Risk factors of preterm birth among newborns delivered in public hospitals of Southern Ethiopia: A case-control study

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Abstract

Introduction:

The rate of premature birth appears to have increased over time. Over 3.1 million babies died due to prematurity and its complications. The definite cause of preterm birth remains concealed with a wide setting variation that puts difficulty in drawing the national figure. Hence, this study scrutinized the determinants of premature delivery.

Methods

Unmatched case-control study was employed on 266 newborns. Data were collected using an interviewer-administered questionnaire, entered into Epi data 4.4.2, and analyzed using SPSS 25. Data were analyzed using binary logistic regression. Variables with $p < 0.25$ in the bi-variable analysis were included in the final model. Finally, a p-value of ≤ 0.05 and an AOR with 95% CI was used to declare the statistical significance and strength of associations.

Findings:

An overall 266 mothers of neonates (89 cases and 177 controls) participated in the study with a 98.5% response rate. Having short inter-pregnancy interval [AOR = 4.00;95%CI:1.12,14.21], antepartum hemorrhage [AOR = 7.27;95%CI:2.16,35.50], premature rupture of membrane [AOR = 5.21;95%CI:1.10,24.72], intimate partner violence [AOR = 8.00;95%CI:1.93,33.21], and residing in rural areas [AOR = 3.72;95%CI:1.14,12.18] showed statistically significant association with preterm birth. Thereby, it is essential to strengthen screening and preventive services focusing on mothers who are at risk for obstetric complications such as antepartum hemorrhage and premature rupture of the membrane.

Introduction

Premature birth is defined as alive childbirth before 37 completed weeks of gestation.[1] It can be categorized as extremely preterm (< 28 weeks), very preterm (28 − 3 weeks), and moderate to late preterm (32–36 weeks).[2, 3] Globally, about 15 million preterm babies are delivered each year, of which more than 3.1 million were died due to prematurity and preterm-related complications, which covers 35% of the total neonatal deaths.[2] Greater than 92% of the world's premature deliveries occur in developing countries. Among those, 60% are in South Asian and African countries, and 12.3% are from sub-Saharan African countries.[2, 4] However, the exact cause of preterm birth is not established clearly, and different risk factors are considered to have an association with preterm birth.[2, 4–12]

According to 2019 mini Ethiopian Demographic and Health Survey (EDHS), the neonatal mortality rate was 30 deaths per 1,000 live births, in which prematurity was the major killer.[13] Surviving infants after

preterm births also suffer from short and long-term disabilities such as cerebral palsy, mental retardation, breathing difficulties, feeding problems, jaundice, visual and hearing impairments, and poor health and growth. Moreover, prematurity has a huge burden at an individual and household level, communities, health care institutions, and a nation at large.[2, 4]

Different programs and interventions targeting primary prevention and risk minimization were initiated to improve the care of preterm neonates. World Health Organization (WHO) has developed guidelines in 2016 with recommendations for improving outcomes of preterm births.[14] The global strategy for women's, children's, and adolescents' health and Sustainable Development Goals (SDGs) are planned and are being implemented to reduce newborn and under-five mortality to 12 and 25 per 1,000 live births every year respectively by 2030.[15, 16] These activities generally include provision of antenatal corticosteroid, antibiotic, kangaroo mother care, immediate intensive care unit and long-term complex health services for preterm birth.[4, 17] Ethiopia also designed the national strategy for newborn and child survival by designing standard maternal and neonatal interventions during pregnancy, labor, Neonatal Intensive Care Unit (NICU), and postnatal periods by incorporating the sustainable development goals.[18, 19]. Nevertheless, none of these strategies addressed the behavioral and maternal lifestyle factors that could lead to premature birth.

Despite several efforts to prevent and reduce preterm birth, its rate appears to have increased over time.[2] Hence, to be successful, the risk factors should be identified, prioritized, and well addressed. Yet, previous studies conducted in Ethiopia focused mainly on the magnitude of preterm birth, rather than its determinants and recommended further analytical studies.[10, 12, 20] Moreover, available studies conducted on risk factors missed to evaluate the effect of pertinent variables such as intimate partner violence, behavioral, and stressful life events, which were reported as determinants of preterm birth in other studies conducted abroad.[11, 12, 21] Therefore, our study aimed to determine the determinants of prematurity among newborns.

Methods And Materials

Study design, area, and period

A facility-based unmatched case-control study was employed in Hawassa, which is found in Southern Ethiopia about 270Km from Addis Ababa, covering 157.2Km^2 areas. There are six hospitals in Hawassa. The study was done at Hawassa University compressive specialized hospital and Adare hospital. Those hospitals serve around 18 million people and are sites for practical training for students and health professionals. Both hospitals provide antenatal care follow-up and delivery services for the catchment and referred cases. The maternal and child health care team consists of 9 gynecologists and 40 midwives in both hospitals. On average, about 16 mothers bring birth daily in the two hospitals. The study was conducted from January to July 2020.

Study population

Cases were all mothers of newborns who gave live birth between 28 and 36 completed weeks of gestation during the study period.

Controls include mothers of newborns who gave live birth on and after 37 completed weeks of gestation during the study period. Women who gave stillbirth had difficulty communicating, and those who had been seriously ill during the study period were excluded.

Sample size determination and sampling procedure

Epi info version 7.2.2 was used to determine the required sample size based on the following assumptions: 95% confidence level, 80% power, and 1:2 ratios of cases to controls. Having less than four ANC visit that was significantly associated with preterm birth in the previous study[11], which brought the largest sample size with percentage exposed among the controls = 88.4%, percent of exposed among the cases = 92.2%, and adjusted odds ratio = 4.8 was considered to determine the sample size that yields 256. After adding a 5% non-response rate, the total sample size required to conduct the study was 270 (90 cases and 180 controls). The calculated sample size was proportionally allocated to each hospital with their previous two-months delivery report (Hawassa University specialized hospital = 159 and Adare hospital = 111). Then, cases (pre-term neonates) were selected randomly, whereas controls (term neonates) were selected systematically among term newborns traced consecutive to the selected case. The sampling interval for the controls was found by dividing the past two months' case flow by the calculated sample size. An overall 921 neonates (153 preterm and 768 term neonates) were delivered in both hospitals from January 2020 to the end of February 2020, which brought 768/180 = 4. Hence, every 4th term newborn consecutive to the selected preterm baby was incorporated as a control. The first control (term neonate) was selected randomly using the lottery method.

Operational definition

Cases (preterm babies) were neonates who were born alive between 28 and 36 completed weeks of gestation, whereas **controls (term babies)** were neonates born alive between 37 and 42 weeks of gestation[2] that confirmed by duty clinicians using either last normal menstrual period, ultrasound, or Ballard score. **Medical problems** were any chronic or acute health problems confirmed during or before the current pregnancy. **Birth interval** is the interval between the delivery of the previous child and the recent pregnancy and was categorized as **short** (< 2 years) and **medium to long** (≥ 2 years). **Substance use** refers to using one or more addictive substances such as alcohol, khat, cigarette, and other drug intakes. Mothers were declared users if they used substances four days per week (daily user) or two days per week for a month (weekly user). **Medication use during pregnancy** was any medication(s) intake during pregnancy, including prescribed, over-the-counter, and traditional medication(s) (excluding vitamins, iron and folic acid supplementation, and vaccinations). **The vigorous intensity of activities** refers to activities that cause a huge impact on the maternal effort, such as carrying or lifting heavy loads, involving in construction works, or prolonged standing during pregnancy. **Stressful life events**

imply for any event that could impose a negative impact on pregnant women, such as sickness, separation, and death of a family member. **Intimate partner violence** was any physical, sexual, or psychosocial violence encountered by pregnant women from their intimate partner.

Data collection tools and procedures

The data was collected using a structured interviewer-administered questionnaire. The questionnaire was developed by reviewing related literature and articles. It comprised questions to assess socio-demographic, preexisting and obstetric maternal conditions, fetal and neonatal characteristics, maternal lifestyles, and behavioral factors as well as intimate partner violence variables. The data were collected through face-to-face interviews, and measurements were taken following the interview. Averagely, 45 to 50 minutes were required to complete each questionnaire. Data on medical, obstetrics, and management history was extracted from medical records. The same interviewer was used to interview both cases and controls to minimize information bias.

Data quality assurance

The questionnaire was prepared in English and translated to local languages (Sidamigna and Amharic), and reverse translation was done to English to check the consistency. One week before the data collection, the questionnaire was pre-tested by the principal investigator on 10% of the samples (9 cases and 18 controls) at Dilla University referral hospital to assure the consistency and clarity of the tool, where unclear items were modified accordingly. Four BSc midwives and nurses were recruited as data collectors, and two nurses (MSc fellow) were assigned for supervision. A one-day training was given for data collectors and supervisors about the research objective, eligible study subjects, data collection tools and procedures, and interview methods. Data collection was coordinated and appraised by the supervisors and principal investigator. The completeness of the collected data was checked daily.

Data processing and analysis

The analysis was conducted using SPSS version 25 after completing data entry using Epi data version 4.4.2. Exploratory analyses of the entered were carried out to determine the nature of data, such as normality and the presence of outliers, and the level of missing values. Then, the data were described using relative frequency, percent, and median with interquartile range (IQR). Binary logistic regression was used to conduct bi-variable and multivariate analysis. In the bi-variable analysis, variables with p-values < 0.25 were scrutinized and fitted to multivariate analysis to identify the independent effects of each covariate on preterm birth. Multi-collinearity was investigated using the variance inflation factor, and the model fitness to the data was checked using Hosmer and Lemeshow test. In multivariate analysis, statistical significance was declared at $p < 0.05$, and the presence and strength of associations were summarized using an adjusted odds ratio with 95% confidence intervals. Finally, study findings were displayed in texts, tables, and graphs.

Ethical Considerations

Addis Ababa University, College of health sciences, institutional review board (IRB) offered the ethical clearance paper. A letter of cooperation was received from the school of nursing and midwifery. Permission to conduct the study was obtained from the Southern nations' nationalities and people regional health bureau, clinical director of each hospital, matron officers, and labor ward coordinators of selected hospitals. The study was conducted per the declaration of Helsinki. Before data collection, the purpose of the study was described to the study participants. Afterward, verbal and written informed consent was obtained to confirm willingness. Besides, respondents were informed to terminate the interview if they feel discomfort. They were informed that no denial of health service for refusal to participate in the study. Confidentiality and autonomy were assured by coding and aggregate reporting instead of any personal identifiers & were meant only for the study.

Results

Of the estimated 270 samples, 266 subjects (89 cases and 177 controls) participated in the study with a 98.5% response rate. Of the 89 preterm deliveries, 28% (25/89) were early preterm (28–32 weeks), and 72% (64/89) were moderate to late preterm (33-36weeks) with a mean gestational age of 33 and 38 weeks for cases and controls respectively.

Description of socio-demographic characteristics

The study finding showed that 48.3% of the cases were below the age of 24 years, whereas 52% of the controls were between the age of 25 to 34 years. The median age of mothers in this study was 27 years (IQR = 7). The proportion of preterm birth was higher (44.8%) among unmarried mothers (n = 29) than neonates delivered from married mothers (32%, n = 237). Among newborns who were diagnosed with preterm (n = 89), 68.5% were delivered from homemaker mothers, and 41.6% were delivered from mothers who reside in rural areas. Moreover, 32.7% of mothers of neonates' were from rural areas, of which 41.6% (37/87) delivered before 37 weeks of gestation (Table 1).

Table 1
Distribution of maternal socio-demographic characteristics among newborns delivered at public hospitals in Hawassa, Southern Ethiopia, 2020 (N = 266)

Covariates	Category	Outcome variable		
		Preterm (%)	**Term (%)**	**Total (%)**
Maternal age (in years)	15–24	43 (48.3)	51 (28.8)	94 (35.3)
	25–34	37 (41.6)	92 (52.0)	129 (48.5)
	≥ 35	9 (10.1)	34 (19.2)	43 (16.2)
Residence	Urban	52 (58.4)	127 (71.8)	179 (67.3)
	Rural	37 (41.6)	50 (28.2)	87 (32.7)
Marital status	Married	76 (85.4)	161 (91.0)	237 (89.1)
	Single	10 (11.2)	9 (5.1)	19 (7.1)
	Divorced	2 (2.3)	4 (2.2)	6 (2.3)
	Widowed	1(1.1)	3 (1.7)	4 (1.5)
Educational status	Illiterate	1 (1.1)	1 (0.6)	2 (0.8)
	Primary	45 (50.6)	74 (41.8)	119 (44.7)
	Secondary	24 (27.0)	66 (37.3)	90 (33.8)
	Collage & above	19 (21.3)	36 (20.3)	55 (20.7)
Occupational status	Homemaker	61 (68.5)	102 (57.63)	163 (61.3)
	Employed	8 (9.0)	39 (22.03)	47 (17.7)
	Merchant	8 (9.0)	25 (14.12)	33 (12.4)
	Daily labor	12 (13.5)	11 (6.22)	23 (8.6)
Family monthly income	< 1500	9 (10.1)	10 (5.7)	19 (7.2)
	1500–2499	18 (20.2)	31 (17.5)	49 (18.4)
	2500–3499	20 (22.5)	25 (14.1)	45 (16.9)
	≥ 3500	42 (47.2)	111 (62.7)	153 (57.5)

Mothers' lifestyle and obstetric related factors

According to the study results, the median weight and height of mothers of neonates who participated in this study were found to be 61.5kgs (IQR = 4.45) and 160cms (IQR = 6). Ninety-six babies were delivered from primipara mothers, of which 52.1% (50/96) of them were born before 37 weeks of gestation. On the other hand, among multipara mothers (n = 170), 38 (22.4%) mothers brought their last baby before the

two-year interval from the previous delivery. Furthermore, the proportion of preterm birth among mothers who had a history of abortion was 47.5% (19/40). Besides, 48.3% (28/58) of newborns delivered from mothers who had a hemoglobin level of < 11gm/dl were preterm. The highest proportion of preterm neonates, 65.2% (58/89), were born from mothers with MUAC of < 21cm (Table 2).

Table 2
Distribution of maternal lifestyle and obstetric factors among newborns delivered at public hospitals in Hawassa, Southern Ethiopia, 2020 (N = 266)

Independent variables	Category	Outcome status		
		Preterm (%)	**Term (%)**	**Total (%)**
Parity	Primipara	50 (56.2)	46 (26.0)	96 (36.1)
	Multipara	39 (43.8)	131 (74.0)	170 (63.9)
Birth interval	< 2 years	21 (23.6)	17 (9.6)	38 (14.3)
	≥ 2years	18 (20.2)	114 (64.4)	132 (49.6)
Number of ANC visit	None	2 (2.3)	7 (4.0)	9 (3.4)
	≤ 3 visits	52 (58.4)	92 (52.0)	144 (54.1)
	≥ 4 visits	35 (39.3)	78 (44.0)	113 (42.5)
History of abortion	Yes	19 (21.3)	21 (11.9)	40 (15)
	No	70 (78.7)	156 (88.1)	226 (85)
History of stillbirth	Yes	6 (6.7)	10 (5.6)	16 (43.6)
	No	83 (93.3)	167 (94.4)	150 (56.4)
History of preterm birth	Yes	9 (10.1)	13 (7.3)	22 (8.3)
	No	80 (89.9)	164 (92.7)	244 (91.7)
Status of labor	Spontaneous	64 (71.9)	118 (66.7)	182 (68.4)
	Induced	25 (28.1)	59 (33.3)	84 (31.6)
Multiple pregnancies	Yes	9 (10.1)	4 (2.3)	13 (42.5)
	No	80 (89.9)	173 (97.7)	153 (57.5)
Hemoglobin	< 11gm/dl	28 (31.5)	30 (16.9)	58 (21.8)
	≥ 11gm/dl	61 (68.5)	147 (83.1)	208 (78.2)
MUAC	< 21cm	58 (65.2)	77 (43.5)	135 (50.8)
	21-22.9cm	19 (21.3)	53 (29.9)	72 (27.0)
	≥ 23cm	12 (13.5)	47 (26.6)	59 (22.2)
Vigorous activity during pregnancy	Yes	30 (33.7)	46 (26.0)	76 (28.6)

Abbreviation:

ANC, antenatal care; MUAC, mid-upper-arm circumstance; cm, centimeters; IPV, intimate partner violence

	No	59 (66.3)	131 (74.0)	190 (71.4)
Stressful life events during pregnancy	Yes	39 (43.8)	13 (7.3)	52 (19.6)
	No	50 (56.2)	164 (92.7)	214 (80.4)
Alcohol intake during pregnancy	Yes	17 (19.1)	25 (14.1)	42 (14.8)
	No	72 (80.9)	152 (85.9)	224 (85.2)
Chewing chat during pregnancy	Yes	3 (3.4)	5 (2.8)	8 (3.0)
	No	86 (96.6)	172 (97.2)	258 (97)
Medication use during pregnancy	Yes	15 (16.9)	8 (4.5)	23 (8.6)
	No	74 (83.1)	169 (95.5)	243 (91.4)
IPV during pregnancy	Yes	44 (49.4)	24 (13.6)	68 (24.6)
	No	45 (50.6)	153 (86.4)	198 (75.4)
Abbreviation:				
ANC, antenatal care; MUAC, mid-upper-arm circumstance; cm, centimeters; IPV, intimate partner violence				

The study also showed that 28.6% (76/266) of mothers of neonates engaged in the vigorous-intensity of activities, and 19.6% (52/266) of those experienced stressful life events during pregnancy. Of those, 39.5% (30/76) and 75% (29/52) respectively end-up with preterm deliveries. Moreover, 19.1%, 1.1%, 3.4%, and 16.9% of mothers of preterm neonates' consumed alcohol, smoke cigarette, chewed chat, and used medications (either prescribed or over the counter) respectively during pregnancy. Also, 24.6% (68/266) of mothers experienced violence from their intimate partners, while 64.7% (44/68) of them delivered their babies before 36 weeks of gestation (Table 2).

Pre-existing maternal illness and obstetric complications

Of the total study participants (N = 266), only 3 (1.1%), 2 (0.8%), 6 (2.3%), 5 (1.9%), and 13 (4.9%) mothers of neonates had chronic hypertension, (HTN), diabetes (DM), chronic cardiac diseases, chronic mental disorder such as epilepsy, and HIV/AIDS respectively. Among the 22 mothers diagnosed with pregnancy-induced hypertension (PIH), 15 (68.2%) terminate their recent pregnancy at or before 36 weeks of gestation. Furthermore, the proportion of prematurity was two times higher among mothers having antepartum hemorrhage (60%) compared to those who did not have APH (31.8%). The proportion of mothers of neonates having premature rupture of membrane (PROM) was almost four folds higher among cases (37.1%) than in controls (9.6%) (Fig. 1).

Description of the characteristics of the Newborn

Regarding the characteristics of the newborn, about 32.6% (29/89) of preterm neonates had low birth weight (< 2500gm), and less than 4% (7/177) of newborns were born at term with a weight of < 2500gm. The finding also notified that almost 81% (29/36) of newborns weighing below 2500 grams were delivered before 37 weeks. Moreover, the proportion of preterm birth was higher among male neonates (49.2%) compared to females (19.7%). Besides, 24.7% of the cases and 19.8% of the controls had an APGAR score below seven within one minute of delivery, whereas 88.8% of the cases and 92.1% of the controls had an APGAR score of ≥ 7 at the fifth minute. On the other hand, 18 (6.8%) newborns were found to have congenital malformation, of which 44.4% (8/18) of them were premature babies (Table 3).

Table 3
Distribution of neonatal characteristics among newborns delivered at public hospitals in Hawassa, Southern Ethiopia, 2020 (N = 266)

Fetal factors	Category	Outcome status		
		Preterm birth (%)	**Term birth (%)**	**Total (%)**
Sex of the newborn	Male	61 (68.5)	63 (35.6)	124 (46.6)
	Female	28 (31.5)	114 (64.4)	142 (53.4)
Baby weight at birth (in grams)	< 2500	29 (32.6)	7 (4.0)	36 (51.2)
	≥ 2500	60 (67.4)	170 (96.0)	130 (48.8)
Fetal presentation	Vertex	68 (76.4)	145 (81.9)	233 (87.6)
	Breech	20 (22.5)	31 (17.5)	51 (19.2)
	Others	1 (1.1)	1 (0.6)	2 (0.7)
1st min APGAR score	< 7	22 (24.7)	35 (19.8)	57 (21.4)
	7–10	67 (75.3)	142 (80.2)	209 (78.6)
5th min APGAR score	< 7	10 (11.2)	14 (7.9)	24 (9.02)
	7–10	79 (88.8)	163 (92.1)	242 (90.98)
Congenital malformation	Yes	8 (9.0)	10 (5.6)	18 (6.8)
	No	81 (91.0)	167 (94.4)	248 (93.2)

Determinants of preterm birth

On the bi-variable analysis, sex of the baby, rural residence, parity, birth interval, multiple pregnancies, maternal hemoglobin, PIH, APH, PROM, history of abortion, history of uterine surgery, vigorous-intense activities during pregnancy, stressful life events during pregnancy, medication use during pregnancy, and intimate partner violence during pregnancy had a p-value < 0.25. Hence, these variables were fitted to the final model to investigate the net effect of each covariate with prematurity.

Afterward, in the multivariate analysis, residing in rural areas, short birth interval, having APH, PROM, and intimate partner violence (IPV) during pregnancy had a statistically significant association with preterm birth at a 95% confidence level (Table 4).

Table 4
Logistic regression analysis for the determinants of prematurity among newborns delivered at public hospitals in Hawassa, Southern Ethiopia, 2020 (N = 266).

Covariates	Category	Outcome status		COR (95% CI)	AOR (95%CI)	Sig.
		Preterm	Term			
Residence	Rural	52	127	1.81 (1.06–3.08)	3.72 (1.14–12.18)	0.030*
	Urban	37	50	1	1	1
Parity	Primipara	50	46	3.65 (2.13–6.25)	0.24 (0.03–18.86)	0.523
	Multipara	39	131	1	1	1
Birth interval	< 2 years	21	17	7.82 (3.48–17.59)	4.00 (1.12–14.21)	0.032*
	≥ 2 years	18	114	1	1	1
Pregnancy status	Single	80	173	1	1	1
	Multiple	9	4	4.87 (1.46–16.27)	6.57 (0.85–50.84)	0.072
Baby sex	Male	61	63	1	1	1
	Female	28	114	0.25 (0.15–0.44)	3.17 (0.92–10.84)	0.067
Hgb (g/dl)	< 11	28	30	2.25 (1.24–4.08)	1.88 (0.49–7.23)	0.356
	≥ 11	61	147	1	1	1
PIH	Yes	15	7	4.92 (1.93–12.57)	4.39 (0.58–32.98)	0.151
	No	74	170	1	1	1
APH	Yes	9	6	3.21 (1.10–9.32)	7.27 (2.16–35.50)	0.011*
	No	80	171	1	1	1
PROM	Yes	33	17	5.55 (2.87–10.73)	5.21 (1.10-24.72)	0.038*
	No	56	160	1	1	1
Abortion history	Yes	19	21	2.02 (1.02–3.99)	0.25 (0.25–2.47)	0.234
	No	70	156	1	1	1
history of uterine	Yes	5	15	0.51 (0.16–	1.16 (0.14–	0.888

surgery				1.58)	9.62)	
	No	84	162	1	1	1
Vigorous activity	Yes	30	46	1.45 (0.83–2.52)	1.21 (0.31–4.71)	0.786
	No	59	131	1	1	1
Stressful life events	Yes	39	13	9.84 (4.87–19.87)	3.71 (0.87–15.90)	0.078
	No	50	164	1	1	1
IPV during pregnancy	Yes	44	24	6.23 (3.43–11.34)	8.00 (1.93–33.21)	0.004*
	No	45	153	1	1	1
Medication use	Yes	15	8	4.28 (1.74–10.54)	4.62 (0.60-35.34)	0.141
	No	74	169	1	1	1

Mothers who brought birth within two years of previous delivery were four times more likely to have a preterm baby compared to those who prolong their pregnancy more than two years after the birth of their previous child [AOR = 4.00; 95% CI: 1.12–14.21]. The finding also showed that the risk of prematurity among neonates delivered from mothers with APH was 7.27 times higher than their counterparts [AOR = 7.27; 95% CI: 2.16–35.50]. Likewise, the odds of preterm birth were 5.21 times [AOR = 5.21; 95%CI: 1.10-24.72] higher among mothers who experienced PROM than their counterparts. Furthermore, mothers who suffered from IPV were at an increased of preterm birth than those who did not [AOR = 8.00; 95%CI: 1.93–33.21]. The other factor that was independently associated with prematurity was the area of residence. Mothers who reside in rural areas were 3.72 times at an increased risk of bringing premature babies than those who reside in urban settings [AOR = 3.72; 95% CI: 1.14–12.18].

Discussion

The burden of preterm birth remains a public health issue worldwide, and a significant cause of morbidity and mortality among neonates and children.[2, 13] The current study aimed to scrutinize factors that could determine preterm birth. According to the study finding, rural residence, short birth interval, intimate partner violence (IPV) during pregnancy, APH, and PROM during pregnancy showed statistically significant association with preterm birth at a 95% confidence level.

Mothers who brought birth within two years of previous delivery were four times more likely to have a preterm baby compared to those who prolong their pregnancy more than two years after the birth of their earlier child. This finding is consistent with reports of previous studies conducted in Nigeria[22], Baghdad, Iraq[23], Northern Tanzania[24], and a systematic review by Conde-Agudelo et al.[25] Several reasons could be stated for this association. The mother's nutritional status is expected to be depleted because of the

previous pregnancy requiring sufficient time to recover to normal physiological needs. A short birth interval might compromise this recovery time so that the mother could not be able to support the fetus to fulfill growth and development requirements. This inadequate nutrient supply could, in turn, lead to physiological competition between the fetus and the pregnant mother and finally end up with undesired perinatal consequences such as preterm birth.[26] Furthermore, mothers who conceive shortly after the birth of their previous baby were expected to have diminished iron and folic acid reserves and thus anemia. Folate deficiency interferes with collagen cross-linking, resulting in weakened connective tissue. This weakened tissue could expose to PROM and bring their current child prematurely.[25–27] On the other hand, the maternal blood vessels supplying the endometrial wall might not have a chance for effective remodeling after the delivery of the previous child. This could interfere with the uterine and placental perfusion, resulting in preterm birth.[22]

The finding also showed that the risk of prematurity among neonates delivered from mothers identified as having APH was 7.27 times higher than their counterparts. Our study result is supported by findings of previous studies done by Jhpiego[28] and Wasrik et al in India.[29] This could be rationalized by the possible maternal and fetal complications imposed by APH. When there is APH, the blood perfusion to the uterus and the placenta will be decreased. This, in turn, could compromise the placental oxygen and nutrient supply to the fetus resulting in early expulsion of the fetus either spontaneously or iatrogenically.[30, 31]

Likewise, the odds of preterm birth were 5.21 times higher among mothers who experienced PROM compared to mothers who did not have PROM. The finding of a study conducted in Tamil Nadu, India was conformable with our finding that two-thirds of neonates born from mothers who had PROM were born preterm.[32] Other studies carried out in Indonesia, Cilegon hospital[33] and Gondar town[20] also reported similar findings. The possible justification might be the activation of pro-inflammatory markers following PROM. The release of these cytokines stimulates the decidual layer of the uterus and the fetal membrane. This stimulation might facilitate the release of prostaglandins and enzymes such as metalloproteinase. Consequently, this may lead to an increased risk of intrapartum infection, cervical wall thinning, enhanced uterine contraction, and finally, stimulation of preterm labor.[33]

Furthermore, mothers who suffered from IPV were at an increased risk of preterm birth than those who did not. Similar findings were published from other studies conducted in Peru[34], Tanzania[35], and Tigray.[36] Violence could be committed against the victim physically, psychosocially, or sexually. Physical violence that involves the victim's abdomen might cause placental damage, rupture of membranes, and thus untimed uterine contraction resulting in preterm labor. On the other hand, women who suffered from other forms of violence such as psychosocial violence could develop anxiety, depression, and behavioral changes such as alcohol consumption and smoking. These consequences were highly linked to premature initiation of labor and inadequate prenatal fetal weight gain.[37–39] Besides, mothers who developed stress and depression after experiencing violence were found to have altered cell adhesion molecules, pro-inflammatory cytokines, and raised C-reactive proteins. This could again lead to

endothelial dysfunction and systemic inflammation, hence, placental insufficiency, abruption, and preterm birth.[37, 39]

The other factor that was independently associated with prematurity was the area of residence. Mothers who reside in rural areas were 3.72 times at higher risk of bringing premature babies than those who reside in urban settings. This finding is in line with the findings of the study conducted in the Tigray region, Axum, and Adwa public hospitals.[21] The possible explanation for this could be multifactorial. First, mothers who resided in rural areas might not receive professional advice and support. Conversely, mothers may miss ANC follow-up visits due to distant settings, living standards (work overload), lack of partner support, poor perception, and cultural barriers. Second, inadequate nutritional intake in terms of nutrient composition could result in the depletion of fetal nutritional supply. Additionally, poor utilization of family planning and reproductive health services in rural areas could lead to unplanned and frequent pregnancies and thus, increased the chance of preterm birth.

Conclusion

The current study revealed that different social, obstetric, and maternal lifestyle factors were independently associated with preterm birth. Rural residence, short inter-pregnancy interval (< 2years), having APH and PROM as well as suffering from intimate partner violence were identified as determinants of preterm birth.

Declarations

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Authors' contributions

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

Disclosure: The findings of this study were presented and submitted to AAU, the college of health sciences, and the school of allied health sciences for the partial fulfillment of the master's of Science degree, and the whole thesis file was just released online in AAU institutional repository. URI: http://etd.aau.edu.et/handle/123456789/23252. The authors declared no conflict of interest.

Data sharing statement: Extra data that support the findings of this study are available and can be shared upon reasonable and legal request via bayayibignabez@gmail.com

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Figures

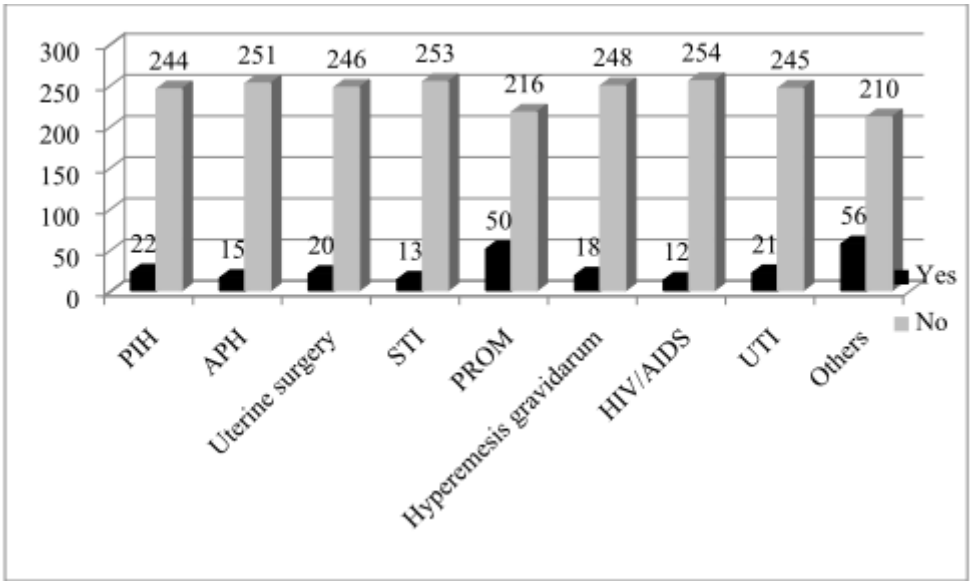

Figure 1

Pre-existing maternal illnesses and obstetric complications of mothers of newborns delivered at public hospitals in Hawassa, Southern Ethiopia, 2020 (N=266)

Key: Others refer to cardiac diseases, diabetes mellitus, respiratory disorders, mental illness, polyhydramnios, oligohydramnios, chorioamnionitis, and periodontal diseases

Abbreviation: HTN, hypertension; PIH, pregnancy-induced hypertension; APH, antepartum hemorrhage; STI, sexually transmitted disease; PROM, premature rupture of membrane; HIV, human immunodeficiency virus