

COLLEGE OF HEALTH SCIENCES  
SCHOOL OF PUBLIC HEALTH

DETERMINANTS OF STILLBIRTH AMONG WOMEN WHO GAVE BIRTH IN NORTH  
WOLLO ZONE HOSPITALS, NORTHEAST ETHIOPIA, 2022

BY:-ATNAF ALEM (BSc)

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- EYOB SHITIE (MSc)

A THESIS PAPER SUBMITTED TO WOLDIA UNIVERSITY COLLEGE OF HEALTH  
SCIENCES SCHOOL OF PUBLIC HEALTH FOR THE PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF GENERAL MASTER OF PUBLIC HEALTH

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## Approval Sheet

The undersigned advisors certify that this thesis paper presented by Atnaf Alem entitled “Determinants of stillbirth among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022” compiles with the regulation of the university and meets the accepted standards with respects to originality and quality.

**Place of submission:** School of Public Health, College of Health Sciences, Woldia University.

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|    | Advisor's name | Signature | Date  |
| 2. | _____          | _____     | _____ |
|    | Advisors name  | Signature | Date  |

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## **Abbreviations/acronyms**

APH: Antepartum Hemorrhage

DM: Diabetic Mellitus

EDHS: Ethiopian Demographic and Health Survey

HDP: Hypertensive Disorders of Pregnancy

HIV: Human Immune Virus

LMICs: Low and Middle-Income Countries

MDG: Millennium Development Goals

MPH: Master of Public Health

PROM: Premature Rapture of Membrane

SDG: Sustainable Development Goals

SSA: Sub-Saharan Africa

STI: Sexually Transmitted Infection

TT: Tetanus Toxoid

UNICEF: United Nations International Children's Emergency Fund

WHO: World Health Organization

## Abstract

**Background:** Stillbirth is still a tragic reality that affects the normal life of women, the entire family and the country at large. In 2019, over 2 million infants worldwide were born at 28 weeks of pregnancy or later without showing any signs of life. However, stillbirth continues to be ignored and Specific stillbirth specific targets were absent from sustainable development goals. An inadequate understanding of the risk factors that cause the majority of stillbirths may impede efforts to lower the stillbirth rate.

**Objective:** To identify determinants of stillbirth among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

**Methods:** An institution-based unmatched case control study design was conducted among 412 (103 cases and 309 controls) mothers who gave birth in North Wollo Zone hospitals. A simple random sampling technique was applied to select both cases and controls of this study. Epi-data version 3.1 and SPSS version 25.0 statistical software were used for data entry and analysis, respectively. A multivariable logistic regression model was used to identify the independent predictors of stillbirth. The goodness of fit was tested using the Hosmer and Lemeshow goodness-of-fit.  $P$ -value  $< 0.05$  was considered to declare a result as a statistically significant association.

**Results:** In this study, 103 stillbirth cases and 309 controls were analyzed. Women with premature rupture of membrane (AOR = 5.53 [95% CI: 2.33–9.94]), induced onset of labor (AOR = 2.24 [95% CI: 1.24–4.07]), labor duration  $\geq 24$  h (AOR = 3.80 [95% CI: 1.94–7.45]), no partograph used to follow their labor (AOR = 2.45 [95% CI: 1.41–4.26]), preterm birth (AOR = 3.46 [95% CI: 1.87–6.39]), postterm birth (AOR = 3.47 [95% CI: 1.35–8.91]), and carry a female fetus (AOR = 1.81 [95% CI: 1.02–3.22]) were found to be at higher risk of having stillbirth.

**Conclusions:** Presence of premature rupture of membrane, induce onset of labor, labor duration  $\geq 24$  h, lack of partograph utilization, carrying female fetus, and prematurity and postmaturity were found the determinants of stillbirth. Therefore, conscious care for these pregnancies with complication like premature rupture of membrane, early identification of labor complications by using partograph and strong referral system for complicated and/or prolonged labors are required.

**Keywords:** Determinant, North Wollo, Stillbirth, Northeast Ethiopia

# **1. Introduction**

## **1.1. Background**

Fetal death simply refers to the birth of a fetus showing no sign of life, as indicated by absent breathing, heartbeats, pulsation of the umbilical cord, or definite movements of voluntary muscles [1]. It can take the form of abortions (miscarriages) or stillbirths, depending on the stage of the pregnancy at which it occurs and the country's policy context. However, the World Health Organization (WHO) has established an internationally agreed gestational age for international comparability that defines stillbirth as the delivery of a fetus with no sign of life, weighing more than 1000g, or with more than 28 full weeks of gestation, whether antepartum or intrapartum [2].

Stillbirth is still a tragic reality for many families. Global stillbirth rate was 13.9 per 1000 live births in 2019. The rate varied widely across regions, from 21.7 stillbirths per 1000 total births in Sub-Saharan Africa (SSA) to 2.9 in Western Europe. Almost 98% of the stillbirth rate concentrated among low- and middle-income countries (LMICs). Even from the LMICs, about 77% of the burden was in SSA and South East Asian countries [3]. The 2016 Ethiopian Demographic and Health Survey (EDHS) showed that the stillbirth rate was 11.7 per 1000 pregnancies at the national level and 23.8 per 1000 in Amhara region, where the study is going to be conducted [4].

The cause of stillbirth is not always known (1 in 3 stillbirths cannot be explained), but the most likely causes include: problems with the placenta and/or the umbilical cord, preeclampsia, birth defect, infection, trauma, clotting disorder, and other chronic medical conditions of the mother [5].

Stillbirths are missing as a specific target in both the Sustainable Development Goals (SDG) and Millennium Development Goals (MDG), despite the United Nations International Children's Emergency Fund (UNICEF), WHO, and other partners have called for a renewed commitment to end preventable stillbirths by 2030. The Every Newborn Action Plan includes a global target for stillbirth reduction that all countries achieve a stillbirth rate of 12 or fewer per 1000 total births by 2030, which was adopted in the Global Strategy for Women's, Children's, and Adolescents' Health 2016-2030 [6]. However, at the current rate of decline, developing-country stillbirth rates will fall short of the every newborn action plan goal. Hence, it is important to identify the determinants of stillbirth and take an appropriate action.

## **1.2. Statement of the problem**

Stillbirth remains a public health agenda of both developing and developed countries. In 2019, over 2 million infants worldwide were born at 28 weeks pregnancy or later without showing any signs of life. An estimated one stillborn child is thought to be born out of every 72 deliveries overall, or once every 16 seconds [7]. In 2019, there were 13.9 stillbirths per 1000 total births worldwide, down from 21.4 per 1000 in 2000 [3]. The rate of stillbirths has decreased over the past two decades, but this progress has lagged behind successes in saving women's lives and the lives of newborns in their first 28 days of life. In contrast to a 2.9% reduction in neonatal and maternal mortality, the annual rate of decline in the stillbirth rate was just 2.3% in the first two decades of this century [8, 9]. In sub-Saharan Africa, the number of stillbirths is rising: They increased from 0.77 million in 2000 to 0.82 million in 2019 [3]. If current trends continue, an additional 20 million stillbirths will take place before 2030, placing immense and unjust strain on women, families and society.

In Ethiopia, the rate stillbirth showed a slow decline from 18.7 per 1000 total births in 2000 to 11.7 in 2016. Of all perinatal deaths in 2016, stillbirth accounts for around thirty-six percent [4]. In a rural and low-income Ethiopian area, one in every four women of reproductive age became pregnant in a year, and one in every four pregnancies did not end in a live birth [10]. Findings from hospital-based studies have reported the rate to be as high as 66 to 124 deaths per 1000 births [11]. However, stillbirths are not systematically documented [12], the information that is now available is likely to underestimate their frequency, and the actual figure may be much higher.

What makes these deaths even more tragic is that the majority of stillbirths result from preventable conditions such as maternal infections (notably syphilis and malaria), non-communicable diseases, and obstetric complications. Few are due to congenital disorders, but some of these are also preventable [13, 14]. However, we are losing so many babies before they take their first breath for a number of reasons. Some of them include the lack of or poor quality of care provided during pregnancy and childbirth; the lack of investment in preventative interventions and the health workforce; measurement challenges and major data gaps; and the lack of established global targets like the SDGs [14]. Thus, stillbirths are preventable through high quality antenatal and intrapartum care within the continuum of care for women and children [15].

The cost of losing a baby during pregnancy through stillbirth is profound. The normal psychological reaction to the loss can sometimes be pronounced and result in grief, guilt, depression and anxiety that can affect the normal life of the entire family. An estimated 4.2 million women are living with depression associated with a previous stillbirth. Parents will also have psychological difficulties in subsequent pregnancies. However, their grief is often not socially recognized nor fully acknowledged by doctors or society [16-18]. Stillbirth have financial consequences for parents and long-term economic repercussions for society [19]. It will also exacerbate the risk of maternal mortality since stillbirth is associated with short intervals between pregnancies and women still do not receive appropriate and respectful care when their baby dies during pregnancy or childbirth [20, 21]. Though the difficult impacts of stillbirth on families – and most especially on women – are severe and long lasting, stigma and taboo hide the hardship of stillbirths [14].

Yet stillbirth is an overlooked tragedy. It is largely absent in worldwide data tracking, rendering the true extent of the problem hidden. Specific stillbirth targets were absent from both MDG and SDG. This poses a significant challenge on prioritizing and planning interventions for stillbirth. In addition, the civil war in northern Ethiopia over the past two years has threatened maternal health services, leading to a high stillbirth rate. Thus, data on the determinants of stillbirth in a setup is critically important for planning maternal and child health care services that will decrease frequency occurrence and its consequence. However, setup based information in this study area was limited. This study aimed at identifying determinants of stillbirth among women attended deliveries in North Wollo Zone hospitals, Northeast Ethiopia, 2022.

### **1.3. Significant of the study**

Even though different programs have been implemented to improve maternal and child health, Ethiopia has a high rate of stillbirths, and the local influential factors are not fully understood. Attempts to lower the stillbirth rate further may be hampered by an incomplete understanding of the risk factors leading to the majority of stillbirths. Therefore, an improved understanding of the risk factors of stillbirth in our setting is important to health planners for targeting strategies to reduce stillbirth as well as improve maternal and child health care. Data from this study could be crucial for health care professionals to successfully reduce the incidence of stillbirth; and its impact on mothers by evidence-based interventions delivered before and during pregnancy, labor, and delivery. AS a result, this study directly benefits individual women, families and communities at large. It may also be used as a source of information for scholars to investigate the topic further.

## **2. Literature review**

### **2.1. Determinants of still birth**

Determinants of stillbirth are multidimensional and complex; and studies in both developed and developing nations have been identified several factors. These factors have been categorized and stated as follows:

#### **2.1.1. Socio-demographic factors**

Stillbirths were more frequent among either very young or very old aged mothers. The exact age at which stillbirth outcome for older mothers becomes significant is unclear. Study done in Tanzania and SSA tertiary hospitals states maternal age  $\geq 35$  years increasingly associated with still birth [22, 23]. Similarly, studies in Ethiopia indicated that the risk of having stillbirth was higher among women aged  $\geq 35$  years and low among those in the age group 20-35 years [24, 25]. On the other hand, in a study from Nigeria that examined pattern and correlates of stillbirth in a hospital setting, young maternal age ( $< 20$  years) was reported to increase the risk of stillbirth [26]. There was also a higher proportion of stillbirths reported among teenage mothers compared with older mothers in a study conducted at hospital setting in India [27]. Rural residence and have no education have also been reported to contribute to the risk of stillbirth in Ethiopia [24, 28]. A study in Gambia and Cameroon also showed similar result that rural residents and those who have low level of education were at high risk of having stillbirth [29, 30].

#### **2.1.2. Health care related factors**

Number of studies reported the association between lack of antenatal care and stillbirth. According to a study in Nepal: inadequate antenatal care increased the risk of stillbirth [31]. Similar results were reported from Nigeria [32], SSA [5, 22] and studies in Ethiopia [33]. According to an unmatched case-control study at Regional Referral Hospital, Uganda, failure to use partograph was significantly associated with stillbirths [34]. Similar results were reported in studies conducted in Bahir Dar [28], Hawassa [35], Aksum [25], Amhara region referral hospitals [36]. A study in Felege Hiwot referral hospital revealed that not taking at least two doses of TT vaccine during pregnancy was found to increase risk of stillbirth [28]. Yet, no significant association between iron folate supplementation and stillbirth have been documented [37].

### **2.1.3. Obstetric and medical complication**

Different obstetric complications during pregnancy described to be associated with stillbirth. From those factors hypertensive disorder during pregnancy had been reported to be associated with stillbirth by studies in Tanzania[23], Nigeria [32], and SSA [22]. Similar results were reported by case control studies on determinants of stillbirth in North Shewa Zone, Oromia region, Ethiopia [38], and central Zone of Tigray, Ethiopia [39]. Antepartum Hemorrhage (APH) was other obstetric complications which have been reported to be significantly associated with stillbirth in studies conducted in Nepal, Nigeria, Cameroon, Northern Tanzania, southwestern Ethiopia and Amhara region, Ethiopia [23, 31, 32, 36, 40, 41]. Premature rupture of fetal membranes (PROM) is also identified determinant factor for stillbirth in studies conducted in katsina, Nigeria, Northwest Ethiopia and Amhara region, Ethiopia [28, 32, 36]. Obstructed labor were significantly associated with stillbirth in a study from Hawassa [42] and Hiwot Fana hospital [43]. Women who developed uterine rupture [41] and cord accidents [34, 44] were also more likely to have still birth.

A ten years analysis of stillbirth in a tertiary hospital in SSA: reported DM in pregnancy significantly associates with stillbirth [22]. A case control study conducted in Felege Hiwot Hospital, Northwest Ethiopia also shows that STI increases the risk of stillbirth [28]. Anemia [24, 32], malaria [45] and being Human Immunodeficiency Virus (HIV) positive [13] are also significantly associated with still birth in studies conducted in the world, Nigeria and Ethiopia.

### **2.1.4. Fetal and obstetric factors**

Prematurity (<37 weeks) is reported as a determinant factor by studies done in Tanzania [23], Cameroon [40], SSA [22], Southern Ethiopia [46], and central Zone of Tigray, Ethiopia [39]. Gestational age above 40 weeks is also a risk factor for stillbirth in a study from Kenya [47] and Northern Tanzania [23]. A study in Northern Tanzania [23], SSA [22] and Oromia Regional State, Southeast Ethiopia [48] reported low birth weight (<2500g) increases stillbirth. On the other hand, a study in Zambia reported that birth weight  $\geq 4000$  g increased the risk for stillbirth [49].

Even though studies done in Brazil [50] and England and Wales [51] concluded that the risk of stillbirth in males fetus was higher, another study in Northern Ghana [52] indicated that female neonates were less likely to be stillborn compared to male neonates. Non-cephalic presentation was also reported as a risk of stillbirth from study in Northern Tanzania [23] and Addis Ababa,



Ethiopia [13]. Fetal congenital malformation found statistically significant risk of stillbirth in studies done in Nigeria [32], SSA [22, 53] and northwest Ethiopia [28]. A risk factor study in tertiary care setting of Nepal also shows multiple births increased risk for stillbirth [31].

Both primiparity and parity  $\geq 5$  have been associated with stillbirth in several studies from developing countries, including Nigeria [32], Ghana [54] and SSA [5, 22]. History of stillbirth in previous pregnancies was also reported as a risk factor of stillbirth in studies conducted in Nepal, SSA, Northwest Ethiopia, and Amhara region, Ethiopia [5, 22, 28, 31, 36]. Other obstetric factors like delivery by cesarean section [32, 46, 55], inter-pregnancy interval  $>2$  years [22], induced onset of labor [36, 38], and duration of labor  $\geq 24$  hour [38, 41, 42, 48] were also reported as determinants of stillbirth.

### 3. Conceptual framework

Conceptual framework organized from available reviewed literature. Factors that affects stillbirth are classified in to four main categories: Socio-demographic characteristics; obstetric and medical complications; fetal and obstetrics factors; and health care related factors and organized as follow (Figure 1).

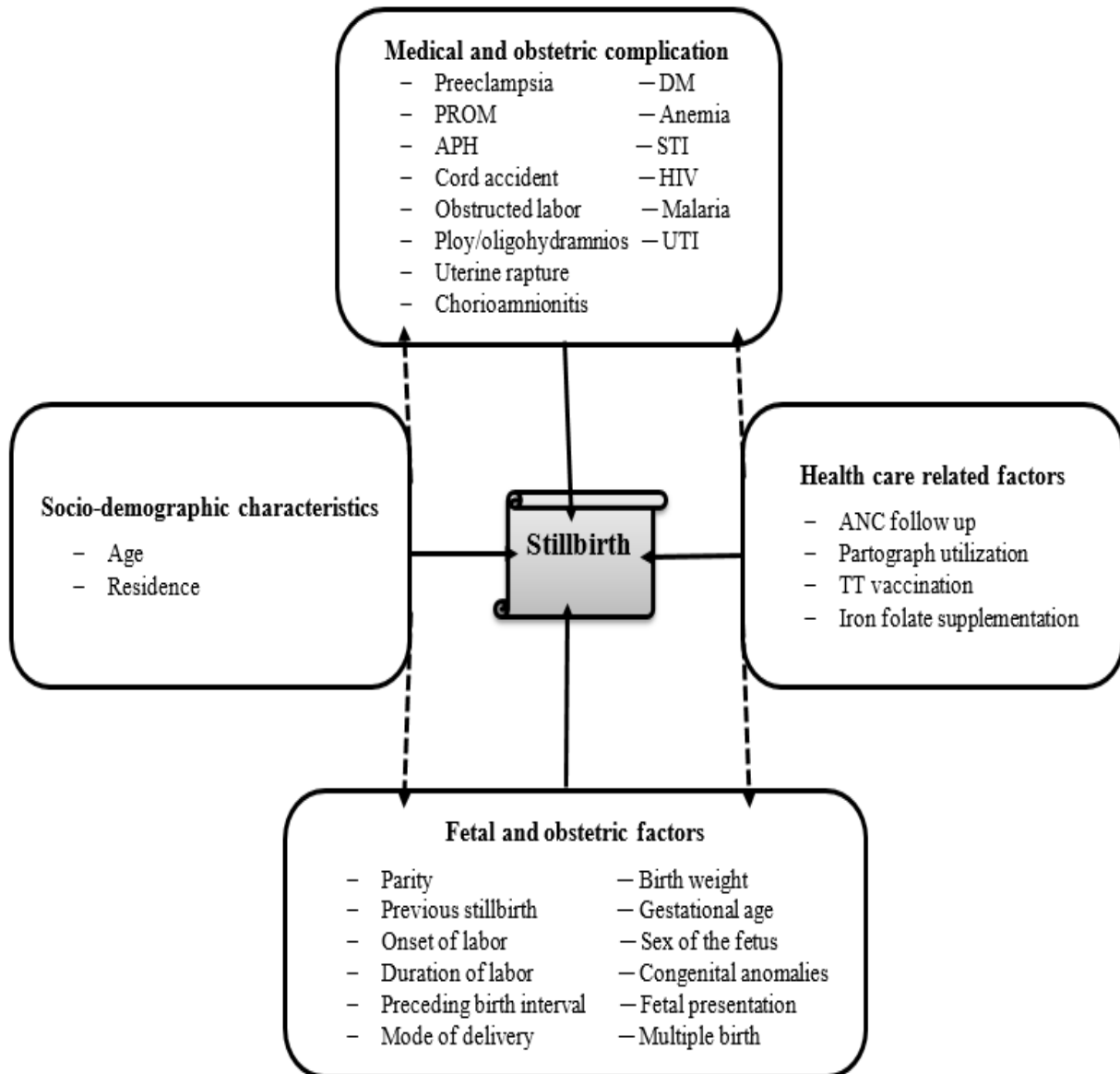


Figure 1: Conceptual framework of a study to identify determinants of stillbirth among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022 [13, 22-32, 34, 36-43, 46, 48, 53, 55]

## **4. Objectives**

### **4.1. General objective**

- ❖ To identify determinants of stillbirth among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

## **5. Methods and materials**

### **5.1. Study area and period**

In this study, the data were collected for one month (January 1 to 30, 2023) from medical charts of women who gave birth in North Wollo Zone hospitals from January 1 to December 31, 2022. North Wollo Zone is one of the thirteen Zones in Amhara regional state with a capital of Woldia, which is located at 360 Km from Bahir Dar and 520 Km from Addis Ababa. Based on the 2007 census, this Zone has a total population of 1,500,303 with 752,895 men and 747,408 women. Currently, North Wollo Zone has 1 specialized hospital, 1 general hospital, 4 primary hospitals, 69 health centers, and 290 health posts.

### **5.2. Study design**

Institution based unmatched case control study design was employed.

### **5.3. Populations**

#### **5.3.1. Source populations**

The source population were all mothers who gave birth in North Wollo Zone hospitals.

#### **5.3.2. Study population**

All mothers who gave birth from January 1 to December 31, 2022 in selected hospitals of North Wollo Zone were the study population.

#### **5.3.3. Sample population**

All randomly selected mothers who gave birth from January 1 to December 31, 2022 in selected hospitals of North Wollo Zone were the sample population of this study.

## 5.4. Eligibility criteria

### 5.4.1. Inclusion criteria

Cases: In this study, cases included all women who experienced a stillbirth between January 1 and December 31, 2022, in selected hospitals in the North Wollo Zone.

Controls: All women who gave birth to live baby between January 1 and December 31, 2022, in selected hospitals in the North Wollo Zone, made up the study's control group.

### 5.4.2. Exclusion criteria

Charts that contain incomplete information on the major variables of the study (no any information about the antenatal period, labor status, and/or birth status), as well as charts that were lost during data collection, were excluded from the study.

## 5.5. Sample size determination

The sample size was calculated based on an unmatched case–control formula using Epi Info version-7 software with the assumption of power = 80%, two-sided level significance= 95%, 1:3 case to control ratio. Several factors that have statistically significant association with stillbirth were taken from previous studies. The sample size from the exposure variable of ANC follow up (412: 103 cases and 309 controls) was chosen as the final sample size because it is higher than the sample sizes from other significant alternative factors (**Table 1**).

Table 1: Sample size calculation to identify determinants of stillbirth among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022 using factors significantly associated with stillbirth in previous studies

S. No	Variables	Percent of controls exposed	Crude odds ratio	Case to control ratio	Sample size			
					Case	Control	Total	Ref.
1	ANC follow up	74.2	2.46	1:3	103	309	412	[42]
2	Maternal age	9.7	3.73	1:3	48	142	190	[25]
3	Duration of labor	23.9	2.28	1:3	77	229	306	[48]
4	Partograph utilization	6.3	3.46	1:3	75	225	300	[42]

## 5.6. Sampling procedure

A simple random sampling technique was applied to select both cases and controls of this study. Initially, three hospitals were selected by a simple random sampling technique from the total of six hospitals in the North Wollo Zone. Then, sampling frame was prepared by listing medical record number of all births in the study period from the delivery registration book of each hospital and categorizing them as stillbirths and live births. Finally, the calculated sample size was allocated to each hospital proportional to the size of their population using the formula  $\text{sample in a hospital} = \text{total sample} \times \frac{\text{population in a hospital}}{\text{total population}}$ , and a simple random sampling technique was applied to select study participants from the above-prepared sampling frame.

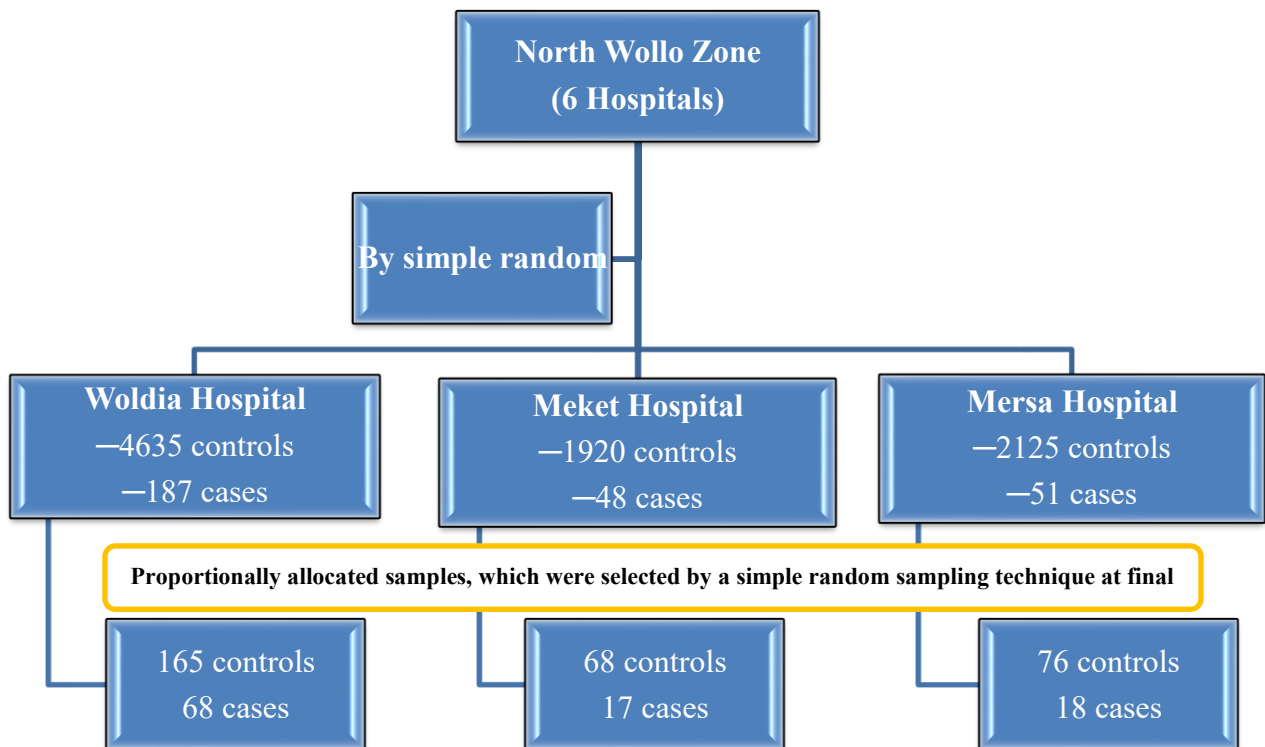


Figure 2: Schematic presentation of the sampling procedure to identify determinants of stillbirth among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

## **5.7. Study variables**

### **5.7.1. Dependent variable**

The dependent variable was stillbirth, which was categorized as "yes" or "no".

### **5.7.2. Independent variables**

Independent variables of this study includes:

- Sociodemographic characteristics: age and residence
- Obstetric and medical complications: preeclampsia, PROM, APH, cord accident, obstructed labor, chorioamnionitis, malaria, and anemia
- Fetal and obstetrics factors: gravidity, prematurity, labor onset, labor duration, type of pregnancy, fetal presentation, stillbirth history, mode of delivery, congenital anomaly, and fetal sex
- Health care related factors. ANC follow-up, partograph utilization, iron folate supplementation, and tetanus toxoid vaccination

## **5.8. Operational or term definitions**

**Cases:** Women who experienced stillbirth, which is defined as baby born with no sign of life after 28 weeks gestation or with  $\geq 1000$  grams birth weight [56].

**Controls:** Women who gave live births after 28<sup>th</sup> weeks of gestations.

**Partograph utilization:** If all the data on the three components of partograph (fetal condition, progress of labor, and maternal condition) were completed as per WHO protocol, it was considered that a partograph was utilized [57].

**Cord accidents:** If there was cord prolapse, cord knot, and/or nuchal cord, it was considered that there was a cord accident in this study.

## **5.9. Data collection tool and technique**

Data were collected by using a structured checklist that was developed in the English language after a thorough literature analysis [22-32, 34, 36-43, 55] and sample chart review for the presence of variables. The checklist consists of relevant information on socio-demographic data, obstetric factor, medical history, healthcare-related factors and birth outcome. Ten midwifery professionals were involved in the data collection and three degree holder midwives were involved as a supervisor. The data collectors, who then filled out the checklist, read the history, delivery summary, lab findings, partograph, progress notes, and operation notes on the patient's chart.

### **5.10. Data quality control**

To ensure quality of data, data collection tool was prepared after thorough analysis of relevant literatures and then sample chart review for the presence of variables. There was a one day training with data collectors and supervisors to have the consensus and the same understanding of what is intended to be measured by each question in a questionnaire and how the data will be collected. The principal investigator and supervisor were made a continuous follow-up throughout the data collection period. The collected data were checked for completeness, accuracy and consistency by supervisor daily and anything unclear was communicated to the data collectors and necessary correction was made accordingly to the aims of the study. Finally, appropriate coding and entry was done after collecting the data.

### **5.11. Data processing and analysis**

Data were analyzed by using SPSS version 25.0 after it is coded, entered, and cleaned by using Epi-data version-3.1. Categorical variables were summarized as numbers and percentages to be displayed by using frequency tables and graphs, whereas continuous variables were presented as mean/median and standard deviations/IQR based on the distribution of the data. Odds ratio with 95% confidence interval was used to measure the association between dependent and independent variables. Bi-variable logistic regression model was executed to determine the crude association of the independent variables with the dependent variable. Variables with  $P$ -value  $< 0.2$  at the bi-variable logistic regression were exported to the multivariable logistic regression model to control confounding factors and to see the independent predictors of stillbirth. Statistical significance was declared at  $P < 0.05$ . Multicollinearity was checked by using variance inflation factor via considering the value of  $>10$  as an indicator for the existence of collinearity, respectively. Hosmer and Lemeshow test was used to check the goodness of model fitness.



### **5.12. Ethical consideration**

Ethical approval was obtained from Woldia University, College of Health Sciences and support letter was sought from North Wollo Zonal Health department to each hospital. Permission was acquired from each hospital to review delivery register book and medical cards. Questionnaires was coded instead of using personal identifiers, and hence, confidentiality was assured throughout the study.

### **5.13. Dissemination plan of the result**

As the study is done for partial fulfillment, the findings will be submitted and presented in an open defense at Woldia University, College of medicine. Other several strategies will be developed to disseminate the information obtained from the study. The paper will be circulated among those agencies, companies, and any other governmental and non-governmental body that directly or indirectly, actively participated in the realization of strategies designed to reduce stillbirth. The main findings will also be presented in different scientific seminars, meetings, and workshops. All the possible attempts will be tried to publish findings of the study on scientific journals.

## 6. Results

### 6.1. Socio-demographic characteristics

This study analyzed 412 charts (103 cases and 309 controls) of mothers who gave birth in selected hospitals in the North Wollo Zone. The median age was 32 years old (IQR: 34–28) and 33 years old (IQR: 34–30) for the case and control mothers, respectively. About 11 (10.7%) of the cases and 7 (2.3%) of the control mothers were found to be below 20 years old, whereas 20 (19.4%) of the cases and 60 (19.4%) of the control mothers were found to be above 35 years old. Two hundred fifty-two (61.2%) of the study subjects were rural dwellers, of which 63 (25.0%) were cases and 189 (75.0%) were controls.

### 6.2. Health care related factors

The higher percentage of mothers—93 (90.3%) of cases and 292 (94.5%) of controls—had at least one antenatal follow-up visit. However, only 17 (16.5%) of cases and 90 (29.1%) of control mothers had four or more antenatal follow-ups throughout their pregnancies (**Figure 3**). From those mothers who had at least one antenatal follow-up visit, 66 (71.0%) of case mothers and 222 (76.0%) of control mothers had been supplemented with an iron-folate pill, and 51 (54.8%) and 187 (64.0%) of case and control mothers had received at least two doses of tetanus toxoid vaccination during pregnancy. In terms of partograph use, partograph was used in 47 (45.6%) of the case mothers' labor and 222 (71.8%) of the control mothers' labor.

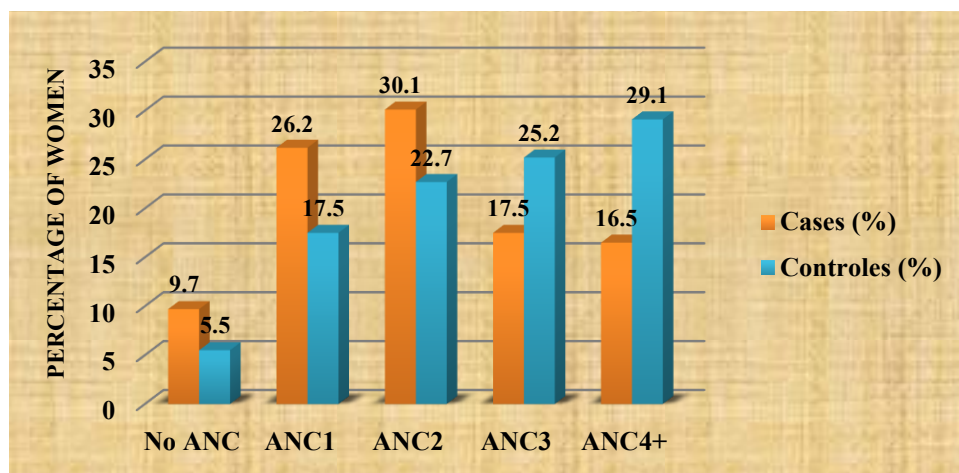


Figure 3: Antenatal care follow-ups among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

### 6.3. Obstetric related factors and medical complications

About 90 (87.4%) of cases and 288 (93.2%) of control mothers were multigravida, and among these, 84 (93.3%) of cases and 219 (76.3%) of controls had a preceding interbirth interval of  $\leq 33$  months. Concerning the onset of labor, 64 (62.1%) of the cases and 246 (79.6%) of the control mothers labor started spontaneously, while 64 (62.1%) of cases and 194 (62.8%) of control mothers gave birth through a spontaneous vaginal delivery. Majority of the study participants, 378 (91.7%) (i.e., 81 (78.6%) cases and 297 (96.1%) controls), had no PROM, while only 37 (9.0%) (9 (8.7%) cases and 28 (9.1%) controls) had experienced a cord accident. About, 10 (9.7%) cases and 15 (4.9%) of control mothers had anemia during the indexed pregnancy (**Table 2**).

Table 2: Medical complications and obstetric related characteristics of women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

Variables	Cases (n = 103) (%)	Controls (n = 309) (%)	Total (%)
Gravidity			
Primigravida	13 (12.6)	21 (6.8)	34 (8.3)
2-4	79 (76.7)	284 (91.9)	363 (88.1)
$\geq 5$	11 (10.7)	4 (1.3)	15 (3.6)
History of stillbirth			
Yes	8 (7.8)	8 (2.6)	16 (3.9)
No	95 (92.2)	301 (97.4)	396 (96.1)
Type of pregnancy			
Single	98 (95.1)	295 (95.5)	393 (95.4)
Twine	5 (4.9)	14 (4.5)	19 (4.6)
Fetal presentation			
Vertex	90 (87.4)	278 (90.0)	368 (89.3)
Not vertex	13 (11.6.7)	31 (10.0)	44 (10.7)
Onset of labor			
Induced	39 (37.9)	63 (20.4)	102 (24.8)
Spontaneous	64 (62.1)	246 (79.6)	310 (75.2)
Duration of labor			
<24 Hrs.	70 (68.0)	275 (90.2)	345 (84.6)
$\geq 24$ Hrs.	33 (32.0)	30 (9.8)	63 (15.4)
PROM			
Yes	22 (21.4)	12 (3.9)	34 (8.3)
No	81 (78.6)	297 (96.1)	378 (91.7)
Hypertension during Px			
Yes	22 (21.4)	38 (12.3)	60 (14.6)
No	81 (78.6)	271 (87.7)	352 (85.4)

APH			
Yes	14 (13.6)	11 (3.6)	25 (6.1)
No	89 (86.4)	298 (96.4)	387 (93.9)
Obstructed labor			
Yes	23 (22.3)	30 (9.7)	53 (12.9)
No	80 (77.7)	279 (90.3)	359 (87.1)
Cord accident			
Yes	7 (6.8)	14 (4.5)	21 (5.1)
No	96 (93.2)	295 (95.5)	391 (94.9)
Cord accident type (n=21)			
Cord prolapse	3 (42.9)	9 (64.3)	12 (57.1)
True cord knot	2 (28.6)	2 (14.3)	4 (19.0)
Nuchal cord	2 (28.6)	3 (21.4)	5 (23.8)
Mode of delivery			
SVD	64 (62.1)	194 (62.8)	258 (62.6)
Instrumental assisted	25 (24.3)	88 (28.5)	113 (27.4)
Cesarean section	14 (13.6)	27 (8.7)	41 (10.0)
Chorioamnionitis			
Yes	12 (11.7)	35 (11.3)	47 (11.4)
No	91 (88.3)	274 (88.7)	365 (88.6)
Malaria			
Yes	3 (2.9)	5 (1.6)	8 (1.9)
No	100 (97.1)	304 (98.4)	404 (98.1)
Anemia			
Yes	10 (9.7)	15 (4.9)	25 (6.1)
No	93 (90.3)	294 (95.1)	387 (93.9)

#### 6.4. Fetal related characteristics

Thirty-two (38.1%) and 18 (5.4%) of the fetuses from the case and control mothers, respectively, exhibited congenital abnormalities. The sex of the fetus was female in 16 (20.0%) of the cases and male in 20 (6.0%) of the control mothers. Large proportions of cases 51 (49.5%) and control mothers 252 (81.6%), however, gave birth to their fetuses at gestational ages between 37 and 41 weeks. Around 59 (57.3%) of cases and 258 (83.5%) of control mothers have a fetus weighing in the range of 2500–4000 g at birth.

## 6.5. Determinants of stillbirth

The association between stillbirth and explanatory variables was first investigated using bi-variable binary logistic regression analysis. Accordingly, gravidity, history of stillbirth, presence of PROM, anemia, APH, hypertension during pregnancy, sex of neonate, onset of labor, partograph utilization, gestational age at birth, duration of labor, and congenital malformation all have a significant association with stillbirth at *P*-value 0.2 (**Table 3**).

Table 3: Determinants of stillbirth identified during the bi-variable binary logistic regression analysis among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

Variables	Stillbirth status		COR (95%CI)	P-Value
	Case	Control		
Gravidity	(treated as continuous)		1.32 (1.05–1.65)	0.016
Sex of newborn				
Male	29	148		
Female	74	161	2.35 (1.45–3.81)	0.001
Gestational age at birth				
<37 Wks.	37	44	4.15 (2.44–7.06)	<0.001
37-41 Wks.	51	252	1	
≥42 Wks.	15	13	5.70 (2.56–12.71)	<0.001
Hypertension during Px				
Yes	22	38	1.94 (1.08–3.46)	0.026
No	81	271	1	
History of stillbirth				
Yes	8	8	3.17 (1.16–8.67)	0.025
No	95	301	1	
Presence of PROM				
Yes	22	12	6.72 (3.19–14.16)	<0.001
No	81	297	1	
Presence of APH				
Yes	14	11	4.26 (1.87–9.72)	0.001
No	89	298	1	
Duration of labor				
<24 Hrs.	70	275	1	
≥24 Hrs.	33	30	4.32 (2.47–7.56)	<0.001
Presence of anemia during Px				
Yes	10	15	2.12 (0.92–4.85)	0.080
No	93	294	1	
Congenital malformation				
Yes	13	14	3.04 (1.38–6.71)	0.006
No	90	295	1	

Onset of labor				
Induced	39	63	2.38 (1.46–3.86)	<0.001
Spontaneous	64	246	1	
Partograph used to follow labor				
Yes	47	222	1	
No	56	87	3.04 (1.92–4.82)	<0.001

Px = Pregnancy; COR = Crude Odds Ratio; CI = Confidence Interval

Multivariable logistic analysis was executed using the significant variables in the bi-variable binary logistic regression at *P*-value 0.2 and showed that the better model (higher Hosmer and Lemeshow test, *P*=0.867). Consequently, the significant determinants identified were sex of the fetus, gestational age at birth, presence of PROM, onset of labor, duration of labor, and partograph utilization (**Table 4**).

The present study found that preterm births were 3.46 (AOR = 3.46 [95% CI: 1.87–6.39]) times and postterm births were 3.47 (AOR = 3.47 [95% CI: 1.35–8.91]) more likely to be a stillbirth as compared to term births. Female fetuses were 1.81 (AOR = 1.81 [95% CI: 1.02–3.22]) times more likely to be a stillbirth as compared to their counterparts. The odds of experiencing stillbirth were 5.53 times higher among mothers who have PROM compared with mothers who have no PROM (AOR = 5.53 [95% CI: 2.33–9.94]). Mothers who have induced onset of labor and  $\geq 24$  h labor duration were 2.24 (AOR = 2.24 [95%CI: 1.24–4.07]) and 3.80 (AOR = 3.80 [95%CI: 1.94–7.45]) times more likely to have a stillbirth as compared to their counterpart, respectively. The odds of experiencing stillbirth was 2.45 (AOR = 2.45 [95%CI: 1.41–4.26]) times higher for those mothers whose labor was not followed by partograph than those whose labor was followed with partograph.

Table 4: Determinants of stillbirth identified during the multivariable binary logistic regression analysis among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

Variables	Stillbirth status		COR (95%CI)	AOR (95%CI)	<i>P</i> -value
	Case	Control			
Gravidity	(treated as continuous)		1.32 (1.05–1.65)	1.09 (0.83–1.42)	0.567
Sex of newborn					
Male	29	148			
Female	74	161	2.35 (1.45–3.81)	<b>1.81 (1.02–3.22)</b>	0.011
Gestational age at birth					
<37 Wk	37	44	4.15 (2.44–7.06)	<b>3.46 (1.87–6.39)</b>	<0.001
37-41 Wks.	51	252	1	1	
$\geq 42$ Wks.	15	13	5.70 (2.56–12.71)	<b>3.47 (1.35–8.91)</b>	0.011

Hypertension during Px					
Yes	22	38	1.94 (1.08–3.46)	0.80 (0.37–1.72)	0.931
No	81	271	1		
History of stillbirth					
Yes	8	8	3.17 (1.16–8.67)	1.57 (0.44–5.67)	0.537
No	95	301	1		
Presence of PROM					
Yes	22	12	6.72 (3.19–14.16)	<b>5.53 (2.33–9.94)</b>	<0.001
No	81	297	1		
Presence of APH					
Yes	14	11	4.26 (1.87–9.72)	2.48 (0.86–7.12)	0.066
No	89	298	1		
Duration of labor					
<24 h	70	275	1		
≥24 h	33	30	4.32 (2.47–7.56)	<b>3.80 (1.94–7.45)</b>	<0.001
Presence of anemia at Px					
Yes	10	15	2.12 (0.92–4.85)	1.40 (0.48–4.08)	0.525
No	93	294	1		
Congenital malformation					
Yes	13	14	3.04 (1.38–6.71)	1.66 (0.65–4.25)	0.212
No	90	295	1		
Onset of labor					
Induced	39	63	2.38 (1.46–3.86)	<b>2.24 (1.24–4.07)</b>	0.015
Spontaneous	64	246	1		
Labor follow by partograph					
Yes	47	222	1		
No	56	87	3.04 (1.92–4.82)	<b>2.45 (1.41–4.26)</b>	0.002

Bold = significant at  $P < 0.05$ ; COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval

## 7. Discussions

The overall aim of this study was to identify the determinants of stillbirth among mothers who gave birth in North Wollo Zone hospitals, Northeast Ethiopia. Accordingly, sex of the fetus, gestational age at birth, presence of PROM, onset of labor, duration of labor, and partograph utilization were identified as significant determinants of stillbirth in the study area among these study populations.

This study acknowledged that both preterm and postterm births were 3.46 and 3.47 times more likely to be stillbirths, which is in line with previous studies that showed being preterm or postterm to be a risk factor for stillbirth [23, 39, 46, 47]. The possible explanation could be that fetuses with preterm birth are mainly associated with trouble breathing due to an immature respiratory system [58], and premature fetuses are more susceptible to ischemia due to incomplete blood-brain barrier formation [59]. These, in turn, may lead the fetus to death during the delivery process. A postterm fetus is also at a higher risk of ending in stillbirth, which is mainly due to meconium aspiration syndrome, and macrosomia [60]. Postterm pregnancy is also an independent risk factor for low umbilical cord pH levels and placental insufficiency, which in turn increases the risk of fetal death before or during delivery [60, 61].

It was also found that most mothers who experienced stillbirth had PROM. This result was similar to the study conducted previously at different settings [28, 32, 36], which identified that stillbirth was significantly associated with the presence of PROM. This might be because, following membrane rupture, amniotic fluid turns into oligohydramnios, and umbilical cord may be compressed, which causes fetal hypoxia and ultimately leads to fetal death. Another possible reason is that prolonged premature membrane rupture results in ascending infection of the uterus (chorioamnionitis) and causes stillbirth [62].

One of the significant determinants of stillbirth in this study was sex of the fetus. The study revealed that the risk of stillbirth in female fetus was 1.81 times higher than male fetus. This finding appear to contradict the general assumption that male fetuses are more vulnerable to intrauterine insults and stillbirth [63]. However, it is supported by the cohort study conducted to see the association between stillbirth and fetal gender [64]. Though it needs a detail investigation, it could be because carrying a female fetus increases the risk of fetal growth restriction [65].



Mother with labor length  $\geq 24$  h was 3.80 times more at risk to end with stillbirth. This finding is in agreement with the findings of different studies in Ethiopia [38, 41, 48], which showed that lengthy labor were significant risk factors for stillbirth. The finding might result from the fact that prolonged labor causes fetal distress that further causes intra partum fetal death. Induced labor onset was also a significant factor that increase the occurrence of stillbirth. It is supported by other a previous study [38]. The possible explanation could be when the labor is induced the fetus might be exposed for stressful uterine contraction, which finally leads to death of the fetus [66].

Furthermore, this study generated that the odds of experiencing stillbirth was 2.45 times higher for those mothers whose labor was not followed by partograph than those whose labor was followed with partograph. This result is in line with studies done previously [25, 34, 36]. This is because the appropriate use of partograph can help health professionals to detect danger signs earlier during labor and take immediate action to save the life of the mother and the fetus. Otherwise, in the absence of a partograph, some factors that may be linked to the occurrence of stillbirths, such as fetal distress, poor labor progression, protracted labor, and obstructed labor, may go unnoticed by medical practitioners [67].

## 8. Conclusion

In general, this study revealed that the induced onset of labor, duration labor  $\geq 24$  h, labor not followed by partograph, female sex of the fetus, presence of PROM, and prematurity and post maturity were factors that significantly determine the risk of stillbirth.

## 9. Recommendations

The majority of the factors that have been identified to have an association with stillbirth are manageable and responsive to interventions. Thus, tailored interventions addressing modifiable risk factors of stillbirths should be devised to improve the health of the fetus during conception and intrapartum.

Regional and Zonal Health offices

- They should give special consideration to PROM, labor induction, and preterm and postterm pregnancy while preparing a maternal care manual/guideline.
- Regional and Zonal health offices should strengthen the partograph utilization practice and establish a strong referral system.

Healthcare Providers

- Healthcare providers are advised to follow every labor using partograph properly and take an appropriate intervention early.
- They are also expected to give special care to mothers whose labor is started by induction.

Researchers

- It is advised that more scholars carry out studies with robust designs, such as the prospective study design, to investigate further maternal factors such as behavioral factors (smoking, drinking, nutritional issues, and the like).

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## Annex

### Annex I: Information sheet

**Research title:** Determinants of stillbirth among women who gave birth in North Wollo Zone hospitals, Northeast Ethiopia, 2022

**Purpose of the research:** Primarily, the result of the study will be submitted to Woldia University College of Health Sciences for the requirements to get Masters of General Public Health. In addition, the finding of this study will contribute its part in filling the information and knowledge gap on stillbirth area and will guide to design specific tailored interventions on those factors focused on lowering stillbirth in the study area.

**Benefits:** The result of the study will use to improve the knowledge of health care provider and to fill information gap on stillbirth. It will also use to improve strategies on stillbirth prevention.

**Confidentiality:** Any information or data obtained from facility will be kept confidentially so no other parties can obtain except the principal investigators. It will not also be utilized for other purpose it will be locked with password.

**Person to contact:** This research project will be reviewed and approved by the institutional review board of College of Health Sciences, Woldia University. In case, if you want to know more information about the research and its undertakings, you can contact us through the following address.

Principal Investigator: Name: Atnaf Alem

Phone: +251 91 872 6966

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Advisors:

- ☐ Asmamaw Demis (MSc, Assistant professor)
- ☐ Eyob Shitie (MSc in clinical midwifery)

Permission: Hence, you are kindly requested to permit and forward your permission to the concern.

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## Annex II: Data extraction checklist

Identification related information

Data collector's Name: \_\_\_\_\_ Signature: \_\_\_\_\_ Date \_\_\_\_\_

Supervisor's Name: \_\_\_\_\_ Signature: \_\_\_\_\_

Questionnaire Code No: \_\_\_\_\_ Completion status (Completely filled or Not)

S.No	Question	Response	Skip
<b>Part I: Socio- demographic Characteristics</b>			
101	Age of the mother	/ _____ / in year	
102	Place of residence	1. Urban 2. Rural	
<b>Part II: Maternal factors</b>			
201	Gravidity	_____	
202	Parity	_____	
203	Preceding birth interval	_____ (In month, if applied)	
204	Antenatal care visit?	1. Yes 2. No	If no skip to 208
205	If yes to Q No 204, how many ANC visits do you have?	_____ in number	
206	Did mother have taken at least two doses TT vaccination?	1. Yes 2. No	
207	Did mother take Iron-folate supplementation during pregnancy?	1. Yes 2. No	
208	Prior history of abortion	1. Yes 2. No	
209	Prior history of stillbirth	1. Yes 2. No	If no skip to 211
210	Number of stillbirth	_____	
211	HIV status	1. Positive 2. Negative 3. Unknown	
212	Do you have STI	1. Yes 2. No	If no skip to 214
213	If yes, mention the type of STI	_____	
214	Hypertension during pregnancy	1. Yes 2. No	
215	Preeclampsia during pregnancy	1. Yes 2. No	
216	Presence of polyhydramnios	1. Yes 2. No	
217	Presence of oligohydramnios	1. Yes 2. No	

218	Do you have PROM	1. Yes 2. No	
219	Do you have APH	1. Yes 2. No	
220	Presence of anemia	1. Yes 2. No	
221	Presence of malaria during Px	1. Yes 2. No	
222	Presence of DM	1. Yes 2. No	
223	Presence of UTI	1. Yes 2. No	
224	Duration of labor	_____ ( in Hour)	
225	Do you have obstructed labor	1. Yes 2. No	
226	Do you have uterine rupture	1. Yes 2. No	
<b>Part III: Fetal condition</b>			
301	Sex of the fetus?	1. Male 2. Female	
302	Weight of the new born (kg)	1. _____ (in Kg)	
303	Gestational age at birth that recorded on the client card	_____ ( in week)	
304	Congenital structure	1. Normal 2. Anomalies	
305	Type of pregnancy	1. Single 2. Twine 3. Triple 4. Other specify _____	
<b>Part IV: labor and delivery related factors</b>			
401	Onset of labor	1. Induced 1. Spontaneous	
402	Use of partograph	1. Yes 2. No	
403	Fetal presentation	1. Cephalic 2. Breach 3. Shoulder 4. Face 5. Other specify _____	
404	Cord accident	1. Yes 2. No	If no skip to 406
405	If yes for Q404, which type	1. Cord prolapse 2. Cord knot 3. Nuchal cord 4. Cord compress 5. Other specify _____	

406	Color of amniotic fluid	1. Liquor 2. Offensive 3. Meconium stained	
407	Presence of chorioamnionitis	1. Yes 2. No	
408	Labor augmentation	1. Yes 2. No	
409	Mode of delivery	1. SVD 2. CS 3. Instrumental	

***Thank you very much!***