



DETERMINANTS OF NEONATAL MORTALITY IN NEONATAL INTENSIVE CARE UNIT OF SIDAMA REGION HOSPITALS, ETHIOPIA: MATCHED CASE CONTROL STUDY

NAME OF CANDIDATE: HAFTU REDA BELAY (BSC IN PUBLIC HEALTH
OFFICER)

A RESEARCH THESIS REPORT SUBMITTED TO DEPARTMENT OF
EPIDEMIOLOGY, SCHOOL OF PUBLIC HEALTH, ST. PAUL'S HOSPITAL
MILLENNIUM MEDICAL COLLEGE, IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTERS OF PUBLIC HEALTH
IN EPIDEMIOLOGY

JANUARY 2022

ADDIS ABABA, ETHIOPIA



DETERMINANTS OF NEONATAL MORTALITY IN NEONATAL
INTENSIVE CARE UNIT OF SIDAMA REGION HOSPITALS,
ETHIOPIA: MATCHED CASE CONTROL STUDY

NAME OF CANDIDATE: HAFTU REDA BELAY (BSC IN PUBLIC HEALTH
OFFICER)

NAME OF ADVISORS: MR. TEMESGEN GELETA (MPH)

MR.SHIKUR MOHAMMED (ASSISTANT PROFESSOR)

A RESEARCH THESIS REPORT SUBMITTED TO DEPARTMENT OF
EPIDEMIOLOGY, SCHOOL OF PUBLIC HEALTH, ST. PAUL'S HOSPITAL
MILLENNIUM MEDICAL COLLEGE, IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTERS OF PUBLIC HEALTH
IN EPIDEMIOLOGY

JANUARY 2022

ADDIS ABABA, ETHIOPIA

Abstract

Background: Neonatal mortality accounts for estimated 2.5 million deaths worldwide. In Ethiopia neonatal mortality constitutes 55 % of <5years mortality and 70% of infant mortality. Neonatal mortality determinant varies by country with the availability and quality of health care. The aim of this study is to identify determinant of neonatal mortality in sidama region Ethiopia.

Method: Matched case-control study carried out among 267 neonates (89 cases and 178 controls) admitted in public hospitals of Sidama region from March 18 to June 30/2021. Cases were neonate discharged as dead, with two controls matched by gestational age, admitted to same Hospital, and survived >28 days of life birth. Data were collected by reviewing chart, interviewing parents using structured questionnaires and in addition for controls from follow up chart. Data entered in Epi info7 software and exported to SPSS version25 for cleaning, recoded and analysis. Descriptive statistics was done to describe and summarize the outcome and exposure variables. Conditional logistic regression was used to estimate the effect size (odd ratio) and identify factors associated with neonatal mortality in Sidama region public hospitals.

Results: The odd of neonate who were born from mother who had no antenatal care visit were 6.90 times at risk of death than their encounter (AOR = 6.90; 95% CI 2.67, 17.98), the neonatal deaths were more likely observed among odd of neonate who had delivered at home (AOR = 2.90; 95% CI=1.09, 7.83) than odd of neonate who delivered at health facility, furthermore no postnatal care visit (AOR = 2.67; 95% CI =1.16. 6.14), not initiating breast feeding within an hour (AOR = 3.65 95% CI=1.65, 8.07), perinatal asphyxia (AOR=6.0; 95%CI=1.98, 18.35), and congenital malformed neonate(AOR=3.40; 95%CI=1.32, 8.80) were determinant of neonatal mortality in Sidama region public hospitals.

Conclusion: Antenatal care visit, maternal home delivery, postnatal care visit, history of antenatal complication, initiating breast feeding within one hour, neonatal complication at birth, perinatal asphyxia, congenital malformed neonate were identified neonatal mortality risk factors, which are preventable and manageable by good antenatal care, intra-partum care, neonatal care increase access of well-equipped ambulance transport system, health education and building the capacity of health professional through training and providing orientations.

Key words: Perinatal death, Neonatal Intensive Care Unit, Sidama Region Southern Ethiopia

Acknowledgements

I would like to express my gratitude to the Department of Epidemiology, school of public health, SPMMC for providing ethical approval and research grant to conduct this study and my deepest appreciation is to my advisors Mr. Temesgen (MPH) and Mr.Shukur Mohammed (Assistant professor) for their valuable comments from the beginning of the study to its completion. I also grateful to study subject's parents for their time and valuable information. I am thankful to my Family's for their moral and material support. My gratitude also goes to my friends for their direct and indirect contribution to the development of this study.

Table of content

Contents	page
Abstract	i
Acknowledgements	ii
Table of content	iii
List of tables	v
List of figures	vi
Acronyms	vii
1. Introduction	1
1.1. Background	1
1.2. Statement of the problem	3
1.3. Significance of the study	4
2. Literature review	5
2.1. Burden of neonatal mortality	5
2.2. Determinates of neonatal mortality	5
2.3. Conceptual frame work	8
3. Objective	9
3.1. Study objective	9
□ What factors contribute to neonatal mortality in Sidama Region?	9
4. Methods and material	10
4.1. Study area	10
4.2. Study period and study design	10
4.3. Source Population	10
4.4. Study Population	10
4.5. Inclusion and exclusion criteria	10

4.5.1.	Inclusion criteria	10
4.5.2.	Exclusion criteria	10
4.6.	Sample size and sampling procedures.....	11
4.6.1.	Sample size estimation.....	11
4.6.2.	Sampling technique and procedure.....	11
4.7.	Measurement	13
4.7.1.	Variables	13
4.7.2.	Instruments.....	13
4.8.	Data collection process.....	14
4.9.	Data quality control	14
4.10.	Data processing and analysis	14
4.11.	Ethical considerations	15
5.	RESULTS	17
6.	Discussion.....	25
	Strength and limitation of study.....	27
7.	Conclusions and recommendations	28
	References	29
	Annexes.....	35

List of tables

Table 1.Shows assumption used to determine sample size calculation at sidama region hospitals on 2021.....	11
Table 2. Proportion and Bivariate conditional logistic regression analysis depicting the association between household and socio demographic variables and neonatal mortality in Sidama Region Hospital in 2021	17
Table 3: Proportion and Bivariate conditional logistic regression analysis depicting the association between maternal, obstetrics and delivery related risk factors and neonatal mortality in Sidama Region Hospital in 2021	19
Table 4: Proportion and Bivariate conditional logistic regression analysis depicting the association between neonatal conditions during and after birth and neonatal mortality in Sidama Region Hospital in 2021	21
Table 5: Multivariable conditional logistic regression model depicting the determinant of neonatal mortality in Sidama Region Hospital in 2021	24

List of figures

Figure 1. Conceptual framework for determinant of neonatal mortality in sidama region hospitals in 2021.	8
Figure 2.Sampling procedure to study determinants of neonatal mortality at sidama region hospitals in 2021.	12

Acronyms

ANC-----	Ante Natal Care
AOR-----	Adjusted Odd Ratio
CS-----	cesarean section
CI-----	confidence interval
COD-----	crude odd ratio
EDHS-----	Ethiopia Demography Health Survey
EMDHS-----	Ethiopia Mini Demography Health Survey
ENM-----	Early neonatal mortality
FMHO-----	Federal minister of health
HIV-----	Human Immunodeficiency Virus
LMICs-----	Low- and Middle-Income Countries
LNМ-----	late neonatal mortality
MUAC-----	mid upper arm circumference
NM-----	Neonatal Mortality
NMR-----	Neonatal mortality rate
NICU-----	Neonatal Intensive Care Unit
PNA-----	Perinatal asphyxia
PNC -----	post natal care
SDG-----	Sustainable Development Goal
SNNPRS-----	southern nation and nationalities people representative

SPMMC-----Saints Paulo's Millennium Medical College

SPSS-----Software package for social science

SSA-----Sub-Saharan Africa

SVD-----spontaneous vaginal delivery

TT-----tetanus toxoid

VIF-----Variation Inflation Factor

WHO-----World Health Organization

1. Introduction

1.1. Background

Neonatal period which is the first 28 days of life are the most vulnerable time for a child's survival. According to World Health Organization (WHO) neonatal mortality is the probability of dying within the first four weeks of life and neonatal mortality can be classified into early and late neonatal mortality. Early neonatal mortality (ENM) is the death of neonates within the first week of life and late neonatal mortality (LNM) is the death of neonates from the seventh day until the 28th day post-birth(1,2).

Thirty years ago, the world made a commitment to protect and fulfill children's rights. Among the most fundamental of these rights is the right of every child to survive. While substantial progress in child survival has been made since then, the failure to fully meet that commitment reverberates today for millions of children to die(3). The total number of under five deaths was 5.3 million in 2018, from this under five mortality 47 percent (2.5 million) death occurred in the neonatal period of life with neonatal mortality rate was estimated at 18 deaths per 1,000 live births globally approximately which means 7,000 neonate die every day (4). The daily risk of mortality in the first four weeks of life is ~ 30fold higher than the post-neonatal period, that is, from one month to 59 months of age (5). Prematurity (36%), infections (23%), asphyxia (23%), and congenital malformations (10%) were identified determinant of neonatal deaths globally (6,7).

Moreover, 98% of neonatal deaths occur in developing countries with a greater burden occurring in Sub-Saharan Africa (SSA); approximately one million deaths occur in the first month of life, which represents the highest neonatal mortality rate (NMR) and shows the least progress in reducing the NMR (8,9). The majority of deaths in SSA are caused by infectious diseases, intra partum asphyxia, pregnancy related complications, and premature births (10). Evidence also indicates that 77.5% of neonatal deaths are caused by preterm complications (11) and from neonatal deaths about 60-80% of deaths are caused by prematurity (12). In other studies from Africa and Asia (13) and Ethiopia (5), prematurity, neonatal infections, and birth asphyxia were the main causes of deaths. The causes of neonatal death also vary among different socioeconomic strata and geographic regions in Ethiopia (14,15).

In 2015, Ethiopia was one of the top five countries contributing more than half of the neonatal deaths globally (16). According to Ethiopia Mini Demography Health Survey (EDHS) 2019, there were 67% decrease in under five mortality, 56% reduction in infant mortality, however neonatal mortality reduced only by 39% in Ethiopia over a period of 19 years (17,18). Report from 2000 EDHS shows neonatal mortality constitute 29.5% of all under five mortality and 50.5% of infant mortality where as in 2019 EMDHS indicate 54.5% of under-five mortality 70% of infant mortality is contributed from neonatal mortality. Accordingly the main predictors of neonatal mortality in Ethiopia are residence and birth interval of neonate from previous child (17). Facility-based study done in Ethiopia indicated that the proportion of neonatal deaths was 14.3% in Gondar(19). Studies conducted in Ethiopia documented many maternal and neonatal factors significantly associated with Neonatal mortality. Accordingly, sex of the neonate (20), antenatal care follow-up (20–22) postnatal care follow-up (20), birth weight (low birth weight) (21,22), and short birth interval (less than 24 months)(20) were some of the factors associated with neonatal mortality.

1.2. Statement of the problem

Globally, the sustainable development goal set for 2030 to be achieved are ending preventable deaths of newborns in all countries and aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births(23).However, neonatal mortality rate was estimated at 18 deaths per 1,000 live births globally in 2018 (4) and 98% of neonatal deaths occur in developing countries with a greater burden occurring in SSA (8,9). Evidence suggests that about 75% of the neonatal deaths in low- and middle-income countries (LMICs) are preventable with existing simple and low-cost tools, such as antibiotics for pneumonia and sepsis, sterile blades to cut the umbilical cords, and knit caps and kangaroo care to keep babies warm (24,25). Despite multiple efforts by both the government and other stakeholders, neonatal death remains higher in Ethiopia than in many developing countries (19). FMOH of Ethiopia aim reducing neonatal mortality to 21 per 1000 live birth from 33 per 1000 live birth by 2025(26).In Ethiopia more than 80% of all newborn deaths are caused by preventable and treatable conditions(26).

As a result, understanding the cause and predictors of neonatal death gives an important public health insight and contributes to ending preventable newborn deaths (27,28) such as reducing preterm-related deaths by 58%, intra partum-related deaths by 79%, and infection-related deaths by 84% (29). Additionally, providing quality care at the time of pregnancy and labor and immediate postpartum care have been shown to avert 92% of newborn deaths (30). Despite the fact that there are researches available to illustrate the determinant of neonatal mortality, those studies involves only single hospital which arises the question of representativeness and didn't come up with controlling confounder by matching. As far as my searching capacity, there were no studies conducted involving almost all hospital found in region and control confounder for known risk factor to assess determinant neonatal mortality, therefore this study aimed at assessing determinants of neonatal mortality in Sidama region hospitals by addressing those issues.

1.3. Significance of the study

The continued reduction in neonatal deaths is critical to progress towards achieving sustainable development goals (SDGs)(11). Due to the recent establishment of the NICU in this study setting, data are not sufficient in both the country and study setting and the available data include only done in single hospital and didn't include the three-health tier system of Ethiopia. In addition to this neonatal mortality is steady or slightly increase the study should aimed to describe the characteristics of the neonates attended in the neonatal care unit of sidama region hospitals in different form and identify the determinant of neonatal mortality in sidama region public hospitals providing NICU service context is crucial and essential. So, this study include almost all hospitals providing the service and used matched case control study to control known determinant of neonatal mortality. This study focus on a specific population of newborns and those whose death reported to the health services its exploration of factors associated with neonatal mortality potentially amenable to health service intervention. As this study fill in these gaps and used them as inputs for policymakers and program implementers to design appropriate interventions that could contribute to the reduction of neonatal mortality in Ethiopia by study the determinant of neonatal mortality in Sidama regional state public hospitals. In addition to this study will be an input for next as literature and identify why research question.

2. Literature review

2.1. Burden of neonatal mortality

In 2018, 2.5 million neonates were died which indicate neonatal mortality rate estimated at 18 deaths per 1,000 live births globally, approximately 7,000 neonate die every day (4). Moreover, 98% of neonatal deaths occur in developing countries with a greater burden occurring in Sub-Saharan Africa (SSA); approximately one million deaths occur in the first month of life, which represents the highest neonatal mortality rate (NMR) and shows the least progress in reducing the NMR (8,9). According to Ethiopia Demography Health Survey (EDHS) in Ethiopia Neonatal mortality decreased from 49 to 29 deaths per 1,000 live births between the 2000 and 2016 EDHS, but has remained stable since the 2016 EDHS and is 30 deaths per 1,000 live births in the 2019 EMDHS(17,18). Similarly, multi-level analysis study in Ethiopia shows the status of neonatal mortality rate was 35.5 per 1000 live births(31).

2.2. Determinates of neonatal mortality

A matched case control study of neonatal deaths reported from selected community health centers in Indonesia found the main risk factors associated with neonatal death were neonatal complications at delivery, neonatal health problem requiring a visit to a healthcare provider, lack of maternal knowledge of neonatal danger signs, low APGAR score, maternal complications during pregnancy, delivery at home, not using the kangaroo method of care, not receiving early initiation of breastfeeding, high-risk maternal pregnancy and mother's age at marriage(32).

A prospective cohort study conducted in Bamenda Regional Hospital in Cameroon shows the main causes of neonatal admissions were complications of preterm birth (32.2%), neonatal infections (31.3%), and birth asphyxia (14.5%). The study also state neonatal hospital mortality was related to complications of preterm birth (69%), birth asphyxia (23%) and neonatal infections (6%). A five-minute APGAR score less than seven was the only predictor of NM (33).

An institutional based unmatched case-control study design conducted at Adama Hospital Medical College State Antenatal follow-up, assisted vaginal delivery, cesarean delivery, gestational age, birth weight, sepsis, and asphyxia were risk factors for neonatal death. Neonates who were delivered by assisted vaginal delivery were 5.9 times at risk of death than neonates who were delivered by SVD AOR 4.8. From the control group 36% of neonates had a birth weight of <2500 gram 60% of cases neonates had a birth weight of <2500 gram and found that birth weight is a significant risk factor for neonatal death with AOR 1.6. Among cases 48% of

neonates were preterm whereas 19% of controls were preterm and revealed that being preterm neonate is a risk for death (34). A similar study done in neonatal intensive care unit of Dessie Referral Hospital among 130 cases and 260 controls describe Pregnancy-induced hypertension, prolonged rupture of membrane, low birth weight, respiratory distress syndrome, perinatal asphyxia, meconium aspiration syndrome, and infections were the major determinants of neonatal mortality (35).

A multi-level analysis study which was conducted in Jimma Ethiopia among 3463 shows the status of neonatal mortality rate was 35.5 per 1000 live births. The study also states at Individual-level variables such as birth order, frequency of antenatal care use, delivery place, gestation age at birth, premature rupture of membrane, complication during labor, twin births, size of neonate at birth and neonatal care practice were identified as determinants of neonatal mortality. Birth asphyxia (47.5%), neonatal infections (34.3%) and prematurity (11.1%) were the three leading causes of neonatal mortality accounting for 93% (31). Similarly, a prospective cohort study conducted in Tigray region describe the leading causes of neonatal death to be prematurity and asphyxia accounted for two (2) of every three (3) deaths, the remaining deaths were caused by infections 12%, congenital abnormalities 7%, and other causes 16%. Moreover, Three-fourths of the total deaths took place during the early neonatal period, primarily due to prematurity and asphyxia (15).

A facility-based study done in eastern Ethiopia of public hospitals shows; Low birth weight, preterm births, length of stay of the neonatal intensive care unit, low five (5) min APGAR score, hyperthermia, and initiation of feeding were predictors of neonatal death among infants admitted to the neonatal intensive care units of public hospitals in eastern Ethiopia. Preterm neonates were almost three times more likely to die compared with term neonates. Low birth weight babies were two times more likely to die when compared with normal birth weight. Furthermore, newborns with a low 5 minute APGAR score were five times more likely to die compared with 5 minute APGAR score of greater than or equal to seven (36).

A study conducted in Amhara referral hospitals state; Maternal age ≥ 35 years, mothers unable to read and write, multiple pregnancy and positive maternal HIV status were predictors of neonatal mortality (37). However, a study conducted in Debre Markos Referral Hospital show; employment status, attending ANC, initiating exclusive breastfeeding, neonatal admission due to respiratory distress syndrome, and first minute APGAR score was significantly increased the risk

of neonatal mortality (38). In addition to those, a study done in the NICU of Karamara hospital shows prematurity and average length of stay below two days were independently associated with neonatal mortality and the study concludes the causes of neonatal death reported are preventable (27).

A retrospective cohort study conducted at Arba Minch General Hospital NICU shows ;Mothers time of rupture of membrane, birth order and neonates APGAR score status during birth were the independent predictors of Neonatal mortality(39). Similar study done in Nekemte Referral Hospital describe neonatal mortality was associated with mode of delivery, birth order, birth weight, crying status at birth and residence mothers. According to this study the major causes of neonatal death during the study period were infection (60%), asphyxia (23%), and premature birth (16%) (40). In addition to those, a study done in neonatal intensive care unit of a University Teaching and Referral Hospital of woliata sodo show Predictors of neonatal mortality were: multiple birth, mothers who did not attend antenatal care visits, neonates born by cesarean section, not initiated breast feeding within one (1) hour of birth, neonates resuscitated, hyaline membrane disease and perinatal asphyxia (41).

2.3. Conceptual frame work

From the available theoretical frameworks to address predictor's of neonatal mortality, we adapt a conceptual framework from different literatures (32,34,42). Accordingly neonatal mortality is affected by the simultaneous presence of multiple factors grouped into the following categories: neonates' individual characteristics, Maternal characteristics, obstetric complication, Household and socio-demographic and socio-demographic.

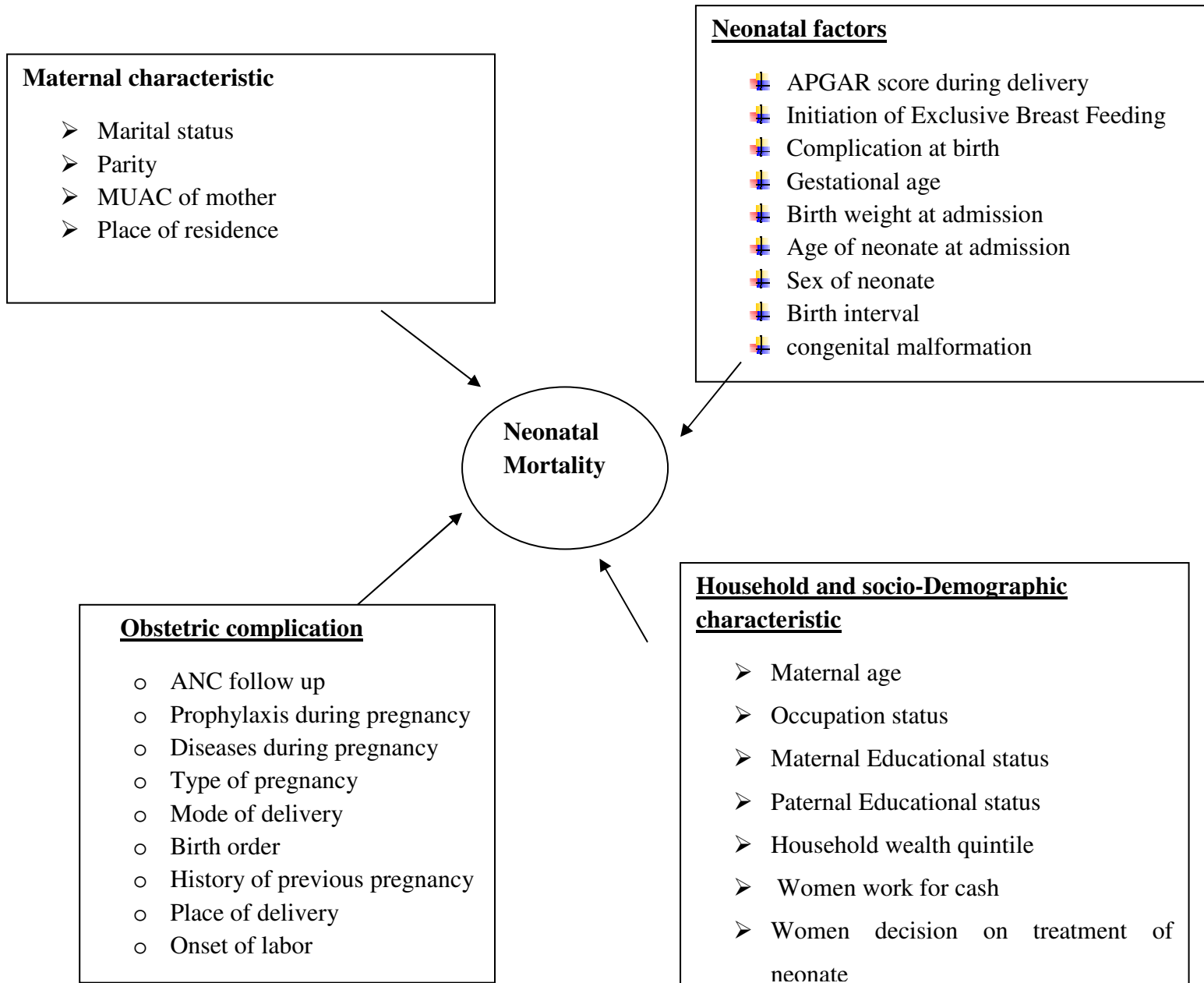


Figure 1. Conceptual framework for determinant of neonatal mortality in sidama region hospitals in 2021.

3. Objective

3.1. Study objective

To identify determinant of Neonatal Mortality among Neonates in Sidama regional state, Ethiopia in 2021

Research question

- What factors contribute to neonatal mortality in Sidama Region?

4. Methods and material

4.1. Study area

This study was conducted in selected sidama regional state hospitals. Sidama region became the 10th regional state in Ethiopia after a zone-wide referendum on 23 November 2019. According to Central Statistics Agency 2017, sidama region has an estimated total population of 3.2 million (4% of the national population), the fifth most populous ethnic group in Ethiopia, with total area of 6,000 km² and their language is called Sidaamu-afoo. Hawassa is the capital city of Sidama regional state and SNNPRS, which is located at 273 km from Addis Ababa the capital city of Ethiopia(43). In sidama regional state there are 21 public hospitals from those 17 hospitals provide NICU service. The study include randomly selected 14 hospitals from hospitals that provide NICU service(44).

4.2. Study period and study design

Institutional based matched case-control study was conducted from March 18, 2021 to June 30, 2021.

4.3. Source Population

All Neonates who were admitted in Public Hospital of Sidama Region during study period

4.4. Study Population

The study population were all neonates who admitted to NICU of selected Hospitals of region. Cases were newborns who were died within 28 days of life. Controls were newborns who survived beyond age of 28 days and matched with gestational age by using Ballard score card category.

4.5. Inclusion and exclusion criteria

4.5.1. Inclusion criteria

Inclusion criteria for the cases were new-born babies who died in the neonatal period in NICU of Sidama regional state selected hospitals. Surviving beyond the age of 28 days who matched with gestational age for cases were included in this study as controls. Matching cases with controls were based on Ballard score card category for gestational age.

4.5.2. Exclusion criteria

Cases and controls with incomplete data on gestational age was excluded from study, severely ill mothers or deaf and neonates whose mothers died. In addition to this for selected as controls but

dead outside health facility were excluded from study to minimize selection bias of selecting controls.

4.6. Sample size and sampling procedures

4.6.1. Sample size estimation

The sample size was calculated by STATA version 14.1 software for matched case control using the following assumption (34)

Table 1. Shows assumption used to determine sample size calculation at sidama region hospitals on 2021

Assumption	Number/percent	Remark
Proportion of sepsis in control group	55%	
AOR of neonate death with sepsis among case	2.4	
Confidence Interval	95%	
Power	80%	
Case to control ratio	1:2	

After ten percent [10%] addition for non-response, the total sample size required for the study were 267 sample [89 cases and 178 controls].

4.6.2. Sampling technique and procedure

The study included 14 randomly selected hospitals and the sample size was allocated based on the proportion of neonatal death DHIS2 report of each hospital from July 01, 2020 to Nov 31, 2020. After allocation of sample for each hospital based on proportion neonatal death to interview the family first we identify the outcome interest which were neonatal death then we interview for each care giver or parents and then we selected two controls for each case until the sample given for each hospital were fulfilled.

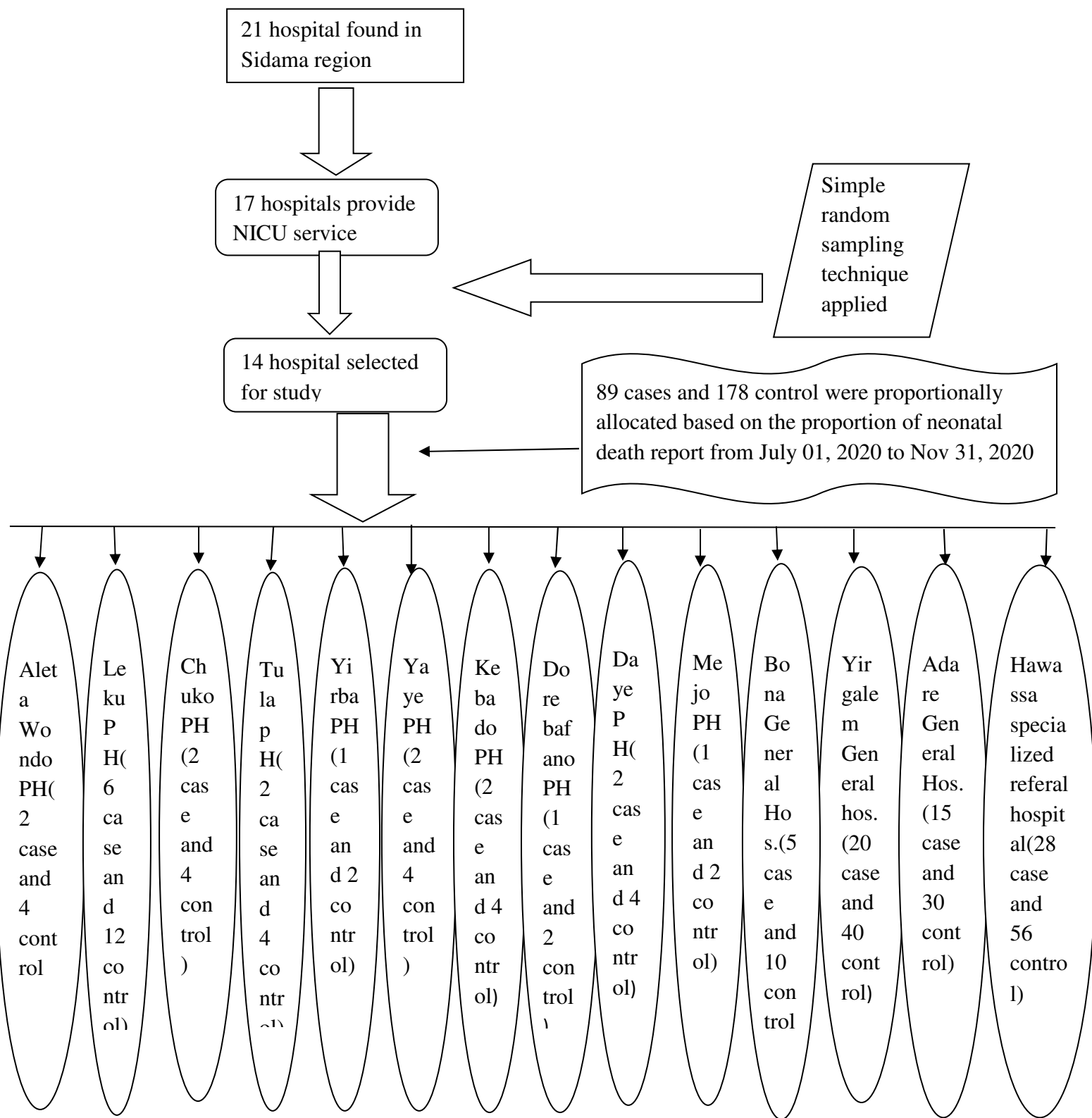


Figure 2.Sampling procedure to study determinants of neonatal mortality at sidama region hospitals in 2021.

4.7. Measurement

4.7.1. Variables

4.7.1.1. Dependent variable

Neonatal death

4.7.1.2. Independent variable

I. Household and socio demographic factors

Place of residence, maternal age, occupation status, maternal educational status, paternal educational status, household wealth quintile, women work for cash, women decision on treatment of neonate

II. Maternal and obstetric factors

Marital status, educational status, parity, MUAC of mother, place of residence, ANC follow up, prophylaxis during pregnancy, antenatal complication/illness during pregnancy, type of pregnancy, mode of delivery, birth order, history of previous pregnancy, place of delivery, onset of labor and postnatal care follow up.

III. Neonatal factors

Sex of neonate, APGAR score during delivery, initiation of exclusive breast feeding, complication at birth, birth weight at admission, age of neonate at admission, birth interval and congenital malformation.

4.7.2. Instruments

To identify and classify the factors that potentially influence Neonatal Mortality: socio demographic factor, neonatal factor, and maternal and obstetric factors conceptual framework proposed by different literature was used (32,34,42). The questionnaire was initially developed in English and then translated into local language, Sidamu-afoo and then re-translated to English. We used structured questionnaire which has dichotomous question, multiple choice and open-ended question to collect data from neonate mother/father or care giver and medical chart /follow up chart for each neonate admitted to NICU selected as cases and control group.

4.8. Data collection process

A nurse or midwife that can speak the local language was assigned for data collection for each selected hospital and data collection was carried out by interviewing mothers/father or caregiver and reviewing medical record charts using structured questionnaires. During the data collection process, the principal investigator supervised those trained data collectors. The outcome variable was death in the first 0–28 days after birth in NICU Sidama regional state hospitals.

4.9. Data quality control

A one-day training was given for fourteen (14) nurse/midwife before data collection was started, the training was focused on the purpose of the study, enumeration procedures, and how to interview mother or caregiver and how to extract from chart and how to follow neonate selected as control. The tool was pre-tested among 4 cases and 8 controls in Adare General Hospital and Yirgalem General Hospital for each 2 cases and 4 controls, and necessary modifications were made for the local context before the final data collection for example in wealth status we included/substituted income level and complication at birth to include which type of complication at birth.

In addition to training for data collectors various efforts were made to assure the data quality, Personal supervision especially in the data collection and data entry, orientation was given how to enter the data into Epi info statistical software for three/3/ professionals by principal investigator. Data quality process started from checking the question to the computer entry. Before the data was entered, it was checked for completeness and consistency by the Principal Investigator and those who enter the data into Epi info statistical software. Double data entry to Epi info7 was performed to check clarity and consistency. The process of data generation and entry was under close supervision of the principal investigator. Data was cleaned, sorted and analyzed using SPSS software version 25.

4.10. Data processing and analysis

Data was coded and entered using Epi info 7 then exported to SPSS Version 25 statistical software for data to be cleaned, recoded and analyzed. For all independent variable frequency and percentage among cases and controls was calculated. Two-step procedure was used to analyze the association between the outcome variables (neonatal death) and independent variables using conditional logistic regression analysis to identify determinants of neonatal mortality and

Covariant with P-value less than 20% in bivariate conditional logistic regression was retain for final analysis. In Multivariable conditional logistic regression 95% confidence intervals (CI) using a P-value < 0.05 was considered as statistically significant association with the outcome variable and Adjusted odds ratio (AOR) with 95%CI was used to show the strength of association between independent and dependent variables. Hosmer and Lemeshow's goodness-of-fit test was used to assess whether the necessary assumptions for the application of logistic regression and the assumption were fulfilled. Assumptions of logistic regression: multi-collinear, Outliers, linearity log of independent and dependent variable were checked. First minute and fifth minute Apgar score had correlation to each other and multi-collinear with place of birth with variance inflation factor (VIF) (27, 28)) respectively then first and fifth minute Apgar score were excluded from final analysis.

4.11. Ethical considerations

Ethical authorizations obtained from the Institutional review Board of SPMMC, Institutional review Board of Hawassa university medical college, the Regional Delegation of Public Health for the sidama region and from the administrative staff of the selected Hospital prior to the start of the study. The purpose and importance of the study was explained and informed consent was secured from each participant mother/father or care giver. Confidentiality was maintained at all levels of the study.

4.12. Operational definitions

Neonatal mortality: is death of a neonate at specific time within the 28 days of life as evidenced by physician confirmation or medical chart reviewing.

Gestational age: is gestation week of neonate at delivery calculated from mother Last menstrual period or ultrasound during pregnancy or Ballard score card at early birth.

Case: is was newborns discharge with died during hospitalization within 28 days of life in the hospital.

Control: is newborns discharged improved after management and survived beyond age of 28 days and matched with gestational age by using Ballard score card category.

4.13. Plan for dissemination of findings

The finding of this study will be disseminated by hard and soft copy to each study hospital, sidama regional state health office, Institutional review Board of Hawassa university medical college and SPMMC department of public health.

5. RESULTS

A total of 267 study participants were recruited in this study. The majority of the cases (79.8%, 71/89) almost three-fourth of controls (76.9%, 137) were delivered from mother whom current occupation responded as housewife. Only (9%%, 8/89) of cases and (11.2%, 20/178) of controls were delivered from mother who graduated from college and above educational level. The majority of the controls (54%, 96/178) almost half of cases (50.6%, 45/89) were from respondent whom wealth status index was classified as lowest wealth status. The majority of the cases (88.8%, 79/89) and controls (91%, 162/178) were born from mother who were married. (Table1)

During Bivariate conditional logistic regression analysis of household and socio demographic factors only maternal Age >35years [COR=5.072; 95%CI: 1.983, 12.971] were found associated with NM at 5% level of significance. However, current occupation of mother, Maternal Educational status, Paternal education status, wealth status, marital status, place of residence, women work for cash and women decision on treatment of neonate were not significantly associated with NM. (Table 1)

Table 2. Proportion and Bivariate conditional logistic regression analysis depicting the association between household and socio demographic variables and neonatal mortality in Sidama Region Hospital in 2021

Variables	Response	Case	Control	COR(95%CI)	P-value
		Count n, (%)	Count n, (%)		
Current occupation of mother	House wife	71 (79.8%)	137 (76.9%)	1	0.783
	Government employee	6 (6.7%)	19 (10.6%)	0.867 (0.315,2.39)	
	Others	12 (13.4%)	22 (12%)	3.007(0.162,55.647)	
Maternal age during delivery	20-35years	148	72	1	
	<20 years	12	7	2.5 (1.3,6.87)	0.98
	>35 years	18	10	5.072 (1.983,12.971)	.001

Maternal Educational status	Illiterate	32 (35.9%)	56 (31.5%)	1.552	(.549	.407
	Able to read and write	10 (11.2%)	23 (12.9%)		4.386)	.783
	Elementary school	22 (24.7%)	43 (24.1%)	1.184	(.357	
	Secondary school	17 (19.1%)	36 (20.2%)		3.922)	.586
	College and above	8 (9%)	20 (11.2%)			.662
				1.360	(.449	
Paternal Educational status	Illiterate	21 (23.6%)	37 (20.8%)		4.117)	
	Able to read and write	15 (16.9%)	30 (16.8%)	1.289	(.413	
	Elementary school	24 (27%)	49 (27.5%)		4.017)	
	Secondary school	19 (21.4%)	41 (23%)	1		
	College and above	10 (11.2%)	21 (11.8%)	1.230	(.463	.678
					3.267)	.930
Wealth Status Index	Lowest	31 (34.8%)	44 (24.7%)	1.046	(.384	
	Medium	45 (50.6%)	96 (54%)		2.846)	.960
	Highest	13 (14.6%)	38 (21.3%)			.925
				1.025	(.389	
Marital status	Married	79 (88.8%)	162 (91%)		2.697)	
	Others	10	18	.955	(.363	
Place of residence	Rural	71 (79.8%)	130 (73%)		2.513)	
	Urban	18 (20.2%)	48 (27%)	1		

Women work for cash	Yes	28(31.5%)	68(38%)	1	
	No	61(68.5%)	110(62%)	1.313 (.784 2.201)	.301
Women decision on treatment of neonate	Yes	49(55%)	111(62%)	1	
	No	40(45%)	67(38%)	1.268 (.788 2.04)	.328
Reference for logistic regression was represented by 1,COR---crude odd ratio, CI---confidence interval					

With regard to maternal and obstetric factors, ANC follow up [COR=6.18;95%CI: 3.15,12.11], history of antenatal complication/illness [COR=3.17; 95%CI: 1.73,5.81], Neonate born from multiple gestation [COR=2.684; 95%CI:1.083,6.65], Home delivery [COR=2.720; 95%CI:1.42,5.20] and post natal care follow up [COR=2.9; 95%CI: 1.75,4.83] were statistically significantly associated in the bivariate conditional logistic regression analysis. Whereas, gravidity status, previous history of still birth, previous history of abortion, tetanus toxoid (TT) vaccination, onset of labor and mode of delivery were not statistically significantly associated (Table 2).

Table 3: Proportion and Bivariate conditional logistic regression analysis depicting the association between maternal, obstetrics and delivery related risk factors and neonatal mortality in Sidama Region Hospital in 2021

Variables	Response	Case	Control	COR (95% CI)	P-value
		Count n, (%)	Count n, (%)		
Gravidity status	No	23 (25.9%)	52 (29.2%)	.861(.501,1.478)	.587
	Yes	66 (74.2%)	126 (70.8%)	1	
History of previous abortion	No	80 (89.9%)	165 (92.7%)	1	.407
	Yes	9 (10.1%)	13 (7.3%)	1.500(.575,3.91)	
History of previous still birth	No	85(95%)	172(96%)	1	.639
	Yes	4(5%)	6(4%)	1.380(.360,5.289)	
ANC follow-up	No	38 (42.7%)	18 (10.1%)	6.18 (3.15,12.11)	<0.001
	Yes	51 (57.3%)	160 (89.9%)	1	
Antenatal complication	No	47 (52.8%)	148 (83.2%)	1	<0.001
	Yes	42 (47.2%)	30 (17%)	3.17(1.73,5.81)	

TT injection status	No	16 (18%)	29 (16.3%)	1.124(.577,2.19)	.731
	Yes	73 (82%)	149 (83.7%)	1	
Type of pregnancy	Singleton	77(86.5%)	168(94%)	1	
	Twin/or above	12(13.5%)	10(6%)	2.684(1.083,6.65)	.033
On set of labor	spontaneous delivery	81 (91%)	164 (92.1%)	1	
	Induced	8 (9%)	14 (7.9%)	1.150(.472,2.802)	.758
Mode of delivery	SVD	56 (62.9%)	153 (86%)	1	
	Instrumental delivery	15 (16.9%)	11 (6.2%)	1.049(.546,2.02)	.88
	CS	18 (20.2%)	14 (7.9%)	2.323(1.054,5.12)	.37
Place of delivery	Home delivery	30(34%)	31(17%)	2.720(1.42,5.20)	.002
	Health facility	59(66%)	147(83%)	1	
Postnatal care follow up	No	64(72%)	73(40%)	2.9 (1.75,4.83)	<0.001
	Yes	25(28%)	105(60%)	1	
Reference for logistic regression was represented by 1,COR---crude odd ratio, CI---confidence interval, ANC—antenatal care, SVD---spontaneous vaginal delivery, CS—cesarean section, TT—tetanus toxoid					

From Neonatal condition during and after delivery, being male sex [COR=1.776; 95%CI: 1.093, 2.886], Neonatal complication at birth [COR=3.279; 95%CI: 1.609, 6.68], initiation of breast-feeding [COR=3.661; 95%CI: 2.17, 6.17], meconium aspiration syndrome [COR=5.216; 95%CI: 2.444,11.13] ,perinatal asphyxia [COR=4.478; 95%CI: 2.210,9.07], and congenital malformation[COR=3.766;95%CI:1.983,7.15],were statistically significantly associated with NM in Bivariate analysis. Nevertheless, weight of neonate in admission, birth interval of neonate from previous pregnancy, respiratory distress and neonatal sepsis were not statistically significant (Table 3).

Table 4: Proportion and Bivariate conditional logistic regression analysis depicting the association between neonatal conditions during and after birth and neonatal mortality in Sidama Region Hospital in 2021

Variables	Response	Case	Control	COR(95%CI)	P-value
		Count n, (%)	Count n, (%)		
weight of neonate in admission	<1500grams	17 (19%)	28 (15.7%)	0.787(.269,2.30)	.662
	1500-1999grams	15 (17%)	39 (22%)	1.214(.164,9.00)	.850
	2000-2499grams	19 (21.3%)	34 (19%)	.43 (.088,2.11)	0.30
	>=2500grams	38 (42.7%)	77 (43%)	1	
Birth Interval of neonate from Previous	Born from Primi-gravida	23 (25.8%)	47 (26%)	1.06 (.596,1.89)	.837
	<2years	11 (12.4%)	15(8%)	1.94(.658,5.72)	.230
	>=2years	55 (61.8%)	116 (65%)	1	
Sex of neonate	Male	61 (68.5%)	92 (51.6%)	1.776(1.093, 2.886)	.020
	Female	28 (31.5%)	86 (48.4%)	1	
Fifth/5 th /minute APGARE score	unrecorded	49 (55%)	44(25%)	19.10(6.639,54.92)	<0.001
	APGARE Score <7	28 (31%)	12 (7%)	29.474(9.03,96.20)	<0.001
	APGARE Score >=7	12 (14%)	122 (68%)	1	
Neonate complication at birth	No	56 (62.9%)	144 (80.9%)	1	
	Yes	33 (37.1%)	34 (19.1%)	3.279(1.609,6.68)	.001
Initiation of exclusive breast feeding	No	64 (71.9%)	62 (34.8%)	3.661(2.17,6.17)	<0.001
	Yes	25 (28.1%)	116 (65.2%)	1	

Diagnosis of respiratory distress	No	52(58.4%)	125(70.2%)	1	
	Yes	37(41.6%)	53(29.8%)	1.446(.928,2.25)	.103
Diagnosis of sepsis	No	41(46.1%)	102(57.3%)	1	
	Yes	48(53.9%)	76(42.7%)	1.490(.924,2.40)	.102
Diagnosis of meconium aspiration	No	58(65.2%)	158(88.8%)	1	
	Yes	31(34.8%)	20(11.2%)	5.216(2.444,11.13)	<0.001
Diagnosis of perinatal asphyxia	No	61(68.5%)	162(91%)	1	
	Yes	28(31.5%)	16(9%)	4.478(2.210,9.07)	<0.001
Diagnosis of congenital malformation	No	57(64%)	155(87%)	1	
	Yes	32(36%)	23(13%)	3.766(1.983,7.15)	<0.001
Reference for logistic regression was represented by 1,COR---crude odd ratio, CI---confidence interval					

In multivariable conditional logistic regression, we identified four (4) determinant of neonatal mortality from maternal and obstetric history and four (4) determinant of neonatal mortality from neonatal condition during and after birth.

Factors which were classified as determinant of neonatal mortality from maternal and obstetric factor were ANC follow-up, place of delivery, antenatal complication, and postnatal care follow up were associated with neonatal mortality. The neonatal death were 6.9 time higher odds among neonates delivered from mothers who had no ANC follow up (AOR = 6.90; 95% CI 2.67, 17.98) compared with their encounter. The neonatal deaths were 2.9 times higher odds among neonate who had delivered at home (AOR = 2.90; 95% CI=1.09, 7.83) than odd of neonate who delivered at health facility and odd of neonate who were born from mother who had antenatal complication were 2.87 times at risk of death than their encounter (AOR = 2.87; 95% CI=1.07, 7.69). The neonate death were higher odd observed among odds of neonates delivered from mothers who had no PNC follow up (AOR = 2.67; 95% CI=1.16, 6.14) than their encounter. (Table 4)

Factors which were classified as determinant of neonatal mortality from neonatal condition during and after birth were initiation of exclusive breast feeding, neonatal complication at birth, perinatal asphyxia, and congenital malformation were associated with neonatal mortality. The odd of neonates who were not initiated breast feeding within one hour of delivery 3.65 times at

risk of death than odd of neonates who were initiated breast feeding within one hour (AOR = 3.65 95% CI=1.65, 8.07) and neonatal death were 4.4 times higher odds among odd of neonates who had history of neonatal complication at birth than who did not had complication at birth (AOR = 4.40; 95% CI =1.25, 15.54). Neonatal deaths were 6 times higher odds among odd of neonate who had diagnosed with perinatal asphyxiated than those who did not have PNA (AOR=6.0; 95%CI=1.98, 18.35). The odd of congenital malformed neonate were 3.40 times at higher odd than their encounter (AOR=3.40; 95%CI=1.32, 8.80). (Table 4)

Table 5: Multivariable conditional logistic regression model depicting the determinant of neonatal mortality in Sidama Region Hospital in 2021

95%CI							
Variable	Response	Case(N)	Control(N)	AOR	Lower	Upper	P-value
ANC follow-up	No	38	18	6.90	2.67	17.98	<0.001
	Yes	51	160	1			
Antenatal complication	No	47	148	1			0.036
	Yes	42	30	2.87	1.07	7.69	
Place of delivery	Home delivery	30	31	2.90	1.09	7.83	0.034
	Health facility	59	147	1			
Postnatal care follow up	No	64	73	2.67	1.16	6.14	0.02
	Yes	25	105	1			
Initiation of exclusive breast feeding	No	64	62	3.65	1.65	8.07	0.001
	Yes	25	116	1			
Neonate complication at birth	No	56	144	1			0.021
	Yes	33	34	4.40	1.25	15.54	
Perinatal asphyxia	No	61	162	1			0.002
	Yes	28	16	6.0	1.98	18.35	
Congenital malformation	No	57	155	1			0.011
	Yes	32	23	3.40	1.32	8.80	
Reference for logistic regression was represented by 1,AOR---Adjusted odd ratio, CI---confidence interval, ANC—antenatal care							

6. Discussion

This study aimed to determine the determinants of neonatal mortality at neonatal intensive care unit of Sidama Region Hospitals. Consequently, antenatal care follow-up, place of birth, antenatal complication, neonatal complication at birth, initiation of exclusive breast feeding, perinatal asphyxia and congenital malformation were associated with neonatal death in multivariable conditional logistic regression.

Concerning household and socio demographic factors maternal education, household wealth status, maternal age and place residence were not significantly associated with NM. This finding was similar with study finding from Indonesia (32), but not consistent with studies done in Ethiopia (37,40). This discrepancy might be probably because of small sample proportion to detect small effect size measure. However, educational status of the mothers and household wealth status could be clinically significantly associated.

Among the maternal and obstetric related factors, neonates born to mothers who had received ANC were statistically significantly associated with decreasing risk of neonatal death. This finding was in agreement with findings of previous studies (20–22,31,34,38,41). It might be explained ANC visits may help to reinforce maternal education and provide a great opportunity for health care providers to provide information/health education regarding warning signs of complications during pregnancy, postpartum care, newborn care, breastfeeding, pregnancy risk signs and appropriate actions to be taken during birth and after birth (45).

The odd of neonate born from mother who had antenatal complication almost triple at risk of death than their encounter, the same result was mentioned in Indonesia (32) and Ethiopia (35). Neonatal death was statistically significantly higher among neonates born to home delivered mothers. This finding was in line with findings from previous studies done in Indonesia (32) and Ethiopia (31,40). This might be due to neonates born to home delivered mothers are highly exposed to different infections and birth traumas, due to absence of safe and clean delivery kits, professional birth attendant, and essential newborn care practices especially during the first hour immediately after birth; this could increase risk of neonate for death.

The death of neonate were more likely observed among odds of neonates delivered from mothers who had no PNC follow up [AOR = 2.67; 95% CI =1.16, 6.14]. This finding was in line with findings from previous studies done in Ethiopia (20).This may be indicate that during PNC follow up time they may indicate during follow up of mothers and neonate it will increase identification of early sign of danger sign of neonatal complication and awareness creation on exclusive breast feeding and avoid other malpractice that will affect neonate health condition.

However, mode of delivery, multiple gestation were not statistically significantly associated. This result were similar with previous studies(15,32,35), but not consistent with previous study(31,40,41). This disagreement might be due to homogeneous distribution of the risk factors in both comparable groups, as well as due to small sample size of this study to detect small effect size to measure explanatory factors. Despite of the above non-statistical significance, mode of delivery could be clinically significantly associated.

Concerning neonatal condition during and after delivery, neonates who did not breastfeed exclusively were at higher risk of death as compared to their exclusively breastfeed counterparts. This finding is supported by studies conducted in Indonesia (32) and Ethiopia(36,38,41). It is well known that Colostrum, the first liquid come out from the breast, is very important for the new-born babies to protect them from infections as it is rich in antibodies and white cells (46). Evidence also suggested that exclusive breastfeeding reduces the risk of NM in related to neonatal infections (i.e., sepsis, pneumonia, tetanus, and diarrhea) which consequently increase neonatal mortality (47).

Neonatal deaths were more likely observed among odd of neonate who had diagnosed with perinatal asphyxiated than their encounter. The result is supported by a study done in Asia (13), Cameron (33), and Ethiopia (5,15,31,33–35,40,41). This finding may be explained by the high proportion of home deliveries in the absence of skilled attendants might have contributed to perinatal complications associated with neonatal asphyxia. It might also be due to a bad prognosis of asphyxia to hypoxic-ischemic encephalopathy (48). and renal system dysfunction(49), as well as lack of a well-equipped ambulance transport system during referral. Therefore, neonatal death could be portrayed as those bad prognostic results.

The odd of neonate's death who had neonatal complication at birth were more likely than their encounters. This was a comparable result with a study conducted in Indonesia (32). This might be explained as most of delivery were conducted at home and delivered by unskilled traditional birth attendant early sign of neonatal complication may not be identified lead to unable to breast feed and perinatal asphyxia and which increase neonatal mortality. The odd of neonate with congenital malformed neonate were more likely at risk of death than who were no diagnosed as congenital malformed neonate, the finding is in line with previous studies done (6,7,14). This could be explained by absence of a neonatal surgery unit at the hospital with adequate surgical, anesthetic, neonatal resuscitation platform and trained health professional, frequent lack of antenatal diagnosis, the delay in surgical procedures, and an consequently increase neonatal mortality. However, low birth weight were not statistically significantly associated. This result were not consistent with previous study(21,22,34,35,37,40). This disagreement might be due to the fact that as low birth weight is associated with preterm neonate in this study preterm gestational age were controlled so it could be non-significant.

Strength and limitation of study

The study design was matched case control study which reduce the influence of confounding factors which is known risk factors enabled a focus on areas of potential health service intervention. As the study is prospectively followed missing in medical record and recall bias may be decreased.

The limitations study are the study population probably underrepresents determinant of neonatal mortality which occur in the community and even if we use match case control study collected prospectively some data may be influenced by recall bias.

7. Conclusions and recommendations

This study identify ANC follow-up, Antenatal complication, place of birth and post natal care follow up from maternal and obstetric history and neonatal complication at birth, initiation of exclusive breast feeding, perinatal asphyxia and congenital malformation from neonatal condition during or after birth were Determinants of neonatal mortality in NICU of Sidama Region Hospitals. As most of these factors are preventable and manageable by good antenatal care, intra-partum care, neonatal care and health education on exclusive breast feeding and other health related condition, the study reinforces the need for more focus on neonatal care during antenatal care, care immediately after delivery, and in the first month of life. The association with ANC follow-up, antenatal complication, place of delivery and post natal care follow up may reflect lack of knowledge of parents on health service utilization.

- Sensitization of pregnant women, through IEC by PHCU health professional
- Building capacity of health personnel to adequately manage high risk neonates with perinatal asphyxia and increase access of well-equipped ambulance transport system and well equipped health facility for neonatal care by region health bureau and all hospitals
- Proper management of congenital malformations; Improve antenatal diagnosis of congenital malformation, decrease delay surgical procedures, availing neonatal surgical unit which have adequate surgical, anesthetic, neonatal resuscitation platform in all hospitals.
- Strengthen the functionality of MPDSR committee in all hospitals and supervision from sidama region health bureau.

References

1. Sankar MJ, Natarajan CK, Das RR, Agarwal R, Chandrasekaran A, Paul VK. When do newborns die? A systematic review of timing of overall and cause-specific neonatal deaths in developing countries. *J Perinatol* [Internet]. 2016;36(S1):S1–11. Available from: <http://dx.doi.org/10.1038/jp.2016.27>
2. Verma J, Anand S, Kapoor N, Gedam S, Patel U. Neonatal outcome in new-borns admitted in NICU of tertiary care hospital in central India: a 5-year study. *Int J Contemp Pediatr*. 2018;5(4):1364.
3. UN Inter-agency group for Child Mortality, Estimation. Levels & Trends in Child Mortality 2019. UN IGME Rep [Internet]. 2019;52. Available from: <https://www.unicef.org/media/60561/file/UN-IGME-child-mortality-report-2019.pdf>
4. World Mortality 2019. World Mortality 2019. 2019.
5. Sankar MJ, Neogi SB, Sharma J, Chauhan M, Srivastava R, Prabhakar PK, et al. State of newborn health in India. *J Perinatol* [Internet]. 2016;36(s3):S3–8. Available from: <http://dx.doi.org/10.1038/jp.2016.183>
6. Lawn JE, Blencowe H, Oza S, You D, Lee ACC, Waiswa P, et al. Every newborn: Progress, priorities, and potential beyond survival. *Lancet*. 2014;384(9938):189–205.
7. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE et al. Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. *The Lancet*. 2015; 385(9966):430–40. In.
8. UNICEF. United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), ‘Levels & Trends in Child Mortality: Report 2018. Estim Dev by United Nations Inter-agency Gr Child Mortal Estim [Internet]. 2018;1–44. Available from: <https://data.unicef.org/wp-content/uploads/2018/09/UN-IGME-Child-Mortality-Report-2018.pdf>
9. Oza S, Lawn JE, Hogan DR, Mathers C, Cousens SN. Estimations des causes de décès néonatales pour les périodes néonatales précoces et tardives dans 194 pays: 2000–2013.

- Bull World Health Organ. 2015;93(1):19–28.
10. Kotsadam A, Østby G, Rustad SA, Tollefsen AF, Urdal H. Development aid and infant mortality. Micro-level evidence from Nigeria. *World Dev* [Internet]. 2018;105:59–69. Available from: <https://doi.org/10.1016/j.worlddev.2017.12.022>
 11. Perin J, Mulick A, Yeung D, Villavicencio F, Lopez G, Strong KL, et al. Global, regional, and national causes of under-5 mortality in 2000–19: an updated systematic analysis with implications for the Sustainable Development Goals. *Lancet Child Adolesc Heal* [Internet]. 2022;6(2):106–15. Available from: [http://dx.doi.org/10.1016/S2352-4642\(21\)00311-4](http://dx.doi.org/10.1016/S2352-4642(21)00311-4)
 12. Wang H, Naghavi M, Allen C, Barber RM, Carter A, Casey DC, et al. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet*. 2016;388(10053):1459–544.
 13. WALTERS K. Recent Developments in Rheometry. *Theor Appl Rheol*. 1992;16–23.
 14. Mortality and Causes of Death Collaborators, “Changes in cause-specific neonatal and 1–59-month child mortality in India from 2000 to 2015: a nationally representative survey,” vol. 17, p. 6736, 2016.
 15. Mengesha HG, Sahle BW. Cause of neonatal deaths in Northern Ethiopia: A prospective cohort study. *BMC Public Health* [Internet]. 2017;17(1):1–8. Available from: <http://dx.doi.org/10.1186/s12889-016-3979-8>
 16. You D, Hug L, Ejdemyr S, Beise J, Idele P, Gerland P, et al. Trends in Child Mortality. *Lancet*. 1944;243(6288):317.
 17. Kaewkiattikun K. Effects of immediate postpartum contraceptive counseling on long-acting reversible contraceptive use in adolescents. Vol. Volume 8, *Adolescent Health, Medicine and Therapeutics*. 2017. 115–123 p.
 18. Ethiopian Public Health Institute (EPHI), ICF. Ethiopia Mini Demographic and Health Survey 2019: Final Report [Internet]. 2021. 1–207 p. Available from:

<https://dhsprogram.com/pubs/pdf/FR363/FR363.pdf>

19. Demisse AG, Alemu F, Gizaw MA, Tigabu Z. Patterns of admission and factors associated with neonatal mortality among neonates admitted to the neonatal intensive care unit of University of Gondar Hospital, Northwest Ethiopia. *Pediatr Heal Med Ther*. 2017;Volume 8:57–64.
20. Kolola T, Ekubay M, Tesfa E, Morka W. Determinants of neonatal mortality in North Shoa Zone, Amhara regional state, Ethiopia. *PLoS One*. 2016;11(10):1–11.
21. Akinyemi JO, Bamgboye EA, Ayeni O. Trends in neonatal mortality in Nigeria and effects of bio-demographic and maternal characteristics. *BMC Pediatr*. 2015;15(1):0–12.
22. Bosco AJ, Muyingo E, Nyegenye W. Trends and determinants of neonatal mortality in Uganda: Analysis of the Uganda demographic and health surveys. *Etude la Popul Africaine*. 2020;34(1):5143–59.
23. Nations U. Transforming our world: the 2030 agenda for sustainable development.
24. Newborn N, Strategy CS, Summary DB. 2015/16-2019/20. 2019;(June 2015).
25. United Nations. The Millennium Development Goals Report. United Nations [Internet]. 2015;72. Available from:
https://visit.un.org/millenniumgoals/2008highlevel/pdf/MDG_Report_2008_Addendum.pdf
26. Sector H, Plan T. *Hstp ii*. 2021;25(February).
27. Assefa N, Lakew Y, Belay B, Kedir H, Zelalem D, Baraki N, et al. Neonatal mortality and causes of death in Kersa Health and Demographic Surveillance System (Kersa HDSS), Ethiopia, 2008–2013. *Matern Heal Neonatol Perinatol* [Internet]. 2016;2(1):1–11. Available from: <http://dx.doi.org/10.1186/s40748-016-0035-8>
28. D. Chou, B. Daelmans, R. R. Jolivet, M. Kinney and LS. Ending preventable maternal and newborn mortality and stillbirths. *BMJ*. 2015; 351:4255. :1–26.
29. Eshete A, Abiy S. When Do Newborns Die? Timing and Cause-Specific Neonatal Death

- in Neonatal Intensive Care Unit at Referral Hospital in Gedeo Zone: A Prospective Cohort Study. *Int J Pediatr* (United Kingdom). 2020;2020.
30. Akseer N, Lawn JE, Keenan W, Konstantopoulos A, Cooper P, Ismail Z, et al. Ending preventable newborn deaths in a generation. *Int J Gynecol Obstet*. 2015;131:S43–8.
 31. Debelew GT, Afework MF, Yalew AW. Determinants and causes of neonatal mortality in jimma Zone, Southwest Ethiopia: A multilevel analysis of prospective follow up study. *PLoS One*. 2014;9(9).
 32. Abdullah A, Hort K, Butu Y, Simpson L. Risk factors associated with neonatal deaths: A matched case-control study in Indonesia. *Glob Health Action*. 2016;9(1).
 33. Ndombo PK, Ekei QM, Tochie JN, Temgoua MN, Angong FTE, Ntock FN, et al. A cohort analysis of neonatal hospital mortality rate and predictors of neonatal mortality in a sub-urban hospital of Cameroon. *Ital J Pediatr*. 2017;43(1):1–8.
 34. Kolobo H, Chaka T, Kassa R. Determinants of neonatal mortality among newborns admitted to neonatal intensive care unit Adama, Ethiopia: A case–control study. *J Clin Neonatol*. 2019;8(4):232.
 35. Alemu AY, Belay GM, Berhanu M, Minuye B. Determinants of neonatal mortality at neonatal intensive care unit in Northeast Ethiopia: Unmatched case-control study. *Trop Med Health*. 2020;48(1).
 36. Desalew A, Sintayehu Y, Teferi N, Amare F, Geda B, Worku T, et al. Cause and predictors of neonatal mortality among neonates admitted to neonatal intensive care units of public hospitals in eastern Ethiopia: A facility-based prospective follow-up study. *BMC Pediatr*. 2020;20(1):1–11.
 37. Mengistu BA, Yismaw AE, Azene ZN, Mihret MS. Incidence and predictors of neonatal mortality among neonates admitted in Amhara regional state referral hospitals, Ethiopia: Prospective follow up study. *BMC Pediatr*. 2020;20(1):1–14.
 38. Alebel A, Wagnew F, Petrucka P, Tesema C, Moges NA, Ketema DB, et al. Neonatal mortality in the neonatal intensive care unit of Debre Markos referral hospital, Northwest

- Ethiopia: A prospective cohort study. *BMC Pediatr.* 2020;20(1):1–11.
39. Dessu S, Kote M, Gebremeskel F, Girum T. Predictors of neonatal mortality among Neonates who admitted in neonatal intensive care unit at Arba Minch general hospital. *Ethiop J Heal Dev.* 2019;33(1):46–52.
 40. Roro EM, Tumtu MI, Gebre DS. Predictors, causes, and trends of neonatal mortality at Nekemte Referral Hospital, east Wollega Zone, western Ethiopia (2010–2014). Retrospective cohort study. *PLoS One.* 2019;14(10):1–13.
 41. Orsido TT, Asseffa NA, Berheto TM. Predictors of Neonatal mortality in Neonatal intensive care unit at referral Hospital in Southern Ethiopia: A retrospective cohort study. *BMC Pregnancy Childbirth.* 2019;19(1):1–9.
 42. Paudel D, Thapa A, Shedain PR, Paudel B. Trends and determinants of maternal and child under-nutrition in Nepal: Further analysis of the Nepal demographic health survey, 1996-2011. *Ann Nutr Metab [Internet].* 2013;63(March):1128. Available from: <http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L71179864%5Cnhttp://dx.doi.org/10.1159/000354245%5Cnhttp://vb3lk7eb4t.search.serialssolutions.com?sid=EMBASE&issn=02506807&id=doi:10.1159%2F000354245&atitle=Trends+and+determinants+o>
 43. Sidama Region - Wikipedia 2021. In: wikipedia.
 44. Organization sidama health. sidama region. 2020.
 45. by Dove Press published. *IJWH-75164-review-----patient-education-during-ante-natal-care---the-ne.* 2015;239–42.
 46. Legesse Liben M, Adem R, Yimer NB. The effect of antenatal care on colostrum avoidance in pastoralists: The case of Afar, Northeast Ethiopia. *Glob Pediatr Heal.* 2021;8.
 47. Account LM, Guidelines S, Access O. The Lives Saved Tool in 2013 : new capabilities and applications Time to initiation of breastfeeding and neonatal mortality and morbidity : a systematic review. *BMC Public Health.* 2018;13(3):1–22.

48. Ahearne CE. Short and long term prognosis in perinatal asphyxia: An update. *World J Clin Pediatr.* 2016;5(1):67.
49. Singh V, Shrikhande CDY, Vohra R, Garg A. Organ dysfunction other than central nervous system in perinatal asphyxia. *Sri Lanka J Child Heal.* 2018;47(2):141–5.

Annexes

Annex 1: Showing the hospital with number of neonates died from July 01, 2020 to Nov 31, 2020 and allocated required sample size for each randomly hospitals with the code of hospital

Code of hospita	Name of study hospital	Number of neonate died		Allocated sample size		Remark
		Number	Relative frequency	Cases	Control	
01	Chuko primary hospital	3	2%	2	4	
02	Aleta wondo primary hospital	4	2.68%	2	4	
03	Yaye primary hospital	3	2%	2	4	
04	Bona primary hospital	9	6%	5	10	
05	Kebado primary hospital	4	2.68%	2	4	
06	Daye primary hospital	4	2.68%	2	4	
07	Yirgalem general hospital	33	22%	20	40	
08	Hawassa comprehensive specialized hospital	47	31.5%	28	56	
09	Tula primary hospital	3	2%	2	4	
10	Dore bafana primary hospital	2	1.3%	1	2	
11	Leku primary hospital	9	6.2%	6	12	
12	Mejo primary hospital	2	1.3%	1	2	
13	Adare general hospital	25	16.79%	15	30	
14	Yirba primary hospital	1	0.67%	1	2	
	Total	149	100%	89	178	

Annex 2: Informed consent form in English

Dear respondent

Hello, my name is ----- . I am here to interview you on behalf of **Haftu Reda** who is Post graduate student of SPMMC for partial fulfillment of Masters of public health in Epidemiology. The main purpose of the study is to assess the magnitude and predictors of neonatal mortality among neonate admitted in NICU sidama regional state Hospitals. In addition to this the information you provide here will be very helpful to the investigators of this study to write a research paper for the requirement in completion of Masters of public health in Epidemiology. To realize those purpose your honest and genuine participation is very important and highly appreciable. I, therefore, kindly request you to fill this questionnaire as accurately and carefully as possible. Please be assure that all the information gathered will be kept strictly confidential and your name will not be written in any part of the questionnaire. Only the investigator has the access to the information and used it for the study purpose. your participation in this study does not involve any direct risk associated with participating in this study except the time spent for responding to the questionnaire and you will not receive any direct benefit. However, your participation is very useful because your answer will help to assess the magnitude and predictors of neonatal mortality in NICU of sidama regional state hospitals. The study will be conducted through structured questionnaire and interview and you are being asked for a little of your time, about 25-30 minutes to complete the questioner. Your participation is voluntary and you are not obligated to answer any question you do not want to answer. If you feel discomfort with the question, it is your right to drop it at any time you want. your relationship with the community or any other body will not be affected in any way. If you have questions regarding this study or would like to be informed of the results after its completion, please feel free to contact the principal investigators.

Thank you for your assistance and cooperation

Address of principal investigator

Name Haftu Reda Phone No: +251-913-30-06-09 Email: haftureda26@gmail.com

Are you willing to participate in this study? YES [] NO []

If yes continue to next page, if no thank you. Address of Information of data collector

Name of data collector-----Date-----signature-----

Annex 3. Questionnaire in English Version

Questionnaire code 01001

Section 1		Hospital characteristics	
Instruction		The possible answer should be circle after asking the respondent or review from chart or follow up checklist and for those question with others option it should be specified and if there is skip use appropriately.	
Qs.C	Questions	Possible responses	Skip /Remark
101	Where is the neonate admitted?	1. Primary hospital 2. General hospital 3. Tertiary referral hospital	
102	Head of NICU	1. pediatrician 2. Doctor 3. Health Officer 4. Nurse 5. Other specify-----	
103	Where were born the admitted neonate?	1. Health center 4.Tertiary hospital 2. Primary hospital 5.Home delivery 3. General hospital 6.Other specify-----	

Questionnaire code 01001

Section 2		Socio-demographic characteristics	
Instruction		The possible answer should be circle after asking the respondent or review from chart or follow up checklist and for those question with others option it should be specified and if there is skip use appropriately.	
Qs.C	Questions	Possible responses	Skip /Remark

201	Relationship of respondent to neonate	1. Mother 2. Father 3. Other specify-----	
202	How old are you? (mothers)	----- Years.	
203	How old are you? (Father)	----- Years.	
204	What is Current occupation?	1. House wife 5. Private org. employee 2. Merchant 6. Student 3. Daily laborer 7. Others(specify) ----- 4. Government Employee	
205	Educational status of the mother of neonate?	1. Illiterate 5. 12 complete 2. Able to read and write 6. Diploma 3. Elementary school 7. Degree and above 4. Secondary school	
206	Educational status of the father of neonate	1. Illiterate 5. 12 complete 2. Able to read and write 6. Diploma 3. Elementary school 7. Degree and above 4. Secondary school	
207	Does Women have decision on neonate treatment?	1. Yes 2. No	
208	Does women work for cash?	1. Yes 2. No	

Questionnaire code 01001

Section 3	Wealth status indication
Instruction	The possible answer should be circle after asking the respondent or review from chart or follow up checklist and for those question with others option it should be specified and if there is skip use

		appropriately.`	
Qs. C	Questions	Possible responses	Skip /Remark
301	What Source of water used?	1. surface water 2. pipe water 3. other specify-----	
302	What Type toilet use?	1. bush outfield 2. dirty toilet 3. ceramic toilet 4. flush or parquet toilet 5. others specify-----	
303	Do you have radio?	1. Yes 2. No	
304	Do you have television?	1. Yes 2. No	
305	Do you have refrigerators?	1. Yes 2. No	
306	Do you have telephone?	1. Yes 2. No	
307	Do you have electricity?	1. Yes 2. No	
308	Do you have vehicle?	1. Yes 2. No	If no skip to 310
309	Which type of vehicle	1. car 2. motorcycle 3. Others specify-----	
310	How many people live in one room?	-----persons	
311	Does the household own agricultural land?	1. Yes 2. No	
312	Income status of house hold	-----	

Questionnaire code 01001

Section 4		Maternal and Obstetric characteristics	
Instruction		The possible answer should be circle after asking the respondent or review from chart or follow up checklist and for those question with others option it should be specified and if there is skip use appropriately	
Qs. C	Questions	Possible responses	Skip /Remark
401	Marital status	1. married 2. single 3. widowed 4. divorced	
402	Place of residence	1. urban 2. rural	
403	Maternal MUAC status	-----cm	
404	Have you ever given birth a child?	1. Yes 2. No	If no skip to 407
405	How many child do have?	-----	
406	Birth interval from the admitted neonate?	-----years	
407	Do have ANC follow up?	1. yes 2. No	If no skip to number 409
408	How frequent ANC follow up	-----follow up	
409	Any illness during pregnancy?	1. yes 2. No	
410	Antenatal complication	1. yes 2. No	If no skip to ques. number 411
411	Which type of antenatal complication	1. high grade fever 2. excessive bleeding 3. convulsion 4. swelling of face or feet	More than one answer's possible

		5. foul smelling discharge 6. others specify-----	
412	Do you take TT injection?	1. Yes 2. No	
413	Do you consume cigarette during pregnancy	1. Yes 2. No	
414	Onset of labor?	1. Spontaneous 2. Induced 3. Other specify-----	
415	Mode of delivery?	1. SVD 2. CS 3. Instrumental delivery 4. other specify-----	
416	Who assist you during Delivery?	1. traditional birth attendant 2. Skilled birth attendant	
417	Do you experience any delivery complication?	1. yes 2. No	If No skip to Qs.501
418	Which type of Delivery complications occurred?	1. excessive bleeding 2. convulsions 3. retained placenta 4. abnormal presentation 5. prolonged labor 6. premature rupture of membrane 7. Others specify-----	More than one answer's possible

Questionnaire code 01001

Section 5	Neonatal factors
Instruction	The possible answer should be circle after asking the respondent or review from chart or follow up checklist and for

		those question with others option it should be specified and if there is skip use appropriately	
Qs. C	Questions	Possible responses	Skip /Remark
501	Where were born the admitted neonate?	1. Health center 4.Tertiary hospital 2. Primary hospital 5.Home delivery 3. General hospital 6.Other specify-----	
502	Sex of neonate?	1. male 2. female	
503	Age of neonate in admission?	-----days	
504	Weight of neonate in admission?	-----grams	
505	1st minute APGAR score of neonate during delivery	-----	
506	5 th minute APGAR score of neonate during delivery	-----	
507	Complication at birth	1. yes 2. no	If no skip 508
508	If yes to question number 507 which type of CAB	1. Meconium aspiration syndrome 2. Respiratory distress 3. Hypothermia 4. Perinatal asphyxia 5. Hypoglycemia 6. Other specify-----	More than one answer is possible
510	Multiple gestation	1. yes 2. no	(Twin or more pregnancy)
511	Birth rank of the neonate	-----birth order	
512	Postnatal care follow up?	1. yes 2. no	
513	Have congenital malformation	1. yes 2. no	

Thank you for your participation

Annex 4. Informed consent form in sidamo-afoo

Qalla

Su'mi'ya----- . Kawiicho leelloommohu **Haftu Reda** layinki digirenni dagate fayyimma daafo yitanno (SPMMC) hattono labbanno xisso buuxate golinni maassamanno rosaanchi maassamate ikkitanno xiinxallora qixxeessinoonnita qaali xa'mo xa'mammoheraati. Tenne xiinxallora qara mixo Sidaamu Dagoomu Qoqqowu Mootimma giddo noo hospitaallara 28 barri wori qaaquulli reyo korkaattubba keena bikka bada ikkitanno. Ledoteno tini ati aatta mashalaqqe tee xiinxallo gumaame assatenna hattono Hawaasi Yuniveristenni layinki digirenni dagate gawajjo abbitanno babbaxxitino xisso xiinxallonni maassamanno maassamaaanchira eo ikkitanno. Tee xiinxallo halaalaanchonna gumaame assate ati aatto/tta heddo lowo qeecha godol'tannotenna lowohunni bokkeessinannite. Konnira ani shooshanqetenni xa'meemmoheri, woroonni xa'minanni borri xa'mo garinni nabbabbe halaalanya tumo aattaera/ttoera xa'meemmo. Aattoti/ttati mashalaqqe halaalanya ikkitinota ate ragaanni seekkite buuxa hasiissanno hattono uyinoonni borri xa'mote woraqati aana su'makki borreessa didandaatto/tta. Xiinxallaanchu callu xiinxallote korira horonsirannota ikkasenni mashalaqqe isiwa buuxantanno. Tini ate millimmo/qeechi tenne xiinxallo borri xa'mo aana assattohu/ttahu ate aana mitte xiiwono abbaheera didandaanno hattono yannakki aate gobbaanni baxxitino horo afirattoti/ttati diheedhanno. Ikkollana ate dawaro/tumo aattoti/ttati lowo horo afidhino. Koruno ati oottotenni/ttatenniiti S/D/Q/M giddo noo hospitaallara qaaqu ilaminkunni 28 barri woro heere reyanno korira halaalanya keeno assa dandiinannihu. Tini xiinxallo loosantannohu qaali xa'monna borri xa'mo injaanno garinni qixeessinoonni doogonniiti. Ati 25-30 xiqqeessi geeshsha yannakki aatenni halaalaancho mashalaqqe aattora/ttara shaqqillunni koyisamootto/tta. Tenne tumo aate umikki fajjo ikkinnina xiiwo assannohehuno ikko afoottokkita/akkita dawarate dimitii'matto/tta. Xa'minoonnihe xa'mo injaa hoogguhero agurte sa'ate dandaatto/tta. Dagatenninna hattono mittu mittuy ledoo noohe xaadooshshi mayinnino dimuramannona waajjitooti. Tenne xiinxallora aatto mashalaqqera aye gari xa'mi heedhuhero mitte waajja macciishshantuhekkinni xa'mi.

Kaa'lokkiranna baatto/tta heddo lowo geeshsha galateemmo.

Te xiinxallora beeqqaancho ikkate hasatto noohe? Ee [] Dee'ni []

Su'masi-----Barra-----malaatesi-----

Qaali xa'mote code 01001

Kifile 1		Hosipitaalet badooshshe	
Hajajo		Tumo uytanno manniwiinni afi'nannita dandaantanno dawaro qoqqowa hasiissanno. Yaano buuxote qixxeessinoonni qixxaawo garinni ikka noose. Afi'nanni qolo garunni farsheessama noose.	
Qs.C	Xa'mubba	Dandaantanno qolo	Buuxo
101	Qaaqqu mama goxinsanni?	1. Umi deerri hosipitaalera 2. Xaphoomu hosipitaalera 3. Luphiima hosipitaalera	
102	Massagaanchu kabbadete xiwamino qaaqquli jaabata geeshsha gooxanno bayiicho	1.Kaa'lo assinohu/ilshiishinohu 2.Dottoraho 3.Fayyimmate mereershi massagaanchi 4.Fayyimmate ogeessi/tte 5.Wolootahoro kuli-----	

Qaali xa'mote code 01001

Kifile 2	Dagoomittenna dagate heeshsho xiinxallo akata
Eo	Tumo uyitanno manniwiinni afi'nannita dandaantanno dawaro qoqqowa hasiissanno. Yaano buuxote qixxeessinoonni qixxaawo garinni ikka noose. Afi'nanni qolo garunni farsheessama noose.

Qs.C	Xa'mubba	Dandaantanno tumo	Buuxo
201	Tumo aanni manchinna ilami qaaqqi xaadooshshe/fiixooma	1.Amate 2.Annaho 3.Wolootahoro xawisi-----	
202	Dirikki me"eho? (Amate)	-----dirooti.	
203	Dirikki me"eho? (Annaho)	-----diroot.	
204	Xaa yannara loosikki maati?	1.Mini looso loossanno 5. Hanni uurrinsha . 2. Daddalaancho 6. Rosaancho 3. Barru hoshsho 7. Wolu loosu dani----- 4. Gashshootu loosaaasinchooti	
205	Qaaqqu amahu rosu deerrise?	1.Dironsoho 5.12 gudino 2. Borreessanno nabbawanno 6. Dipilooma 3. 1-8 geeshsha ronso 7.Deireнна ale 4. Layinni dirimi roso gundo	
206	Qaaqqu anni rosu deerra	1.Dironsoho 5.12 gudino 2. Borreessanno nabbawanno 6. Dipilooma 3. 1-8 geeshsha ronso 7.Deireнна ale 4. Layinni dirimi roso gundo	
207	Qaaqqo garunni ilaallisate/la"aatisate hasatto nooseamate?	1.Ee 2.Dee'ni	

208	Baatooshshe baantanna lossitannote?	1.Ee 2.Dee'ni	
------------	--	------------------	--

BORRO xa'mote code 01001

Kifile 3		Durimmate ikkito	
Hajajo		Tumo uyitanno manniwiinni afi'nannita dandaantanno dawaro qoqqowa hasiissanno. Yaano buuxote qixxeessinoonni qixxaawo garinni ikka noose. Afi'nanni qolo garunni farsheessama noose.	
Qs. C	Xa'mubba	Dandaantanno dawaro	Buuxo
301	Horoonsi'rannoti/dhannoti way jiro gari?	1.Kofote waa 2.Baambu waa 3.Wolu gari way nooro xawisi-----	
302	Cilu/shumate mine hiittooha horonsiranno?	1.Araddate/dubbu giddo 2.Woyyaawinokkiha 3.Woyyaawinoha 4.Danchu garinni loosaminoha 5.Wole nooro xawisi-----	
303	Raadiyo noohe?	1. Ee 2. Dee'ni	
304	Televizhiine noohe?	1. Ee 2. Dee'ni	
305	Sagale ba'ukkinni keeshshiishanno uduunni(refrigetar) noohe?	1. Ee 2. Dee'ni	
306	Bilbilu noohe?	1. Ee	

		2. Dee'ni	
307	Caabbichu/korreente noohe?	1. Ee 2. Dee'ni	
308	Kaameelu/xexxerrisu noohe?	1. Ee 2. Dee'ni	Nookkiro sai 310
309	Ma danihu noohe?	1.Kaameelu 2. Xexxerris. 3.Wolootu-----	
310	Mittu galtoomira mageeshshi manni heedhinanni?	-----Mannu kiir	
311	Mine gashshinohura loosiranno baatto noosi?	1.Noosi 2.Dinosi	
312	Mine gashshinohura mini loosiranno loosaasinni noosi?	1.Noosi 2.Dinosi	

Borri xa'mo code 01001

Kifile 4		Amimmatenna ilshiishate ikkito	
Hajajo		Tumo uyitanno manniwiinni afi'nannita dandaantanno dawaro qoqqowa hasiissanno. Yaano buuxote qixxeessinoonni qixxaawo garinni ikka noose. Afi'nanni qolo garunni farsheessama noos	
Qs. C	Xa'muwa	Dandaantanno qolo	Skip /Remark

401	Adhammete ikkito	1.adhaminoho/ntinote 2.Mine 3.dikalaqqi'rinoho/dhinote 4.Shii'rinoho/dhinote 5.Tiraminoho/ntinote	
402	Heerannowi	1.Quchuma 2.Baadiyye	
403	Amate dassa likinonni kiir me'ette?	-----sa'anti meter	
404	Ooso ilootta?	1.Ee 2.Dee'ni	Nookkiro sai 407
405	Me"e ooso noohe?	-----	
406	Xa ilammo qaaqqira albiidihu mageeshshi geeshsha balaxanno?	-----diro	
407	Fayyimmate uurrinsha harunsatta ANC?	1.Ee 2.Dee'ni	Nookkiro sai 409
408	Harunsokki gari hiittooho ANC kititile	----- harunsa	
409	Ilitta waro macciishshantinohe xisso no?	1.Ee 2.Dee'ni	
410	Ilate albaanni kalaqantino buuxote hoonge no?	1.E'e no 2.Dino	Nookkiro sai 411
411	Hiittoote kalaqantuhe buuxote hoonge?	1.Kaajjado bisu iibbabbishshi 2.Bikkimale mundeete du'nama 3.Huxise qece assa 4.Albanna lekka du'misa	Mitte Ali dawaro qola dandiinanni

		5.Sanote eanno baali giwisa 6.Wolootuno nooro xawisi--	
412	Godobbe heedheenna marfe qansoonnihe?	1.Ee 2.Dee'ni	
413	Godobbe heedhenni sigaara wiliishshatta?	1.Ee 2.Dee'ni	
414	Gamete gari hiittoho?	1.Hedeweelchoho 2.Malaate aanni 3.Wolu gari hee'riro wori---	
415	Ilakki ikkito?	1.Bisose kinsikkinni iltino 2.Umisenni nitte iltino 3.Darreennahe 4.Wole nooro kuli-----	
416	Ilitta yanna irko ay assihe?	1.Budu ogeette 2.Rosino/ssino fayyimate ogeette	
417	Ilate aana baxxino qarrubba kalaqantuhe?	1.Ee 2.Dee'ni	Nookkiro sai 501
418	Hiikku?	1.Bikkimale mundeel du'nama 2.Huxatto/qece qece yaa 3.Layinki ila keeshshitino 4.Baajji assa 5.Haannu ga'manni keeshshihe 6. Yanniweelo ilami	Mittete ali dawaro qola dandiinanni

		7.Wolootu nooro kuli-----	
--	--	---------------------------	--

Borri xa'mote code 01001

Kifile 5		Qoqqulu ilshiishate ikkito	
Hajajo		Tumo uyitanno manniwiinni afi'nannita dandaantanno dawaro qoqqowa hasiissanno. Yaano buuxote qixxeessinoonni qixxaawo garinni ikka noose. Afi'nanni qolo garunni farsheessama noos	
Qs. C	Xa'mubba	Dandaantanno tumo	Buuxo
501	Qaaqqu mama ilami?	1.Fayyimmate mereershira 2. Umi deerri hosipitaalera 3.Xaphoomu hospitaalera 4.Luphiima hosipitaalera 5.Mine ilammo 6.Wolu garinni ilammo-----	
502	Qaqqulu Koo/tee akata?	1.Labbaaho 2.Meyaate	
503	Dirisi/se?	-----barraati	
504	Qelpheephosi/se kiilograametenni?	-----kiilogiraameeti.	
505	umiha xiqeessa APGAR gumma	-----	
506	ontikiha xiqeessa APGAR gumma	-----	

507	Ilami yanna kalaqammo qarra	1.Ee 2.De'e'ni	Nookkiro sai 508
508	ikkito Ilami yanna kalaqammo qarra	1.adhaminoho/ntinote 2.Mine 3.dikalaqqi'rinoho/dhinote 4.Shii'rinoho/dhinote 5.Tiraminoho/ntinote 6.woolatu/tsafiii.....	Mitte Ali dawaro qola dandiinanni
510	Sorantinoti lekka ayirrate yanna no?	1.Ee 2.Dino	(Lakkuwahonso roore kulloonni)
511	Ilamishshu deerri ikkito	-----ilamishshu aante	
512	Ilamihu gedenaanniiti?	1.Ee 2.De'e'ni	
513	Hedeweelcho ledoo kalaqantino xisso no	1.Ee 2.De'e'ni	

Yanna aakkira wodaanni galateemmo!

Annex 6: Detail of data processing and Analysis

Data was coded and entered in Epi info 7 then export to SPSS Version 25 statistical software for data to be cleaned, recoded and analyzed. In the recoding stage our interest of outcome was coded by 1 for case and 0 for controls. For all that need category had given code starting from Zero (0) or one (1) up to number of response variables and frequency and percentage among case and control was calculated. In addition to this, as the analysis was done by conditional logistic regression in SPSS version 25, which need stratum and F-time (factious time) to be formed. Eighty nine triplet stratum which start from one (1) and end eighty nine (89) was created based on matched gestational age by using Ballard score category. F-Time was created by coding if condition in SPSS by coding one (1) for case and two (2) for control for all study subject. Two step procedure were used to analyze the association between the outcome variables (neonatal death) and independent variables using conditional logistic regression analysis to identify determinant of neonatal mortality and Covariant with P-value less than 20% and considering COR in bivariate conditional logistic regression was retain for final analysis. That means in bivariate conditional logistic regression with $p < 0.2$ will be retained to be analysis in final steps. In Multivariable conditional logistic regression 95% confidence intervals (CI) using a P-value < 0.05 was considered as statistically significant association with the outcome variable and Adjusted odds ratio (AOR) with 95%CI was used to show the strength of association between independent and dependent variables. Hosmer and Lemeshow's goodness-of-fit test was used to assess whether the necessary assumptions for the application of logistic regression and the assumption were fulfilled. Assumptions of logistic regression: multi-collinear, Outliers, linearity log of independent and dependent variable were checked. Outliers for quantitative variable with continues data were checked using mahalobious test with probability < 0.001 to be counted as outliers but their probability were all greater than 0.001 so there were no outliers. Linearity of log odd weight of neonate in admission and maternal age at delivery were checked with dependent variable by first calculating log odd of each independent variables in SPSS using transform into $\ln(\text{independent variable}) * \text{independent variables}$ for both of independent variables then both were linear for log odd of dependent variable. Multi colinearity were checked for all independent variables, then first minute and fifth minute Apgar score had correlation to each other and multi-collinear with place of birth with variance inflation factor (VIF) (27, 28)) respectively then first and fifth minute Apgar score were excluded from final analysis.

Annexes7. Checkup form of for those selected as controls

[illegible]

DECLARATION

I, Haftu Reda, declare that this thesis work entitled “Determinant of Neonatal Mortality among Neonates admitted in Neonatal Intensive Care Unit in sidama regional state hospitals, Ethiopia in 2020. (Matched case control study)” is my own original work. I have carried out it independently with the guidance and suggestion of the research advisors. I also assure that it has not been submitted to any university/college for award of any degree or Diploma.

Name of candidate: Haftu Reda Belay

Signature: _____

Date: _____

This thesis has been submitted with my approval as university advisor

Advisors Name: Mr.Temesgen Geleta Signature:_____Date_____

Name: Mr.shikur mohammed Signature:_____Date:_____
