 67.1% (208 of 310; 95% confidence interval [CI] 61.5, 71.9).

Among the 310 patients, 23 (7.4%) tested positive for HIV, 128 (41.3%) had anaemia and 12 (3.9%) had a history of DM (Table 4).

Table 1. Sociodemographic characteristics of patients ($n = 310$) that were enrolled in a study to determine the magnitude of spontaneous preterm births and to identify the associated risk factors in the neonatal intensive care unit at Asella Teaching and Referral Hospital, Asella, Ethiopia.

Characteristic	Study cohort $n = 310$
Maternal age, years	
≤ 19	42 (13.5)
20–34	215 (69.4)
≥ 35	53 (17.1)
Residence	
Urban	49 (15.8)
Rural	261 (84.2)
Marital status	
With a partner	264 (85.2)
Without a partner	46 (14.8)

Data presented as n of patients (%).

Table 2. Healthcare service utilization of patients ($n = 310$) that were enrolled in a study to determine the magnitude of spontaneous preterm births and to identify the associated risk factors in the neonatal intensive care unit at Asella Teaching and Referral Hospital, Asella, Ethiopia.

Characteristic	Study cohort $n = 310$
ANC follow-up	
Yes	299 (96.5)
No	11 (3.5)
Frequency of ANC visit	
1	285 (91.9)
2	9 (2.9)
≥3	5 (1.6)
VDRL	
Positive	81 (26.1)
Nonreactive	229 (73.9)
UTI	
Positive	53 (17.1)
Nonreactive	257 (82.9)

Data presented as n of patients (%).
ANC, antenatal care; VDRL, Venereal Disease Research Laboratory Test; UTI, urinary tract infection.

With regard to factors related to spontaneous preterm birth, bivariate analysis identified the following characteristics that had a *P*-value < 0.25: place of residence (address) of the patients, number of parity, number of gravida, types of pregnancy, history of PIH, a history of PROM, a history of anaemia, a history of cardiac problems and marital status. Maternal age, ANC follow-up, history of VDRL, history of UTI, gestational age, pregnancy status, history of APH, birth interval, maternal HIV status, history of hypertension, history of asthma and history of DM were not significant factors and were not transferred to the multivariate analysis. The multivariate analysis identified marital status, place of residence (address) and history of PIH during current pregnancy as significant factors associated with spontaneous preterm birth (Table 5). The likelihood of having a spontaneous

Table 3. Obstetric-related characteristics of patients ($n = 310$) that were enrolled in a study to determine the magnitude of spontaneous preterm births and to identify the associated risk factors in the neonatal intensive care unit at Asella Teaching and Referral Hospital, Asella, Ethiopia.

Characteristic	Study cohort $n = 310$
Parity	
<1	100 (32.3)
≥2	210 (67.7)
Gravida	
<1	92 (29.7)
≥2	218 (70.3)
Gestational age, weeks	
<28	17 (5.5)
28–31	142 (45.8)
32–36	151 (48.7)
Pregnancy status	
Planned	234 (75.5)
Unplanned	76 (24.5)
Mode of delivery	
Spontaneous vaginal	274 (88.4)
Caesarean section	36 (11.6)
Pregnancy types	
Single	252 (81.3)
Multiple	58 (18.7)
History of APH	
Yes	81 (26.1)
No	229 (73.9)
History of PIH	
Yes	73 (23.5)
No	237 (76.5)
History of PROM	
Yes	189 (61.0)
No	121 (39.0)
Birth interval	
Short	157 (50.6)
Optimal	153 (49.4)

Data presented as n of patients (%).
APH, antepartum haemorrhage; PIH, pregnancy-induced hypertension; PROM, premature rupture of membrane.

preterm birth among patients without a partner was almost twice ($AOR = 1.470$, 95% CI 1.23, 4.42; $P = 0.037$) that of those patients with a partner. Patients residing in a rural area were twice ($AOR = 2.51$, 95% CI 1.123, 5.513; $P < 0.001$) as likely to

Table 4. Medical-related characteristics of patients ($n = 310$) that were enrolled in a study to determine the magnitude of spontaneous preterm births and to identify the associated risk factors in the neonatal intensive care unit (NICU) at Asella Teaching and Referral Hospital, Asella, Ethiopia.

Characteristic	Study cohort $n = 310$
HIV positive	23 (7.4)
Hypertensive	19 (6.1)
Anaemic	128 (41.3)
Asthma	4 (1.3)
Cardiac disease	7 (2.3)
Diabetes mellitus	12 (3.9)

Data presented as n of patients (%).

experience a spontaneous preterm birth than those living in an urban area. Patients with a history of PIH during their current pregnancy were 89.6% (AOR = 0.104, 95% CI 0.053, 0.014; $P < 0.001$) less likely to have a spontaneous preterm birth compared with those without a history of PIH.

Discussion

The primary objective of this study was to assess the prevalence of spontaneous preterm birth and its associated risk factors in Asella Teaching and Referral Hospital, Asella, Ethiopia between 30 December 2019 and 30 December 2020. The prevalence of spontaneous preterm birth in the current study was 67.1% (95% CI 61.5, 71.9), which was higher than that reported by a study conducted in Nigeria (57%).[21] The possible cause of this difference could be the use of intervention for pregnant mothers during ANC follow-up compared with the previous study.[21] Furthermore, there could be the differences in the sociodemographic characteristics of the study population compared with the previous study.[21] This current study also had a higher prevalence of spontaneous preterm

birth than a study conducted in Denmark (51%).[22] A possible reason for the variation between the studies might be due to the study participants. For example, the study conducted in Denmark only enrolled primiparous, singleton and low-risk women.[22] This could have resulted in an underestimation of the prevalence of spontaneous preterm births.[22] The current prevalence was also higher than that reported by a study conducted in Brazil (35.9%).[23] This inconsistency between the studies might also be due to differences in the two study populations, such as sociodemographic and behavioural characteristics. In contrast, the prevalence of spontaneous preterm birth was lower in the current study compared with a study conducted in Canada (85.5%).[24] The difference could have been due to there being a different study design in the Canadian study, which used a retrospective population-based cohort design.[24] In addition, the Canadian study enrolled singleton deliveries only, which might have impacted on the study outcomes.[24] The prevalence of spontaneous preterm birth in the current study was inconsistent with studies conducted in Birmingham, Alabama, USA (67.3%),[25] Brazil (62.4%),[26] Third Affiliated Hospital of Zhengzhou University, China (61.5%),[27] Addis Ababa (66.1%)[14] and Lusaka, Zambia (68.9%).[28]

The likelihood of a having spontaneous preterm birth among mothers without a partner was almost twice that of mothers with a partner (AOR = 1.470, 95% CI 1.23, 4.42; $P = 0.037$) in the current study. Mothers with a partner are more likely to detect signs of medical problems during pregnancy and take early preventive action during ANC service utilization, which might decrease the chance of having a spontaneous preterm birth.[14] Mothers with a partner have support or encouragement about health-related service utilization during pregnancy from their partner

Table 5. Bivariate and multivariate logistic regression analyses of factors associated with spontaneous preterm birth in patients ($n = 310$) that gave birth at Asella Teaching and Referral Hospital, Asella, Ethiopia between 30 December 2019 and 30 December 2020.

Variables	Category	Spontaneous preterm		COR (95% CI)	P-value	AOR (95% CI)	P-value
		Yes $n = 208$	No $n = 102$				
Residence	Rural	186 (71.3%)	75 (28.7%)	3.044 (1.632, 5.678)	$P < 0.001$	2.51 (1.123, 5.513)	$P < 0.001$
	Urban	22 (44.9%)	27 (55.1%)	1 (reference)	—	—	—
Parity	1	62 (62.0%)	38 (38.0%)	1 (reference)	—	—	—
	≥2	146 (69.5%)	64 (30.5%)	1.39 (0.849, 2.304)	$P = 0.188$	2.006 (0.396, 10.163)	$P = 0.4$
Gravida	1	57 (62.0%)	35 (38.0%)	1 (reference)	—	—	—
	≥2	151 (69.3%)	67 (30.7%)	1.384 (0.831, 2.304)	$P = 0.212$	0.652 (0.124, 3.423)	$P = 0.613$
Pregnancy types	Single	174 (69.0%)	78 (31.0%)	1 (reference)	—	—	—
	Multiple	34 (58.6%)	24 (41.4%)	0.635 (0.353, 1.142)	$P = 0.129$	0.717 (0.359, 1.432)	$P = 0.345$
History of PIH	Yes	21 (28.8%)	52 (71.2%)	0.108 (0.06, 0.196)	$P < 0.001$	0.104 (0.053, 0.014)	$P < 0.001$
	No	187 (78.9%)	50 (21.1%)	1 (reference)	—	—	—
History of PROM	Yes	141 (74.6%)	48 (25.4%)	2.367 (1.457, 3.847)	$P = 0.001$	1.092 (0.592, 2.014)	$P = 0.778$
	No	67 (55.4%)	54 (44.6%)	1 (reference)	—	—	—
Anaemia	Yes	93 (72.7%)	35 (27.3%)	0.646 (0.395, 1.056)	$P = 0.082$	1.279 (0.716, 2.286)	$P = 0.406$
	No	115 (63.2%)	67 (36.8%)	1 (reference)	—	—	—
Cardiac disease	Yes	2 (28.6%)	5 (71.4%)	0.188 (0.036, 0.988)	$P = 0.048$	0.169 (0.025, 1.145)	$P = 0.069$
	No	206 (68.0%)	97 (32.0%)	1 (reference)	—	—	—
Marital status	With a partner	173 (65.5%)	91 (34.5%)	1 (reference)	—	—	—
	Without a partner	35 (76.1%)	11 (23.9%)	1.674 (0.812, 3.45)	$P = 0.163$	1.470 (1.23, 4.42)	$P = 0.037$

Data presented as n of patients (%).
COR, crude odds ratio; CI, confidence interval; AOR, adjusted odds ratio; PIH, pregnancy-induced hypertension; PROM, premature rupture of membrane.

as compared to those without a partner.[14] For example, medical problems during pregnancy (such as HIV) can increase the risk of experiencing spontaneous preterm birth as compared with pregnant mothers that had no any medical problems during pregnancy.[14]

In the current study, mothers residing in a rural area were twice as likely to experience a spontaneous preterm birth compared with those living in an urban area (AOR = 2.51, 95% CI 1.123, 5.513; $P < 0.001$). A possible explanation for this finding might be that mothers residing in rural areas have little opportunity to access information regarding warning signs of medical conditions that can contribute to spontaneous preterm birth, so they might be unaware of what can go wrong if they do not respond to the warning signs in a timely manner. Also, mothers residing in a rural setting are assumed to have a lower educational status, which could have a negative impact on spontaneous preterm birth. All stakeholders need to focus on this segment of the population to minimize the consequences of spontaneous preterm birth by giving appropriate counselling during ANC service utilization. Mothers with a history of PIH during their current pregnancy were 89.6% (AOR = 0.104, 95% CI 0.053, 0.014; $P < 0.001$) less likely to have a spontaneous preterm birth compared with those without a history of PIH in the current study.

This current study had several limitations. First, it was only a single-centre study conducted to measure the prevalence of spontaneous preterm birth and its associated risk factors in Ethiopia, which makes comparison difficult. There are limited publications globally that discuss the risk factors associated with spontaneous preterm birth.[22,23,28] Secondly, as the study was cross-sectional it did not investigate the cause-and-effect relationship between dependent and independent variables.

This current study will act as the baseline for other researchers that can undertake a similar study in other populations of pregnant women.

In conclusion, the prevalence of spontaneous preterm birth in Asella Teaching and Referral Hospital, Asella, Ethiopia between 30 December 2019 and 30 December 2020 was 67.1%, which is high. Women without a partner, women residing in a rural area and mothers with a history of PIH during their current pregnancy were at significantly greater risk of spontaneous preterm birth. It is hoped that these current findings with encourage healthcare providers to design effective strategies to address these risk factors for women in their care. In order to achieve this, healthcare providers and stakeholders are recommended to screen pregnant women for the risk of spontaneous preterm birth, especially those without a partner, women residing in rural areas and mothers that have a history of PIH. Stakeholders should promote quality healthcare, community-based health education and awareness creation campaigns through women's conferences in order to reduce the prevalence of spontaneous preterm birth and its consequences. Mothers without a partner and those residing in rural areas should attend awareness creation campaigns regarding the consequences of spontaneous preterm birth.

Authors' contributions

A.B.W., B.D.O., D.T.J. and S.T.G. conceived the research idea and prepared the proposal, participated in the data collection process, analysed the data and drafted the paper. T.S.T., G.B.A. and A.D.W. approved the proposal with some modification, took part in the write-up process and reviewed the manuscript. All

authors have reviewed and approved the final version of the manuscript.

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