ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE

SCHOOL OF PUBLIC HEALTH

EFFECT OF MATERNAL NEAR MISS ON NEONATAL MORTALITY IN BALE ZONE SOUTHEAST ETHIOPIA: PROSPECTIVE COHORT STUDY

INVESTIGATOR

AHMEDNUR ADEM ALIYI (BSc)

THESIS SUBMITTED TO SCHOOL OF PUBLIC HEALTH OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR DEGREE OF MASTER'S OF PUBLIC HEALTH IN EPIDEMIOLOGY AND BIOSTATISTICS.

OCTOBER, 2019

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APPROVAL BY THE BOARD OF EXAMINATION

The thesis by **Ahmednur Adem Aliyi,** entitled "**Effects of maternal near miss on neonatal mortality in Bale Zone selected hospitals Southeast Ethiopia: prospective cohort study"** is accepted in its present form by the board of examiners as satisfying thesis requirement for the degree of master's in Public Health Epidemiology and Biostatistics.

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STATEMENT OF DECLARATION

By my signature below, I declare and affirm that this thesis entitled "**Effects of maternal near miss on neonatal mortality: prospective cohort study in bale Zone Southeast Ethiopia** is my own work.

This thesis is submitted in partial fulfillment of the requirement for a graduate degree from the Addis Ababa University at College of Health Sciences, School of Public Health. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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ACKNOWLEDGEMENT

I like to express my deeper thanks and gratitude to my advisors **Dr Negussie Deyessa** and **Mr Mengistu Yilma** for their constructive guidance and comment. I would also like to thanks Addis Ababa University, College of Health Science School of Public Health specially Department of Preventive Medicine for sharing of experience and advice on how to do real and relevant problem solving research by showing us how to criticize previously done article which help me a lot. Also I would like to thank Dr. Tilahun (Medical Director of Ginnir General Hospital), and Dr. Telalak (Medical Director of Goba Referral Hospital) and their staff members. I would like to thanks all data collectors and staff for their valuable assistance.

And also, my heartfelt gratitude will pass to all research participants those who had voluntarily participated in the study. Lastly I would like to pass my deep thanks and gratitude to my families and those friends who were always at my side with everything they have.

ACRONYMS

ANC: Antenatal Care

APGAR: Appearance, Pulse, Grimace, Activity, Respiration

EX(B): Exponent of Beta

FGM: Female Genital Mutilation

HSTP: Health Sector Transformation Plan

ICU: Intensive Care Unit

IMR; Infant Mortality Rate

IUD: Intrauterine Death

IUGR: Intrauterine Growth Retardation

MCH: Maternal and Child Health

MDG: Millennium Development Goal

MMR; Maternal Mortality Ratio

MNM: Maternal Near Miss

NICU: Neonatal Intensive Care Unit

NMCR: Near Miss Case Review

Q: Question

RMNCAH: Reproductive, Maternal, Neonatal, Child and Adolescent Health

SDG: Sustainable Development Goal

SMM: Severe Maternal Morbidity

SPSS: Software Package of Social Science

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ABSTRACT

Background: Maternal near-miss is a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy. It has very close effect on maternal and neonatal heath. Hence the study assess effect of maternal near miss on neonatal mortality. *Methods:* Prospective cohort study was done on 354 pregnant women who came for delivery service to selected hospitals in Bale Zone. The hospitals were selected purposely based on average number of delivery and neonatal mortality they have in the last six month. Then all mothers with near miss were included until the required sample size is obtained. Two non near miss mothers were selected using lottery. Frequency distribution was done for selected important variable. Survival curve for both groups and Cox regression to look for effect of maternal near miss on neonatal mortality was done. Ethical clearance from Addis Ababa University School of Public Health and verbal informed consent from study participant were obtained. *Results:* Out of the 384 sampled pregnant complete responses were obtained from 354 respondents yielding a response rate of 92.2%. . Of all 55 (15.5%) of them have previous history of abortion and 44 (12.4%) and 22 (6.2%) have history of past delivery of still birth. From the total live birth there were 17 (48 per 1000 live birth) neonatal death at the end of the study. As monthly income increase by one Ethiopian birr the risk of neonatal mortality decrease by 0.002 [(AHR 0.998, 95% CI (0.996, 0.999)]; 6.48 times for non cephalic presentation than for cephalic presentation [(AHR 6.48, 95% CI 1.84-22.73)]. As APGAR score increase by one score risk of neonatal mortality decrease by 0.2 [(AHR 0.746, 95% CI (0.620, 0.898)], 8.40 times for mother with severe morbidity than for mother with no maternal near miss after controlling for the effect of other variables (AHR 8.40, 95% CI (1.638, 43.118). C*onclusion:* Neonatal mortality was higher among near miss mothers. But it was not only the result of maternal complication. It has share from other factors. Therefore most of the factors were modifiable if efforts were done to improve socioeconomic status of community.

Key words: Maternal near miss, Neonatal mortality, Bale Zone, Ethiopia.

1. INTRODUCTION

1.1. Background

Mothers and children comprise the essential component of population and their health was interrelated (1). The neonatal period, which is globally accepted as beginning at birth and ending at 28 completed days of life (2).

A maternal near-miss case is defined as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy; In practical terms, women are considered near miss cases when they survive life-threatening conditions (i.e. organ dysfunction) (3). Neonatal death (mortality) is defined as the death of a live born infant, regardless of gestational age at birth, within the first 28 completed days of life. Each neonatal death can be further clarified into viable and non-viable deaths depending on the gestational age at which they were born. Neonatal deaths can be subdivided into (i) very early neonatal death (0 to<24 h), (ii) early neonatal deaths, occurring from the first day to the seventh day of life (≥24 h to <7 days), and (iii) late neonatal deaths, occurring after the seventh day but before 28 completed days of life (≥7 to <28 days) (4)

It is one of the international community's top priorities, and both the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) have specific targets for reduction in the maternal and child mortality. Improving maternal and children health is key focus of Sustainable Development Goal by reducing maternal mortality to 70 per 100000 live births and neonatal mortality to 12 death per 1000 live birth (5). Globally maternal and neonatal mortality is 216 death per 100000 and 19 death per 1000 live births respectively (5).

Over the 25-year period, the annual number of maternal deaths declined from approximately 532,000 to 303,000. This is a substantial reduction but falls short of the three-quarters target set in the MDGs in 1990. Maternal mortality varies widely among regions, with the highest rates in sub-Saharan Africa 546 death per 100,000 live births and the lowest in the developed regions 12 death per 100,000 live births.

Developing regions account for 99 percent of maternal deaths worldwide (6). In 2016 neonatal mortality accounts for 46 % of under five mortality (5, 6). Ethiopia made major progress in reducing maternal and neonatal mortality over last two decades. This reduce maternal mortality ratio from 871 death per 100,000 live birth to 412 death per 100,000 live birth and neonatal mortality from 47 death per 1000 live birth in 2000 to 29 death per 1000 live birth in 2016 (7).

Maternal near-miss could serve as a proxy for maternal and neonatal death to evaluate quality of obstetric care in particular health institutions. Assessing near-miss has an advantage over maternal death as near-misses are more common and statistically robust and we can get further information from mother because she was alive (8, 9). Thus investigating severe maternal morbidity (near-miss) helps to identify women at highest risk of maternal death ease identification of its effect on baby hence helps allocate resources especially in the area where it is needed most (10).

1.2. Statement of the problem

Every year, many women suffer from pregnancy-related complications and numbers die. Linked to this is the burden of perinatal mortality and morbidity (11). This makes the first 28 days of life (neonatal period) most vulnerable time for child survival. Children face highest risk of dying in their first month of life (12). Infant mortality rate is affected by antenatal, postnatal quality care and socio-economic factors and delayed care seeking due to poverty. 70.8% of neonatal deaths occur during the first week of life (13). It is estimated that 40 percent of neonatal deaths could be prevented by providing high-quality care for both mother and baby around the time of birth (11).

The burden of neonatal deaths is also unevenly distributed across regions and countries. At the country level, half of all neonatal deaths are concentrated in five countries, namely, India (24 per cent), Pakistan (10 per cent), Nigeria (9 per cent), the Democratic Republic of the Congo (4 per cent) and Ethiopia (3 per cent)(12). Ethiopia is one of sub Saharan Africa with high maternal and neonatal mortality which is 412 per 100000 and 29 deaths per 1000 live birth respectively(7). Different studies had conducted on maternal near miss in Ethiopia and report different maternal near miss ratio. (14. 15). As reported by Bale Zone health bureau there 56 death of mother related to pregnancy and 24 neonatal death during the six month preceding this study.

Due to the success of modern medicine, maternal deaths are fewer in number but there are innumerable “near miss” events which have the potential to teach us lessons. For every maternal death there is 20 to 30 severe maternal morbidities (16). There are several advantages of investigating near miss cases e.g. they are more common than maternal deaths, provide useful information on the same pathways that leads to morbidity and death, less threatening for service providers as women has survived, women can be interviewed and as a result more realistic analysis of gaps can be done (10).

The odds of women and babies dying or developing severe complications are particularly high when pre-eclampsia and eclampsia occur. The risk of fetal and neonatal deaths, as well as preterm birth and admission to a Neonatal Intensive Care Unit (NICU), was, in general, similarly increased in both pre-eclampsia and eclampsia, albeit slightly higher in eclampsia (17).

The prevalence of all maternal complications was significantly higher in macerated and fresh late fetal deaths and early neonatal deaths. Only 14.4% of macerated late fetal deaths; 13.5% of fresh late fetal deaths; and 11.4% of early neonatal deaths did not have a maternal complication present. The risks of macerated late fetal death, fresh late fetal death, and early neonatal death were consistently increased in mothers with placental abruption, ruptured uterus, systemic infections/sepsis, pre-eclampsia, eclampsia, and severe anemia (18). Hence identification of severe maternal morbidity (maternal near miss) using appropriate and feasible criteria has endless benefits in improving health of mother and baby (19). Only few of the laboratory and management based WHO maternal near miss criteria were rated applicable in resource scarce setting and Delphi international study brought forward important suggestions for adaptations in the WHO MNM criteria to enhance its applicability in sub-Saharan Africa and possibly other low–resource settings (19). Hence this study investigated effect of maternal near miss on neonatal mortality using modified WHO maternal near miss criteria for Sub Saharan Africa and other developing regions.

1.3. Rationale and significance of the study

Previous studies suggest high rate of maternal near miss specially in developing areas. Evidence on the effect of maternal near miss on neonatal mortality is not well documented using appropriate criteria for the developing country. There were only few studies in this area which also suggest conflicting results and they use secondary data from patient records. No study was done to look for effect of maternal near miss on neonatal mortality. Previously conducted study use unmodified WHO maternal near miss criteria despite its proved not applicable in sub-Saharan and other resource limited area. This study identified effects maternal near miss on neonatal mortality by using the Modified WHO maternal near miss by the Delphi international study.

This study will inform program managers, policy makers and other stakeholder who work on improving maternal and child health. The study will inform health care provider on the identification of maternal near miss using the right approach (criteria). These will help in giving attention for prevention and management of maternal and neonatal mortality by early identifying severe maternal morbidity and taking appropriate measure which in turn will improve the health of community. It is better way to understand indirectly how maternal mortality happens. It will also serve as reference for those who will conduct the study in the area of maternal and child health

2. LITERATURE REVIEW

A mother is female parent who becomes pregnant and gives offspring of her own. She is responsible for almost for keeping household and raising children(1). According to WHO definition neonatal period comprise time between birth and 28 days after delivery. Baby whose age is between first and 28 days after delivery is termed as neonate (2). Women and children play a crucial role in development. Investing more in women's and children's health is not only the right thing to do; it also builds stable, peaceful and productive societies. Everyone has a critical role to play in improving the health of the world's women and children (20).

In 2009 World health organization defines maternal near-miss case as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy; In practical terms, women are considered near miss cases when they survive life-threatening conditions (i.e. organ dysfunction). She is woman who experience the same pathological change as maternal mortality but escape death due to chance or available effective management(3). Neonatal death include all death after viable delivery or born of live birth up to completed 28 days (4).

2.1 Response to Problem and Current Situation

Reducing maternal and child mortality is one of the international community's top priorities, and both the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) have specific targets for declines in the maternal and children mortality ratio. Globally, the MMR is estimated at 216 per 100,000 live births in 2015. This represents a decline of 44 percent from the 1990 MMR of 384 (5).

The world has made substantial progress in reducing child mortality in the past several decades. The total number of under-five deaths dropped to 5.6 (5.4, 6.0) million in 2016 from 12.6 (12.4, 12.8) million in 1990. Progress is slower in reducing neonatal mortality rates than in reducing mortality rates in children aged 1–59 months. The neonatal mortality rate fall by 49 percent from 37 (36, 38) deaths per 1,000 live births in 1990 to 19 (18, 20) in 2016; while the mortality in children aged 1–59 months declined by 62 per cent from 1990 to 2016 (12).

Ethiopia as one of international community also made progress in reducing maternal and neonatal mortality. Reproductive, maternal, newborn, child, adolescent health and nutrition will continue to be top priority for the next 5 years. As indicated in the sustainable development goals (SDG), Ethiopia will intensify RMNCAH interventions to end preventable maternal and child deaths by 2030. The targets set in the HSTP are in line with the global aspirations. The country gives focus on increasing health facility delivery and neonatal care. By doing so the country reduces maternal and neonatal mortality over the last two decades (21). The government of Ethiopia has made different strategies to lower the rate of maternal and neonatal mortality. For instance, the members of women's association of Ethiopia were trained to address social and structural barriers to sexual, reproductive, maternal and newborn health (22). These efforts reduce maternal mortality ratio from 871 deaths per 100,000 live births in 2000 to 412 death per 100,000 live births in 2016. Neonatal mortality was also reduced from 47 deaths per 1000 live in 2005 births to 29 deaths per 1000 live birth in 2016 (7).

But despite all these measures taken by international communities to reduce maternal and child mortality, world still have unacceptably high numbers of maternal and newborn deaths (20) 2015 around 303,000 maternal deaths occurred worldwide with sub-Saharan Africa alone accounts for 66% of the deaths and 5.6 million children died in 2016 46% during their first month of life (5, 6).

The burden of maternal mortality is only a small fraction of the burden of maternal morbidity. Maternal deaths have been described as the tip of the iceberg and maternal morbidity as the base. For every woman who dies of pregnancy-related causes, 20 or 30 others experience acute or chronic morbidity, often with permanent sequelae that undermine their normal functioning (16). Incidence of maternal near miss range from 0.04% to 14.98 % (23).

Disparities in child survival exist across regions and countries: in sub-Saharan Africa, approximately 1 child in 13 dies before his or her fifth birthday, while in the world's high-income countries the ratio is 1 in 189. Among newborns in sub-Saharan Africa, about 1 child in 36 dies in the first month, while in the world's high-income countries the ratio is 1 in 333.If current trends continue with more than 50 countries falling short of the Sustainable Development Goal (SDG) target on child survival, some 60 million children under age 5 will

die between 2017 and 2030 – and half of them will be newborns. Among newborns in sub-Saharan Africa, about 1 child in 36 dies in the first month, while in the world's high-income countries the ratio is 1 in 333.If current trends continue with more than 50 countries falling short of the Sustainable Development Goal (SDG) target on child survival, some 60 million children under age 5 will die between 2017 and 2030 – and half of them will be newborns (12). Ethiopia is still one of the sub-Saharan Africa countries with the highest rate of maternal and neonatal mortality. According to Ethiopia Demographic Health Survey there is 412 per 100,000 live birth maternal mortality and 29 per 1000 neonatal mortality (7).

2.2. Importance of Investigating Maternal Near miss

Due to the success of modern medicine, maternal deaths are fewer in number but there are innumerable "near miss" events which have the potential to teach us lessons. In any setting, women who develop severe acute complications during pregnancy share many pathological and circumstantial factors. While some of these women die, a proportion of them narrowly escape death. By evaluating these cases with severe maternal outcomes (both "near-miss" cases and maternal deaths), much can be learnt about the processes in place (or lack of them) for the care of pregnant women and her baby (3). There are several advantages of investigating near miss cases including cases are more common than maternal deaths, provide useful information on the same pathways that leads to morbidity and death, less threatening for service providers as women has survived, women can be interviewed and as a result more realistic analysis of gaps can be done. Investigating the instances of severe morbidity may be less threatening to providers because the woman survived. One can learn from the women themselves since they survived and are available for interview about the care they received, all near misses should be interpreted as free lessons and opportunities to improve the quality of service provision (10).

The main advantages are the higher number of cases available, and that women are still alive and therefore able to provide information on relevant factors possibly associated with complications or with any delay in appropriate care (9). Near-miss cases occur more frequently than maternal deaths, their review can directly inform on both strengths and weakness in the process of care, and it is usually perceived by staff as easier to perform than mortality audits. Researchers should aim at generating more evidence on how to effectively

implement the NMCR cycle, how to improve its impact on newborn outcomes (24). For every woman who dies of pregnancy complications, about 20 more roughly 7 million women annually experience injury, infection, disease, or disability (25).

Relying solely on maternal mortality to assess a country's status in the area of maternal health overlooks the importance of maternal morbidity, which is not only a precursor to maternal mortality but also a potential cause of lifetime disability and poor quality of life (16).The review that captures the experiences of those pregnant women who suffered complications during pregnancy but survived a major fatality due to timely intervention provides a lot of learning opportunities, which is available more easily due to the availability of the mother as well as the willingness of health professionals who are eager to share their 'success' stories. Thus investigating severe maternal morbidity (near-miss) helps to identify women at highest risk of maternal death and helps allocate resources especially in the area where it is needed most. Moreover, the mother who interacted with the system was available to share her experience (10).

Different studies revealed conflicting finding on the cause and determinants of maternal near miss. The study done in multiple site of Brazil find as hemorrhage, hypertension, , clinical/surgical infection and having more than one child were common cause of maternal near miss while smoking, low weight and neurologic disease did not related with maternal near miss (26).

Another study which done in the same country by Madero and his colleagues suggest that current cesarean section delivery, length of hospital stay and neonate APGAR score less than seven were significant determinants of maternal near miss while having more than four children and previous cesarean section has no effect on occurrence of maternal near miss (23).

Other study conducted by Azize and colleagues found as hypertensive disorders were the most common (2.7%), cause of maternal morbidity followed by other complications/diseases (2.5%), hemorrhagic disorders (1.1%), and infective disorders (0.6%). In terms of maternal cause Pre eclamptic toxemia of the neonate mothers estimated as a higher range 31%, followed by 25.0% antipartum hemorrhage, 22.6% with Diabetes Mellitus and 21.4% were rupture uterus. There is a statistically significant relationship between Mode of delivery and maternal cause of neonatal mortality ($p<0.005$) (27) .

One study which was conducted in South Africa reveals in addition to unexplained intrauterine deaths, intrapartum asphyxia, hypertensive disorder and spontaneous preterm labour remain the most common obstetric causes of death which mostly related with poor maternal health (28). According to study conducted in Ethiopia common cause of maternal near miss were extent of ANC follow up, anemia, hypertension, educational level, marital status, income, number of child mother and early marriage. This study also suggest delivery through cesarean section and FGM has nothing to do with maternal near miss (29). The underlying cause for the majority of maternal near-miss cases was hypertensive disorder (53%), followed by obstetric hemorrhage (38%), pregnancy with abortive outcome (4%), and pregnancy-related infections (1%). The major contributing causes of maternal near-miss reported were anemia (40%) followed by prolonged/obstructed labor (9%). Around 37% of maternal near-miss cases did not show any form of contributing causes (15).

Children face the highest risk of dying in their first month of life, at a rate of 19 deaths per1,000 live births (12). The risk of death from each cause is higher in high-mortality settings, even for causes that dominate proportionally in low-mortality settings. The risks of death due to preterm birth, intrapartum complications, and sepsis are 10, 36, and 34 times greater, respectively, in settings with more than 30 neonatal deaths per 1000 live births compared to settings with less than 5 neonatal deaths per 1000 live births (30).
The majority of the neonatal deaths are concentrated in the first day and week, with about 1 million dying on the first day and close to one million dying within the next six days. Reducing neonatal mortality is increasingly important not only because the proportions of under-five deaths that occur during the neonatal period is increasing as under-five mortality declines but also because the health interventions needed to address the major causes of neonatal deaths generally differ from those needed to address other under-five deaths (31).

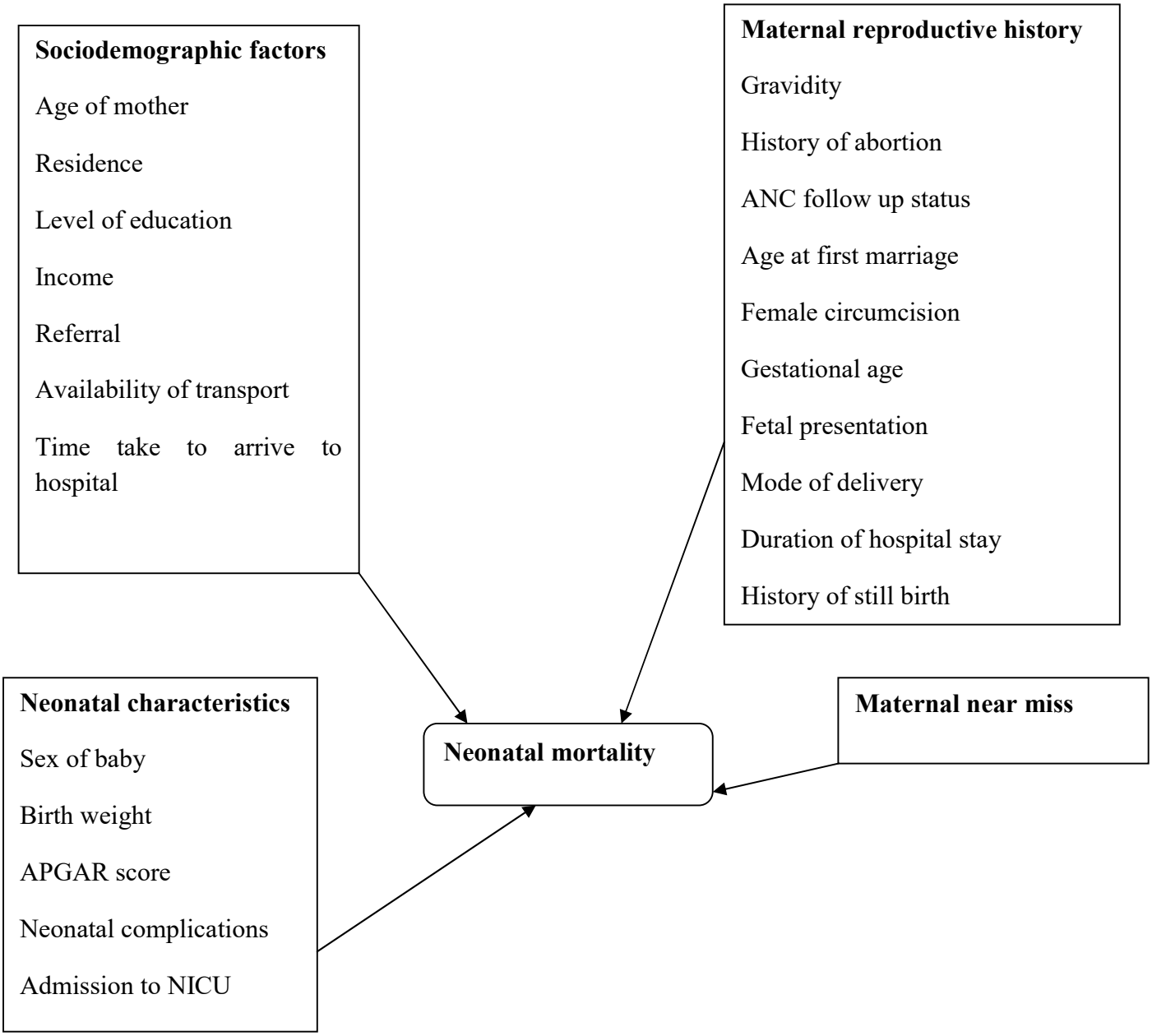
MNM's harmful consequences are numerous, including separating mothers and newborns, interfering with bonding, lengthy hospital stays and health care costs, and emotional distress. MNM is increasingly used as an indicator of the quality of obstetric care and clinical practice (32). The World Health Organization’s recent survey on maternal deaths and near-miss cases reported an increased risk of perinatal mortality in the presence of maternal complications

such as placental abruption, uterine rupture, systemic infections and sepsis, preeclampsia/eclampsia, postpartum hemorrhage, and severe anemia (18).

Common cause of still birth and neonatal death is uterine rupture and abnormally invasive placenta (33). Comparatively, the early neonatal mortality group had a higher prevalence of mothers who were <20 years of age, without partners, with education of ≤9 years, with a history of more than one caesarean section, male gender, non-cephalic presentation, no labour, and delivery by caesarean section. Both late fetal and early neonatal deaths had a higher prevalence of low birth weight and preterm birth, and 72.9% of live born neonates that died were admitted to a neonatal intensive care unit (NICU). Of early neonatal deaths, 67.1% had occurred by day 3 of life, and nearly 33% occurred on the first day (18).

Information regarding causes of neonatal death, particularly in the first week of life when three-quarters of neonatal deaths occur, is fundamental for developing public health strategies (34). In order to do so, the right kind of information is needed upon which to base actions (13). Therefore, the time of childbirth and the period immediately after birth are particularly critical for maternal, fetal and neonatal survival and well-being. Effective care to prevent and manage complications during this critical period is likely to have a significant impact on reducing maternal deaths, stillbirths and early neonatal death a triple return on investment. Within this critical period, quality of care improvement efforts would target essential maternal and newborn care and additional care for management of complications that could achieve the highest impact on maternal, fetal and newborn survival and well-being (35). Therefore maternal near miss is the most important area to look for maternal and child health. It is crucial indicator to monitor quality of care and barriers for health service utilization. Hence this study was conducted to assess effect of maternal near miss on neonatal mortality.

2.3. Conceptual framework of the study



Research question

What are the common causes of maternal near miss among women in bale Zone Southeast Ethiopia?

What are risk factors for the occurrence of neonatal mortality among women selected for the study?

3. OBJECTIVES OF THE STUDY

3.1. General Objective

The objective of this study was to assess effect of maternal near miss on neonatal mortality in Bale Zone; South East Ethiopia

3.2 Specific Objectives

1. To identify common complication leading to maternal near miss in Bale Zone; South East Ethiopia
2. To identify effect of maternal near miss on neonatal mortality in bale zone; south east Ethiopia

4. METHODS

4.1. Study area

Bale zone is located in Oromia Regional State about 400 km to the Southeast of the capital, Addis Ababa. It has all three climate zone; means: lowland (kola), midland (woinadega) and highland (dega). According to Census 2007 the population of the zone is 1,402,492 million. From this population 688,975 were female of whom around 300,000 were reproductive age groups who gave birth to 55,306 babies in the last 12 month of the census. There are 5 hospital, 89 health center and 323 health post in the zone. All these facility were working to improve the health of community by providing antenatal care, immunization service, basic obstetrics care, emergency obstetric care and postnatal care.

4.2. Study design and period

Prospective cohort study in which women come for delivery service were classified as exposed (near miss) and non exposed (non near miss) and followed to assess effect of near miss neonatal mortality was conducted among women utilizing obstetrics service in selected hospitals from February 1 to May 30 2019.

4.3. Population

4.3.1. Source population

All women receiving obstetrics care from governmental health facilities in Bale zone, southeast Ethiopia.

4.3.2. Study population

Women who came for obstetrics service to selected hospitals during the study period.

4.3.2.1. Inclusion criteria

Women who came to selected hospital for delivery service and fulfill one of modified near miss criteria according to Delphi international study and those without near miss and selected randomly as non exposed group were included in the study. Modified near miss criteria according to Delphi international study comprise twenty six criteria which subdivided in to three categories; clinical, laboratory and management based. The detail of it is in the annex 1..

4.3.2.2. Exclusion criteria

Women who came for other service other than delivery like;

- Abortion care
- Women who develop life threatening condition not related with delivery.
- Those who come from no phone network area will be excluded.

Exposed were mothers who came for delivery service to the selected hospital and fulfill diagnosis maternal near miss according to modified WHO maternal near miss criteria for Sub Saharan Africa and other developing region. Non exposed were women who come for delivery service to the selected hospital and with no near miss diagnosis.

4.4. Sample size calculation and sampling procedure

4.4.1. Sample size calculation

Sample size was calculated using Statcalc of Epi info version 7.2.2.2 by taking proportion of early neonatal death among mother with eclampsia 8.61% and in mother without eclampsia 1.38% and odds ratio of 6.58 which was taken from study multicounty study conducted by Abalous and his colleagues assuming 80% power, 95% confidence and ratio of exposed to non exposed 2 and loss to follow up 10% which give the final sample size 384 of whom 128 were exposed (near miss) and 256 were non exposed (non near miss) participants respectively (17).

Sample size was calculated by applying formula for two population proportion for hypothesis testing.

$$n_1 = \frac{[z_{\alpha/2}\sqrt{1+1/r(pq)} + z_{\beta}\sqrt{p1q1+p2q2/r)}]^2}{(p_1-p_o)^2}$$

Where r is the allocation ratio of group 2 to group 1, i.e., n2:n1 (n2 = r*n1)

P_1 is proportion of neonatal mortality among eclamptic mother

P_2 is proportion of neonatal mortality among non eclamptic mother

Zα/2 is the quintile of the standard normal distribution for type I error

Zβ is the quintile of the standard normal distribution for type II error/power

n_1 is the sample size for near miss group

n_2 is the sample size for non near miss group

Table 1 sample size calculation for respective objectives

No-	Objectives	Assumption for sample size calculation	Final sample size	Reference
1	To identify common complication leading to maternal near miss	Incidence of severe post partum haemorrhage (p) 10.5% , precision 5% design effect 1 and loss to follow up 10%	160 participant	(36)

2	To assess effect of maternal near miss on neonatal mortality	Incidence (proportion) of early neonatal death among mother with eclampsia 8.61% and in mother without eclampsia 1.38 % and odds ratio of 6.58 assuming 80% power, 95% confidence and ratio of exposed to non exposed 2 and loss to follow up 10%	384 participant	(17)

4.4.2. Sampling procedure

Two hospitals were selected purposely based on the average number of delivery and neonatal mortality they have in the last six month. Sample sizes were allocated to the selected hospitals proportionally. Then every mother come with severe maternal complication (near miss) according to modified WHO criteria for sub Saharan Africa and other developing country were included. Then for every selected near miss mother two non near miss mothers (randomly if there are more than two) by matching on the day and place of delivery were selected in each health facility separately.

4.5. Variables

Dependent/outcome variables: Time of occurrence of neonatal mortality

Exposure variable: Maternal near miss

Covariates: Maternal sociodemographic characteristics like residence, history of genital cutting, previous medical, surgical, gynecological and obstetric history.

4.6. Operational definition

Event: The occurrence of death for live born neonate from date of birth up to 28 days of after birth

Censor: loss to follow up of the mother (care giver) before occurrences of neonatal mortality and alive neonate at the end of the 28 days follows up period

Gestational age classification: is age of neonate in completed weeks starting from last normal menstrual period or from physical examination or from ultrasound examination. Subcategories include post term (>= 42 weeks), term (37 to 42 weeks), preterm (34 to 37 weeks) and extremely preterm (28 to 34 weeks).

4.7. Measurement of variable

Gestational Age: was measured from last normal menstrual period (if mother remember LNMP) or from ultrasound examination if she has; as well as from mother recall and by measuring fundal height.

Birth weight: neonatal birth weight was measured using electronic weight scale after removing thick cloth and will be recorded by rounding to the last 1 gram of the measurement.

Time of neonatal mortality: was measured by close follow up during hospital stay and using phone call follow up by asking family members or close relatives after discharge from hospital and recording the exact days of occurrence.

4.8. Data collection and quality control

Data was collected using structured questionnaires and checklist. The questionnaire was adopted from Delphi international study for modification of WHO near miss criteria for Sub Saharan Africa and other developing region. Maternal sociodemographic, reproductive history and neonatal outcome after delivery were measured using tools adopted from EDHS and previous articles. The questionnaire was prepared in English and translated into Afan Oromo. Then, Afan Oromo version questionnaire was translated back to English to check for consistency. Before the actual data collection questionnaires was pretested on 5% of total sample size subjects who were not included in the study before actual data collection. Data was collected by two non provider nurses (those who don't work in selected hospitals). Two

days training was given to data collector on objectives, relevance of the study, confidentiality, respondent right, and informed consent. They were trained on how to collect data using developed tool in hospital not selected for study. Then data about sociodemographic, and maternal reproductive history was collected using interview with patient or relative. Other like diagnosis and management provided were retrieved from card. Data was checked by data collector for completeness every time before leaving the respondent and their card. During data collection data collector gave clarification on difficulty of understanding question for every respondent.

Consistency and Completeness of data were also checked by principal investigator twice per week. Phone follow up was done for all selected women to check neonatal outcome after discharge from the hospital. Then after data collection, filled questionnaire were kept carefully.

4.9. Data processing and analysis

Data was checked for completeness and entered to epidata version 3.1 and exported to Stata version 14.0 for analysis. Data cleaning was done using frequency distribution and descriptive statistics. Frequency distribution was also done for socio demographic (general maternal characteristics), maternal reproductive medical and surgical history as well as for neonatal outcome for both near miss and non near miss group. Bar chart was done to compare common complication leading to maternal near miss. Life table for neonatal mortality from mothers with maternal near miss and without maternal near miss was done separately. Survival analysis using Cox regression (to look effect of different independent variable on neonatal outcome) was done. Assumption for Cox regression was checked graphically, using goodness of fit and by including time varying variable in the model.

Crude hazard ratio with 95% confidence interval was calculated by including each independent variable and outcome (neonatal outcome whether dead or alive) only. Then variable with p value greater or equal with 0.25 in bivariate analysis were included in final multivariable analysis. Then adjusted hazard ratio with 95% confidence interval were calculated by including other variables from general maternal characteristics, previous obstetrics and gynecology and medical and surgical history as well as neonatal cause of mortality.

4.10 Ethical Consideration

Ethical clearance was obtained from Institutional Review Board of College of Health Sciences, Addis Ababa University and formal letter was written from School of Public Health to Bale zone Health Bureau. Zonal Health Bureau in turn wrote formal letter to selected hospitals. Supportive letters were written from selected hospital to data collection site (ward). Verbal consent was obtained from the respondents after explanation of the objective, benefit and risk of the study. Only those who volunteered were included in the study. Every eligible participant has equal chance of participating in the study. Data collectors were trained to be part of those who provide help for mothers. No harm imposed on study participant and they were interviewed after they were stable. The result of their response was used only for this study. Confidentiality was assured through avoiding personal information and coding of questionnaires.

5. RESULTS

5.1. General characteristics

There were 1677 women who gave birth in these two selected hospital during three month of data collection period. Out of these 384 pregnant women were sampled and 30 questionnaires were excluded because of loss to follow up. Complete responses were obtained from a total of 354 respondents yielding a response rate of 92.2%. Power of the study which was calculated by taking rate of neonatal mortality in near miss and health mother was 99.3 %.

The respondents general characteristics such as; age, religion, ethnic group, educational status, occupation and monthly household income are described in table 5.1. . The mean age of them was 25.3 years with standard deviation of 5.65 years ranging from 16 to 45 years. From these respondents 186 (52.5%) were rural residents. And all most all of them (98.9%) were married women. Of these 354 women participated in this study 252 (71.2%) were Muslim and 317 (89.5%) were Oromo.

Based on educational status 196 (55.4) were learned up to elementary followed by 78 (22%) illiterate and 313 (88.4%) were house wife. 148 (41.2%) of them were referred from other health facility 146 from public health sector. Referring health facility provides transportation for 116 (32.8%) of these women. The mean time taken by these pregnant women to arrive these selected hospitals was 61 minutes ranging from 15 to 180 minutes.

Table 2 general characteristics of study participants from Goba and Ginnir hospital, 2019

General characteristics	Both group Number (354)	Health mother (236)	Near miss mother (118)
Age in years			
Mean	25.29	24.87	26.14
SD	5.65	5.53	5.8
Minimum	16	16	16
Maximum	45	45	42
Residence			
Rural	186(52.5%)	108(45.8%)	78(68.1%)
Urban	168(47.5%)	128(54.2%)	40(33.9%)

Marital status			
Single	2(0.6%)	0(0%)	2(1.7%)
Married	350(98.9%)	236(100%)	114(96.6%)
Divorced	2(0.6%)	0(0%)	2(1.7%)
Religion			
Orthodox	101(28.5%)	79(33.5%)	22(18.6%)
Muslim	252(71.2%)	156(66.1%)	98(81.4%)
Other	1(0.3%)	1(0.4%)	0(0.00%)
Ethnicity			
Oromo	317(89.5%)	205(86.9%)	112(94.9%)
Amhara	36(36%)	30(12.7%)	6(5.1%)
Other	1(0.3)	1(0.4%)	
Level of education			
illiterate	78(22%)	31(13.1%)	47(39.8%)
elementary	190(55.4%)	142(60.2%)	54(45.8%)
high school and preparatory	60(16.9%)	47(19.9%)	13(11%)
higher education	20(5.6%)	16(6.8%)	4(3.4%)
Occupation			
Merchant	7(2%)	6(2.5%)	1(0.8%)
Government employee	18(5.1%)	14(5.9%)	4(3.4%)
Private employee	10(2.8%)	8(3.4%)	2(1.7%)
Student	4(1.1%)	3(1.3%)	1(0.8%)
House wife	313(88.4%)	204(86.4%)	109(92.4%)
Other	2(0.565%)	1(0.4%)	1(0.8%)
Income per month			
Median	1000	1500	900
Minimum	100	100	100
Maximum	10,000	10,000	6000
Referral from other health facility			
No	206(58.2%)	162(68.6%)	44(37.3%)
Yes	148(41.8%)	74(31.4%)	74(62.7%)
Types of health facility visited			
Public	146(41.2%)	73(30.9%)	73(61.9%)
Private	2(0.6%)	1(0.4%)	1(0.8%)
Availability of ambulance transport			
No	32(9%)	17(7.2%)	15(12.7%)
Yes	116(32.8%)	57(24.2%)	59(50%)

Time take to arrive the hospital			
Median	60	30	90
Minimum	15	15	15
Maximum	180	180	180

5.2. Maternal reproductive history

In this sub section maternal reproductive history such as number of pregnancy, history of abortion, ANC and age at first marriage were considered. As shown in the table 5.2 the average number of pregnancy was 3.07 times with standard deviation of 2.38 ranging from 1 to 12 times and mean number of birth was 2.83 with standard deviation of 2.23. Of the birth they gave they have 2.7 alive children.

Of all 55 (15.5%) of them have previous history of abortion and 333(94.1%) have ANC follow up. The mean age at first marriage these women is 18.44 years (standard deviation 2.3years) and 12 (3.4%) of them have previous history of cesarean delivery. Majority of (323 (91.2%) have had female genital cutting. The median gestational age was 38 weeks with interquartile range of 2 weeks. The maximum length of hospital stay was 10 days. From all respondents 44 (12.4%) of respondents were admitted to ICU in the current delivery and 22 (6.2%) have history of past delivery of still birth.

Table 3 Maternal reproductive history of respondents, 2019

History	Both group N (%)	Health mother N (%)	Near miss mother N (%)
Gravidity			
Mean	3.07	2.92	3.37
SD	2.4	2.13	2.75
Minimum	1	1	1
Maximum	12	12	11
Parity			
Mean	2.83	2.72	3.05
SD	2.23	2.01	2.62
Minimum	0	1	0
Maximum	12	12	11
Number of alive children			
Mean	2.47	2.61	2.89
SD	2.22	2.03	2.55
Minimum	0	0	0
Maximum	11	11	10

History of abortion			
No	299(84.5%)	199(84.3%)	100(84.7%)
Yes	55(15.5%)	37(15.7%)	18(15.3%)
ANC follow up			
No	21(5.9%)	4(1.7%)	17(14.4%)
Yes	333(94.1%)	232(98.3%)	101(85.6%)
Age at first marriage			
Mean	18.44	18.36	18.58
SD	2.3	2.25	2.4
Minimum	15	15	15
Maximum	36	36	28
History of cesarean delivery			
No	342(96.6%)	234(99.2%)	108(91.5%)
Yes	12(3.4%)	2(0.8%)	10(8.5%)
FGM			
No	31(8.8%)	22(9.3%)	9(7.6%)
Yes	323(91.2%)	214(90.7%)	109(92.4%)
Gestational age			
28-34 weeks	9(2.5%)	5(2.1%)	4(3.4%)
34-37 weeks	94(26.6%)	63(26.7%)	31(26.3%)
37 -42weeks	250(70.6%)	167(70.8%)	83(70.3%)
>42 weeks	1(0.3%)	1(0.4%)	0(0.00%)
Fetal presentation			
Cephalic	338(95.5%)	231(97.9%)	107(90.7%)
Non cephalic	16(4.5%)	5(2.1%)	11(9.3%)
Mode of delivery of current baby			
SVD	311(87.9%)	222(94.1%)	89(75.4%)
Instrumental	11(3.1%)	7(3%)	4(3.4%)
C/S	32(9%)	7(3%)	25(21.2%)
Duration of hospital stay			
Mean	2.07	1.01	4.01
SD	1.7	0.436	1.64
Minimum	1	1	1
Maximum	10	4	10
Admission to ICU			
No	310(87.6%)	236(100%)	74(62.7%)
Yes	44(12.4%)	0(0.00%)	44(37.3%)
History of medical illness			
No	352(99.4%)	236(100%)	116(98.3%)
Yes	2(0.6%)	0(0.00%)	2(1.7%)
Surgical history			
No	352(99.4%)	235(99.6%)	117(99.2%)

Yes	2(0.6%)	1(0.4%)	1(0.8%)
History of still birth			
No	332(93.8%)	15(6.4%)	7(5.9%)
Yes	22(6.2%)	221(93.6%)	111(94.1%)

5.3. Neonatal characteristics

As shown in the table below 354 women gave birth to 313(88.4%) normal singleton live birth and 31(8.8%) still birth. More than half 186(52.5%) of neonates were female. There were 290 (81.9%) neonate in the normal birth weight while 53 (15%) low birth weight while the rest 11 (3.1%) have large birth weight.

From total birth 27(7.6%) of live birth neonate born with complication of whom 18(5.1%) were admitted to neonatal intensive care unit (NICU). Of those 18 neonates admitted to NICU 11 of them were cured while 7 of them were dead. From the total live birth there were 17 (48 per 1000 live birth) neonatal death at the end of the study in 8739 person day stayed. Six of these occurred in the first day.

No neonatal mortality occurred after ten days. This gives rate of neonatal mortality 119 deaths per 1000 live birth among mothers with near miss and 13 deaths per 1000 live birth.

Table 4 Neonatal characteristics (absolute and relative frequency)

Characteristics	**Both group N (%) 354 (100%)**	**Health mother N (%) 236 (66.7%)**	**near miss mother N(%) 118(33.3%)**
Neonatal condition after birth			
Normal singleton live birth	313(88.4%)	226(95.8%)	87(73.7%)
Still birth	31(8.8%)	7(3%)	24(20.3%)
Congenital anomaly	1(0.3%)	0(0.00%)	1(0.6%)
Twin	9(2.5%)	3(1.3)	6(5.1%)
Sex of the baby			
Female	186(52.55)	114(48.3%)	72(61%)
Male	168(47.5%)	122(51.7%)	46(39%)

Birth weight			
>4000gram	11(31%)	6(2.5%)	5(4.2%)
2500 -4000 gram	290(81.9%)	205(86.9%)	85(72%)
1500-2500gram	46(13%)	24(10.2%)	22(18.6%)
1000-1500gram	5(1.4%)	1(0.4%)	4(3.4%)
<1000gram	2(0.6%)	0(0.00%)	2(1.7%)
5 minute APGAR score			
>=7	266(75.1%)	27(11.4%)	61(51.7%)
<7	88(24.9%)	209(89.6%)	57(48.3%)
Neonatal complication			
No	295(83.3%)	217(91.9%)	78(66.1%)
Yes	27(7.6%)	12(5.1%)	15(12.7%)
Types of neonatal complication			
Asphyxia	19(5.4%)	9(3.8%)	10(8.5%)
Meconium aspiration	4(1.1%)	1(0.4%)	3(2.5%)
Early neonatal sepsis	5(1.4%)	2(0.8%)	3(2.5%)
Prematurity	3(0.8%)	2(0.8%)	1(0.8%)
Neonatal admission to NICU			
No	9(2.5%)	3(1.3%)	6(5.1%)
Yes	18(5.1%)	9(3.8%)	9(7.6%)
Outcome of neonate after NICU admission			
Cured	11(3.1%)	8(3.4%)	3(2.5%)
Dead	7(2.0%)	1(0.4%)	6(5.1%)
Neonatal condition at the end of follow up			
0. alive	306(86.4%)	226(95.8%)	80(67.8%)
1. Dead	17(4.8%)	3(1.3%)	14(11.9%)
Total duration in the study in days (person time)			
Minimum	1	1	1
Maximum	28	28	28
Sum of person time	8739	6377	2362

5.4. Common complication lading to maternal near miss

Near miss was classified using parameter categorized into three sub categories; severe life threatening condition, laboratory and management based. Of 118 near miss mother 76 , 28 and 1 were diagnosed using severe life threatening condition, management based and laboratory based criteria respectively. And from the rest 13 cases 12 were classified by both

severe life threatening condition and management based parameter. Only one case was counted by severe life threatening condition and laboratory based parameter.

Table 5 parameters used to classify maternal near miss status

No-	Categories of parameter	Frequency	Relative frequency
1	Severe/life threatening condition	76	64.4
2	Laboratory based	1	0.85
3	Management based	28	23.7
4	Life threatening and management based	12	10.2
5	Life threatening and laboratory based	1	0.85
6	**Total**	**118**	**100**

As shown in the table 6 below severe preeclampsia with ICU admission was common complication leading to maternal near miss (occur in 42 women) followed by severe anemia with transfusion of greater than 2 units of blood among 33 of women included in the study. Eclampsia ranked third while sepsis/systematic infection ranked fourth. Bar graph in figure 5.1 also shows the same finding.

Table 6 Complication leading to maternal near miss

No-	Complication leading to maternal near miss	Frequency	Rank
1	Preeclampsia with ICU admission	42	1
2	Severe anemia with transfusion of > 2 units of blood	33	2
3	Eclampsia	26	3
4	Sepsis/Systematic infection	12	4
5	Uterine Rupture	6	5
6	Shock	2	6

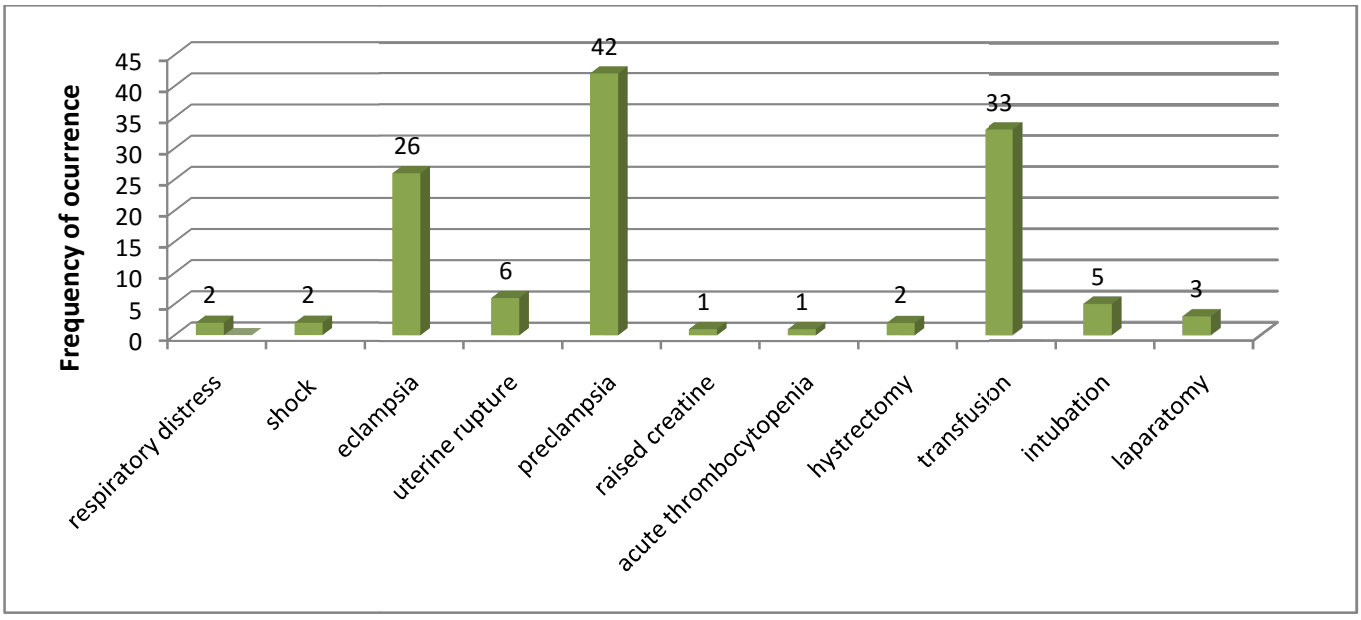


Figure 1 common complication leading to maternal near miss in study participants

5.5. Life table

As shown in the table 7 below 323 women were at risk at the beginning of the study participants. At the end of the study 17 baby of these women were dead.

Table 7 Life table for observed cumulative survival of neonates among study participants

Interval Start Time	Number Entering Interval	Number Withdrawing during Interval	Number Exposed to Risk	Number of Terminal Events	Proportion Terminating	Proportion Surviving	Cumulative Proportion Surviving at End of Interval
0	323	0	323.	6	.02	.98	.98
3	317	1	316.5	3	.01	.99	.97
6	313	0	313	6	.02	.98	.95
9	307	0	307	2	.01	.99	.95
12	305	0	305	0	.00	1.00	.95
15	305	0	305	0	.00	1.00	.95
18	305	0	305	0	.00	1.00	.95
21	305	0	305	0	.00	1.00	.95
24	305	1	304.5	0	.00	1.00	.95
27	304	304	152	0	.00	1.00	.95

As shown in the figure 2 below neonatal mortality occur sharply from day one to third post natal day. Then it continues to occur from third day up to 10 post natal days in steady fashion. After 12 days no neonate died until the end for the follow up in these women.

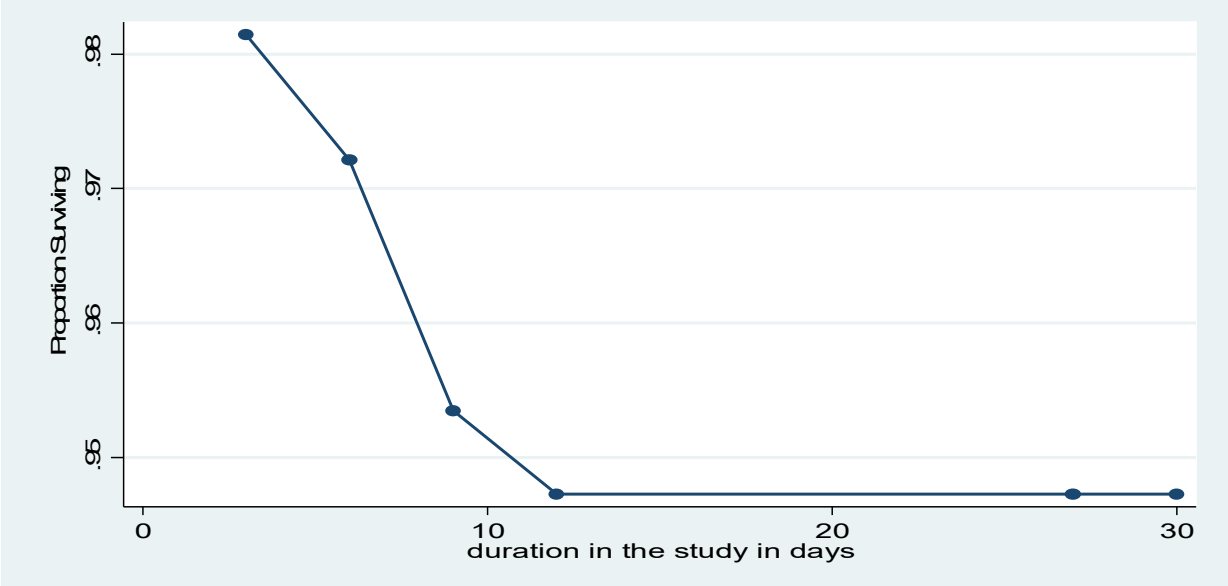


Figure 2: Survival curve of observed survival of neonates

As shown in the figure 3 below neonatal mortality occurs in steady fashion among non near miss mothers. But among near miss mothers neonates death occur rapidly in first 10 days of post natal days. Then after there no neonates die.

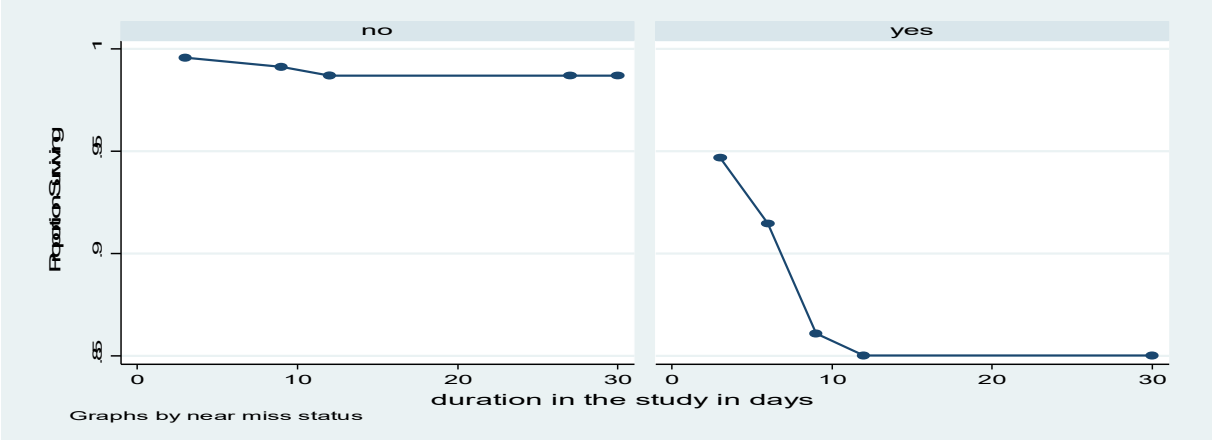


Figure 3 Graph for observed survival of study participants for non near miss and near miss mothers separately

5.6. Comparison of neonatal survival experience in study participants

Table 8 Log Rank comparison of neonatal survival experience in study participants

Overall Comparisons			
	Chi-Square	Df	Sig.
Log Rank (Mantel-Cox)	25.531	1	.000

There is a significant difference on survival experience between neonates born to mother with near miss and mother without near miss (log-rank test chi square 25.531 which is significant at p value less than (0.000).

5.7 Effects of maternal near miss on neonatal mortality

5.7.1 Checking assumptions of Cox regression

Graphical method of testing assumption

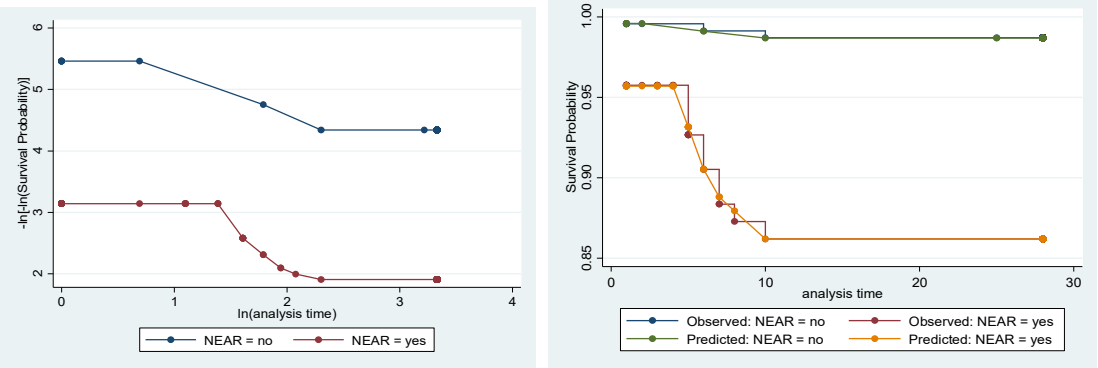


Figure 4 –ln (-ln) graph and observed versus predicted survival graph

The finding from - *ln (-ln)* show **parallel line** for near miss and non near miss mothers which indicate assumption for Cox regression (assumption of proportional hazard) is fulfilled. Also *observed versus predicted survival time graph* shows the line which is close together for both group which suggest assumption for Cox regression is fulfilled

Table 9 Test of proportional hazard assumption using Goodness of fit test

Test	Chi square	Degree of freedom	P value
Global test	0.12	1	0.7319

Goodness of fit test for Cox regression assumption (assumption of proportional hazard) suggest assumption for Cox regression was fulfilled because its p value is greater than 0.1(0.7319).

Table 10 Breslow method for checking time varying variables

Variables	Haz. Ratio	SE	Z	p/z/
Main Near miss	16.56	21.985	2.11	0.034
tvc near miss	0.929	0.1969	0.34	0.730

The result from considering near miss status as time dependent variable is **not significant** which suggests that the assumption of proportional hazard is fulfilled

5.7. 2. Bivariate Cox Regression

The following table show list of 8 variables which are important to be included in multivariable analysis (variables with P- value <= 0.2) in bivariate analysis. Of these 2 variables were from general characteristics of respondent, 3 from maternal reproductive history and two from neonatal condition.

Table 11 list of variables found important in bivariate analysis

Neonatal outcome status				
Alive	**Dead**	**CHR with 95%CI**	**P- value**	
Income per month	1834 ETB	765ETB	**0.998(0.997,0.999)****	**0.001**
Time travelled	55.6 minutes	84.7 minutes	**1.009(1.001,1.017)****	**0.025**
ANC follow up Yes No	 296(91.6%) 10(3.09%)	 13(4.02%) 4(1.24%)	 1 **5.987 (1.946, 18.415)****	 **0.001**
Fetal presentation Cephalic Non cephalic	 296(91.6%) 10(3.09%)	 13(4.02%) 4(1.24%)	 1 **7.045(2.295, 21.623)***	 **0.001**

Duration of hospital stay	2 days	3.41 days	**1.367(1.135, 1.647)****	**0.001**
Near miss status				**0.000**
No	226(69.9%)	3(0.93%)	1	
Yes	80(24.75%)	14(4.33%)	**11.276(3.324, 39.305)****	
weight (in grams)	3172.8	2629.4	**0.9987(0.998, 0.999)****	**0.000**
Five minute APGAR score	8.36	4.65	**0.676(0.590, 0.776)****	**0.000**

5.8. Multivariable Cox Regression

Multivariable Cox Regression was done by including variable found to be important in bivariate analysis. There were 17 neonatal death (event) happen and 305 censor in total study participants during total 8725 person days. Total of 322 cases were available for the analysis.

Table 12 Case Processing Summary of from multivariable analysis

		N	Percent
Cases available in analysis	Event	17	4.8%
	Censored	305	86.2%
	Total	322	91.0%
Cases dropped	Cases with missing values	32	9.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	0	0.0%
	Total	32	9.0%
Total		354	100.0%

As shown in the table below omnibus test for model adequacy is significant which suggests as the model fits the data. Hence we can rely up on this model to predict effects of these variables on the neonatal mortality.

Table 13 Omnibus Tests of Model Coefficients

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	Df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
118.109	157.949	8	.000	77.515	8	.000	77.515	8	.000

Collinearity between continuous variables was checked using option from linear regression. Hence there is no multicolinearity between four continuous variable included in he final analysis (income,, time travelled, five minute APGAR score and birth weight). The results from multivariable Cox regressions demonstrate the variables that are important in predicting neonatal survival. Eight variables were included in multivariable analysis after selection was done based on the finding from bivariate Cox regression. As shown in the table 13 below four variables were found to significant factors on the survival of neonates. These are one of (household monthly income) them from general characteristics, two (fetal presentation and near miss status) from maternal reproductive history, one (five minutes APGAR) from neonatal characteristics from neonatal characteristics and near miss status of the mother. And the rest four variables, time taken to arrive to the selected hospital, ANC follow up status, duration of hospital stays and birth weight failed to be statistically significant in multiple logistic regression model.

There is strong predictive ability of monthly household income on neonatal survival status.. In other term, participants with low monthly income experience more neonatal mortality when compared with those with relatively high income. As monthly household income increase by one Ethiopian birr the risk of neonatal mortality decrease by 0.002 [(AHR 0.998, 95% CI;(0.997, 0.999; with P value of 0.032)] after controlling for the effect of other variables.

The study also found fetal presentation as important predictor variable for neonatal mortality. The rate ratio of neonatal death was 4.5 times for non cephalic presentation than for cephalic presentation after controlling for the effect of other seven variables in the model [(AHR 4.483, 95% CI (1.848, 22.734; with P value of 0.004)].

The other variable from neonatal characteristics that has significant effect on the survival of neonatal mortality is five minutes APGAR score. As five minutes APGAR score increase by one score risk of neonatal mortality decrease by 0.2 [(AH 0.746, 95% CI (0.620, 0.898; with P value of 0.002)] after controlling for the effect of other variables in the model.

More over this study also reveals maternal near miss status as statistically significant predictor for the occurrence of neonatal mortality. The risk of neonatal death before 28 days of their birth was 8.406 times for mother with severe morbidity than for mother with no maternal near miss after controlling for the effect of other variables [(AHR 8.406, 95% CI (1.636, 43.116; with P value of 0.001)]. Duration of hospital stay and time taken to arrive at the selected hospital, birth weight as well as status of ANC follow up show no significant effects on neonatal survival.

Table 14 variable included in the equation in Bivariate and Multivariable analysis

Neonatal outcome status					
Alive	**Dead**	**CHR with 95%CI**	**AHR with 95% CI**		**P – Value for AHR**
Income per month	1834 ETB	765ETB	**0.998(0.997,0.999)****	**0.998(0.996, 0.999)****	**0.032**
Time travelled	55.6 minutes	84.7 minutes	**1.009(1.001,1.017)****	0.994(0.984, 1.004)	0.282
ANC follow up					
Yes	296(91.6%)	13(4.02%)	1	1	
No	10(3.09%)	4(1.24%)	**5.987 (1.946, 18.415)****	1.225(0.356 ,4.214)	0.747
Fetal presentation					
Cephalic	296(91.6%)	13(4.02%)	1	1	
Non cephalic	10(3.09%)	4(1.24%)	**7.045(2.295, 21.623)***	**4.483(1.848, 22.734)****	**0.004**
Duration of hospital stay	2 days	3.41 days	**1.367(1.135, 1.647)****	0.731(0.516, 0.1.038)	0.080
Near miss status					
No	226(69.9%)	3(0.93%)	1	**1**	
Yes	80(24.75%)	14(4.33%)	**11.276(3.324, 39.305)****	**8.406(1.636, 43.116)****	**0.001**
weight (in grams)	3172.8	2629.4	**0.9987(0.998, 0.999)****	0.999(0.998, 1.001)	0.065
Five minute APGAR score	8.36	4.65	**0.676(0.590, 0.776)****	**0.746(0.620, 0.898)****	**0.002**

6. DISCUSSION

This study tried to show common complication leading to maternal near miss and effect of maternal near miss neonatal mortality. Variables from maternal general characteristics, current reproductive history and neonatal characteristics were studied to look for their effect on neonatal mortality. Effect of maternal near miss on neonatal mortality was also detailed by collecting hospital based data prospectively. It show high neonatal mortality ratio which is higher than national figures reported in EDHS 2016((7). Proportion of cesarean delivery is lower in this study when compared with findings of two studies from Kenya and Pakistan (37, 38). This might be because women in this area prefer to have spontaneous vaginal delivery.

Current still birth was also higher than what were found in other studies conducted in Ethiopia and Pakistan (38, 39). The reason for the difference might be in this study high proportions of mothers with severe maternal morbidities were included. It can be also due to difference in sociodemographic status of study participants. The finding from current study reveals severe pregnancy induced hypertension, severe anemia with transfusion of greater than two units of blood and sepsis as common causes of severe maternal morbidity (maternal near miss). This finding was supported by the results of others studies (18, 37, 40).

The study found monthly house hold income as significant factor which affect neonatal survival. This finding was in line with other multi country study conducted in 194 countries (30). This might be because house hold income level may determine early seeking of care during labour and influence access to health facility as soon as possible. For those with low income level preparing financial requirement is one of barrier in seeking early care.

Other variables which show significant effect on neonatal mortality in bivariate and which loss significance in multivariable analysis was time required to reach selected health facility. This finding is consistent with the study conducted in Indonesia on maternal characteristics and obstetrical complications impact neonatal outcomes (41).

ANC follow up status which shows statistically significant finding in bivariate analysis at 95 % confidence level loss its effect after inclusion of other variables in the model. This result is in agreement with the finding from study conducted Uganda and Pakistan (38, 42). But it is in conflict with other study which found ANC as significant factor on neonatal mortality (41).

This might be because only few (5.9%) women from participants in this study didn't have ANC follow up and hide effect of antenatal care follow up on neonatal survival. Fetal presentation was also found as one of factor affect neonatal \mortality in current study. This finding was the same with finding from multi country study conducted in 29 countries and other study conducted in Kenya (18, 43). This might be because malpresentation prolong duration of labour and increase likelihood of intrapartum complication on neonate.

This study found duration of hospital study as statistically non significant factors for survival of neonate. This finding is supported other study which found duration of hospital stay as statistically non significant factors for neonatal mortality (41). This might be due to more neonatal mortality occurs in the first day of delivery and mothers were excluded from contributing in the study.

The major finding of the study is that the presence of maternal near-miss is a risk factor for neonatal mortality independent of time taken to reach selected hospitals, monthly income, fetal presentation, birth weight and five minutes APGAR score. This study was consistent with other studies conducted by various author in different parts of the world (17, 18, 37, 38, 41-43). This might because severe maternal morbidity affects wellbeing of baby.

Neonatal birth weight was found as not statistically significant factors for neonatal mortality. This was not in line with the various studies finding (18, 33, 38, 40). This might be because of difference in sociodemographic characteristics as well as inclusion of other important variables in this study.

Five minutes APGAR score is the last variables found significant factor in determining neonatal survival. This agree with the finding of other studies (18, 33). This is because

neonates with low APGAR score might have underlining complications which affect its survival.

7. STRENGTH AND LIMITATION OF THE STUDY

Strength

The study used the modified WHO criteria for Sub Saharan Africa and other resource limited settings. Variety of neonatal outcomes which includes stillbirth, preterm birth, birth weight classification and admission to NICU were studied. Information on other confounding factors were also included. To see the effects of maternal near miss on neonatal mortality, the effect of other possible determinants of adverse neonatal mortality were controlled during analysis. Furthermore, adequate training was given to data collectors to reduce measurement bias.

Limitation

Self-reported information is subjected to reporting errors and biases. The study is solely quantitative and not supplemented by qualitative data. The study was conducted only in public hospitals hence; neonatal mortality in these two groups does not represent those deliver at private health facility. It may also relate to quality of care issues that this study doesn't investigate it.

8. CONCLUSION AND RECOMMENDATIONS

8.1. Conclusion

This study found different factors from general maternal characteristics, maternal reproductive status, near miss status and neonatal characteristics as factor important for determining neonatal survival. Neonatal survival was not only the result of maternal complication. General Sociodemographic and neonatal characteristics also have their share. Hence most of the factors were modifiable if efforts were done to improve socioeconomic status of community. The study found that women with maternal near miss have adverse neonatal outcome which require evidence based management to improve neonatal survival

8.2. Recommendation

To Zonal Health Bureau

- Train health professionals on early diagnosis of maternal near miss as this can save lfe of many neonates.
- Improving early referral procedures to facilitate quick managements of this problem.
- To create awareness in collaboration with public Medias about maternal near miss and its effect on mothers and her baby.

Health care provider

- Improving public and professional awareness on early detection and prompt treatment using feasible and effective ways.
- Inclusion of detailed patient characteristics, active follow up of mothers and neonatal outcome by telephone contact, and establishing a data base will be beneficiary for quality of care and treatment, and quality researches.

To researchers

- There is still the need for further studies on effects of maternal near miss on neonatal survival by incorporating other issues like quality of care and private health institution.
- Therefore, studies that can fill the limitations of this study will be more important by addressing the limitations of this study.

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ANNEXES

Annex 1. Modified who near miss criteria by Delphi study

MODIFIED NEAR MISS DIAGNOSIS CRITERIA	
Severe complication/life threatening condition criteria (clinical criteria)	0. Acute cyanosis 1. Gasping 2. Respiratory rate > 40 3. Shock 4. Oliguria non responsive to fluids or diuretics 5. Failure to form clot 6. Loss of consciousness lasting more than 12 hours 7. Cardiac arrest 8. Stroke 9. Uncontrollable fit/total paralysis 10. Jaundice in the presence of preeclampsia 11. Eclampsia 12. Uterine rupture 13. Sepsis or severe systemic infection 14. Pulmonary edema 15. Severe malaria 16. Severe pre-eclampsia with ICU admission
Laboratory based criteria	0. Oxygen saturation < 90% for > 60 min 1. Creatinine ≥ 300 µmol/l or ≥ 3.5 mg/dL 2. Acute thrombocytopenia (<50,000

	platelets/ml) 3. Loss of consciousness and ketoacids in urine
Management based criteria	0. Hysterectomy following infection or hemorrhage 1. Transfusion of ≥ 2 units of red blood cells 2. Intubation and ventilation for ≥ 60 min not related to anesthesia 3. Cardio-pulmonary resuscitation 4. laparotomy other than caesarean section

Annex 2. Consent form

Greeting

My name is----------I am _____(state profession). The main purpose of this study is to find effect of maternal near miss on neonatal mortality. I am inviting pregnant women who come for delivery service in this hospital.

So I would like to ask you some questions about issue related to severe maternal morbidity and will review your card. It would be helpful in identifying effect of maternal near miss on neonatal outcome. Your name will not be recorded. All information you give will be kept strictly with care and you have the right not to respond any question you don't want to.

Yes----------, No----------

Name and signature of the interviewer certifying that the informed consent has been verbally by respondents----------

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Addis Ababa University College of Health Science Ethical Review Committee

+251115157701 or +251115513099

Principal Investigator Name and address

Name: Ahmednur Adem

Telephone: 0924051855

Email address: ahmedhariro@gmail.com

Card number_____

Phone number_____

Annex 3. Questionnaires

This questionnaire is designed to assess effect of maternal near miss on neonatal mortality. All participants are kindly requested to give their response for all questions and permit review of their record. Your kind answer is of have great value to the outcome of the research and that all the answers and your identity are kept with confidentiality. If you need clarification you can communicate with the interviewer.

Thank you in advance!

INSTRUCTION: circle the code number given parallel to the answer you choose and for questions that you give direct answer, writes the answer in the space provided.

NO-	QUESTION AND FILTERS	CODING	SKIP
	GENERAL INFORMATION		
101	Date of admission	____/____/_____	
102	Date of discharge	____/_____/_____	
103	Types of discharge	0. By health worker 1. Self	
104	How old are you (in completed years)	_____years	
105	Where did you live? specify	0. Rural_____ 1. Urban_____	
106	What is your current marital status?	0. Single 1. Married 2. Divorced 3. Widowed 4. Other _____	
107	What is your religion?	0. Orthodox 1. Muslim 1. Catholic 2. Protestant	

		3. Other _____	
108	What is your ethnicity?	0. Oromo 1. Amhara 2. Somale 3. Tigre 4. Woloita 5. Other _____	
109	What is your highest level of education(completed grades)	0. illiterate 1. elementary 2. high school and preparatory 3. higher education	
110	What is you occupation?	0. Farmer 1. Merchant 2. Government employee 3. Private employee 4. Student 5. House wife 6. Daily laborer 7. Other specify_____	
111	How much does you earn per month (in birr)	_____ETB	
112	Condition at time of admission	0. Admitted to hospital with near miss 1. Admitted with no disorder and become near miss 2. Admitted with disorder and become near miss 3. Admitted with no disorder and not develop near mss	
113	Are you referred from other health	0. No	If no skip

	facility	1. Yes	to 118
114	How many number of place did you visit before arrive here.	_____place(s)	
115	Which health institution have you visited	0. Public 1. private	
116	Does transportation provided for you from referring health institution	0. No 1. Yes	
117	How long you stay to reach this health facility	___/___-/_____	
	MATERNAL REPRODUCTIVE HISTORY(CURRENT AND PAST)		
201	How many times you become pregnant?	_____ times	
202	How many times you gave birth?	_____times	
203	How many children did you have?	_____	
204	Did you have history of abortion?	0. No 1. Yes	
205	Did you have ANC follow up	0. No 1. Yes	If no skip to 207
206	If yes how many times	_____ times	
207	How old are you when you firs marry?	_____ years	
208	Did you have history of cesarean delivery?	0. No 1. Yes	If no skip to 210
209	If yes how many times?	_____ times	

210	Does female genital mutilation is common in your community?	0. No 1. Yes	
211	Did you have genital cutting?	0. No 1. Yes	
212	How long you stay with this pregnancy?	_____weeks	
213	How long you travel to reach here	_____hour and ____ minutes	
214	Fetal presentation	0. Cephalic 1. Non cephalic	
215	Mode of delivery of current baby?	0. SVD 1. Instrumental 2. C/S	
216	Duration of hospital stay	_____days	
217	Did she admitted to ICU?	0. No 1. Yes	If no skip to 218
218	If yes for how long?	_____hours	
219	Did you have history of the following diseases?	0. Heart disease 1. Kidney problem 2. Bleeding disorder 3. Hypertension 4. Diabetic mellitus 5. Thyroid disorder	
220	Did you have history of surgery?	0. No 1. Yes	
221	Did you have history of the following?	0. Still birth 1. Congenital anomaly 2. Labor problem	
	NEAR MISS DIAGNOSIS		If no skip

	CRITERIA		to 401
301	**Did she have near miss**	0. No 1. Yes	
302	If yes tick **x** by which criteria/parameters		
303	Severe complication/life threatening condition criteria	0. Acute cyanosis 1. Gasping 2. Respiratory rate > 40 3. Shock 4. Oliguria non responsive to fluids or diuretics 5. Failure to form clot 6. Loss of consciousness lasting more than 12 hours 7. Cardiac arrest 8. Stroke 9. Uncontrollable fit/total paralysis 10. Jaundice in the presence of preeclampsia 11. Eclampsia 12. Uterine rupture 13. Sepsis or severe systemic infection 14. Pulmonary edema 15. Severe malaria 16. Severe pre-eclampsia with ICU admission	
304	Laboratory based criteria	0. Oxygen saturation < 90% for > 60 min 1. Creatinine ≥ 300 μmol/l or ≥	

		3.5 mg/dL 2. Acute thrombocytopenia (<50,000 platelets/ml) 3. Loss of consciousness and ketoacids in urine	
305	Management based criteria	0. Hysterectomy following infection or hemorrhage 1. Transfusion of ≥ 2 units of red blood cells 2. Intubation and ventilation for ≥ 60 min not related to anesthesia 3. Cardio-pulmonary resuscitation 4. laparotomy other than caesarean section	
	NEONATAL HISTORY		
401	Neonatal condition after birth	0. Normal singleton live birth 1. Still birth 2. With congenital anomaly 3. Twin	
402	Sex of the baby	0. Female 1. Male	
403	Birth weight (in grams)	_____grams	
404	If alive circle 5 minute APGAR score	_____	
405	Is there any complication on neonate?	0. No 1. Yes	
406	If yes which complication?	0. Asphyxia 1. Meconium aspiration	

		2. Early neonatal sepsis 3. Prematurity 4. Congenital abnormality	
407	If neonate has one of those mentioned in Q 405 does he/she admitted to NICU?	0. No 1. Yes	
408	If the answer for Q 406 is yes for how long does neonate stay in NICU?	_____days	
409	What happen to neonate after admitted to NICU?	0. Cured 1. Referred to other facility 2. Dead	
410	What happen to neonate at the end of follow up (after 28 days of delivery)	0. Alive 1. Dead	
411	If dead how may days after birth	_____days and _____hours	

Annex 4. Translated Afan Oromo Questionnaire

Gaaffilee

Gaaffileen kunniin rakkoo dhukkubbi cimaa dubartoota ulfaa mudatuu fi dhiibbaa inni daa'ima dhalatu irratti qabu qorachuuf kan qophaahaniidha. Hirmaattonni qorannichaa hunduu gaafiwwan kanaaf akka deebii nuuf kennitanii fi kaardiin keessan akka ilaalamuf akka nuuf hayyamtan kabajaan isin gaafanna.deebiin keessan bu'a qabeessummaa qorannichaaf qooda guddaa qaba. Deebiin keessan akka hin banneef ciminaan qabama akkasumas eenyummaan nama deebii kennee ni eeggama. Gaaficharrat yoo ibsa barbaaddan gaafachuu dandeessu.

Baay'ee isin galateeffannna.

AJAJA GAAFICHAA**: lakkoofsa icciitii gaaffii fuulduraan kenname irra marsuun deebii guutaa. Gaaffiwwa deebii isaa barreessuu isin barbaachise eddo duwwaa fuuldura gaafichaa jiru irratti barreessaa.**

LAKK.	GAAFFIIWWANII FI ADDA BAASTUU	KOODII	UTAALI
	Odeeffannoo walii galaa		
101	Guyyaa itti hospitaala dhufte	____/____/_____	
102	Guyyaa hospitaa itti baate	____/_____/_____	
103	Haala ittiin hospitaalaa baate	0. Ajaja ogeessaatiin 1. Murtii ofiitiin	
104	Umriin kee meeqa (waggaan)	Waggaa_____	
105	Eessa jiraatta?	0. Baadiyaa 1. Magaalaa	
106	Haala bultii keetii naaf himi?	0. Hin heerumne 1. Heerume 2. Heerumee adda baane 3. Abbaan manaa koo ni du'e	

107	Amantaan kee kami?	0. Ortoodoksii 1. Muslima 1. kaatoolikii 2. Pirootestaantii 3. kan biraa_____	
108	Sabni kee maali?	0. Oromoo 1. Amaara 2. Somaalee 3. Tigree 4. Walaaytaa 5. Kan biraa_____	
109	Sadarkaan barnoota keetii akkami?	0. Hin baranne 1. Sadarkaa tokkoffaa 2. Haay iskuulii fi qophaa'ina 3. Barumsa olaanoo	
110	Dalagaan kee maali?	0. Qonnaan bulaa 1. daldalaa 2. hojjataa mootummaa 3. hojjataa dhuunfaa 4. barataa/tuu 5. Haadha manaa 6. Hojjataa guyyaanii 7. Kan biraa_____	
111	Ji'atti galii hangam takka argatta (qarshiin)?	Qarshii_____	

112	Haala haadhaa yeroo jalqaba hospitaala dhuftu	0. Jalqabuma dhukkuba cimaa haadhaa qabdi 1. Fayyaa dhuftee dhukkuba haadhaa cimaan qabamte 2. Osoma dhukkubuu dhuftee hospitaalatti itti cime	
113	Mana yaalaa biraa irraa riifariin dhuftee	0. Miti 1. Eeyyee	Miti yoo tahe gara gaafii 118 utaali
114	Osoo as hin dhufin dura mana yaalaa meeqa deemte.	Mana yaalaa_____	
115	Deemte yoo ta'e mana yaalaa isa kami?	0. Kan mootummaa 1. Kan dhuunfaa	
116	Eddoon rifarii irraa taate tiraanispoortii siif ramadee?	2. Miti 3. Eeyyee	
118	Hospitaala kana gahuuf hangam takka turte	___/___-/_____	
	SEENAA HORMAATA HAADHAA		
201	Yeroo meeqa ulfooftee beekta?	_____	
202	Ilmaan meeqa deesse?	_____	
203	Ijoollee meeqa qabda?	_____	
204	ulfi sirraa bahee beekaa?	0. Miti 1. Eeyyee	

205	Hordoffii yeroo dahaan duraa qabdaa?	0. Miti 1. Eeyyee	Miti yoo tahe gara 207 utaali
206	Ni qabda yoo tahe yeroo meeqa	_____	
207	Yeroo jalqaba heerumtu umriin kee meeqa (waggaan).	Waggaa_____	
208	Tajaajila baqaqsanii dhoosuutiin deessee beektaa?	0. Miti 1. Eeyyee	Miti yoo tahe gara 210 utaali
209	Eeyyee yoo tahe yeroo meeqa?	_____	
210	Naannoo keessanitti kittaannaan dubartii beekkamaa?	0. Miti 1. Eeyyee	
211	Ati hoo kittaannamtee?	0. Miti 1. Eeyyee	
212	Ulfa kana wajjiin hangam turte?	_____	
213	Haala daa'imni ittiin dhufe yeroo ciniinsuu	0. Mataadhaan 1. Mataadhaan malee	
214	Haala dahumsa daa'ima kanaa?	0. Dahumsa uumamaa 1. Meeshaadhaan 2. Tajaajila baqaqsuutiin	
215	Yeroo hospitaala keessa turte	_____	
216	Kutaa tajaajila addaa seentee?	0. Miti 1. Eeyyee	Miti yoo tahe gara218

			utaali
217	Eeyyee yoo tahe hangam turte?	_____	
218	Seenaa dhukkuboota kanniinii qabdaa?	0. Dhukkuba onnee 1. Rakkoo kalee 2. Rakkoo dhiiguu 3. Dhiibbaa dhiigaa 4. Dhukkuba sukkaaraa 5. Rakkoo taayrooyidii	
219	Kanaan dura tajaajila baqasanii yaaluu argattee beektaa?	0. Miti 1. Eeyyee	
220	Kanneen qabaattee beektaa?	0. Daa'imni sirraa bahuu 1. Daa'ima rakkoo qabu 2. Rakkoo ciniinsuu	
	MALA ITTIIN DUBARTII SIRRITTI DHUKKUBU ADDA BAASAN		Miti yoo tahe gara 401 utaali
301	**Sirritti dhukkubaa?**	0. Miti 1. Eeyyee	
302	Eeyyee yoo tahe kan armaan gadii keessaa ka ishee qabdu irratti **x** barreessi		
303	Mala dhukkuba cimaa waliin wal qabatu	0. Cuquliisummaa qaamaa yeroo gabaabaa 1. Hoomacha baasuu 2. Hargansuu > 40 3. Shookii 4. Hamma fincaanii xiqqaa kan dhangal'aa fi qorichaaf deebii hin	

		kennine. 5. Itituu dhabuu dhiigaa 6. Gaggaba sa'aatii 12 ol ture. 7. Hojii dhaabuu onnee 8. Istirookii 9. Laamshahuu/hagufann aa qaamaa 10. Keellawuu qaamaa dhiibbaa dhiigaa yeroo ulfaatiin wajjiin 11. Hurgufamuu qaamaa ulfaan wal qabatu 12. Dhoohuu gadaamessaa 13. Dhukkuba walii gala cimaa 14. Iitawuu sombaa 15. Dhukkuba buusaa cimaa 16. Dhiibbaa dhiigaa ulfaan wal qabatu cimaa kutaa yaala addaa feesisu	
304	Maloota bu'aa laaboraatorii fayyadamuun	0. hamma oksijiinii qaama keessaa < 90% Daqiiqaa 60 oli 1. kiri'eetiinii ≥ 300 µmol/l or ≥ 3.5 mg/dL 2. dhiigni itichituu dhabuu yeroo gabaabaa (<50,000 platelets/ml)	

		3. gaggabuu fi ketooasiidii fincaan keessaa qabaachuu	
305	Gosa yaalaa kennameef irratti hundaa'uun	0. Gadaamessa baasuu sababa infeekshinii yookiin dhiigaa 1. Dhiiga diimaa yuunitii 2 ol fudhachuu 2. Mala namtolcheen hafuura baafachiisuu daqiiqaa 60 oliif anisteeshiyaan wal hin qabanne 3. Gargaarsa onneef sombaa argachuu CPR 4. Garaa baqaqsuu ittiin dahuun wal hin qabanne	
	SEENAA DAA'IMAA		
401	Haala daa'imaa yeroo dhalatu	0. Tokko fi kan ruuhiin jiru 1. Du'ee kan dhalate 2. Rakkoo qaamaa wajjiin kan dhalate 3. Lakkuu	
402	Saala daa'imichaa	0. Dhalaa 1. Dhiira	
403	Saala daa'imichaa	0. Dhalaa 1. Dhiira	
404	Ulfaatina daa'imaa akkuma dhalateen	_____grams	
405	Hamma safar APGAR kan daqiiqaa 5	_____	

406	Daa'imichi dhibee cimaa qabaa?	0. Miti 1. Eeyyee	
407	Dhibee cimaa qabaata yoo tahe isa kam?	0. ukkaamamuu 1. Oota gad fudhachuu 2. Infeekshinii ariifataa 3. Yeroo malee dhalachuu 4. Rakkoo qaamaa	
408	Rakkoolee gaafii 405 ni qaba yoo tahe kutaa yaala addaati ciibsameeraa?	0. Miti 1. Eeyyee	
409	Ciibsameera yoo tahe guyyaa meeqaa ?	_____	
410	Erga kutaa yaala adda ciibsamee daa'imtichi maal tahe?	0. Ni fayye 1. Gara mana yaala biroo ergame 2. Ni du'e	
411	Daa'imichi dhalatee bultii 28 keessatti maaltu tahe	0. Daa'imtichi ni jira 1. Ni du'e	
412	Yoo du'e guyyaa meeqa erga dhalatee	_____	
413	Guyyaa meeqa qorannicha keessa turte	_____	

Annex 5. Curriculum vitae of advisors

CURRICULUM VITAE (CV) OF MAIN ADVISOR

I. Personal identification

Full Name: Negussie Deyessa Kabeta Sex: Male Date of birth: August 17, 1966

Marital Status: Married Religion: Orthodox Christian Nationality: Ethiopian

Address Office: Department of Preventive Medicine, School of Public Health, Addis Ababa University,

P.O. Box: 3253; Addis Ababa, Ethiopia; Phone Number: +251911400059

Email: negdaysun@yahoo.com, negdaysun@gmail.com

II. Education Background

A. Higher Education

I. PHD in Psychiatric Epidemiology

June 2004-September 2010; Department of Clinical sciences, Division of Psychiatry, Umea University, Sweden

II. Master of Public health

September 1994-July 1996; School of Graduate Studies, School of Public Health, Medical Faculty, Addis Ababa University.

III. Doctorate Degree in Medicine

September 1983-August 1989 Gondar College of Medical Science(GCMS), Addis Ababa University

III. professional Background

- Since 2013 Associate professor in epidemiology unit, Department of Preventive Medicine, School of Public Health, Addis Ababa university.
  - ✓ PhD program coordinator of the school of Public Health, Addis Ababa University (since Jan 2016).
  - ✓ Lecture in principles of epidemiology, research methods and data software for undergraduate medical students and graduate classes

- ✓ Lecture on applied epidemiology and biostatistics useful for biomedical research.
- ✓ Lecture and practical class on epidemiological statistics and statistical software (mainly EPI info, SPSS, and STATA) for health professionals.
- ✓ Advanced analysis of surveillance data for investigating outbreaks at district, region and federal levels.
- ✓ Advanced analysis of demographic and surveillance data for use in a research.
- ✓ Training of health professionals with surveillance data, both aggregated and raw data.
- ✓ Advising thesis work of graduate class students (more than 130 thesis work)
- ✓ Core member of the Butajira Rural Health Program, (actively participating in the data manipulation of the program)

- ➢ Assistant Professor in epidemiology unit, School of Public Health, Addis Ababa University, with duties including (may 2002-2013)
- ➢ Public Health Research Assistant. Butajira Schizophrenia and Bipolar Disorder Project, School of public Health, AAU, (July 2000 to April 2002), with duties including.
- ➢ Research Assistant, Butajira Rural health project, School Of Public Health, AAU, (July 1998 June 2000), with duties:
  - ✓ Overall administration of the field work and data manipulation process
  - ✓ Leading management of data entry (double entry and validation) from more than 68,000 people.
  - ✓ Developed a programming to convert entered data in CIDI-entry format into SPSS for windows and cleaning it.
  - ✓ Develop an adopted algorithm program to diagnosis the data from 68,000nadult population.
  - ✓ Actively participating in writing articles.
  - ✓ Coordinating the field work of the continuous data collection process of vital sign in the program.
  - ✓ Actively participate in quality control of the collected data.

Projects

- Principal Investigator of "Evaluation of the Disasters and Emergency Preparedness program, in Ethiopia" from Harvard T.H Chan, School of Public Health, [133,000 USD, Feb2017 May 2018]
- Principal Investigator of " Using cultural ceremony to reduce intimate partner violence in four district of Ethiopia" an intervention with grant exceeding 840,000USD, USAID, 2013-2017.
- Training of health professionals using "SPSS/EPI info training of health professionals" of Addis Ababa Health Bureau staff, Birr 130,000; Sept 2016.
- Training of health professionals using "SPSS/EPI info training of health professionals" of Addis Ababa Health Bureau staff, Birr 130,000; Sept 2015.
- Principal Investigator of "Effect of mental illness and intimate partner during gestation on cognitive and common mental illness of children" an intervention with grant exceeding 120,000 USD, Sweden, 2014 to date.
- Principal Investigator of "Evaluation of Health Extension Workers training and work performance as related to environmental, reproductive and child health in Tigray" an intervention with grant exceeding 340,000 ETYB, UNICEF; 2010 to 2012.
- Principal Investigator of "Evaluation of Health Extension Workers work performance as related to Millennium Development Goal achievement in Ethiopia" an intervention with grant exceeding 140,000 ETB, WHO;2014 to 20154.
- Training of Health professionals using "SPSS/EPI info training of health professionals" Addis Ababa health Bureau staff, birr 65,000; Sept 2013.
- Many other co-investigators.

Student Supervision

Advised 135 students in Masters of Public Health for the School of Public Health, Addis Ababa University,

Advised 28 students in Masters of Public Health for Addis Continental Institute of Public Health

Advised 5 students in PhD for the School of Public Health, 2 students for the School of Health alliance (nursing) and 3 students for Institute of Water Resource, Addis Ababa University

Additional work implemented

- ✓ Work as general practitioner, medical director and head, regional health bureau for ministry of health, in different hospitals, districts , zones and regions in Ethiopia (Sept 1989-March 1998)
- ✓ Postgraduate program coordinator (assistant), School of Public Heath, January 2007 to date
- ✓ Coordinator of two libraries of the department, School of public Health, Jan 2005 to date
- ✓ Member of technical committee for Global fund projects for training of health workers on HIV/AIDS in Ethiopia, Faculty of Medicine (2004)
- ✓ Facilitated nine courses of Information Education Communication/Behavioral Change
- ✓ Communication (IEC/BCC) on HIV/AIDS for health workers in Ethiopia, Faculty of Medicine (2004)
- ✓ Member of researchers for the Bipolar and Schizophrenia project by the School of Public Health (2001 to date)
- ✓ Member of core committee for the Telemedicine unit of Medical Faculty, (June 2007 to date)
- ✓ Member of development of curriculum for "Field epidemiology Training Program) in the School of Public Health (Nov 2006-Feb 2007)
- ✓ Completed six weeks short course on statistical methods in psychiatric epidemiology and health and social care research held at institution of psychiatry in January – February 2004

IV. Seminars and Workshops Attended

- ➢ Taken a 4 credit hours on 'Gender Perspective in developing countries' at John Hopkins University, Baltimore, Maryland, USA; January-March 2005
- ➢ Taken a 4 credit hours on ' Social and Psychological processes of mental and behavioral disorders' at John Hopkins University, Baltimore, Maryland, USA; January-March 2005
- ➢ Taken a 4 credit hours on' The Economics of Mortality, morbidity and fertility' at John Hopkins University, Baltimore, Maryland, USA; January-March 2005

- Taken a 4 credit hours on' methods in sample surveys' at John Hopkins University, Baltimore, Maryland, USA; January-March 2005
- Poster presentation of poster entitled " violence against women and depression in rural Ethiopia" at conference in American Population in Philadelphia, USA, March.2007

Signature of Main Advisor_____

Curriculum vitae (cv) of co advisor

I. Personal information

Name: Mengistu Yilma Dilnessi

Date of birth: July 15, 1978

Sex: Male

Marital status: Married and two children

CURRENT ADDRESS

Addis Ababa University
College of health Science School of public health
Mobile: +251913593241
E-mail: newmany55@gmail.co
mP.O.Box: 81088

II. Educational Background

- 2010–2012:MasterofPublicHealth(MPH)inHealthInformatics,UniversityofGondar,Ethiopia
- 2005 – 2008: BSc in Environmental health, University of Gondar, Ethiopia
- 1997 – 1998: Diploma in Environmental health, Haramaya University, Ethiopia

III. Professional Training and short courses

- Certificate on higher education diploma program from Addis Ababa university
- CertificateonIntroductiontoprincipleandpracticeofclinicalresearchfromtheNationalInstitute of Health Clinical Center - 1-year, online course
- Certificate on V.C.T counseling from FMOH with FHI

- Certificate on Integrated Refreshment Training for HEWs TOT from Amhara RHB
- Certificate on Injection safety & health care waste management TOT from USID/AID star one
- Certificate on Contraceptive logistic system from USID/Deliver
- Certificate on EPI mid level training. From ARHB
- Certificate on School community partnership program TOT from USID/ school partnership
- Certificate on Community led total behavioral change on hygiene & sanitation from Plan International

IV. Conferences and workshops attended

- The 13th international public health conference
- AMREF international conference
- The 8th and 12th TB Research Advisory committee annual conferences
- The 25th to 28th Ethiopia public health association annual conferences
- Ethiopia Medical Association 53rd annual conference

V. Work Experience

- September 2014 to present – lecturer in Addis Ababa University September 2013 to Sep. 2014 – Lecturer in Addis Ababa Science and Technology University. June 28, 2009 – Sep.22, 2013 - Hygiene and sanitation program officer in North Shoa zone health department
- April 23, 2007-June 27, 2009 - Health extension program coordination & malaria prevention & control expert in Siadebirna Wayuworeda health office
- Dec.8, 1998-April 22, 2007 – Health education coordinator and hygiene & sanitation expert in Moretna Jiru woreda health office

VI. Teaching Experience

- Biostatistics for undergraduate and post graduate students
- Epidemiology for undergraduate students
- Environmental health for undergraduate students
- Health informatics for undergraduate students
- Disaster management for undergraduate students

VII. Experience on consultancy services and training

- SPSS,STATA, EpiInfo, EpiData, Atlasti and others statistical software trainer
- MERQ with FMOH – member of core team in Land scape analysis of Regional health bureaus of Ethiopia - quantitative and qualitative study
- MERQ and WHO – Maternal death surveillance and response - qualitative study data collection, transcription and translation
- MERQwithCIRT–highereducationscholarsresearchpracticeinEthiopia-qualitativestudydata collection, transcription and translation
- MERQ with SC - chlorhexidine application and its implementation in newborns - qualitative data collection, transcription and translation
- In HED – member of lead researchers in Immunization administrative and serology coverage survey in Ethiopia.
- ABH – FP-watch contraceptive drugs inventory survey supervisor
- Save the children – school WASH qualitative study data collector and transcriber
- ARHB – coordinator in national WASH inventory survey
- Mentionfurmention-onjobtrainerfordistricthealthoffice,healthcenterandhealthposthealth workers on HMIS and ENA
- World vision Ethiopia – on job trainer for health extension workers on CLTSH
- Addis Ababa university – data manager for the two urban health survey projects
- Work as data collectors' supervisor in different surveys

VIII. Professional and Committee Membership

- Member of Ethiopian public health association
- Member of Ethiopian health informatics professional's association
- Member of Amhara region environmental health professional's association.

IX. Research Experience/Publications

- SurveyofHepatitisBvirusinfectionandriskfactorsamongpregnantwomenatpublichospitalin Ethiopia-
- The effect of HIV co-infection on tuberculosis treatment in N.Shoa, Ethiopia: A retrospective cohort study.

X. Publications in press

- A Predictive Model to Determining the Status of Tuberculosis Patients in Ethiopia
- Incidence of Severe Side Effects Associated with the Treatment of Multidrug Resistant Tuberculosis among Patients Treated for MDR Tuberculosis

XI. Proceedings

- The effect of HIV co-infection on tuberculosis treatment in N.Shoa, Ethiopia: A retrospective cohort study (2017 EMA and TRAC annual conference abstract book)
- A Predictive Model to Determining the Status of Tuberculosis Patients in Ethiopia (AMREF international conference abstract book and 25th EPHA annual conference abstract book)

XII. Grant Awards

- 2017: Ethiopia Medical Association 53rd annual conference best poster presentation certificate and money award.

XIII. Voluntary service

- Support the Black Lion specialized hospital on HMIS data management

XIV. References

- Dr. Girma Taye _ Associate professor of Biostatistics and Unit Head in Addis Ababa University, School of Public Health(mob-+251911769926)
- Mr. Yimer Seid – Instructor in Addis Ababa University, School of Public health(mob-+251911742435)
- Mr. Kasahun Dessie – Instructor in University of Gondar(mob-+25191207134

Signature of Co Advisor_____

Annex 6. Curriculum vitae of investigator

I. Personal information

Full name: Ahmednur Adem Aliyi

Date of birth: June 10, 1993 G.C

Place of birth: Region 04, Bale zone

Sex: Male

Marital Status: Single

Nationality: Ethiopian

Address: Email: ahmedhariro@gmail.com

Mobile: +251924051855 or +251927978888

II. Personal background

I am Ahmednur Adem 26 year old single man graduated from Dilla University in 2015 in BSC Degree of public health. Currently I am on completion of MPH in Epidemiology and Biostatistics from Addis Ababa University.

III. Academic Background

Academic year (E.C)	Level	Institution	Certificate
1991-1998	Elementary school(1-8	Elbuko Primary School	Grade 8 regional exam certificate
1999-2001	High School	Gindhir Secondary School	Ethiopian general secondary education qualification certificate
2002-2003	Preparatory	Gindhir Preparatory School	Ethiopian higher education entrance exam

			certificate
2004-2007	Undergraduate	Dilla University	BSC degree in public health

IV. Language skill

No	Language	Speaking	Reading	Writing	Listening
1	Amharic	Fluent	Excellent	Very good	Excellent
2	Afan Oromo	Excellent	Excellent	Excellent	Excellent
3	English	Excellent	Excellent	Excellent	Excellent

V. Qualification

Bachelor of Science Degree in Public Health with CGPA 3.87

VI. Training and practical background at University and Hospitals

- I have taken different field work trainings such as community based Training Program (CBTP), Team Training Program (TTP) at wonago health center, Dombosco clinic and in local area of Dilla University communities.
- I have taken practical clinical attachments at Dilla Referral Hospital and Bule Hora Hospital.
- After graduation I have taken training on CMAM, IYCF, IMNICI AND ICCM

VII. Basic computer skills

I have skill and experience in basic computer skill like MS word, Excel and power point.

I have skill of writing on these windows in good manner.

VIII. Additional Qualification

- I have experience in planning and conducting data collection, data entry and data cleaning activities

- I had experienced in preparing data collection tools (Questionnaires, observational checklists, Discussion Guidelines) needed for the data collection.
- I have experience in data (documents and records) handling and data analysis with computer software's.
- I have knowledge of statistical software like EPI INFO, EPIDATA, SPSS, STATA, Open Epi and Join Point.

IX. Hobby

Reading scientific books, watching movies, watching footballs

X. Reference

- For my personal profile
  - My brother, Mohammed Adem Aliyi (phone no. 0972837359), Current address-Bale zone, Ginnir
- For my work experience and performance: Madda Walabu University

Declaration: I confirm that all the information provided in this C.V.is true and correct to the best of my knowledge and understanding.

Signature of investigator_____