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Neonatal Mortality and Assoited factors Among Low Birth Weihgt Neonates Admitted to Neonatal Intensive Care Unit in Selected Hospitals, Amhara Region, North West, Ethiopia

Workineh, Gedamu

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BAHIR DAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCINCES

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF EPIDMIOLOGY AND BIOSTATISTICS

NEONATAL MORTALITY AND ASSOITED FACTORS AMONG LOW BIRTH WEIHGT NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNIT IN SELECTED HOSPITALS, AMHARA REGION, NORTH WEST, ETHIOPIA

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A THESIS SUBMITED TO BAHIR DAR UNIVERSITY, COLLEGE OF MEDICINE AND HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH, DEPARTMENT OF EPIDMIOLOGY AND BIOSTATISTICS IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH IN EPIDEMIOLOGY

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List of abbreviation and acronyms

| ANC | Antenatal Care |
|--------|--|
| ARHB | Amhara Regional Health Bureau |
| BEMONC | Basic Emergency Maternal and Neonatal Obstetric Care |
| BMI | Body Mass Index |
| CEMNOC | Comprehensive Emergency Maternal and Neonatal Obstetric Care |
| DM | Diabetes Mellitus |
| EDHS | Ethiopian Demographic and Health Survey |
| ENMR | Early Neonatal Mortality Rate |
| DHSS | Demographic and Heath surveillance System |
| HTN | Hypertension |
| ICCM | Integrated Community based Childhood illness Management |
| IMNCI | Integrated Management of Neonatal and Child Illness |
| LBW | Low Birth Weight |
| MAS | Mycelium Aspiration Syndrome |
| NGO | None Governmental Organization |
| LNMR | Late Neonatal Mortality Rate |
| NMR | Neonatal Mortality Rate |
| NICU | Neonatal Intensive Care Unit |
| PNC | Post Natal Care |
| PMR | Prenatal Mortality Rate |
| ROM | Pre Rupture of Membrane |
| RDS | Respiratory Distress Syndrome |
| SDG | Sustainable Development Goal |
| UNICEF | United Nations Child Fund |
| WHO | World Health Organization |
| | |

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Abstract

Background: Globally about 4 million neonates died each year within 28 days of life. Low birth weight is still continued global public health problem and it has both short and long term health impact. According to UNICEF report each year 1.1 million neonates die due to complication of preterm birth. Prematurity, birth complication, neonatal sepsis, meningitis and pneumonia were the main determinant of neonatal mortality. Of the cause of neonatal mortality low birth weight covers 60% to 80%.

Objective: The aim of this study was to assess neonatal mortality and associated factors among low birth weight neonates admitted to neonatal intensive care unit in selected hospitals, Amhara region North West Ethiopia 2018.

Methods: An institutional based cross sectional study was conducted. The study was conducted from July 1/2017 to June 30/2018. One year data were collected retrospectively from November1 to November30/2018, entered into Epi Info version7 software and exported to SPSS version23software for analysis. Both Bi-variate and multivariable logistic regression analysis was carried out. Adjusted odds ratio with 95% CI was used to measure strength of association.

Results: A total of 635 low birth weight neonates were incorporated in the study. Number of male participants were371 (58.4%). Among these low birth weight neonates 161/635 death were recorded with 253.5 per 1000 low birth weight live birth and the prevalence was 25.4%.

In multivariable logistic regression analysis gestational age below 32 weeks (AOR: 3.83, 95%CI: 2.18-6.72), presence of asphyxia (AOR: 2.27, 95%CI: 1.17-4.39), presence of congenital abnormality (AOR: 2.29, 1.05-4.99), Presence of respiratory distress syndrome (AOR: 2.831,95CI: 1.99-4.23), history of maternal TT vaccination (ARO: 0.55, 95%CI: 0.33-0.93) history of maternal high risk (AOR:1.72,95%CI: 1.078-2.748), presence of hypothermia (AOR: 1.64, 95%CI: 1.08-2.49) and presence of anemia (AOR: 4.28, 95%CI: 1.19-15.46) were significantly associated with neonatal mortality.

Conclusion and recommendations:-In this study neonatal morality was high (95%CI: 22.2-28.7). Gestational age below 32weeks, maternal TT vaccination, asphyxia respiratory distress syndrome, hypothermia, maternal high risk and anemia had significant association with neonatal mortality. Community and institutional based quality of health care delivery system and awareness creation should be emphasized.

Key words: Neonatal mortality, low birth weight, neonatal ICU, Amhara Region, North West Ethiopia

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1 Introduction

1.1 Background

Neonatal period is the most critical period for human being and neonatal death accounts the highest morbidity and mortality among under five children but it is preventable[1]. Neonates are died after birth due to different factors. Among the factors babies are severely mal-formed, they face obstetric complication before and during birth, difficulty of adaptation to external environment or due to harmful practices that leads to different infection like sepsis[2].

Worldwide, out of 130 million children born every year, about 4 million had died in the first 4 weeks of life, around 75% of death occurs in the first seven days of life and up to 25% to 45% of death occurs in the first 24 hours [1, 3].

Low birth weight baby is a neonate which is born below the standard neonatal weight at birth. Based on the definition of World Health Organization (WHO), neonates which are born with birth weights of less than 2500g are classified as low birth weight (LBW) without regardless of their gestational age. Subcategories of low birth weight include very low birth weight (VLBW), which is less than 1500 g and extremely low birth weight (ELBW), which is less than 1000g[4].

According to WHO 2016 report 60% to 80% of neonatal death occur due to low birth weight globally [5]. It is still continued global public health problem and it has association both short term and long term health impact. There is great variation in the prevalence of low birth weight between the regions and between the countries. However most low birth weight occurs in low and middle-income countries. It is also a public health problem in some high income countries like Spain, the United Kingdom of Great Britain, (UK) and the United States of America (USA) ([6].

One of the main priorities of sustainable development goal three (SDG) 3 is continues redaction of neonatal mortality[7]. But neonatal mortality is still high in Sub Saharan Africa including our country Ethiopia.

From 1999 to 2016 under five mortality were reduced by 62% but the neonatal mortality is only decreased by 49%, so neonatal mortality take great share from under five mortality[8].

Among the neonatal death, grater than80% of neonatal death occurs due to prematurity, birth complication at labor and delivery like asphyxia, neonatal sepsis, meningitis and pneumonia[9].

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These cause of neonatal mortality can be prevented with basic solutions such as affordable and quality health care delivered by well-trained doctors, nurses and midwives, antenatal and postnatal nutrition for mother and baby, and clean water supplementation for both [8]or affordable quality of care for the` mothers and the child can save a millions of lives[9].

1.2 Statement of the problem

Under-five mortality is decreased but neonatal mortality is still high. Acording to UNICEF 2018 report each day in the world 7000 babies are still died and it is because of lack of global commitment to newborns[8].

In Africa 1.16 million neonates die each year in the first 28 days of life. Fifty percent of these neonatal death occur in the five countries, Nigeria, Democratic Republic of Congo, Ethiopia Tanzania and Uganda[10]. Developed countries on average has low neonatal mortality rate with 3/1000 live birth and low income countries have 27/1000 live birth[8].

Neonatal mortality is now 6.5 times lower in the high income countries than in low income Countries. The life time risk for a woman to lose a newborn baby is 1 in 5 in Africa, compared with 1 in 125 in more developed countries [11].

Neonates who born from illiterate mothers face the risk of dying compared to neonate born from mothers at list secondary education. On the other hand neonates who born from the poorest house hold face the risk of dying compared to poorer household [8].

Each year1.1 million neonates die due to complication of preterm birth (7). Low birth weight is the main determinant of childhood morbidity. It also restricts physical and mental developmental growth, especially neurons developmental impairments such as mental retardation and learning disabilities.

As resent study shows low birth weight is not only cause of neonatal mortality and morbidity it also increase the risk of non communicable disease like diabetics mellitus(DM) and cardiovascular disease like hypertension late trough out the life [12].

According to Stoll, B.J., et al report, low birth weight is significantly affected hearing ability of neonate throughout the life[13]. In Bangladesh prevalence of low birth weight ranges from 23% to 60%. Generally 1/3 of neonatal death occurs among very low birth weight neonates. Preterm accounts about 75% of neonatal death [14].

In Ethiopia in 2014, 17.1% of neonates were born with low birth weight. Maternal education, marital status and house hold wealth were associated factors for neonatal mortality and low birth weight[15].In Ethiopia, rates of neonatal mortality is the highest than other sub Saharan Africa countries [11].

As the past fifteen years analysis (1995 to 2010) report shows Ethiopian total neonatal mortality was decreased on average rate of 1.9% per year but ENM was decreased by 0.9%. In Ethiopia by 2015, 3,200,000 neonates were born in a year and 8,700 neonates per a day. Among these neonate240 neonates were day every day before 28 days of life. Generally the Ethiopian neonatal mortality rate is 28 per 1000 live birth with 43/1000 death in rural and 41/1000 death in urban area[10].In Ethiopia neonatal death varies between low income households and high income household with mortality rate of 50/1000 live birth and 37/1000 live birth respectively[15].

As Ethiopian demographic and health survey (EDHS) sixteen years analysis (2000-2016) progress report shows, in Ethiopia under five mortality was decreased by sixty present from 166 death per 1000 live birth in 2000 to 67 death per 1000 live birth in 2016. But neonatal mortality was decreased only by 41% from 49 death per 1000 live birth in 2000 to 29 death per 1000 live birth in 2016 with the progress of 49,39,37 and 29 death per 1000 live birth in 2000,2005,2011 and 2016 respectively[16-19]

In Amhara Regional state the neonatal mortality rate is high compared to other 8 Regions of Ethiopia. It is the leading Region in neonatal death with, 59.7death per 1000 live birth in 2000, 50death per 1000 live birth in 2005, with increasing rate 54death per 1000 live birth in 2011 and 47 death per 1000 live birth in 2016 with slow redaction. During this time the Ethiopian national neonatal mortality rate were 49, 39, 37 and 29 death per 1000 live birth in2000,2005,2011 and 2016 respectively[16-19]

In addition neonatal mortality is among the ten top causes of under-five mortality and morbidity in the study area. There are different studies in community based on total neonatal mortality rate including Ethiopian Demographic and health survey (EDHS)[18] in the area, and there are little study on preterm and all neonatal mortality admitted to neonatal intensive care unit.

But no any study was conducted on low birth weight neonate admitted to neonatal intensive care units and associated factors in the study area.

Despite huge Government investment and against different neonatal mortality reduction program like kangaroo mother care (KMC) tetanus toxic (TT) vaccination, integrated management of neonatal and child illness IMNCI, ICCM, focused antenatal care(ANC),Post natal care (PNC) early breast feeding incitation, basic emergency maternal, neonatal and obstetric (BEMNOC) and comprehensive emergency management of neonatal and obstetric care (CEMONC) neonatal mortality is still high. This is the reason what I intends to study neonatal mortality and associated factors in the neonatal intensive care unit(ICU) in Amhara Region North West Ethiopia [20].

1.3 Significance of the study

This study had a great role to identify neonatal mortality and associated factors among low birth weight neonates admitted to neonatal intensive care unit (NICU) in selected hospital Amhara Regional state North West Ethiopia.

This study helps to show the hospital administrators burden of neonatal mortality, to preventable cause and its burden to the community.

It is also used to aware Amhara Regional State health bureau the burden of neonatal mortality among low birth weight and associated factors relationship to overcome the challenges with under incorporated health institution and stake holders including nongovernmental organization (NGO).

It is also used to show the burden of neonatal mortality for federal ministry of health(FMOH) and under incorporated health institution (health bureau, zonal health departments, hospitals health centers, health posts and private health institutions) to give priority reducing neonatal mortality in their day today activities and to reduce preventable cause of neonatal mortality.

It is also used to higher official police maker to give concerns in their program and to do farther analysis throughout Ethiopia about determinants of neonatal mortality.

2 Literature review

2.1 Prevalence of neonatal mortality

In the main land of China the total survival rate of the neonates during discharge time was 50%. Sixty (23.3%) died during the first seven days despite aggressive treatment, the rest 69 neonates died after discharge from medical care. From 129 neonates who died during hospitalization,52 neonates died within 24 hours and 45 died within 7 days [21].

In Johannesburg the survival rate of neonates were 413/562(73.45, with 95%CI (69.6-77%). Most neonatal death 111/149 (74.49%) happens in the early neonatal period. The duration of hospitalization were high in surviving neonates than non-surviving neonates[22].

As the study done in Bangladesh shows, prevalence of low birth weight rages from 23% to 60%. Generally 1/3 of neonatal death occurred among very low weight neonates. Preterm accounts about 75% of neonatal death. Among 103 neonatal death, 48 babies died within 48 hours,87 babies were died within one week and the rest were died within four weeks. Of these neonates 81 were died in hospital and 22 were died at home. Among low birth weight of less than 1500g neonates 39% babies were born below 32 weeks of gestational age and 61% of new born babies death occurred among birth weight of 1500-2499g and gestational age of 32 or more. The overall neonatal death were 133,112,and 21 per 1000 live birth NMR, ENMR and LNMR respectively[14].

As the study conducted in Libya in 2013 shows the mortality rate of neonates based on birth weight,37% were less than 1.5Kg, 13% were greater than 3Kg, 21% were between 1.5-2kg, 9% between 2-2.5Kg and 20% between 2.5-3Kg. Among the neonatal death 67 babies were died within the first 6 days and 39(46%) were died in the first 24 hours. Based on the gestational age twenty four (29.5%) were term, sixty(71%) were preterm between 32-36 weeks,21% between 24-28 weeks and 14% between 28-32 weeks of gestational age[23].

As the study done in Egypt Cairo university shows the total prevalence of neonatal mortality was 29.1% (240). Of these neonatal mortality 50% were preterm babies. Among low birth weight (<1000g) neonate the mortality rate was 69.4%.

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Generally among neonatal death occurred in NICU,2.1% is occurred within 24 hours,15.8% in 2 days,29.2% within 3 days, and 91.3% within 12 days. But only 8.75 % of deaths (n=21) occurred after the first month of NICU admission[24]. The occurrence of LBW was 61.9%, 14.3% and 9.4% among the preterm, term and post-term neonates respectively[25].

In Amhara Regional State the prevalence of low birth weight babies were 28% and the associated factors were residence, educational status and economical status of the household.[26]. As Tewabe et al study shows in Felege-hiwot referral hospital the neonatal mortality was 13.29%[27].

2.2 Factors associated with neonatal mortality

2.2.1 Socio demographic factors

As different epidemiological study including EDHS 2011 shows, in Ethiopia neonatal mortality among low birth weight is highly influenced by income of house hold, maternal educational label, Paternal literacy label and presence or absence of electronics communication material like radio /television in the household [11, 15].

As the study done in Bale Zonal hospital Southern Nation and Nationality and People Region of Ethiopia shows, mothers not gaining antenatal care visit for current pregnancy, birth spacing between pregnancy, Body mass indecs(BMI) 18.50kg/m2 of the mother and >25kg/m2, chat chewing, source of water for daily use and amount of consumption, use of latrine, maternal height less than 150m, mothers hand washing practices, solid and fluid disposal site and source of energy for cooking were more likely gave low birth weight neonate compared with other mothers use the listed service better [3].

2.2.2 Maternal related factors

Worldwide 14 million age between 15-19 year young women become pregnant per annum. Neonatal mortality related to adolescent pregnancy and the neonatal death is high in a single or unmarried mothers. Other maternal factors include, low label of maternal education, maternal illness during pregnancy and living in rural residence were the main factors of neonatal mortality[28]. In addition to this, maternal human immune virus (HIV) status and mode of delivery also risk of neonatal mortality (11).

Based on the study conducted at Gondar referral hospital and Mettukarl shows, among the cause of low birth weight prime parity, maternal height less than 1.5m, thinness of the mothers ,upper arm circumference(MUAC) below 23cm of the mothers, BMI<18kg/m2,birth interval below two years, irregular antenatal care visit, unwanted pregnancy, history of preterm birth, current preterm birth hypertensive disorder of the mothers, anemia presence of any medical illness, maternal age less than 16 and above 34 is highly associated with low birth weight compared to maternal age between 25-29 years and being positive for human immune virus or acquired immune deficiency syndrome(HIV/AIDS) were the predictors of low birth weight [26].

As Tolessa et al, study shows in Ethiopia low maternal educational label, gender inequality, lack of good health service in the community is the main determinants of neonatal mortality [27].

2.2.3 Neonatal related factors

As world health organization (WHO) 2014 report shows up to fifty present of neonatal mortality is preventable through cost effective intervention. Preterm and intra partum complications are the main cause of early neonatal mortality and sepsis is the main cause of late neonatal mortality [29].

As prospective cohort study done in Iran on low birth weight neonate indicated small for gestational age, birth weight and apigar score of neonate at five minutes had association with neonatal mortality[30, 31].

Study carried out in India tertiary care hospital neonatal intensive care units shows Prematurity, RDS, asphyxia and birth weight below 1000g had significant relationship with neonatal survival [32, 33].

As the study done in Mainland of China shows, gestational age below 28weaks, birth weight below 750g and small gestational age were the cause of neonatal mortality[21].

As the study done in Johannesburg shows the cause of death for low birth weight neonates were immaturity of multi-organs,11(55%), hypoxia,4(20%) and congenital malfrmation2(10%). In addition to birth weight, resuscitation at birth, and necrotizing enter colitis(NEC) were cause of new born death[22].

As the study conducted in Egypt at Cairo University shows the most frequent cause of death were infection 135 (56.25%), RDS 64(26.7%), hypoxic-ischemic encephalopathy 45[18.8%], CHD 25deaths [10.4%] and chromosomal or congenital anomalies (18 deaths [7.5%])[24] respiratory distress, preterm birth, low birth weight and extremely very low birth weight[34].

Similarly in Ethiopia the leading cause of neonatal mortality were birth asphyxia (31.6%), prematurity(21.8), sepsis(18.55), neonatal tetanus(1.9%), diarrhea (0.8%) and respiratory infection (8.4%)[10]. Other determinant factors of neonatal mortality include, first and 5th birth order, number of maternal ANC follow up during pregnancy, home delivery, prematurity (GA<37 weeks), Premature and prolonged rupture of membrane(1-12hours before the onset of labor), obstetric complication during labor, poor neonatal care, home delivery twin birth and big and small size of the new born were cause of neonatal mortality[35].

As different study shows in Ethiopia most cause of neonatal mortality is preventable. Among the cause of neonatal mortality neonatal infection, birth complication during labor, preterm complication, low label utilization of health service like ANC follow up, birth with skilled birth attendant, lack of quality of health service, post natal care for the mothers and for the new born during post natal period, poor maternal nutritional status before and during pregnancy, low birth weight, and preterm birth were the main determinant of neonatal death [27].

As Mengesha et al study shows in Tigry Regional state Ethiopia cause of neonatal mortality were prematurity, Congenital abnormalities, neonatal infection, asphyxia, monthly income of the mothers, age of the mothers below 18 years old, residence of the mothers, distance from the hospitals and other undefined cause were course of death for neonates [36].

As the study conducted in Kersa Oromya Regional state Ethiopia, shows prenatal complication, external cause, circulatory disease, gastro–intestinal disease, infection, parasitic disease, un determined and unspecified cause were cause of neonatal mortality[30].

The study carried out at Jima University hospital in intensive care unit indicated prematurity, infection, neonatal jaundice, asphyxia, respiratory distress syndrome, gestational age and body temperature at admission had significant association with neonatal mortality[37].)

Study done at University of Gondar hospitals at neonatal intensive care units indicated birth complication, gestational age ,hyaline membrane disease ,RDS, hypoglycemia and kangaroo-mother care institutional delivery had significant association with neonatal survival [38].

Among the specific cause bacterial sepsis, birth asphyxia, respiratory distress syndrome and prematurity were the main determinant of neonatal mortality. Among the cause prenatal respiratory syndrome, sepsis due to bacterial infection and prematurity were cause for early neonatal mortality. Also from these cause of neonatal mortality pneumonia, acute lower reparatory infection, bacterial sepsis were the leading cause for late neonatal mortality[39].

As population based case control study conducted in North Shawa Amhara Regional state Ethiopia shows, not attending antenatal care visit(ANC), home deliver, mother not taken post natal care visit during post natal period, not inciting breast feeding within one hours, not feeding colostrums, mothers note taking tetanus toxic vaccination, being small in size at birth for neonate, being male sex were the cause of neonatal mortality [40].

As Yirgu et al 2017 nested case control community based study conducted indicates, in West Gojam zone Amhara Regional state Ethiopia show the cause of neonatal mortality were age of the mother below 20 years, maternal educational status, maternal occupation, family size of house hold more than six, history of privies neonatal loss, mothers born above two children and privies history of still birth were the main determinants of neonatal mortality [41].

2.4 Conceptual framework

Conceptual framework of neonatal mortality and associated factors among low birth weight neonate admitted to NICU in selected hospital Amhara Region, North West, Ethiopia 2018.



Figure 1: Conceptual framework of neonatal mortality among low birth weight neonates

3 Objectives

3.1 General objective

To assess neonatal mortality and associated factors among low birth weight neonates admitted to neonatal intensive care units from July 1/2017 to June 30/2018 in selected hospitals Amhara Region, North West Ethiopia.

3.2 Specific objectives

To determine neonatal mortality among low birth weight neonates admitted to neonatal intensive care unit in selected hospital Amhara Region, North West, Ethiopia.

To identify associated factors with neonatal mortality among low birth weight neonates admitted to neonatal intensive care unit in selected hospital Amhara Region, North West Ethiopia.

4 Methods

4.1 Study area and period

The study was conducted in three selected hospital neonatal intensive care unit Amhara Regional state North West Ethiopia. Based on central statistical agency in 2005 E.C the study area has a total of around 17million population 2.3 million under five children and around 0.45million neonates were born in the area and 14,795 neonates were born from selected hospitals in 2017/2018 [19].

The study was conducted specifically on Debre-Markos, Felege-Hiwot and Debre-Tabor hospital Amhara Regional state North West Ethiopia.

Debre-markos is the capital city of East Gojjam Zone. It is located in North West of the capital city of Ethiopia AdisAbaba at a distance of 300 km and 294km far from capital city of Amhara Regional state Bahir-Dar to the south east direction. Debre-Markos referral hospital is found in Debre-Markos town. In 2017/2018, 3706 neonates were born in this hospital but among these neonates 213 neonates were died within 7 days. Among these neonates, 80(37.6%) were died within 24 hours and 133(62.4%) were died between 24hours and seven days.

Also Debre-Tabor is the capital city of South Gondar Zone. It is found in North West of capital city of Ethiopia Addis-Ababa at a distance of 684km and it is found 90 km far from the capital city of Amhara Regional State Bahir-Dar. Debre-tabor Zonal hospital is found in Debre-tabor town. In 2017/2018, 5214 neonates were born in this hospital. Among these neonates 161 were died within the first 7 days. Of these neonates 7(4.3%) were died within 24 hours and 154(95.6%) were died from 24hours to seven days.

Similarly, Felege-Hiwot referral hospital is found in the capital city of Amhara Regional State Bahi-Dar in the west direction near Lake Tana, North West of capital city of Ethiopia Addis-Ababa at a distance of 594km.

In 2017/2018, 5875 neonates were born in this hospital but among these neonates 281 were died within the first 7 days. Among these neonates 42(19.7%) were died within 24 hours and 213(81.3%) were died between 24 hours and seven days [20].

4.2 Study period

The study was conducted from July 1/2017 to June 30/2018 in AmharaRegional state North West Ethiopia

4.3 Study design

An institutional based retrospective cross sectional study was conducted

4.4 Population

4.4.1 Source population

All low birth weight neonates admitted to neonatal intensive care unit in selected hospital from July 1/2017 to June 30/2018 Amhara Region, North West Ethiopia

4.4.2 Study population

Selected low birth weight neonates admitted to neonatal intensive care unit in selected hospital from July 1/2017 to June 30/2018 Amhara Region, North West Ethiopia

4.5 Inclusion and exclusion criteria

4.5.1 Inclusion criteria

All low birth weight neonates who were admitted to neonatal intensive care unit (NICU) of three selected hospitals, Amhara Region North West Ethiopia

4.5.2 Exclusion criteria

Low birth weight neonates those had unknown discharge result from all selected hospitals were excluded.

4.6 Sample size determination and sampling procedure

4.6.1 Sample size determination for the first objective

Sample size calculation by using a single population proportion formula considering proportion of neonatal mortality (P=0.13=13%) [42]

 α =5% of margin of error =0.05

 $No=[Z(a/2)p(1-P)]/d^2$

Where, Z a/2=standard value for 95% CI = 1.96

CI (confidence interval) =95%,

d (marginal error) =0.05 (i.e. 5%)

P (single population proportion) =13.29~13

So, ni= (1.96)²0.13(1-0.13)/(0.05)²=174

4.6.2 Sample size determination for the second objective

The sample size was calculated by using two population proportion formula with EPI-Info Version 7 software with 95%CI and 80% power including percent of outcome

| Variables | %of | CI | Power | Sample |
|---------------------------|-----------|----|-------|--------|
| | neonatal | | | size |
| | mortality | | | |
| BC(asphyxia) | 9 | 95 | 80 | 635 |
| Place of birth | 42.5 | 95 | 80 | 142 |
| Twin birth | 21.1 | 95 | 80 | 259 |
| History of neonatal death | 34.7 | 95 | 80 | 190 |
| Maternal age | 9 | 95 | 80 | 86 |
| Birth spacing<2 years | 14.7 | 95 | 80 | 44 |
| | | | | |

Table 1: sample size determination table

As the above table shows, output of Epi-info version 7software was listed based on the calculation. To increase the representativeness of the target population the highest number is taken for this study, it is 635

4.7 Sampling procedure

Stratified random sampling technique was used for the stratification based on the population from each selected hospital and systematic random sampling technique was used to selected study participants.

The calculated samples were allocated based on the population of low birth weight neonates admitted in neonatal intensive care units in selected hospitals of Debre-markos, Felege-Hiwot, and Debre-Tabor hospitals from July 1/2017 to June 30/2018.

Then the total study population was divided by the sample population to determine k-value. From each selected three hospitals all low birth weight neonate medical record numbers were marked, counted and arranged in table. Then between the k-value using lottery method 2 was voted by third person to avoid selection bias. Then the sample was taken every two digits and non completed charts were filled by taking the next neonate charts based on kvalue from each hospitals up to the sample size is filled.



Figer2: sampling procedure

4.8 Study variables

4.8.1 Dependent variables: neonatal mortality

4.8.2 Independent variables

- Socio demographic factors
 - ✤ Age
 - ✤ Sex
 - Residence
 - ✤ Age of the mother

Maternal related factors

- ✤ DM
- HTN
- Gravidity of mothers
- ✤ ANC follow up
- HIV Status of the mothers
- ✤ Other medical history
- ✤ TT vaccination
- ✤ ROM
- Duration of labor
- ✤ Iron supplementation

Neonates related factors

- ✤ Gestational age
- ✤ Congenital anomaly
- Infection
- ✤ Place of birth
- ✤ Mode of delivery
- ✤ Birth complication
- Types of births
- ✤ Asphyxia
- RDS
- ✤ Apigar score

4.9 Operational definitions

Low birth weight: Is a neonate whose weight was below 2500 gram when it measures and recorded on neonate chart immediately after birth by health workers including referred neonates from other health institution for neonatal intensive care.

Congenital abnormality: Any congenital malformation of the neonate during birth up 28 days of life and recorded from neonate charts and found during data collection.

Sepsis: A neonate who developed early, late and late- late neonatal sepsis diagnosed at admission or during hospital stay and registered in the patient chart.

Not died: All neonates whose treatment outcome were improved, left against medical advice, absconded and referred to higher institution or other health facility within the study period.

Maternal high risk: A mother who had history of vaginal bleeding, facial edema or whole body swelling, high blood pressure, blurred vision, severe headache and sever lower abdominal pain during pregnancy were taken as high risk mother in this study.

4.10 Data collection procedure

The data were collected by chart review retrospectively with prepared checklist adopted from different literatures including EDHS and based on the neonatal and maternal medical history recorded from neonate chart[17]. Data were collected by trained 5 bachelors of sciences in nursing (BSCN) and one BSC midwife data collectors and supervised by principal investigator.

4.10.1 Data quality assurance

Training materials were prepared based on tools .One day training was given for each hospital data collectors on the contents of the tools clarity, objectives of the study and how to they collect and record the data. Each and every checklist was checked for its completeness daily at the end of the day before data entry.

4.10.2 Data management and analysis procedures

The collected data were coded and entered to Epi-info version7 software and exported to SPSS version 23 for further data cleaning and analysis.

Descriptive statistics like frequency, cross tabulation and multiple response analysis was used to show frequency and the prevalence of neonatal mortality and co-morbidity factors for neonatal mortality.

Both Bi-variate and multivariate analysis of binary logistic regression was carried out to identify associated factors. Variables with P-value <0.2 in bi-viraite logistic regression was used for multivariable logistic regression analysis. In multivariable logistic regression analysis adjusted odds ratio with 95% CI and p-value <0.05 and were used to measure the significance and strength of association.

4.11Ethical consideration

First of all ethical approval was obtained from Bahir-dar University College of medicine and health since school of public heath ethical review board. Then legal official clearance letters was written to Ethiopian public health institute (EPHI).Finally legal official clearance letter was written for the selected hospitals by EPHI, Debremarkos, Felege-Hiwot, and Debre-Tabor hospitals. Data were collected with confidentiality was secured.

5 Results

6.1 Socio-demographic characteristics

A total of 635 neonates were included in the study. Number of male participants were 371(58.4%), 424(66.8%) neonates were from rural residence and 470(74%) neonates were admitted within 24huors. The majority of the mothers (64.1%) were found in age group of between 20-30 years (Table2).

Table2: Socio demographic characteristics of the study participants in Amhara Region, North West Ethiopia 2018 (n=635)

| Characteristics | Category of variables | Frequency (%) |
|-------------------|-----------------------|---------------|
| Sex | Male | 371 (58.4) |
| | Female | 264 (41.6) |
| Age of neonate | 1 day | 470 (74) |
| | 2 days | 45 (7.1) |
| | 3-7 days | 71 (11.2) |
| | >7 days | 49 (7.7) |
| Residence | Rural | 424 (66.8) |
| | Urban | 204 (32.1) |
| Age of the mother | <20 | 87 (13.7) |
| | 20-30 | 407 (64.1) |
| | 30-40 | 126 (19.8) |
| | >40 | 15 (2.4) |

5.2 Magnitude of neonatal mortality

5.2.1 Neonatal and socio-demographic related frequency of neonatal mortality

Six hundred thirty five neonates were included in the study. Among these neonates 161(25.4%) were died with mortality rate of 253.5 death per 1000 low birth weight live birth. Of the total 161 low birth weight neonates died, 100(62.1%) were males and 129(80%) neonates were died within 24 hours. From 161low birth weight neonates died 68(47.6%) were born at gestational age below 32 weeks and 64(19.9%) neonates were born at gestational age below 32 weeks.

Among the total 161 low birth weight neonates died 112(69.6%) were single birth and the rest 49(30.4%) were multiple birth. Of the total 6 neonates those apigar score at the 1^{st} minute between 0 to3, 3(50%) were died and from 167 neonates whose apigar score at the 1^{st} minute between four to six, 60(35.92%) neonates were died. In addition among 66 neonates whose appigar score at the 5^{th} minute between 4 to 6, 28(42.4%) were died (table3).

Table3: Neonatal related and socio-demographic factors with frequency and percentage distribution of neonatal mortality in Amhara Region, North West Ethiopia 2018 (n=635).

| Characteristics | Category | N (%) died | N (%) not died |
|-------------------|-----------|------------|----------------|
| Age of neonate | 1 -3 days | 144(89.5) | 395 (83.3) |
| | 4-7days | 6(3.7) | 41 (8.7) |
| | >7 days | 11(6.8) | 38 (8) |
| Sex | Male | 100(62) | 271(57) |
| | Female | 61(38) | 203(43) |
| Residence | Rural | 99(61.5) | 325 (69.3) |
| | Urban | 60(38.5) | 144 (29.7) |
| Age of the mother | <20 | 23(14.3) | 64(13.5) |
| | 20-30 | 105(65.2) | 302(63.7) |
| | 30-40 | 30(18.6) | 96(20.3) |
| | >40 | 3(1.9) | 12(2.5) |

| | <32 | 68(42.2) | 75(15.8) |
|--|-------------------------|-----------------------|-----------------------|
| Gestational age | 32-36 | 64(39.8) | 258(54.4) |
| | >36 | 29(18) | 141(29.8) |
| Birth weight in gram | 1500-2499 | 90(55.9) | 407 (85.9) |
| | 1000-1499 | 55(34.2) | 66(13.9) |
| | <1000 | 16(9.9) | 1 (0.2) |
| Types of birth | Single | 112(69.6) | 347(73.2) |
| | Multiple | 49(29.4) | 127(26.7) |
| Place of delivery | Health facility Home | 135(83.9) 26(16.1) | 418(88.2) 56(11.8) |
| Apigar score status recorded at | Yes | 100(62.1) | 281(59.3) |
| birth | No | 61(37.9) | 193(40.7) |
| If apgar score is no apigar score | Cried | 40(64.5) | 135(69.6) |
| status | Not cried | 10(16.1) | 14(7.2) |
| | Unknown | 12(19.4) | 45(23.2) |
| Apigar score at 1 st minute | 0-3 | 3(3) | 3(1) |
| | 4-6 | 60(60) | 107(38.1) |
| | 7-10 | 37(37) | 171(60.9) |
| Apigar score at 5 st minute | 4-6 7-10 | 28(28) 72(72) | 38(13.5) 243(86.5) |

5.2.2 Maternal and institutional based frequency of neonatal mortality

Among all 635 low birth weight neonates included in the study, mothers of 534(84%) were vaccinated for tetanus toxic vaccination two times and above during their current pregnancy and mothers of 557(87.7%) neonates had antenatal care follow up. Of the total 161 neonates died 86(53.4%) were from Felege-Hiwot hospital (table: 4).

Table 4: Maternal related and other factors with frequency and percentage distribution of neonatal mortality in north West Ethiopia 2018(n=635)

| Characteristics | Category | N(%)Died | N(%) not Died |
|-----------------|----------|----------|---------------|
| | | | |

| History of TT vaccination | Yes | 128 (79.5) | 406(85.7) |
|-------------------------------------|---|----------------------------------|-------------------------------------|
| Parity of the mother | No 1 birth | 33 (20.5) 76 (47.2) | 68(14.3) 198(42) |
| | 2-4 birth | 67 (41.6) | 201(42.7) |
| | >_5 birth | 18 (11.2) | 72(15.3) |
| ANC follow up | Yes | 138 (85.7) | 422(89) |
| | No | 23 (14.3) | 52(11) |
| Number of ANC follow up | 1 times | 11 (7.9) | 13(3.1) |
| | 2-3 times | 75 (54) | 160(37.6) |
| | >_4 times | 53 (38.1) | 252(59.3) |
| History of acute maternal illness | Yes | 21 (13) | 36(7.6) |
| | No | 140 (87) | 438(92.3) |
| History of maternal chronic illness | Yes No | 3 (1.8) 159 (98.2) | 5 (1) 469(99) |
| Maternal HIV status | Reactive | 5 (3.1) | 10(2.1) |
| | Non reactive Unknown | 138 (85.7) 18(11.2) | 417(88) 47(9.9) |
| History of neonatal loss | Yes No | 21 (13.4) 136 (86.6) | 47(10.2) 415(89.8) |
| History of maternal high risk | Yes No | 44 (27.3) 117 (82.7) | 84(17.7) 390(82.3) |
| History of iron supplementation | Yes | 39 (24.2) | 90(19) |
| | No | 122 (83.8) | 384(81) |
| Duration of labor | <6 | 72 (44.7) | 240(50.6) |
| | 6-12 | 64 (39.8) | 145(30.6) |
| | 12-24 | 23(14.3) | 74(15.6) |
| | >24 | 2(1.2) | 15(3.2) |
| Duration of rupture of membrane | 0-7 | 126 (78.3) | 401(84.6) |
| | >7 | 33 (21.7) | 72(15.4) |
| List of hospital | Debre-Markos Felege-Hiwot Debre-Tabor | 35(21.7) 86(53.4) 40(24.8) | 120(25.3) 228(48.1) 126(26.6) |

5.3 Co-morbidity factors for neonatal mortality in selected hospitals

As table 5 shows among 635 admitted low birth weight neonate 419(66%) were admitted due to sepsis. Among these neonates 117(27.92%) were died and it covers 72.7% of the total 161 death. Also among 221 admitted low birth weight neonates due to respiratory distress syndrome (DRS) 89(14%) were died and from 55 neonates admitted due to asphyxia 19(3%) were died. Of the total198 hypothermic low birth weight neonates 64(10%) were died (table 5).

Table 4:- Frequency and percentage distribution of low birth weight neonate with co morbidity factors in North West Ethiopia (n=635)

| Co-morbidity factor | Response | Outcomes of neonate at discharge | |
|---------------------|----------|----------------------------------|----------------|
| | | Died: N (%) | Not died N (%) |
| Prematurity | Yes | 144(89.4) | 31(6.5) |
| | No | 17(10.6) | 443(93.5) |
| Sepsis | Yes | 117(72.7) | 302(63.7) |
| | No | 44(26.3) | 172(36.3) |
| Asphyxia | Yes | 19(11.8) | 36(7.6) |
| | No | 142(88.2) | 438(92.4) |
| MAS | Yes | 10(6.2) | 22(5.7) |
| | No | 151(93.8) | 452(94.3) |
| RDS | Yes | 89(55.3) | 132(27.8) |
| | No | 72(44.7) | 342(72.2) |
| Hypothermia | Yes | 64(39.8) | 134(28.3) |
| | No | 97(40.2) | 340(71.7) |
| Anemia | Yes | 5(3.1) | 7(1.5) |
| | No | 156(96.7) | 467(98.5) |
| Jaundice | Yes | 4(2.5) | 14(3) |
| | No | 157(97.5) | 460(97) |
| Meningitis | Yes | 5(3.1) | 21(4.4) |
| | No | 156(96.9) | 453(93.6) |
| Congenital anomaly | Yes | 13(8) | 25(5.3) |
| | No | 148(92) | 449(94.7) |
| Others | Yes | 27(16.8) | 74(15.6) |
| | No | 134(83.2) | 400(84.4) |

5.4 Factors Associated with neonatal mortality

In this study history of maternal ANC follow up, duration of labor, duration of ROM, MAS, jaundice, meningitis, history of maternal neonatal loss, hospital list, maternal HIV status, , history of maternal chronic illness, parity of the mother, sex , residence of neonate, maternal age, gestational age, history of maternal acute illness, history of maternal high risk, history of maternal iron supplementation, place of delivery, history of maternal TT vaccination, age of neonates, asphyxia, anemia, RDS, congenital abnormality, hypothermia, sepsis and prematurity were used for logistic regression analysis.

But gestational age, history of maternal acute illness, history of maternal high risk, history of maternal iron supplementation, place of delivery, history of maternal TT vaccination, age of neonates, asphyxia, anemia, RDS, congenital abnormality, hypothermia, sepsis and prematurity were eligible for multivariable regression analysis at p-value of <0.2.

In multivariable logistic regression analysis gestational age, history of maternal high risk, history of maternal TT vaccination, hypothermia, asphyxia, respiratory distress syndrome (RDS) anemia and congenital abnormality were significantly associated with neonatal mortality at p-value of <0.05).

Gestational age below 32 weeks was significantly association with neonatal mortality. Neonates born at gestational age of below 32 weeks were 3.827 times more likely to die compared to neonates born above 36weeks of gestation (AOR: 3.83, 95%CI: 2.181-6.715).

Neonates who were admitted due to asphyxia were 2.268 times more likely to die compared to neonates those were admitted other than asphyxia (AOR: 2.268, 95%CI: 1.172-4.387) and neonates who were admitted due to anemia were 4.281 times more likely to die compared to neonates those were admitted other than anemia[(AOR: 4.281,95%CI: 1.186-15.456).

Neonates whose mother had TT vaccination two times and above during her current pregnancy were 45% less likely to die compared to neonates of non TT vaccinated mothers (AOR: 0.55,95%CI: 0.333-0.925).

Table 5: Bivariate and multivariable logistic regression table between neonatal mortality and associated factors in selected hospital, Amhara Region, North West Ethiopia (n=635)

| Predictors | Response | Out come at discharge | Odds ratio | P-value |
|------------|----------|-----------------------|------------|---------|
| | | albenaige | 25 | |

| | | Died(n) | Not died(n) | COR(95% CI) | AOR(95% CI) | |
|--------------------|--------------------|-------------|----------------|------------------|------------------|---------|
| Age of neonate | 1-3 | 144 | 395 | 1.26(0.63-25) | 0.973(0.44-2.16) | 0.723 |
| | 4-7 | 6 | 41 | 0.51(0.17-1.01) | 0.66(0.20-2.17) | |
| | >7 | 11 | 38 | 1 | 1 | |
| Gestational age | <32 | 68 | 75 | 4.41(2.63-7.39) | 3.83(2.18-6.72) | |
| | 32-36 | 64 | 258 | 1.21(0.74-1.96) | 1.19(0.71-1.99) | <0.0001 |
| | >36 | 29 | 141 | 1 | 1 | |
| History of acute | Yes | 21 | 36 | 0.68(0.34-1.37) | 0.72(0.37-1.40) | 0.333 |
| maternal illness | No | 140 | 428 | 1 | 1 | |
| History of TT | Yes | 128 | 406 | 0.65(0.41-1.03) | 0.55(0.33-0.93) | 0.026 |
| vaccination | No | 33 | 68 | 1 | 1 | |
| History of | Yes | 44 | 83 | 1.75(1.15-2.66) | 1.72(1.08-2.75) | 0.023 |
| maternal high risk | No | 117 | 391 | 1 | 1 | |
| Duration of | >24 | 2 | 15 | 1.44(0.95-2.14) | 1.44(0.92-2.23) | |
| labor | 12-24 | 23 | 74 | 0.94(0.56-1.57) | 1.25(0.69-2.26) | 0.227 |
| | 6-12 | 64 | 145 | 6.67(0.59-74.59) | 0.389(0.07-2.05) | |
| | <6 | 72 | 240 | . 1 | 1 | |
| Sepsis | Yes | 117 | 302 | 1.51(1.02-2.23) | 1.392(0.91-2.52) | 0.128 |
| | No | 44 | 172 | 1 | 1 | |
| Asphyxia | Yes | 19 | 36 | 1.63(0.91-2.93) | 2.27(1.17-4.39) | 0.015 |
| | No | 142 | 438 | 1 | 1 | |
| RDS | Yes | 89 | 132 | 3.20(2.21-4.64) | 2.83(1.96-4.23) | <0.0001 |
| | No | 72 | 342 | 1 | 1 | |
| Hypothermia | Yes | 64 | 134 | 1.49(0.95-2.33) | 1.64(1.08-2.49) | 0.02 |
| | No | 97 | 340 | 1 | 1 | |
| Anemia | Yes | 5 | 7 | 2.14(0.67-6.83) | 4.28(1.19-15.46) | 0.026 |
| | No | 156 | 467 | 1 | 1 | |
| Place of delivery | Health facility | 135 | 418 | 1.52(0.83-2.77) | 1.34(0.76-2.38) | 0 .315 |
| | Home | 26 | 56 | 1 | 1 | |
| Congenital | Yes | 13 | 25 | 1.58(0.58-3.16) | 2.29(1.05-4.99) | 0.037 |
| anomaly | No | 148 | 449 | 1 | 1 | |
| History of iron | Yes | S90 | 39 | 1.36(0.89-2.01) | 1.209(0.61-2.39) | 0.585 |
| supplementation | No | 384 | 122 | 1 | 1 | |

6 Discussion

The aim of this study was to determine neonatal mortality and associated factors among low birth weight neonates admitted to neonatal intensive care unit in selected hospitals, Amhara Region, North West Ethiopia.

From the three selected hospitals 635 low birth weight neonates were included in the study. The neonatal mortality rate was 254.3per 1000 low birth weight live birth and the prevalence was 25.4% [22.2-28.7]. It is high compared to similar cross sectional study conducted in Bangladesh [14]. The main reason of this difference could be, Banglandish is middle income country but Ethiopia is low income country due to this the health care coverage and quality of care is better and awareness of the community is also relatively high. Bt in line with study done in Mainland of China with the prevalence of premature death 26.5% [24] and in line with study conducted in Nalanda Medical College and Hospital, Patna, Bihar, India (23.40%) [33].

Gestational age below 32 weeks was significantly associated with neonatal mortality among low birth weight neonates, the possible scientific reason for this finding is as gestational age decreases multi-organ immaturity will increase due to this neonatal death will be increase. This finding is in line with the study done in Mainland of China[24], study conducted in Kersa HDSS located at the eastern Hararge of the Oromyia regional state in eastern Ethiopia[30], study conducted in Tigry Regional state Ethiopia[35], WHO 2014 report[29] and Study conducted in Iran [30].

Presence of birth asphyxia is significantly associated with neonatal mortality (AOR: 2.268, 95%CI: 1.172-4.387). The main reason could be when the neonate is asphyxiated oxygen concentration in the blood of neonates decrease this lead the neonates to die within minutes hours and days due to origin hunger.

This finding is in line with WHO 2014 report[29], study conducted in Johannesburg[25], study conducted at Cairo University and Assiut University hospitals of Egypt [24, 34], study conducted in Tigry Regional state Ethiopia[35], study conducted in Kersa HDSS located at the eastern Hararge of the Oromyia regional state in eastern Ethiopia[30], stud carried out at university of Gondar hospital [38] and Study conducted in tertiary care hospital in central India [32].

Additionally presence of congenital abnormality was significantly associated with neonatal mortality. This finding is in line with study conducted in Johannesburg [29], study conducted in Egypt at Cairo University [33], study conducted in Tigry Regional state Ethiopia [36] and Study conducted in tertiary care hospital in central India[32].

In this study presence of respiratory distress syndrome (RDS) was significantly associated with neonatal mortality (OR: 2.629, 95%CI: 1.698-4.071). This finding is in line with Study conducted in tertiary care hospital in central India [32], Study conducted in University of Gondar comprehensive specialized hospital, Study carried out Jima University Hospital, Study carried out Cairo University and Study carried out Assiut University hospitals of Egypt [24, 34].

Presence of anemia was significantly associated with neonatal mortality (AOR: 4.281, 95%CI: 1.186-15.456). I didn't get supporting study but there are many scientific evidence and literatures carried out on cause of neonatal anemia supporting this finding. As different journals and neonatology books indicated neonates are exposed to anemia due to internal and external bleeding, scalp hematoma due to instrumental delivery and prolong labor, hemoglobin abnormality, bleeding due to birth trauma, jaundice, born from Rh incompatible mother and maternal anemia cause neonatal anemia [43, 44].

In addition there are other pathological and physiological reason like megalo-plastic anemia, hemolytic anemia, hem dilution and decrease bone marrow erythropoitic activity. Additionally as different literatures carried out on umbilical cord care in Ethiopia indicated, most people living in rural area did not give attention for cord care they simple cut the cord and put the neonate to the maternal side and cover with close. Due to this the neonate may bleed on the cord and it cause the neonate to died [45].

Maternal history of taking tetanus toxic vaccination two times and above during current pregnancy was significant association with neonatal survival (AOR:0.55, 95%CI: 0.333-0.925), this finding is in line with the study conducted in north Shawa, Amhara region, North East Ethiopia [44]

Hypotermia had significant association with neonatal mortality this finding is in line with the study caried out at Jima University hospital in intensive care unit[38].

Maternal high risk was significantly associeted with neonatal mortality, this is in line with study condacted in Gondar University specialized hospital[26].

7 Strength and limitation of the study

7.1 Strength of the study

The study covered large geographical study area and the study was conducted on large sample. In addition the study was representative of low birth weight neonates in the study area and the data was collected by trained health professional

7.2 Limitation of the study

The limitation of this study was lack of adequate variable due to the use of secondary data and the study was conducted in a hospital sample that may be different from the general population.

8 Conclusions

In this study neonatal mortality was high (95%CI, 22.2-28.7). Based on the finding of this study, gestational age, history of maternal high risk, anemia, respiratory distress syndrome, congenital abnormality and history of maternal TT vaccination were significantly associated with neonatal mortality.

9 Recommendations

For selected hospitals: It recommended that the selected hospitals seiner management team(SMT) to prepare fast and effective implementation plan to reduce neonatal mortality coordinating the cluster public health sectors and partners which have done on neonatal mortality reduction.

For Amhara regional state health bureau: It is recommended that Amhara Regional State health bureau (ANRSHB) to give more concern and invest more on reduction of neonatal mortality by increasing quality of care in the community and strengthening health institution for better service utilization.

In addition to this it is recommend that ANRSHB to work in collaboration with zonal heath department, woreda health office, hospitals, health centers and nongovernmental organization (NGO) to reduce preventable factors of neonatal mortality by expand tetanus toxic vaccination for all pregnant women and preventing low birth weight, low gestational age delivery, congenital

abnormality, asphyxia, hypothermia, respiratory distress syndrome and anemia by increasing quality of care and community awareness throughout the region.

For federal ministry of health: It is also recommended that federal ministry of health (FMOH) Ethiopia, to give more concern and invest more on reduction of neonatal mortality by increasing quality of care in the community and also in health institution collaborating with regional bureaus.

Additionally FMOH should expand tetanus toxic vaccination for all pregnant women and work with partners and underneath health institutions.

It is also recommend that FMOH Ethiopia to reduce preventable cause of neonatal mortality like low birth weight, gestational age, congenital abnormality, asphyxia, hypothermia, respiratory distress syndrome and anemia by increasing quality of health service and community awareness.

For stake holders: All concerned bodies health workers, health extension workers, community leaders, public health experts, higher policy makers and other stake holder work with collaboration to prevent and early treatment of neonatal by increase community awareness to prevent low birth weight, congenital abnormality, asphyxia, RDS, hypothermia, anemia and participating in TT vaccination program.

It is also recommended that all concerned body should invest more on prevention, awareness creation and integrated health care system strengthening to reduce neonatal mortality and to prevent factors.

For researchers: In the last it recommended that for other public heath researcher to do farther investigation including other determinant factors like wealth index, educational status of the mother, birth interval, maternal occupation and soon.

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11 Annex

Semi standardized check list to assess the prevalence of neonatal mortality rate among low birth weight neonates admitted at intensive care units (NICU) of Debre-Markos, Felege-Hiwot, Gondar and Debre-Tabor hospitals north West Ethiopia

Code number of the check list.....

I-Socio-demographic data

| code | Question | Responses |
|-----------|---|---|
| 101 | Age of neonate (in days) | days |
| 102 | Sex of neonate | M F |
| 103 | Residence of the neonate/mothers | Rural Urban Uknwn |
| 104 | Age of the mother | |
| II -Neona | tal related factors | • |
| 201 | Types of birth | 1-singe 2-multipile |
| 202 | Place of birth of neonates | 1-Health institution 2-Home |
| 203 | Birth weight of neonate | gram (Write the weight of neonates in gram) |
| 204 | Reason of admission | 1-prematurity7-Congenital abnormality2-MAS8-PNA (per natal asphyxia)3-menegitus9-RDS4-sepsis10-sesure5-asphexia11-Neonatal tetanus6. other11-Neonatal tetanus |
| 205 | Gestational age of neonates at birth | |
| 106 | Appigar score neonate at birth | 1.yes 2.no |
| 107 | If QN107 is yes APGARS at 1 st Minute | (write the number) |
| 108 | If QN107 is yes APGARS at 5 minute | (Write the number) |

| 100 | If ON107 is no ADCADS | 1 Cried 2 Not arised 2 Ultrouwn | | |
|-----|----------------------------|---|--|--|
| 109 | II QN107 IS IIO APGARS | 1. Cried 2. Not cried 5. Oknown | | |
| | status at birth | | | |
| 110 | Outcome of the neonates up | Died | | |
| | to discharge | Survived | | |
| | | LAMA(left against medical advice)/absconded | | |
| | | Referred to higher institutions | | |
| 111 | Mod of delivery | 1-SVD 2-Instrumental 3-CS | | |
| | | | | |

III -Maternal related factors

| pregnancy(atlist2X) | |
|---|--|
| | |
| 302 Parity of the mother (write the gravidity of the mother) | |
| 303 ANC follow up 1-yes 2-no 2-no | |
| 304 Number of ANC follow up (if 1=1 | |
| (2303 is yes) $(2=2-3)(3-> 4)$ | |
| 305 Maternal illness during 1-yes | |
| pregnancy(acute) 2-no | |
| 306 History of maternal chronic 1-yes 2-no | |
| illness (DM,HTN,CVD,etc.) | |
| 307 Maternal HIV status 1-reactive | |
| 2-non reactive | |
| 3-uknown | |
| 308 History of perverse neonatal 1-yes 3-uknown | |
| mortality 2-no | |
| 309 History of neonatal complication 1-yes 3-uknown | |
| 2-no | |
| 3010 History of maternal high rick 1 yes 2 no | |
| during pregnancy | |
| 3011 History of iron supplementation 1-yes 2-no 3-uknown | |
| during pregnancy | |
| 3012 Duration of labor Write the duration in hours | |
| 3013 Duration of rapture of membrane | |
| in hourwrite the duration in hours | |

Declaration

I the undersigned, declare that this thesis is my original work, where my work is indebted to the work of others, it has not been accepted or presented for a degree in this or any other university and that all source of materials used for the thesis have been fully acknowledged

Name of Investigator: Workineh Gedamu

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Date of submission_____

This thesis has been submitted for examination with my approval as University advisor

Name and signature of the first advisor

Name and signature of the second advisor

Name and signature of the external examiner

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