

Determinants of stillbirth among mothers in Asella Referral and Teaching Hospital, Oromia Regional State, Ethiopia: An unmatched case-control study

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ABSTRACT

Background: Ethiopia experiencing one of the highest rates in East Africa. Despite several measures taken to reduce this burden, the stillbirth rate in Ethiopia remains considerably high. Efforts to lower these rates may be hampered by an incomplete understanding of the underlying risk factors. Therefore, this study aims to identify the determinants of stillbirth among mothers who gave birth at Asella Referral and Teaching Hospital.

Methods: An unmatched case-control study was conducted from February 11 to August 31, 2022, at Asella Referral and Teaching Hospital. A total of 351 postpartum women were enrolled with a case-to-control ratio of 1:2 (117 cases and 234 controls). Cases were defined as postpartum mothers who gave birth to a stillborn infant at 28 weeks or more of gestation, or with a birth weight of 1 kg or more, or a body length of 35 cm or more. However, controls included postpartum mothers who gave birth to a live-born infant meeting the same characteristics of cases. Data were entered into EpiData and analyzed by SPSS. Descriptive statistics as well as binary and multivariable logistic regression analyses were used to assess the associations between independent and dependent variables. Statistical significance was determined at a P-value of less than 0.05.

Results: A total of 351 women participated in this study, yielding a 100% response rate. Having a birth interval of less than 2 years (AOR = 4.1, 95% CI: 1.2–13.4), antepartum hemorrhage (AOR = 13.1, 95% CI: 2.4–17.5), and having preeclampsia (AOR = 7.0, 95% CI: 1.4–35.4) were significantly associated with stillbirth. In addition, rural residence (AOR = 13.0, 95% CI: 3.4–29.9), being referred from another health facility (AOR = 6.1, 95% CI: 2.3–16.2), antenatal care (ANC) contact at 28 weeks or later (AOR = 12.5, 95% CI: 3.2–21.4), preterm birth (AOR = 14.6, 95% CI: 2.4–27.3), and having a birth weight under 2500 grams (AOR = 10.6, 95% CI: 3.2–24.9) were significantly associated with stillbirth.

Conclusion: In the present study, several factors were significantly associated with stillbirth. Targeted interventions are vital for mothers who are rural residents, have a birth interval of less than two years, or are referred from other health facilities to reduce stillbirth burden. Furthermore, addressing clinical factors such as late antenatal care (ANC) follow-up, preeclampsia, antepartum hemorrhage, preterm delivery, and low birth weight are crucial.

Keywords: Stillbirth, Maternal and child health, Determinant of stillbirth, Child mortality

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This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International license. Address correspondence to Shiferaw et al et al. getachewshiferaw38@yahoo.com. The authors declare that they have no competing interests. The views expressed in this article do not necessarily reflect the views of HAJHBS. Submitted: September 08, 2025 | Revised: December 28, 2025 | Accepted: December 30, 2025 | Published: August 25, 2026

BACKGROUND

The World Health Organization (WHO) defines a stillbirth as a baby born with no signs of life at 28 weeks or more of gestation with a birth weight of 1000 grams or more or a body length of 35 cm or more. Fetal death may occur either before the onset of labor (antepartum death) or during labor (intrapartum death) (1–4).

The average stillbirth rate in developing countries has been reported at 26 per 1,000 births—five times higher than the rate in developed countries, which stands at 5 per 1,000 births (3,5). The vast majority (98%) of these stillbirths occur in low- and middle-income countries, with more than half (55%) taking place within rural areas of Sub-Saharan Africa (2, 3,5,6,7). In this region, stillbirths account for more than 3% of all deliveries each year (8).

The burden of stillbirth varies extremely by country, which ranges from the lowest rates of two per 1,000 births in Finland and Singapore to the highest rates of 47 in Pakistan and 42 in Nigeria (2, 3). Ethiopia is among the ten countries that collectively contribute to two-thirds of the world's stillbirth burden (2, 3). According to the World Health Statistics report, the Ethiopian stillbirth rate stands at 26 per 1,000 deliveries which make the country the third highest in East Africa after Djibouti and Somalia, and the seventh highest globally (7, 9). Furthermore, the 2016 Ethiopian Demographic and Health Survey indicated a national perinatal mortality rate of 33 per 1,000 births (7). In the Oromia Regional State,

the rate is 30 per 1,000 births, making it one of the highest-burden regions in the country (7).

Although, stillbirths comprise a large proportion of preventable deaths, determining their exact cause remains challenging because the fetus cannot be directly observed at the time of death, nor can the preceding events (10). Risk factors for stillbirth are generally categorized into maternal, fetal, and placental factors (2,5,7). Maternal risk factors include pregnancy-induced hypertension, severe anemia, infections, and labor complications. Fetal risk factors encompass congenital anomalies, Rhesus (Rh) isoimmunization, non-immune hydrops fetalis, multiple pregnancy, and premature rupture of membranes. Additionally, placental risk factors include placenta previa, placental abruption, intrauterine growth restriction (IUGR), umbilical cord accidents, and post-term pregnancy. Road traffic accidents represent another external trauma risk factor that increases the likelihood of stillbirth (2,5,7).

Numerous studies highlight that stillbirth inflicts a tremendous psychological impact and negative stigma on families, communities, caring obstetricians, and healthcare institutions (10). The financial cost of managing this complication places a heavy burden on the national economy (10-15). Despite these impacts, a significant gap remains in establishing the specific determinants and risk factors associated with stillbirth in Ethiopian context, particularly within the Oromia Regional State. Very few studies have provided evidence explaining the disproportionately high magnitude of stillbirths occurring in this area. There are limited studies investigating the

determinants of stillbirth at referral hospitals in the region. Thus, this study aims to identify the specific determinants of stillbirth at Asella Referral and Teaching Hospital (ARTH), located in Oromia Regional State of Ethiopia.

METHODS

Study area

This study was conducted at Asella Referral and Teaching Hospital (ARTH), a tertiary teaching institution under Arsi University that serves the Arsi Zone. The hospital provides medical service to a catchment population of approximately 3.5 million people and provides round-the-clock maternity and delivery services.

Study design, period and population

An institution-based, unmatched case-control study was conducted from February 11 to August 31, 2022. The source population comprised all pregnant women residing in the Arsi Zone during the study period, while the study population consisted of mothers who gave birth at ARTH and were in the immediate postpartum period during the same study period. Cases were defined as postpartum mothers who gave birth to a stillborn infant at 28 weeks or more of gestation, or with a birth weight of 1 kg or more, or a body length of 35 cm or more. Whereas, controls included postpartum mothers who gave birth to a live-born infant meeting the same gestational age, birth weight, or body length criteria.

Inclusion criteria

All mothers who were in the immediate postpartum period at ARTH were included as cases if they delivered a stillborn infant, and as controls if they delivered a live-born infant,

provided that they met the following baseline criteria: gestational age 28 weeks, birth weight 1 kg, or body length 35 cm. However, all mothers were excluded if they were severely ill, required immediate medical attention, or were unable to respond to the interview questions.

Sample size calculation

A two-population proportion formula was used to determine the sample size using Epi Info version 7.2.5. The calculation assumed an 80% statistical power, a 95% confidence level (CL), and a 1:2 case-to-control ratio. Based on a 12.2% exposure proportion of premature rupture of membranes among controls and an odds ratio of 2.26 (28), the required sample size was determined to be 351 participants (117 cases and 234 controls). Cases were selected consecutively until the required sample size was achieved. For each identified case, controls were selected via simple random sampling using the delivery room registration log as the sampling frame.

Data collection procedures

Data were collected using a structured questionnaire for interviews with the mothers and a clinical checklist to extract information from maternal medical charts. Anthropometric measurements of the mothers and neonates were obtained using calibrated weight scales and measuring tapes. The data collection tool covered sociodemographic variables as well as obstetric and medical histories. In addition, neonatal physical examinations were performed and

recorded. The tool was adapted from similar peer-reviewed studies. The questionnaire, initially developed in English was translated into local languages (Afaan Oromoo and Amharic). To ensure clarity, a pretest was conducted on 5% (18 participants) of the total sample size at Adama Medical College Hospital prior to the actual data collection, and necessary amendments were made. Four data collectors and two supervisors were recruited and underwent a two-day training session focusing on the study objectives, data collection procedures, the questionnaire, and ethical principles. Data collection was closely monitored by the supervisors and the principal investigator. Completed questionnaires were checked and verified daily, and all collected data were double-entered into the database to ensure accuracy.

Data processing and analysis

Data were entered into EpiData version 4.6 and exported to SPSS version 26 for Windows for statistical analysis. Descriptive statistics such as frequencies, percentage and mean with standard deviation were used to summarize and present the data. Multicollinearity among the independent variables was assessed using variance inflation factors (VIF) or standard correlation matrices. Bivariate logistic regression was performed initially, and variables with a p-value less than 0.25 were selected for inclusion in the multivariable logistic regression model to identify independent risk factors for stillbirth and control

for confounding. Model fitness was evaluated using the Hosmer–Lemeshow goodness-of-fit test with a p-value greater than 0.05 indicating an acceptable fit. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated, and p-values less than or equal to 0.05 were considered statistically significant.

RESULTS

Socio-demographic characteristics of study participants

A total of 351 postpartum mothers (117 cases and 234 controls) participated in the study, yielding a response rate of 100%. The majority of the participants (83.2%) were within the age group of 20–34 years. The ages of the mothers ranged from 17 to 48 years, with an overall mean age of 32.6 years. In terms of sociodemographic characteristics, most participants were married (98.3%) and urban residents (53.8%). Regarding ethnicity and religion, nearly three-quarters of the participants were Oromo (74.1%), and 49.3% were Muslim. Out of the 351 participants, 317 (90.3%) were literate, and the vast majority (92.3%) were unemployed (Table 1).

Table 1: Sociodemographic characteristics of study participants at Asella Referral and Teaching Hospital, 2022 (n = 351)

Variable	Categories	Case, n (%)	Control, n (%)
Age group	<20 years	8(6.8)	17(7.3)
	20-34 years	95(81.2)	197(84.2)
	≥35 years	14(12.0)	20(9.7)
Marital status	Single	3(2.6)	3(1.3)
	Married	114(97.4)	231(98.7)
Level of education	Primary school	50(42.7)	75(32.1)
	Secondary school	41(35.0)	117(50.0)
	University	6(5.1)	28(12.0)
	Unable to Read and write & Others	20(17.1)	14(5.2)
Place of residence	Rural community	82(70.1)	80(34.2)
	Urban community	35(29.9)	154(65.8)
Occupation	Student	3(2.6)	24(10.3)
	Employed	2(1.7)	24(10.3)
	Farmer	6(5.1)	15(2.1)
	House wife	99(84.6)	158(67.5)
	Factory worker and others	7(6.0)	13(5.5)

Fetal and obstetric factors that associated with stillbirth

Among the cases, 14.5% presented with gross congenital anomalies, 9.4% with umbilical cord accidents, 1.7% with uterine rupture, and 1.7% with hydrops fetalis; none of these conditions were identified in the control group (Table 2). Low birth weight (LBW) and preterm birth were

observed in 57.3% and 34.2% of cases, respectively, compared to 9.4% and 3.4% of controls. Regarding obstetric complications, preeclampsia occurred in 18.8% of cases and 4.3% of controls, while antepartum hemorrhage (APH) was recorded in 27.4% of cases compared to 3.0% of controls. Furthermore, initiation of antenatal care (ANC) at a gestational age of 28 weeks was reported by 23.1% of cases and 3.0% of controls. Finally, a short birth interval of less than 2 years was observed among 32.1% of cases and 7.7% of controls (Table 2).

Table 2: Unadjusted analysis of factors associated with stillbirth at Asella Referral and Teaching Hospital, 2022

Variable	Categories	Case, n (%)	Control, n (%)	COR (95% CI)	P-Value
Birth interval (in year)	≥2	42 (35.9)	160(68.4)	1.00	< 0.001
	<2	38 (32.5)	18(17.7)	8.0 (4.0–16.4)	
Condition of current pregnancy	Planned	111(94.4)	208(88.9)	1.00	0.066
	Unplanned	6 (5.1)	26(11.1)	0.43(0.14–1.1)	
Types of pregnancy	Singleton	113 (96.6)	228(97.4)	1.00	0.650
	Twins	4 (3.4)	6(2.4)	1.3(0.27–5.8)	
APH	No	85(72.4)	227(97.0)	1.00	< 0.001
	Yes	32(27.4)	7(3.0)	12.2(5.0–33.8)	
Preeclampsia	No	95(81.2)	224(95.7)	1.00	< 0.001
	Yes	22(18.8)	10(4.3)	5.2(2.2–12.7)	
Residence of participants	Urban	35(29.9)	154(65.8)	1.00	< 0.001
	Rural	82(70.1)	80(34.2)	4.5(2.7–7.5)	
Maternal admission status	From home	36(30.8)	186(79.5)	1.00	< 0.001
	Referred	81(69.2)	48(20.5)	8.7(5.1–14.9)	
Obstructed labor	No	112(95.7)	232(99.1)	1.00	0.030
	Yes	5(4.3)	2(0.9)	5.2(0.80–54.9)	
ANC booking status	Booked	111(94.9)	229(97.9)	1.00	0.129
	Not booked	6(5.1)	5(2.1)	2.5(0.61–10.5)	
Gestational age at first ANC contact (in week)	<28	86(73.5)	224(95.7)	1.00	< 0.001
	≥28	27(23.1)	7(3.0)	10.0(4.0–28.1)	
Number of ANC (count)	≥4 times	27(23.1)	125(53.4)	1.00	< 0.001
	1-3 times	85(72.6)	106(45.3)	3.7(2.2–6.4)	
History of stillbirth	No	65(55.6)	175(74.8)	1.00	0.212
	Yes	7(6.0)	6(2.6)	3.1(0.86–11.7)	
Sex of neonate	Female	57(48.7)	131(56.0)	1.00	0.198
	Male	60(51.3)	103(44.0)	1.33(0.83–2.14)	
Birthweight of neonate (in gram)	2500-3999.99	46(39.3)	206(88.0)	1.00	< 0.001
	<2500	67(57.3)	22(9.4)	13.6(7.4–25.5)	
	≥4000	4(3.4)	6(2.4)	3.0(0.59–13.1)	
Gestational age at delivery	Term	43(36.8)	199(85.0)	1.00	< 0.001
	Preterm	40(34.2)	8(3.4)	23.1(9.7–60.5)	
	Post-term	2(1.7)	3(1.3)	3.1(0.24–27.6)	
Anemia	No	113(96.6)	231(98.7)	1.00	0.177
	Yes	4(3.4)	3(1.3)	2.7(0.45–18.7)	
Meconium-stained amniotic fluid	No	112(95.7)	232(99.1)	1.00	0.208
	Yes	5(4.3)	2(0.9)	5.2(0.82–54.9)	
Parity status	2-4	59(50.4)	166(70.9)	1.00	< 0.001
	1	45(38.5)	53(22.6)	2.4(1.4–4.0)	
	≥5	13(11.0)	13(5.0)	2.8(1.1–7.0)	
Occupation	Employed	2(1.7)	24(10.3)	1.00	0.221
	Daily laborer	3(2.6)	5(2.1)	7.2(0.60–10.0)	
	Farmer	6(5.1)	15(6.4)	4.8(0.71–25.2)	
	House wife	99(84.6)	158(67.5)	7.5(1.8–66.7)	

	Factory worker	7(6.0)	13(5.5)	6.5(0.98–17.0)	0.210
Educational Status	University	6(5.1)	28(12.0)	1.00	
	Primary	50(42.7)	75(32.1)	3.1(1.1–9.8)	0.015
	Secondary	41(35.0)	117(50.0)	1.63(0.60–5.16)	0.307
	Unable to read and write	11(9.4)	9(3.8)	5.7(1.4–24.1)	0.004
Place of ANC	Teaching Hospital	11(9.4)	75(32.1)	1.00	
	Other	8(6.8)	19(8.1)	2.2(0.57–7.3)	0.170
	Government Hospital				
	Health Center	81(69.2)	111(47.4)	5.0(2.4–11.0)	< 0.001

APH-antepartum hemorrhage ANC-antenatal care; COR-crude odds ratio, CI-confidence interval

In the multivariable logistic regression analysis, several independent predictors were significantly associated with an increased risk of stillbirth (Table 2). A short birth interval of less than 2 years (AOR = 4.1, 95% CI: 1.2–13.4; $p = 0.021$), the presence of APH (AOR = 13.1, 95% CI: 2.4–17.5; $p = 0.003$), and preeclampsia (AOR = 7.0, 95% CI: 1.4–35.4; $p = 0.019$). Moreover, rural residence (AOR = 13.0, 95% CI: 3.4–29.9; $p = 0.001$), referral from another health facility (AOR = 6.1, 95% CI: 2.3–16.2; $p = 0.001$), and late antenatal care (ANC) initiation at greater than 28 weeks of gestation (AOR = 12.5, 95% CI: 3.2–21.4; $p = 0.004$) were structural and clinical factors that significantly associated with stillbirth. Neonatal factors such as a birth weight below 2500 grams (AOR = 10.6, 95% CI: 3.2–4.9; $p = 0.001$) and preterm gestational age (AOR = 14.6, 95% CI: 3.4–37.3; $p = 0.003$) were also significantly associated with stillbirth (Table 2). Being having a housewife (AOR = 4.1, 95% CI (1.1–50.6); $p = 0.040$), and factory worker (AOR = 6.5, 95% CI (1.2–36.5); $p =$

0.041) occupation, and attending secondary education (AOR = 0.04; 95% CI (0.001–0.66); $p = 0.028$) were socioeconomic status that significantly associated with stillbirth (Table 3).

DISCUSSION

The present study identified several independent predictors that were significantly associated with an increased risk of stillbirth. A short birth interval of less than 2 years, the presence of APH, preeclampsia, rural residence, referral from another health facility, and late ANC initiation significantly increased the odds of stillbirth. Moreover, neonatal factors such as a birth weight below 2500 grams and preterm gestational age, alongside maternal socioeconomic factors specifically being a housewife or a factory worker were associated with significantly higher odds of stillbirth. In contrast, attaining a secondary education significantly reduced the odds of stillbirth, serving as a protective factor.

Table 3: Fetal and obstetric factors that associated with stillbirth at Asella Referral and Teaching Hospital, 2022

Variable	Categories	AOR (95% CI)	P-Value
Birth interval (in year)	≥2	1.00	0.021*
	<2	4.1 (1.2–13.4)	
Condition of current pregnancy	Planned	1.00	0.259
	Unplanned	0.31 (0.04–2.4)	
Types of pregnancy	Singleton	1.00	0.935
	Twins	1.1(0.05–25.5)	
APH	No	1.00	0.003*
	Yes	13.1(2.4–17.5)	
Preeclampsia	No	1.00	0.019*
	Yes	7.0(1.4–35.4)	
Residence of participants	Urban	1.00	0.001*
	Rural	13.0(3.4–29.9)	
Maternal admission status	From home	1.00	0.001*
	Referred	6.1(2.3–16.2)	
Obstructed labor	No	1.00	0.101
	Yes	2.5(0.53–4.4)	
ANC booking status	Booked	1.00	0.603
	Not booked	0.24(0.00–52.1)	
Gestational age at first ANC (in week)	<28	1.00	0.004*
	≥28	12.5(3.2–21.4)	
Number of ANC follow up	≥4 times	1.00	0.248
	1-3 times	1.9(0.65–5.3)	
History of stillbirth	No	1.00	0.113
	Yes	4.3(0.70–26.4)	
Sex of neonate	Female	1.00	0.146
	Male	1.9(0.79–4.7)	
Birthweight of neonate (in gram)	2500-3999.99	1.00	0.001*
	<2500	10.6(3.2–24.9)	
	≥4000	2.9(0.22–38.0)	
Gestational age	Term	1.00	0.003*
	Preterm	14.6(3.4–37.3)	
	Post-term	2.6(0.15–44.2)	
Anemia	No	1.00	0.980
	Yes	1.1(0.01–29.8)	
Meconium-stained amniotic fluid	No	1.00	0.355
	Yes	2.7(0.02–39.1)	
Parity status	2-4	1.00	0.503
	1	0.25(0.01–14.0)	
	≥5	2.6(0.15–44.2)	
Occupation	Employed	1.00	0.040*
	Daily laborer	10.1(0.15–67.6)	
	Farmer	5.1(0.16–15.2)	
	House wife	4.1(1.1–50.6)	
	Factory worker	6.5(1.2–36.5)	
Educational Status	University	1.00	0.023*
	Primary	0.18(0.01–2.3)	
	Secondary	0.04(0.00–0.66)	
	Unable to read and write	0.18(0.01–4.5)	
Place of ANC	Teaching Hospital	1.00	0.300

Other Gov't Hospital	0.68(0.10–5.1)	0.764
Health Center	1.3(0.18–4.2)	0.889

**-significantly associated; APH-antepartum hemorrhage; ANC-antenatal care; AOR-adjusted odds ratio CI-confidence interval*

In the current study, mothers who were referred from another health facility had 6.1 times higher odds of experiencing a stillbirth compared to those who were admitted directly from home. This finding is consistent with results from previous studies conducted in similar settings (16–20). This elevated risk is likely due to referral delays; many women from rural and peripheral facilities arrive at tertiary referral hospitals only after developing severe obstetric complications, which drastically increases the risk of perinatal death.

Mothers residing in rural areas had 13 times higher odds of stillbirth than their urban counterparts. This finding aligns with previous studies conducted in Nigeria and other regions of Ethiopia (21–25). The disparity may be attributed to deep-rooted traditional practices, limited health literacy, and a subsequent reluctance or delay in utilizing ANC services, all of which adversely affect maternal and neonatal outcomes in rural settings. To address this gap, it is vital to evaluate the structural differences in healthcare access and maternal education between urban and rural populations, identifying which urban-focused interventions could be successfully adapted. Moreover, facility-based data may underreport the true burden of fetal mortality due to unrecorded home deliveries. Therefore, community-based assessments of births and

stillbirths are warranted in future research to capture realistic baseline rates.

This study also demonstrated that mothers with a secondary education had 96% lower odds of stillbirth compared to those with a university education. This finding is in contradict with previous literature from Uganda, Nigeria, and India, which consistently shows that higher maternal education positively impacts healthcare utilization and birth outcomes (26–29). However, this difference is likely attributable to selection bias (specifically Berkson's bias) inherent to a tertiary-level hospital study design. As a specialized referral center, the hospital attracts a disproportionately high volume of high-risk obstetric cases. University-educated women may preferentially choose or be referred to this tertiary facility for complicated deliveries, leading to an overrepresentation of highly educated mothers among the cases compared to those with a secondary education.

Mothers who initiated ANC after 28 weeks of gestation had 12.5 times higher odds of stillbirth compared to those who started their follow-up earlier. This finding aligns with previous studies conducted in Cameroon and other settings (20, 30,31). The clinical rationale behind this association is that early ANC booking allows for the timely identification and management of silent obstetric complications, such as

preeclampsia, before they escalate. In addition, women who begin initiated ANC early are more likely to achieve the recommended number of total visits throughout their pregnancy. This sustained contact with the healthcare system ensures continuous monitoring, ultimately resulting in optimized maternal care and a significant reduction in the odds of stillbirth.

In the present study, mothers with APH had 13.1 times higher odds of experiencing a stillbirth compared to those without APH. This finding is similar with studies conducted in Ethiopia, East Africa, and India (4, 29, 32). A plausible clinical explanation is that even severe forms of APH may not present with obvious external bleeding, remaining hidden as a concealed hemorrhage. Consequently, cases where the fetus is initially viable may go undetected, or due to delayed hospital presentation, the hemorrhage may progress to a critical stage before medical intervention is sought. This severely compromises the opportunity to salvage the fetus from rapidly developing, life-threatening anemia. The acute reduction in placental perfusion subsequently leads to impaired fetal oxygenation, severe birth asphyxia, and ultimately, intrauterine fetal death.

The present study identified that the odds of stillbirth were 7 times higher among women with preeclampsia compared to those without the condition. The association between preeclampsia and stillbirth is physiologically plausible and has

been widely documented in the literature (4, 20, 29). Preeclampsia characteristically leads to uteroplacental insufficiency resulting from the impaired remodeling of maternal spiral arteries. This defective vascular adaptation causes chronic fetal hypoxemia and intrauterine growth restriction, ultimately culminating in intrauterine fetal death.

The odds of stillbirth were more than 10 times higher for low-birth-weight (LBW) neonates compared to those with normal birth weight. This finding aligns with previous studies conducted in northern and southeastern Ethiopia (29, 30). A plausible explanation is that low birth weight often stems from intrauterine growth restriction or preterm birth. These conditions are characterized by compromised placental function and chronic fetal hypoxia, rendering the fetus highly vulnerable to acute distress and intrauterine death, particularly under the stress of uterine contractions during labor.

Preterm neonates had nearly 15 times higher odds of being stillborn compared to term babies, a finding that is highly consistent with previous literature (20, 29, 30). This elevated risk is primarily due to the physiological immaturity of the preterm fetus. These compromised fetuses have very limited physiological reserves, rendering them significantly less resilient against intrauterine insults and less capable of withstanding the hypoxia associated with regular uterine contractions during labor.

Mothers with a birth interval of less than 2 years from their previous delivery had approximately 4 times higher odds of stillbirth compared to those with an interval greater than 2 years. This finding is consistent with previous studies reported from Ethiopia (31, 32). This association is strongly supported by the maternal depletion hypothesis, which posits that a short birth interval prevents the maternal body from fully recovering and replenishing essential nutrient stores such as iron and folate depleted during the preceding pregnancy. This chronic nutritional insufficiency can impair subsequent placental development, lead to fetal growth restriction, and predispose the fetus to preterm delivery. These secondary complications significantly elevate the risk of intrauterine fetal death. Consequently, systematic reviews of stillbirth risk factors consistently identify short interpregnancy intervals as a major threat to perinatal survival in developing countries.

Maternal occupation as a housewife was associated with significantly higher odds of stillbirth compared to being a government employee. This finding aligns with previous studies conducted in Cameroon, in which maternal employment serves as a protective factor against stillbirth (20, 31). This disparity is likely driven by financial barriers to care. House professions often lack independent, regular income, which can restrict an ability of the woman to cover out-of-pocket expenses such as transport costs for routine antenatal care (ANC) visits.

Moreover, this lack of financial autonomy can cause critical delays in seeking emergency obstetric care when pregnancy-related complications arise, ultimately increasing the risk of intrauterine fetal death.

The present study has some limitations which should be considered when interpreting the findings of this study. Being facility-based study, could limit the generalizability of the results of this study. The inherent nature of a case-control design could also make difficult to completely eliminate the risk of selection bias and recall bias. Moreover, while we identified several independent risk factors, the exact underlying causes of stillbirth were not verified through histopathological placental examinations or fetal autopsies. The relatively small sample size has resulted in wide confidence intervals for some variables, which limits the precision of those specific estimates. Finally, as previously noted, the unexpected finding that secondary education was protective against stillbirth compared to a university education may have been artificially driven by admission-rate selection bias (Berkson's bias) inherent to a tertiary referral hospital.

CONCLUSION

Several determinant factors were significantly increased the odds of stillbirth. Being referred from another health facility, late ANC initiation, rural residence, presence of preeclampsia, APH, preterm delivery, low birth weight, and a short

birth interval of less than 2 years were identified as independent determinants of stillbirth. It is critical that the referral hospital evaluates its catchment hospitals and health centers to strengthen the zonal referral system. This should be achieved by establishing standardized, timely transfer protocols, conducting targeted staff training on obstetric emergencies, and improving the medical transport infrastructure. Because of the facility-based nature of this study, its generalizability is limited, Future community-based research is strongly recommended to capture the true population-level burden of stillbirths.

List of Abbreviations

AOR-Adjusted Odd Ratio; ANC-Antenatal care; APH-Antepartum Hemorrhage; ARTH-Asella Referral and Teaching Hospital; cm- Centimeter; CI-Confidence Interval; COR-Crude Odd Ratio; GA-Gestational Age; IUGR-Intrauterine Growth Restriction; Kg- Kilogram; SPSS-Statistical Package for Social Science; WHO-World Health Organization

Declarations

Ethical consideration

Ethical clearance was obtained from the Arsi University Institutional Review Board in accordance with Declaration of Helsinki and a permission letter was received from the Hospital management board. The objective of the study was explained to the participants and written consent was obtained from those who agreed to

participate in the study. Participants were informed that their involvement in the study contribute to generating evidence for the development of interventions aimed at reducing stillbirth rates. They were also informed that participation was voluntary, that they had the right to refuse participation, and that they could withdraw from the study at any time during the interview, discussion, or observation. Each participant was explained that information was kept confidential and participants' card number only used for identification purpose. Code used to ensure confidentiality that only entail, indicative of the research activity, the location, date and time of the activity. This interviewee code was used in the reports and field notes for anonymous identification.

Availability of data and materials

The data generated and analyzed during this study is available from corresponding author on reasonable request.

Consent for publications: Not applicable

Competing interests

The authors declare that they have no any competing interests.

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Authors contributions

GS, A.J, AK, AJ, and A.K- conceptualized the study; GS carried out the investigation and analysis the data. All authors critically reviewed the

manuscript, and approved the final version for submission.

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