

**ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF ALLIED HEALTH SCIENCES
DEPARTMENT OF NURSING & MIDWIFERY**

**PREVENTABLE CAUSES OF NEONATAL MORTALITY AND ASSOCIATED FACTORS
AMONG NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNITS OF
ADDIS ABABA GOVERNMENTAL HOSPITALS FROM 2011-2015 GC: A
RETROSPECTIVE STUDY.**

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Abstract

Background: Ethiopia witnessed an unprecedented decline in under-5 mortality from 166 per 1000 in 2000 to 88 per 1000 live births in 2011; an average decline of 47%. But still today, approximately 42% of mortality in Ethiopia attributes to high neonatal deaths; which needs further action like implementing SDG.

Objective: To assess preventable causes and factors associated with neonatal mortality among neonates admitted to NICUs of Addis Ababa Governmental Hospitals from 2011-15GC.

Methods and materials: Facility based retrospective study was conducted at NICUs of public hospitals in Addis Ababa using secondary data of neonatal mortality among neonates admitted in Neonatal Intensive Care Units from 2011-2015 GC. The sampling has two stages and the overall design effect of 1.5 was considered. Data was collected using the data extraction checklist after conducting pre-test. Then the collected data was coded and entered in to Epi data of version 3.1 and exported to SPSS for windows version 21.0 for cleaning, editing, and analysis. Binary and multiple logistic regressions have been used to observe the association between independent variables and dependent variable.

Result: The study included 561 neonates died after admission to NICUs in Addis Ababa Governmental Hospitals and data was collected for different variables of interest like obstetrics and gynecologic related, medical problems on admission including time of death to find significant association with neonatal mortality. The likely of dying from sepsis(recorded cause of death) within 7-28 days was 1.8 times more likely as compared to likely of dying within first week of life (AOR=1.81, 95% CI: 1.119-2.934, P=0.016). In the same way, The likely of dying from hypothermia within 7-28 days was 1.68 times more likely as compared to likely of dying within first week of life (AOR=1.68, 95%, CI: 1.054-2.67, p=0.029)

Conclusion and Recommendation: In general, the study has found significant association of neonatal mortality with hypothermia and sepsis which are both potentially preventable. The concerned bodies are then recommended to focus on general respective preventive mechanisms.

Key words: Neonatal Mortality, Perinatal Mortality, Causes of Death in NICUs.

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Acronyms and abbreviations

EDHS: Ethiopian Demographic Health Survey

GC: Gregorian calendar

GC: Gregorian calendar

IMR: Infant Mortality

MRN: Medical Record Number

NGOs: Nongovernmental organizations

NICU: Neonatal Intensive Care Unit

NM: Neonatal Mortality

OR: Odds ratio

PNM: perinatal Mortality

RDS: Respiratory Distress Syndrome

SDG: Sustainable Development Goal

UNICEF: United Nations International and Children's Emergency Fund.

WHO: World Health Organization

CHAPTER 1: INTRODUCTION

1.1. Background

The neonatal mortality rate (NMR), defined as the annual number of deaths less than 28 days of age per 1000 live births, is an important indicator of health(1–4). It is also considered as a key indicator of population health, being associated with socio-economic conditions, quality of and access to medical care(3,5). It has a close relation to infant mortality rate (IMR), which is used as major indicator of the quality of life of a population and can be broken down into two components: neonatal and post neonatal mortality (1, 2).

Neonatal mortality includes all deaths occurring before the 28th day of life, whereas post-neonatal mortality encompasses all deaths occurring between the 28th day of life and the day before the child's first birthday. This could be further subdivided into early (occurring before the seventh day of life) or late neonatal mortality (occurring thereafter). The subdivision is necessary, because the causes of early and late neonatal mortality are distinct. The extent to which the neonatal component contributes to overall infant mortality is proportional to the development status of each country, as improved social and environmental conditions lead to reductions in post neonatal mortality (6).

The majority of the developing countries in the world have been given highest priority for reducing child mortality in the first few years of life(less than five years child) (7). The Every Newborn Action Plan, launched in June 2014, provides a stimulus to accelerate progress by implementing effective cause-specific interventions that can rapidly reduce neonatal mortality (8). More over the Sustainable Development Goals (SDGs) are intended to be universal in the sense of embodying a universally shared common global vision of progress towards every aspects of life for all human beings to thrive on the planet and planned to be fully implemented by 2030 GC. All of the SDGs are relevant and apply in general terms to all countries including developed countries. Accordingly, Goal 3 ensure healthy lives and promote well-being for all at all ages especially neonatal age group contributing to more death (9).

Ethiopia is the second most populous country (with population grows at a rate of 2.6% per annum) in Africa after Nigeria whose the majority of people live in rural areas(10). High mortality, high fertility, and low life expectancy characterize the country's demography, like most sub-Saharan African countries. In the past decade, however, the country witnessed an unprecedented decline in under-5 mortality from 166 per 1000 in 2000 to 88 per 1000 live births in 2011; an average decline of 47%. But still today, approximately 42% of mortality in Ethiopia contributes to high neonatal deaths; which needs further action like implementing SDG even though application of this plan will have different challenges of various aspects (9,11).

1.2. Statement of the problem

Globally, about 6.6 million children die before their 5th birthday each year, 5 million of this occurs in the first year of life and nearly 3 million die within the first 28 days of birth. This indicates that about 44% of under-five deaths and 60% of infant deaths account for the neonatal mortality. Moreover, the share of neonatal mortality from the under-five death rose from 37% in 1990 to 44% in 2009 (12). Among the four million neonatal deaths across the world; 3 million of these deaths occur in the early neonatal period i.e., in the first week of life (9). Every minute 37 newborns die worldwide, representing 37% all infant mortality(13). Neonatal mortality (NM) until nowadays is still the highest mortality in human life, among these deaths around 50-60% occur during the first week of life is associated with preventable causes (14–16). According to World Health Organization data, 7.3 million of perinatal deaths take place annually and 300,000 of them in developed countries. The remaining 7 million deaths occur in lesser developed countries, of which it is estimated that between 40 and 50% occur during the first seven days of life(17).

The top ten contributing countries of the world to neonatal deaths are India (27%), China (10%), Pakistan (7%), Nigeria (6%), Bangladesh (4%), Ethiopia (4%), Democratic Republic of the Congo (3%), Indonesia (2%), Afghanistan (2%) and United Republic of Tanzania (2%) and these accounts for 67% of neonatal deaths. Since causes of neonatal death vary by country and with the availability and quality of health care, understanding neonatal mortality in relation

to these factors is crucial. Globally, the main direct causes of neonatal deaths are preterm birth (28%), severe infections (26%), asphyxia (23%) and neonatal tetanus (7%) (14). As PMR and NMR designates fetal and neonatal deaths influenced by prenatal conditions and circumstances surrounding delivery which could in turn help in anticipating prenatal problems and taking prompt preventive therapeutic measures (1).

It is currently known that the study of risk factors for infant mortality is very important, as particularly in the newborn, it can be considered one of the best quality indicators for health care, as well as an indicator of population, social and economic welfare which is determined by multiple and complex factors related to biological, substantial and social-economic variables, mainly in its neonatal component(5,18,19). There is broad consensus in the literature that neonatal mortality is due to a close, complex relationship between biological, socioeconomic, and care-related variables (6,19).

Identifying and understanding these factors which include low and very low birth weight, preterm or very preterm birth, adequate prenatal care, and adequate care during delivery and labor can lead to a reduction in neonatal mortality rates. Studies meant to assess the influence of these variables on neonatal mortality may have descriptive designs which means fall in short to explain association (10). Most infant deaths occur in the perinatal and neonatal periods, mostly due to prematurity, hypothermia, hypoglycemia, intrauterine growth retardation, and congenital causes; later deaths are more likely to be the result of infection. It may be useful to identify risk factors that predict early infant mortality, especially those that have the potential for intervention with modest resource(12,20). The major causes of neonatal deaths globally were estimated to be infections (35%), pre-term births (28%) and asphyxia (23%). Sepsis is the commonest cause of neonatal mortality and is probably responsible for 30-50% of the total neonatal deaths each year in developing countries(14,21).

Considering the major cause of death, obstetrical variable, maternal age 35 or more and maternal age under 18 ,respiratory insufficiency of prematurity are found to play the major

role (1,12,22). Studies identified modifiable risk factors like maternal age (age at the pregnancy), maternal obesity, chronic diseases, infection, substance misuse, multiple deliveries, living in deprived area gestational age/weight (small or large for gestational age), gender of infant (male preponderance) (17,18). With identification of risk factors, it is possible to prevent, particularly aiming the improvement of newborn children care. Here, neonatal intensive care units (NICUs) surge as hope, and one of the most effective tools to face this country's newborn mortality for treating newborns with a group of birth problems (5). According to the 2011 Ethiopia Demographic and Health Surveys (DHS) Ethiopia is among the countries with the highest neonatal mortality with the rate of 37 deaths per 1000 live births comparable to the average rate of 35.9 per 1000 live births for the African region overall. In spite of many efforts by the government and other partners, non-significant decline has been achieved in the last 15 years (10). The causes of neonatal mortality are not well documented in Ethiopia, but there are few studies those report causes such as sepsis, asphyxia, birth injury, tetanus, preterm birth, congenital malformations and unknown (11). As it is known the neonatal mortality is high in Ethiopia which is 37 per 1000 live births (10). Despite of this, little is known about factors affecting neonatal mortality in Ethiopia among those admitted to NICU.

The researcher of the study believe that preventable causes of neonatal mortality are serious problem in Ethiopia, and hypothesized as there are preventable causes of neonatal mortality and associated factors among neonates admitted to NICUs of governmental hospitals in Addis Ababa. As a result the researcher posed questions as:

What are preventable causes of mortality among neonates died after admission to NICUs of Governmental Hospitals in Addis Ababa?

What are sociodemographic factors associated with neonatal mortality in NICUs of Governmental Hospitals in Addis Ababa?

What is association between preventable causes and time of neonatal mortality among neonates died after admission to NICUs of Governmental Hospitals in Addis Ababa?

Therefore, the purpose of this study was to assess preventable causes of neonatal mortality and associated factors among neonates admitted to neonatal intensive care units of Addis Ababa governmental hospitals.

1.3. Significance of the study

Little is known about factors affecting neonatal mortality in Ethiopia among those admitted to NICUs. Therefore, this study have positive impact in decreasing the neonatal mortality by providing information helpful for programming and policy improvement in identifying associated factors determinants to neonatal mortality. Accordingly, study has identified the specific factors namely, sepsis and hypothermia having significant association with neonatal mortality. This helps the health professionals to take special consideration on general preventive mechanisms of these factors. Similarly, finding is helpful for policy makers in filling the gap of preventing these specified factors aside from being a base line data for NGOs and other researchers interested in the area.

CHAPTER 2: LITERATURE REVIEW

2.1 Review of Empirical Literature

Ensuring the survival and well being of children is a concern of families, communities and nations throughout the world(23). Infant mortality rates (IMR) are a useful measure to compare the health of populations worldwide and within individual geographic areas or populations (1). In the developed world, IMR has decreased dramatically in the past 100 years, since the turn of the 20th century infant and child mortality in more developed countries has steadily declined and, currently, has been reduced to almost minimal levels(4,23). Much of this change has been due to clean water, sewer systems, and vaccination programs, which have resulted in very large reductions in infant and childhood mortality from infectious illness. The decline in PMR and NMR had been declared in European and American literatures for the last decade, had been attributed primarily to the development of new technology and therapeutics such as new generation of ventilators, and pulmonary surfactant, thus providing a more aggressive respiratory and cardiovascular support at intensive care settings, while improvement in some developing countries had been attributed further to the improvement in socioeconomic and educational status(1).

In this context, it can be said that the emergence of NICUs brought a widened universe for newborn assistance, offering improved survival for those who, few years ago, wouldn't be likely to survive in spite of which mortality still 10 times higher in developing countries than in developed countries(12). Neonatal mortality remains a major contributor to death among children younger than 5 years in developing countries. It accounts for approximately 40% of all childhood mortality in resource-poor countries(24). Such countries have weak health metrics and systems, resulting in a paucity of perinatal and neonatal mortality information and a deficiency in quality of available data(25).

Each year, 7 million neonates globally are stillborn or dying within 30 days of birth (neonatal period). Nearly 99% of these neonatal deaths occur in low- and middle-income countries, mostly in sub-Saharan Africa, including Nigeria. Globally, Nigeria ranks second to India with

the highest number of neonatal deaths, with the highest reported number in Africa. The majority of these deaths are caused by preventable or treatable diseases, such as infectious diseases, which contribute to approximately 36% of these deaths(24).

About 472,000 Ethiopian children die each year before their fifth birthday, which places Ethiopia sixth among the countries of the world in terms of the absolute number neonatal deaths , despite of the existence of low cost effective interventions to prevent two-thirds of these deaths(26). Maternal factors, which are biological attributes of birth, such as the age of mother at the time of childbirth, birth order and birth interval (23). Reducing Neonatal mortality requires that interventions be readily accessible and available in the immediate perinatal period(25). It has been proposed that the performance of a health system should be measured primarily by the effect on mortality. Most of the burden (99%) occurs in low- and middle-income countries. Intrapartum-related neonatal mortality rates are 25-fold higher in the lowest income countries and intrapartum stillbirth rates are up to 50-fold higher. Maternal risk factors and delays in accessing care are critical contributors and thus perinatal is a care good marker of the performance of any health system(18,24,27).

In achieving this goals, Public health policies focuses on improving neonatal and infant survival rates by a thorough understanding of the factors contributing to neonatal and infant mortality (12). The easy access to these secondary data, along with the wide coverage and good quality of information, have allowed for the development of simple low-cost studies for investigating factors associated with infant mortality. Most of these studies are restricted to a descriptive analysis of the data, although analytical studies have been carried out based on these databases in general, in developing countries, there is very little information on the causes and factors associated with perinatal mortality (12). The lack of extensive and uniform multinational data, however, has constrained international comparisons(4).

There is broad consensus in the literature that neonatal mortality is due to a close, complex relationship between biological, socioeconomic, and care-related variables. This factors are

generally classified as associated factors (level 1), maternal (level 1) neonate (related (level 3) and others (level 4). Several studies have examined the role of risk factors for infant mortality(23). Others have identified risk factors for low birth weight, prematurity, and intrauterine growth retardation that are strongly associated with infant mortality(22). Maternal characteristics, labor, and delivery are associated more strongly with perinatal and neonatal mortality; Environmental factors are associated more strongly with later infant mortality. In spite of technical advances that have increased survival of children in developing countries, infant mortality rates are still at least 10 times higher in developing countries than in developed countries, most infant deaths occur in the perinatal and neonatal periods, mostly due to prematurity, intrauterine growth retardation, and congenital causes; later deaths are more likely to be the result of infection (12). It may be useful to identify risk factors that predict early infant mortality, especially those that have the potential for intervention with modest resources. Some studies have evidenced the importance of socioeconomic factors in determining infant mortality. Other studies address healthcare during gestation and delivery, however, low birth weight is the strongest determinant of infant mortality, and is frequently associated with both neonatal and post-neonatal components (18).

Neonatal mortality (NM) is more linked to biological factors such as congenital anomalies and it is particularly sensitive to proximal determinants (i.e. life-styles of the mother during the prenatal period, mode of delivery and the care given to mothers and their babies).Post-neonatal mortality (PNM) is more influenced by distal determinants, parental circumstances (like education and income) and the care they provide for their infant (3). The five leading causes of neonatal deaths from the hospital were acute respiratory distress, bacterial sepsis of the newborn, birth asphyxia, prematurity, and brain hemorrhage (subarachnoid hemorrhage) due to the trauma of the head of the fetus. Examining the specific causes of death provides additional insight and enables care providers and researchers to focus improvement efforts on areas that are likely to provide the greatest benefit(25).

Premature birth remains one of the most significant causes of neonatal death but mortality from both hyaline membrane disease and sepsis is declining(28). Furthermore, although the

proportion of deaths attributable to congenital malformations has remained relatively constant, deaths from neural tube defects have declined significantly; however, certain chromosomal abnormalities may be increasing. Thus, the results of published studies would seem to indicate that there have been important changes in the causes of neonatal mortality despite static mortality rates. Newborns admitted to centers that offer specialized medical or surgical care represent an important sub-group of infants who have higher mortality rates and likely have a different profile of specific causes of death than those admitted to perinatal centers (29). Neonatal septicemia is one of the commonest causes of neonatal mortality and morbidity throughout the world, it is estimated that 20%(10).

Poverty is influencing the likelihood of infant death through two general mechanisms: increasing of risk, and reduction of access to (preventive and therapeutic interventions) that may be effective in minimizing the impact of the elevated risks. Elevated maternal and fetal risk can include increased prevalence of medical conditions (e.g., hypertension), demographic factors (e.g., young maternal age), or adverse maternal behavior (e.g., smoking and drug abuse). Reduced access implies socially-determined differences in the use of interventions capable of improving neonatal outcomes (4).

Parity was associated with mortality during all periods up to 24weeks of age, although the association was strongest for deaths in the first week of life. Numerous studies have shown that primiparous have higher mortality than multiparous pregnancies(30). This increase was not seen in our study for those with a parity of five or more(18,25). Miscarriage of the previous pregnancy was a risk factor for mortality in the first week of life but not thereafter, whereas a history of mortality for live-born children was associated more strongly with infant mortality beyond the neonatal period(31). Early deaths are more likely to be associated with prematurity, and this would have a stronger association with previous miscarriage than previous child deaths(32). Apart from maternal and paternal education, socioeconomic factors were not important predictors of mortality(23). This maybe because more proximate factors were controlled for or because the variation in socioeconomic status in this community was relatively small compared with other studies (18,33).

Available data shows that there has been no measurable reduction in early neonatal mortality in Sub-Saharan Africa (SSA) over the last decade, and the gap between the rich and the poor continues to widen(13,30). Hence reducing neonatal deaths, especially early neonatal mortality is crucial to meeting SDG. However, evidence shows that most of the neonatal deaths are linked to maternal problems especially those related to the management of the intra-partum period. A solution addressing both maternal and newborn health is cost-effective. Most of these efforts are based on global recommendations. Moreover, most of the evidence is based on small scale studies from Asia and a few from South America, and none to date from SSA. In fact, WHO and UNICEF have already recommended community based interventions through home visits as one of the key strategies(13).

According to the study conducted in India by analyzing variables ; sex, birth weight, gestational age, maternal age, place of delivery, mode of delivery, and sepsis by using Chi square and binary logistic regression with 95% confidence intervals (CI), Results Out of 841 neonates; the mortality rate was 212 (25.2%). Univariate logistic regression revealed that the significant risk factors for neonatal mortality were preterm (OR 4.41; 95%CI 4.24 to 4.57; P=0.0001), low birth weight (OR 4.30; 95%CI 4.13 to 4.47; P=0.0001), sepsis (OR 2.99; 95%CI 2.81 to 3.17;1.70), and non-spontaneous delivery (OR 1.67; 95%CI 1.50 to 1.84)(34).

It is important that LBW babies are provided with scientifically sound, best, low cost, humane and comprehensive method of care. KMC meets the needs of warmth, nutrition and protection from infection with multimodal stimulation and humanizing high technology to achieve improvement in survival, morbidity and appropriate growth and development of LBW infants who are thermodynamically stable and are weighing between 1800 gm to 2000 gm (13).

KMC substantially reduces neonatal mortality amongst preterm babies (birth weight <2000 g) in hospital, and is highly effective in reducing severe morbidity, particularly from infection. However, KMC remains unavailable at-scale in most low-income countries(35).

According to study conducted on 194 countries from 2000-2013 out of the 2.76 million neonatal deaths in 2013, 0.99 (uncertainty: 0.70-1.31) million (35.7%) were estimated to be from preterm complications, 0.64 (uncertainty: 0.46-0.84) million (23.4%) from intrapartum-related complications, and 0.43 (0.22-0.66) million (15.6%) from sepsis. Preterm (40.8%) and intrapartum-related (27.0%) complications accounted for the majority of early neonatal deaths while infections caused nearly half of late neonatal deaths. In every region, preterm is the leading cause of neonatal death, with the highest risks in Southern Asia (11.9 per 1000 live births) and Sub-Saharan Africa (9.5). The neonatal cause-of-death distribution differs between the early and late periods, and varies with NMR level and over time. To reduce neonatal deaths, this knowledge must be incorporated into policy decisions. The Every Newborn Action Plan provides stimulus for countries to update national strategies and include high-impact interventions to address these causes(8).

According to the World Health Organization low birth weight (LBW) babies are those born with less than 2500g. A descriptive retrospective cross - sectional study using existing data from a one-year (2001) block of birth registers of 3464 pregnant women was done at Kilimanjaro Christian Medical Centre in Moshi, Tanzania. The objective was to determine factors associated with LBW and their contribution to the problem. Out of 648 pregnant women who were tested for HIV infection 59 (9.1%) were positive for the infection. Twelve (20.3%) of HIV positive women gave birth to LBW neonates. HIV positive women were twice more likely to give birth to LBW infants than HIV negative ones ($\chi^2= 6.7$; $P<0.01$; OR = 2.4; 1.1, 5.1). There is a statistical significant difference between the proportions of LBW infants from mothers who did not receive antenatal care (28.6%) and those who attended the services (13.8%) ($\chi^2= 8.8$; $P= 0.01$). There is need of increasing promotion of reproductive health services in relation to safe motherhood at community level in order to reduce risk factors of LBW. Generally the risk of neonatal mortality for LBW infants is 25 to 30 times greater than for infants with birth weight exceeding 2500g, and it increases sharply as birth weight decreases(36).

The study conducted in Uganda revealed that among 809, neonates admitted during the study period, 68% (490/717) of whom were in born, the most common admission diagnoses were infection (30%, 208/699), prematurity (30%, 206/699), respiratory distress (28%, 198/699) and asphyxia (22%, 154/699). Survival to discharge was 78% (578/745). Mortality was inversely proportional to birth weight and gestational age (P-value test for trend <0.01). This was true for both inborn and out born infants ($p < 0.01$). Out born infants were more likely to be preterm (44%, (86/192) vs. 33%, (130/400), P-value <0.01) and to be low birth weight (58%, (101/173) vs. 40%, (190/479), P-value <0.01) than inborn infants. Out born neonates had almost twice the mortality (33%, 68/208) as inborn neonates (17%, 77/456) (P-value <0.01)(37).

Other significant factors that affected neonatal deaths included neonates born to mothers younger than 20 years (2.83–5.86), neonates born to mothers residing in rural areas compared with urban residents (CI: 1.03–1.55), male neonates (CI: 1.12–1.53), mothers who perceived their neonate's body size to be smaller than the average size (CI: 1.77–2.50), and mothers who delivered their neonates by caesarean section (CI: 1.84–4.25)(37).

Despite this unbelievable magnitude of avoidable premature deaths, historically neonatal health was a forgotten area left in the cracks of safe motherhood and child health programs. The five topmost causes of neonatal deaths within the period were: prematurity, birth asphyxia, neonatal sepsis, neonatal jaundice, and respiratory distress(38).

Birth asphyxia deaths (9.7/1000.0 live births) accounted for 30% of neonatal mortality. Ante partum risk factors for birth asphyxia mortality included low paternal education, Madeshi ethnicity, and primiparity. Facility delivery; maternal fever; maternal swelling of the face, hands, or feet; and multiple births were significant intrapartum risk factors for birth asphyxia mortality. Birth asphyxia is defined by the World Health Organization as “the failure to initiate and sustain breathing at birth”(23,28).

Hypothermia 5 minutes after birth and at NICU admission was noted in 44% and 51%, respectively, with 6% of early neonatal deaths. Hypothermia at NICU admission increased the chance of early neonatal death by 1.64-fold (95% CI 1.03-2.61)(39).

Diseases contributing to neonatal death were prematurity LBW (27.4%), respiratory distress (20.6%) and birth asphyxia (17.3%). Overall, survival and mortality was 803 (78.7%) and 192 (18.8%) respectively. Mortality was significantly higher in the first 24 hours of admission and among neonates with LBW ($p < 0.05$). Neonate's birth weight, maternal education, parity and breastfeeding was significantly associated with outcome of care(25).

The total number of delivery in Misurata hospital in 2013 was 6199 births out of which 6135 were live births. Among the live births, 610 babies were admitted to neonatal ICU after delivery. Total number of death in NICU were 84 babies, neonatal mortality in NICU were 13.7%. 67 babies (10.9%) died in the first week of life and 46% (39) of the first week deaths died in the first 24 hours. The main reasons of admission to neonatal unit were preterm delivery, sepsis, meconium delivery, birth asphyxia, and congenital malformation. Perinatal mortality rate was 21.1/1000 total births (51% death in the first week of life and 49% still birth) where as main causes of early neonatal deaths were RDS 48%, congenital malformation 22%, neonatal sepsis 12%, CHD 12% and birth asphyxia 4%. While, the main cause's of late neonatal deaths were neonatal sepsis 59%, congenital malformation 17%, birth asphyxia 12%, CHD 6% and Intravascular hemorrhage 6%. About 24 (29%) of death were full term and 60 (71%) were PT, 29% of these PT between 32-36weeks gestation, 21% between 24-28 weeks and 14% between 28-32weeks gestation. Regarding birth weights, 37% of death their weight <1.5 Kg, 13% more than 3 Kg, 21% between 1.5-2 Kg, 9% between 2-2.5 Kg and 20% were between 2.5-3 Kg. The study concluded that vast majority of perinatal mortality is secondary to preterm delivery, Low birth weight, birth asphyxia, sepsis and congenital anomalies, which usually increased in presence of maternal risk factor(31).

Improvements in antenatal management and neonatal intensive care over the past 10 to 15 years have changed the prognosis for preterm infants. More than 85% of infants born at 25 weeks' gestation now survive their preterm birth. This has resulted in a dramatic change in the populations of infants occupying neonatal intensive care beds. The average length of stay for a term or near-term infant who has surgical or respiratory problems is about 15 days; the length of stay for preterm infants born at 26 weeks' gestation is more than 2 months. The duration of hospitalization is inversely related to gestational age. The population of extremely low-birth weight (ELBW) infants who remain hospitalized for extended periods of time (and who undergo numerous invasive procedures) is most susceptible to nosocomial infections. Nosocomial infections are defined as those that occur beyond 48 hours after birth and are caused by pathogens that are not maternally derived. Such infections are 100 times more common than early-onset bacterial infections, which are caused by pathogens acquired in utero or perinatally(40).

According to the information collected on live births from the 2000, 2005 and 2011 EDHS, neonates born to women with secondary or higher schooling vs. no education had a lower risk of dying (95% CI, 0.49–0.95). Compared with neonates in Addis Ababa, neonates in Amhara (95% CI: 1.26–2.83), Benishangul Gumuz(95% CI: 1.15–2.67) and Tigray (95% CI: 1.01–2.34) regions carried a significantly higher risk of death(11).

The study conducted in Jimma on 3463 live births using multivariate models, revealed that Miscarriage in the previous pregnancy predicted mortality in the first week of life (OR =1.98, 95% CI = 1.37–2.87. In the same study, the status of neonatal mortality rate was 35.5 (95%CI: 28.3, 42.6) per 1000 live births. Individual level variables such as birth order, frequency of antenatal care use, delivery place, gestation age at birth, premature rupture of membrane, complication during labor, twin births, and size of neonate at birth and neonatal care practice were identified as determinants of neonatal mortality. Birth asphyxia (47.5%), neonatal infections (34.3%) and prematurity (11.1%) were the three leading causes of neonatal mortality accounting for 93%(10).

185 neonates were enrolled in the study and 10.5% died before the 28th day of life. Variables that were significantly associated to neonatal death by the Cox regression analysis model were birth weight <1500g, 5th minute Apgar score <7, mechanical ventilation and previous still birth(6).

The perinatal mortality rate at Fallujah General Hospital during the year 2010 was 50.3/1000 of total birth, while neonatal mortality was 41.5/1000 of total live birth. Obstetrical variable showed that 74.1% of neonatal death had mothers of age 20 - 35 years and 16.5% were >35 years and only 9.3% had mothers <20 of age. In regard to mode of delivery 60% of neonatal deaths were delivered spontaneously versus 40% delivered by cesarean section(1).

Sudden infant death syndrome accounted for 33% of all infant deaths in the AAIHS, Prematurity was the second most prevalent cause-specific mortality category, accounting for 22% of all infant deaths. The authors found that infant mortality was surprisingly recurrent, with 32% of mothers of this infant having had a previous infant death(6). Factors related primarily to the newborn and the hospitalization (except corticosteroids therapy) were identified to be associated with mortality, highlighting a possible protective factor of phototherapy and the risk for very low birth weight infants(5).

The Ethiopian neonatal mortality rate constitutes 42% of under-5 deaths(11,16). 99% of the approximate 1 million annual neonatal deaths from life-threatening invasive bacterial infections occur in developing countries, at least 50% of which are from home births or community settings which could greatly affects the number of deaths records (41).There is a general dearth of studies on neonatal mortality in Ethiopia, which significantly limits our understanding of the breadth and depth of the problem for evidence-based programming(8). Therefore this study is aimed to provide information on preventable causes of neonatal mortality and associated factors among those admitted to neonatal intensive care unit.

2.2. Conceptual framework

The figure below shows the effect of independent variables labeled as level 1-level 4, on the outcome variable; neonatal mortality. These variables directly (level 2, 3 & 4) and indirectly (level 1) will have impact on neonatal mortality whose significance of association is to be identified.

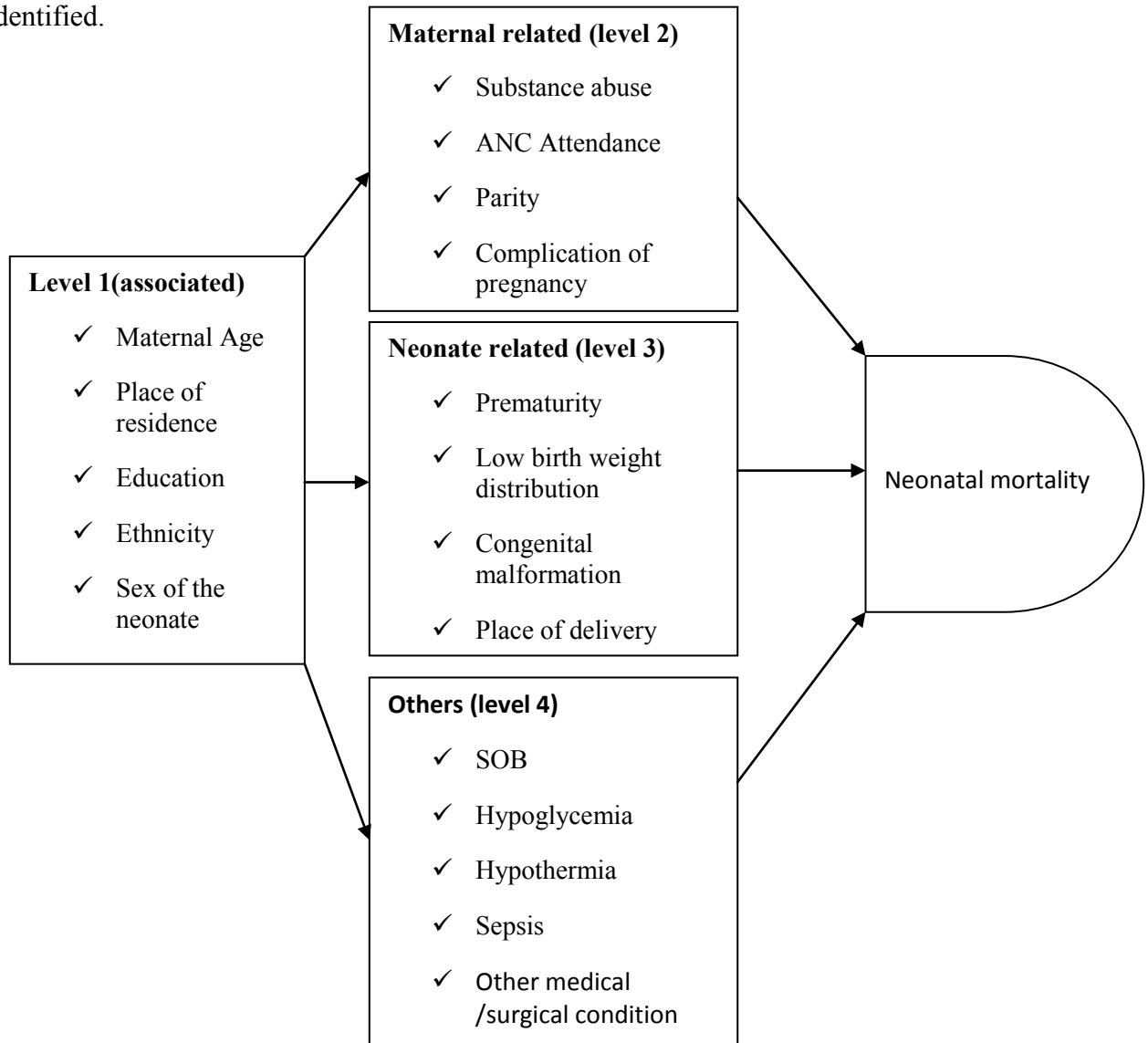


Figure 1: Conceptual framework adopted and modified from literature review (3,5,11)

CHAPTER 3: RESEARCH OBJECTIVES

3.1. General objective

To assess preventable causes and factors associated with neonatal mortality among neonates died after admission to NICUs of Addis Ababa Governmental Hospitals from 2011-15GC.

3.2. Specific objectives

1. To describe preventable causes of mortality among neonates died after admission to NICUs of Governmental Hospitals in Addis Ababa from 2011-15GC.
2. To identify sociodemographic factors associated with neonatal mortality in NICUs of Governmental Hospitals in Addis Ababa from 2011-15GC.
3. To determine the association between preventable causes and time of neonatal mortality among neonates died after admission to NICUs of Governmental Hospitals in Addis Ababa from 2011-15GC.

CHAPTER 4: METHODS AND MATERIALS

4.1. Study design, period and setting

Facility based retrospective study was conducted at NICUs of Governmental hospitals in Addis Ababa using secondary data (registration book) of neonatal mortality among neonates admitted in Neonatal Intensive Care Units from 2011-2015 G.C. The study was conducted from February one to February thirty 2016G.C. Addis Ababa has ten sub-cities at which the City lies at an altitude of 7,546 feet (2,300metres) and is a grassland biome, located at 901°48'N38044°24'E9.030N38.740E. The city is surrounded by Oromia liyu zones in all directions. It has twelve governmental and nine nongovernmental hospitals .From 12 governmental hospitals six of them (backline, Paulos, Gandhi, yekatit, zewditu and Tirunesh Beijing have NICUs; among these three of them are selected. The followings are the three selected hospitals for the study.

1. Black lion specialized referral hospital is the one and it has 600 beds in medical, gynecological and obstetrics, surgical, pediatrics and emergency departments and facilitated with the outpatient department (OPD) and it has also 7 x-ray, 9 surgical and 3 laboratory diagnostic rooms. The hospital has also specialized units (referral clinics) and these are chest, renal, neurology, cardiology, dermatology, gastro intestine, infectious disease, orthopedics, general surgical, gynecologic and obstetrics, diabetic, hematology, medical intensive care unit (ICU) and surgical ICU units. Black lion specialized referral hospital offers diagnostic and treatment for approximately 370,000 to 400,000 patients per year and there are around 715 nurses.

2. Gandhi memorial specialized hospital is located at the center of Addis Ababa and founded in 1951 E.C on the 6225 m² land during the 21st coronation of Imperial Hailesilassie former Emperor of Ethiopia. Currently the hospital has around 248 total man powers who deliver service to the community. The composition contains 13 doctors, 136 diploma and degree nurses and 98 other health professionals and the rest administrative staff dedicated to providing health care

services. The hospital have a total number of 128 bed categorized into four class based on case served as first class, second class ,class prenatal ward and emergency.

3. Zewditu Memorial Hospital Zewditu Memorial Hospital is one of the governmental hospitals in central Addis Ababa kirkos kifleketema. It was built, owned and operated by the Seventh day Adventist Church, but was nationalized during the Derg regime in about 1976. The hospital is named after Empress Zewditu, the cousin and predecessor on the throne of Emperor Haile Selassie. Today Zewditu Hospital is operated under Addis Ababa health bureau and it is Ethiopia's leading hospital in the treatment of ART patients and currently became the largest HIV clinic in Ethiopia. The hospital has annual delivery of 1800 new born and it has NICU with an average admission of 110 new born per month.

4.2. Source population

A collection of all medical charts (records) of neonates died after admission to Neonatal Intensive Care Units of Governmental hospitals in Addis Ababa from 2011-2015 GC.

4.3. Study population

A collection of selected medical charts (records) of neonates died after admission to Neonatal Intensive Care Units of the three selected Hospitals, namely: Black Lion Specialized Hospital, St. Paulo's Hospital & Gandhi Hospital from 2011-2015 GC.

4.4. Eligibility criteria

4.4.1. Inclusion criteria

All medical charts (records) of neonates died after admission to Neonatal Intensive Care Units during 2011-2015 G.C in the three selected Hospitals.

4.4.2. Exclusion criteria

Medical charts (records) of neonates died after admission to Neonatal Intensive Care Units during 2011-2015 G.C in the three selected Hospitals whose medical records were illegible and incomplete.

4.5. Sample size determination

Assumption

P: proportion of neonatal mortality from under five children to be 42%, taken from EDHS of 2011

Confidence interval 95% and

Marginal error 5% (tolerated error)

Formula for sample size calculation of single population proportion

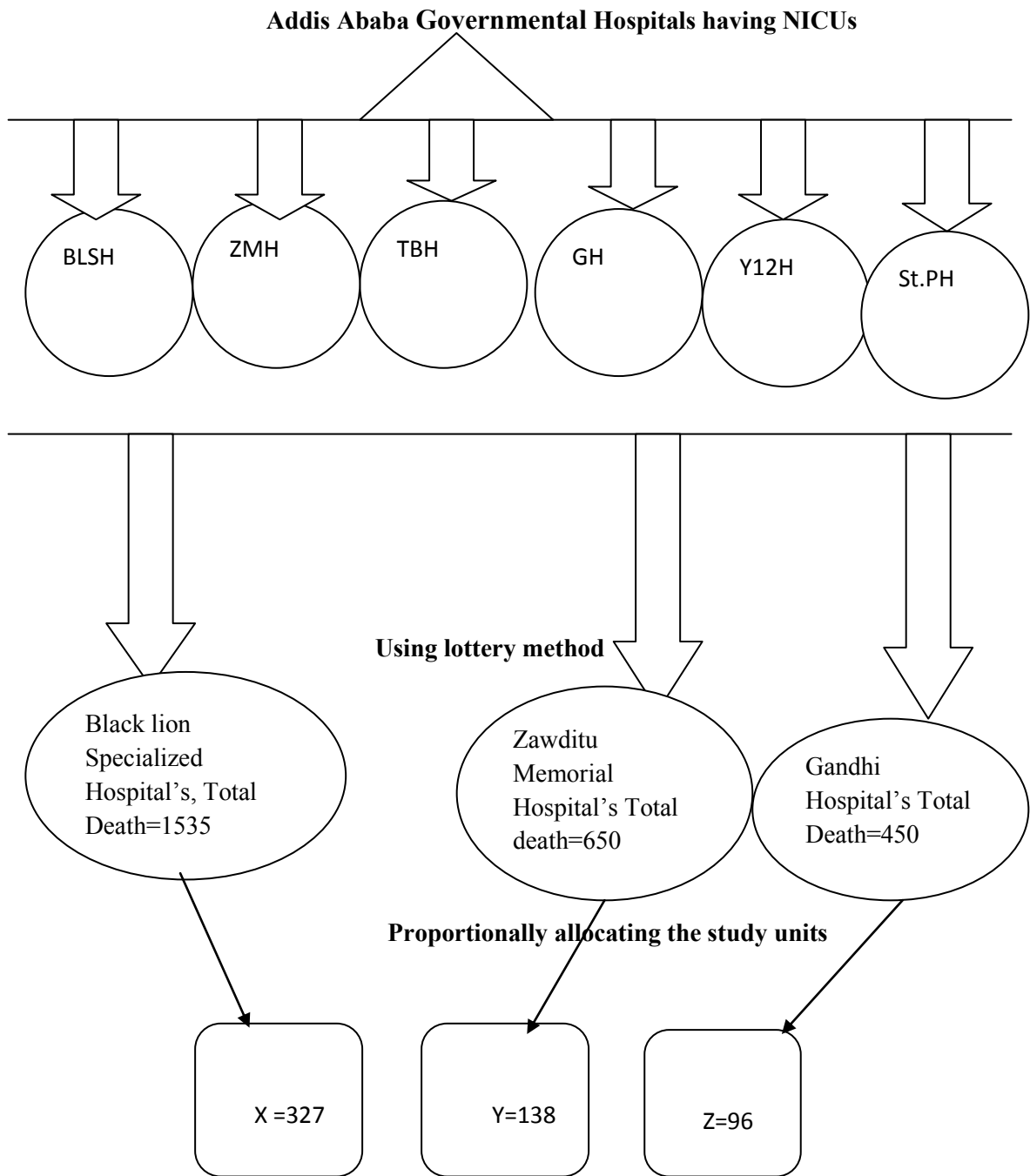
$$n = \frac{(Z_{\alpha/2})^2 p(1-p)}{d^2}$$

$$= \frac{(1.96)^2 (0.42)(0.58)}{(0.05)^2} \approx 374$$

The final sample size, considering the design effect of 1.5 was $1.5 \times 374 = 561$.

4.6. Sampling technique and procedure

There are six hospitals in Addis Abba having Neonatal Intensive Care Units. These hospitals are Black Lion Specialized Hospital, Zewditu Memorial Hospital, Yekatit 12 Hospital, St. Paul Hospital, Gandhi Hospital, and Tirunesh Bejing Hospital. Among these, three of them namely: Black Lion Specialized Hospital, Zewditu Memorial Hospital and Gandhi Hospital were selected using the lottery method. During the study period, that means from 2011-2015GC, the total admission to Neonatal Intensive Care Units of the selected hospitals was 23115. Among these neonates, 2635 were died. Then proportional allocation to each hospital, 327, 138 and 96 study units respectively have been selected by using systematic sampling from the three selected hospitals. The sampling has two stages and the overall design effect of 1.5 was considered.



Then the study units were selected using systematic sampling technique using the frame (list of the medical record number of the charts from the registration book).

Figure 2: Schematic representation of sampling procedure

4.7. Sampling frame

List of all MRN of all medical charts (records) of neonates died after admission to Neonatal Intensive Care Units during 2011-2015 G.C in the three selected Hospitals. Then by using the systematic sampling technique the study units were selected from each selected hospital.

4.8. Study variables

4.8.1. Independent variables (explanatory variables)

4.8.1.1 Associated factors (Level)

Maternal Age

Place of residence

Education

Ethnicity

Sex of neonate

4.8.1.2. Maternal related factors (level 2)

Substance abuse

ANC attendance

Complication of pregnancy

Parity

4.8.1.3. Neonate related factors (level 3)

Prematurity

Low birth weight distribution

Congenital malformation

Place of delivery of neonate

4.8.1.4. Other factors (level 4)

Shortness of breathing (RDS)

Sepsis (infection)

Hypoglycemia

Hypothermia

Other medical/surgical condition

4.8.2. Dependent variable (Outcome variable)

Neonatal mortality

4.9. Operational definitions

Antenatal care visit: Any history of visit or follow up during current or index pregnancy at any health institution for check up of pregnancy and designated or recorded on chart.

Congenital malformation: Body deformity or deformities from the birth believed to have impact on health of the baby.

Hypoglycemia: A measure of low blood glucose that was diagnosed and recorded on charts by professionals on admission.

Hypothermia: Any low body temperature measurement diagnosed and recorded on charts during admission of neonates.

Premature: Any viable neonate before term (<37weeks of gestation) that was already diagnosed by professionals in charge on admission of neonate to neonatal intensive care units.

Sepsis: Record of Infection or sepsis diagnosed either clinically or with culture by professionals during admission of the neonate and as possible causes of death and designated or recorded on chart.

Shortness of breathing: Any respiratory problem, fast breathing, and or difficulty of breathing.

Preventable causes: Any cause that is potentially preventable and have directly related to neonatal death

Associated factors: Factors indirectly related to neonatal mortality

4.10. Ethical consideration

Letter of cooperation from institutional review board of Addis Ababa University, Department of Nursing and Midwifery was written to the three selected hospitals. After getting permission from the hospital administration, the request letter was written for the concerned bodies of respective

departments. Following this, searching and obtaining of the selected samples' medical record was processed with assigned person. Finally, strict care for the patients' medical records and the confidentiality of records that could identify study participants was protected. This has been achieved through anonymity and by abandoning the individually identifiable information, which specifically refers to identity of patient like MRN and coding was used instead.

4.11. Measurements and Data collection process

The training of two days was given for six nurses; three degrees and three diplomas. These trained data collectors used data extraction checklist adopted and modified from different literatures to collect information from medical charts(10,42). First of all, the medical charts of neonates died after admission to selected hospitals over five years (2011-2015 GC), were collected using sampling frame from registration book. Then using the checklist, sociodemographic characteristics of the mother, the medical problem during the pregnancy, place of delivery, gestational age, age of the neonate, medical problem and treatments were some of items included in the data extraction checklist. During the process, the principal investigator has supervised these trained data collectors.

The dependent variable for this study is neonatal mortality where as independent variables are grouped in to 3 levels i.e., level 1(maternal related factors), level2 (Neonate related factors) and level 3(other factors like those associated with treatment). These variables are listed under study variables under the preceding sub section. Note that levels are labeled simply regardless of degree of association.

4.12. Data Quality control

Pretest was employed on 5% of the sample size by using the data extraction checklist in Yekatit 12 Hospital with medical charts of neonates died after admission to Neonatal Intensive Care Unit during 2011-2015 G.C. This helped for modification of prepared tools to measure intended variables. In addition, the close supervision of data collectors by principal investigator was continued during the progress of data collection.

4.13. Data management and Analysis

After data was collected, coded and entered in to Epi data of version 3.1 and was exported to SPSS for windows version 21.0 for cleaning, editing, and analysis. Proportions and summary statistics were also computed. Binary and multiple logistic regressions were used to observe the association (p-value < 0.2 for binary and p-value < 0.05 for multiple) between independent variables and dependent variable. The logistic function was used to calculate the odds of dying with time death and written as

$$E(Y/Z) = \frac{e^z}{1 + e^z}$$

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \dots + \beta_n X_n$$

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ were regression parameters

$$\text{For model } y = \begin{cases} 0, & \text{if neonatal mortality occurred } < 1 \text{ week of age} \\ 1, & \text{if neonatal mortality occurred } > 1 \text{ week of age} \end{cases}$$

For explanatory variables

$$X_1 = \begin{cases} 1, & \text{if there was sepsis} \\ 0, & \text{if not} \end{cases}$$

$$\text{And written for } X_n = \begin{cases} 1, & \text{if there was } n \\ 0, & \text{if otherwise} \end{cases} \text{ where } n \text{ is all independent variable}$$

4.14. Result dissemination and Presentation

Finding has been presented and submitted to Addis Ababa University, department of nursing and midwifery and copy of the document has been dispatched to Addis Ababa Governmental hospitals, Addis Ababa Health bureau and Federal Ministry of Health. Presentation of the results on different scientific forums and Publication is also planned in the near future.

CHAPTER 5: RESULT

During the time of 2011-2015 GC, there were the total admissions of 23,115 neonates to Neonatal Intensive Care Units of the three selected hospitals. From these, 2635 were died. This means the proportion of death to total admission was 11.4%. Among the neonates died during the period, 561 were included in the study and the result is presented in subsequent sections.

Table 3 shows majority of mothers were in 18-35 reproductive age group and living in Addis Ababa, around 1/3 of the mothers were referred in to the facilities from outside of Addis Ababa.

Table 1 : Sociodemographic factors of mothers in Addis Ababa Governmental Hospitals from 2011-2015GC, Addis Ababa, 2016 GC (n=561).

Residence		Frequency	Percent
Addis Ababa		411	73.3
Outside of Addis Ababa		150	26.7
Age of mother	Less than 18 years	20	3.6
	18-35 years	507	90.4
	Greater than 35 years	34	6.1
Total		561	100.0

The figure 3 shows from 561 neonates included in the study, more than half of them were died between 7-28 days age and similarly, more than half of the neonates were male.

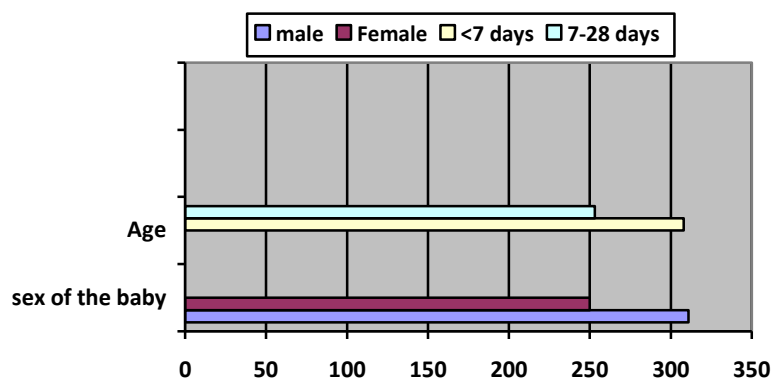


Figure 3 : Sociodemographic factors of neonates died after admission to Neonatal Intensive Care Units in Addis Ababa Governmental Hospitals from 2011-2015 GC, Addis Ababa 2016(N=561).

Table 2 shows more than half of mothers were primi gravid and most of them had no bad obstetric history. Similarly most of the women had regular follow up at antenatal care attendance and delivered at health institution by spontaneous vaginal delivery with rupture of membrane during intrapartum.

Table 2: Obstetrics and Gynecologic history of mothers in Ababa Governmental Hospitals from 2011-2015GC, Addis Ababa, 2016(N=561).

Variables		Frequency	Percentage
Parity	Primigravida	344	61.3
	Multigravida	217	38.7
Previous pregnancy outcome	Abortion	41	7.3
	Stillbirth	8	1.4
	Normal live birth	512	91.3
ANC Attendance	Regular follow up	416	74.2
	Incomplete(Not regular)	145	25.8
Multiple for current pregnancy	Yes	77	13.7
	No	484	86.3
Place of delivery	Home	13	2.3
	Institutional	548	97.7
Mode of delivery	Spontaneous vaginal delivery	366	65.2
	Other mode of delivery	195	34.8
Duration of rupture of membrane	Intrapartum	459	81.8
	Less than 18hrs	71	12.7
	Greater than 18hrs	30	5.3
Gestational age	Less than 37 weeks	381	67.9
	37-42 weeks	169	30.1
	Greater than 42 weeks	11	2.0

Figure 4 represents the weight distribution with only few of neonates with extremely low birth weight, majority of the neonates were with weight above 1500(76%).

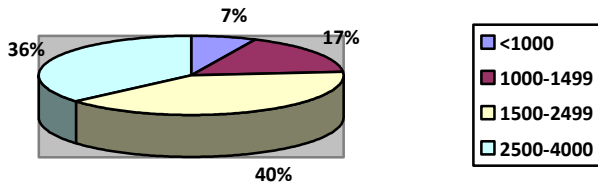


Figure 4: Weight (in grams) distribution of neonates admitted and died in Neonatal Intensive Care Units in Addis Ababa Governmental Hospitals from 2011-2015 GC, Addis Ababa 2016(n=561).

The figure 5 shows that most of the women were screened for infectious diseases and only some of the mothers were seropositive and few of them started on ART.

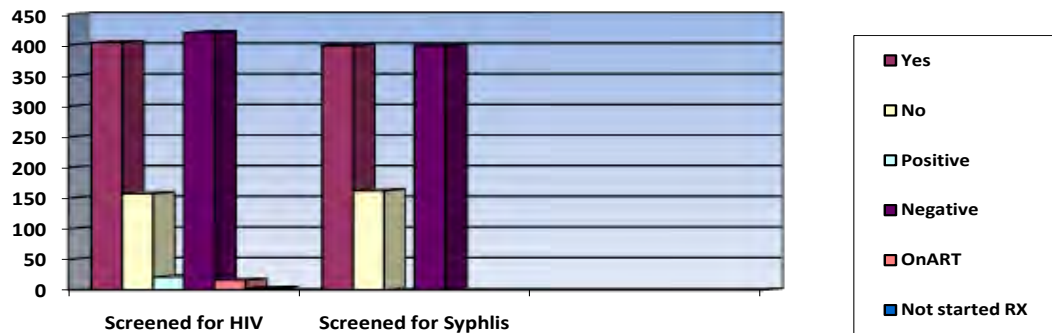


Figure 5 : Mothers screened for infectious diseases during pregnancy in Addis Ababa Governmental hospitals from 2011-2015 GC, 2016(N=561).

According to figure 6, 47(67.14%) mothers experienced pregnancy induced hypertension, amniotic fluid abnormality during pregnancy accounting for 10(14.28%) followed by seropositivity and bleeding during pregnancy.

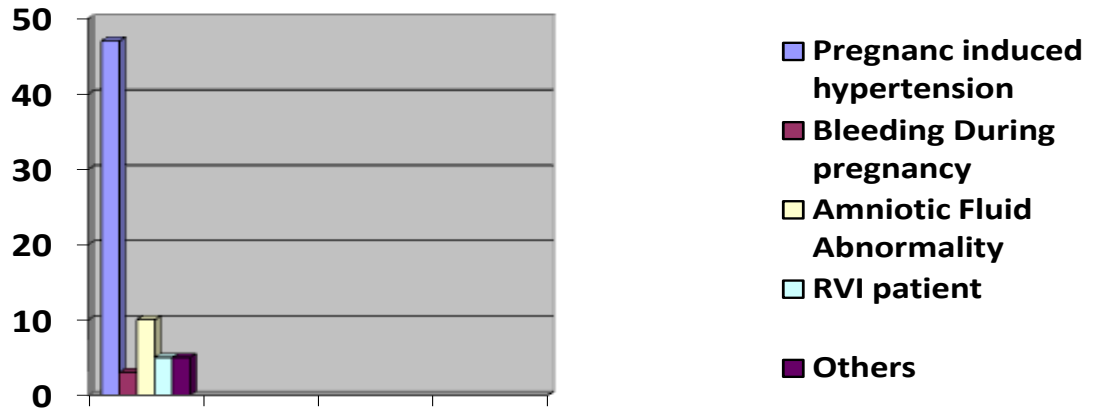


Figure 6: Pregnancy-related complications of mothers in Addis Ababa Governmental hospitals from 2011-2015 GC, Addis Ababa, 2016(N=70).

Table 3 shows majority of the neonates had low APGAR score both at 1st and 5th minute; but around ¼ and 1/3 of the neonates had APGAR score of greater than 7 at 1st and 5th minute respectively. For neonates delivered at home the APGAR score was unknown, and this accounts for 13(2.3%).

Table 3 : APGAR score of the neonates died after admission to Intensive Care Unit in Addis Ababa Governmental Hospitals from 2011-2015 GC, Addis Ababa2016(N=548).

APGAR score		Frequency	percentage
At 1 st minute	Less than 7	414	75.55
	7 and above	134	24.45
At 5 th minute	Less than 7	371	67.77
	7 and above	177	32.23

Figure 7 shows 561 study population (neonates), most of the babies were AGA (Appropriate for Gestational Age) 1/5th of the neonate were SGA (Small for Gestational Age), very few of them being LGA (Large for Gestational Age) attributing to 11(2%).

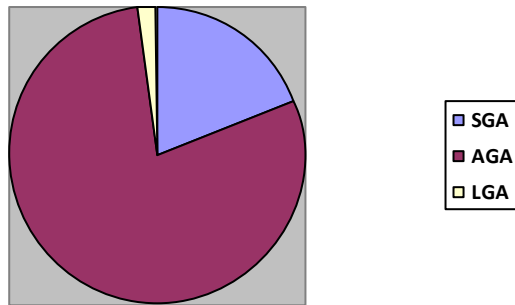


Figure 7: Size distribution of neonates died after admission to Neonatal Intensive Care Units in Addis Ababa Governmental Hospitals from 2011-2015 GC, Addis Ababa 2016(N=561)

Among 561 neonates in the study, more than half of the neonates breast-fed and accounts for 311(55.43%). The rest of the neonates, did not breast-fed due mainly to medical conditions and some of them were because of prematurity accounting only for 45 (17.9%).

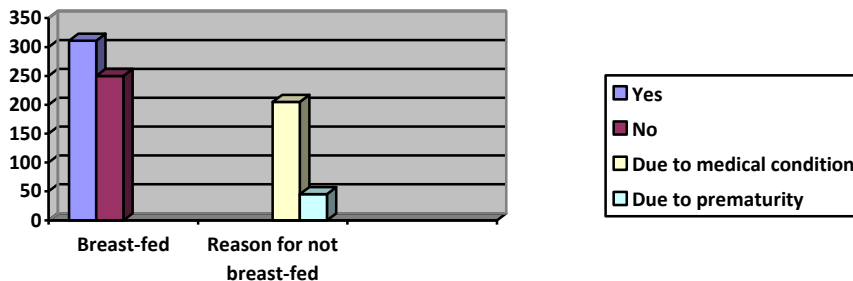


Figure 8: Neonates breast-fed and reason for not breast-fed among neonates admitted and died in Intensive Care Units of Addis Ababa Governmental Hospitals from 2011-2015GC, Addis Ababa, 2016 (N=561)

Table 4 shows there were different medical problems diagnosed during admission of the neonates to Neonatal Intensive Care Unit. A neonate had experienced at least a medical problem and accordingly, hypothermia 326(29.6%), sepsis 297(26.97%), RDS 408(37.05%), hypoglycemia 48 (4.35%) had been diagnosed with the baby on admission. There were also some problems in addition to the above mentioned and these were neonates diagnosed as RVI exposed 18(3.2%) and congenital malformations 4 (0.7%) are rare problems.

Table 4: Medical problems experienced by neonates on to Neonatal Intensive Care Units of Addis Ababa Governmental Hospitals, from 2011-2015 GC, Addis Ababa, 2016.

Medical problems on admission	frequency	Percentage
Hypothermia	326	29.6
sepsis	297	26.97
RDS	408	37.05
Hypoglycemia	48	4.35
RVI exposed	18	1.63
Congenital malformation	4	0.36
Total	1101	100.00

The figure 5 shows half the neonates did not use any of the heat sources while 1/3 and ¼ of neonates used incubator and radiant warmer respectively.

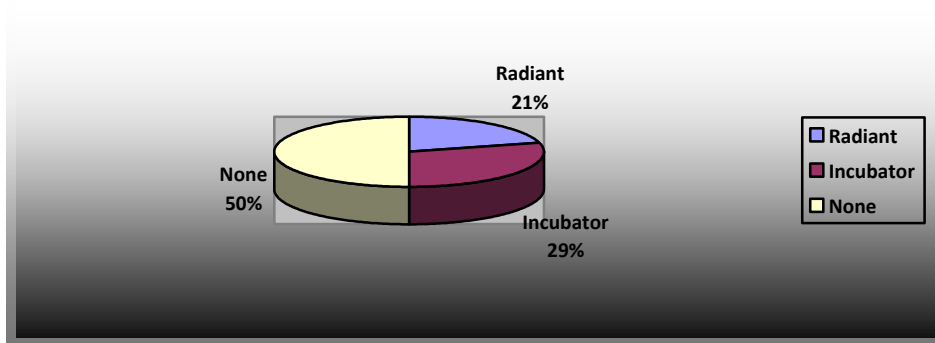


Figure 5: Sources of heat used (Incubator and radiant warmer) by neonates died after admission to NICUs of Addis Ababa Governmental Hospitals from 2011-2015 GC, Addis Ababa,2016(N=561)

The table 5 shows identified different causes of deaths among neonates admitted and died in Intensive Care Units; RDS, sepsis, RDS and sepsis were the three leading repeatedly recorded as possible cause of death. For detail refer table below.

Table 5: Recorded causes of deaths of neonates after admission to Neonatal Intensive Care Units in Addis Ababa Governmental Hospitals from 2011-2015 GC, Addis Ababa, 2016(N=561).

Variables	frequency	percentage
RDS	195	34.8
Sepsis	111	19.8
RDS and Sepsis	132	23.5
Sepsis and other medical problem	13	2.3
RDS and other medical problem	52	9.3
Hypoglycemia	11	2.0
Hypothermia	7	1.2
Multi organ failure	21	3.7
Others	19	3.4
Total	561	100.0

Study identified that most of the variables have no significant association. For example sociodemographic factors like place of residence, age of the mother, sex of baby have no association with neonatal mortality. Likewise obstetric factors like parity, previous outcome of pregnancy, antenatal care attendance, complication during pregnancy, rupture of membrane, place of delivery, state of delivery, mode of delivery and Apgar score of both 1st and 5th minute were all found to have insignificant association with neonatal mortality.

According to the table 6, result of the study using binary logistic regression showed that the neonates diagnosed with sepsis on admission were less likely to die from sepsis within the first week of life when compared with those neonates without sepsis on admission at (**COR=1.492, 95% CI: 1.015-1.98**). The reason behind might be sepsis for neonates delivered at facility is less likely to occur during the first week of life unlike for those delivered in the community. Similarly, hypothermic neonates were less likely to die within the first week of life for the

similar the rationale above, as early diagnosed baby is kept in incubator or radiant warmer (**COR=0.566, 95%CI: 0.397-.808, P=0.002**). Similarly those neonates with recorded cause of death are less likely (0.519 times) to die within the first week of life as compared to the neonates with no recorded cause of death within the same period. The likely or risk of dying of neonates within the first week of life from hypothermia and sepsis (as recorded cause of death) is (**AOR =0.595, 95% CI: 1.054-2.67, p=0.029**) and (**AOR=0.552, 95%CI: 1.12-2.93, p=0.016**) respectively. On the other way, this is same to odds ratio of dying within the first week (odds of hypothermia = 0.510, odds of sepsis (record of death) =0.511) to odds of dying within 7-28 days (for hypothermia=0.86, odds of sepsis (record of death) =0.923), applying regression function.

Table 6: Odds of dying of neonates within the first week of life in Neonatal Intensive Care Units of Addis Ababa Governmental Hospitals from 2011-2015 GC, Addis Ababa, 2016.

Variables		Crude OR	Adjusted OR
Hypothermia on admission	Yes	0.566(.397-.808)*	.595(1.054-2.67)*
	No	1.0	1.0
Sepsis on admission	Yes	0.68(1.015-1.98)* P=0.002	1.32(.832-2.10)
	No	1.0	1.0
Recorded causes of death Sepsis	Yes	0.519(.323-.835)* P=0.007	0.55(1.12-2.93)*
	No	1.0	1.0

*p-value<0.05

Table 7 shows that eventhough the neonates of weight of less than 1000gram fail to be significant by multiple logistic regression, it is significant at binary level that is neonates with weight less than 1000 gram were less likely to die within the 7-28 days of age when compared with those neonates with greater than 1000gram. That is the likely of dying within 7-28 days of age for neonates weighing less than 1000gram is 0.46 times less likely when compared with those neonates dying within the first week of life. The possible reason may be most of the neonates with low birth weights are tend to die within the first week of life because of prematurity eventhough it might not be always the case.

The hypothermia within the 7-28 days is more likely for the neonates; hypothermic babies on admission were more likely to die when compared with neonates with no hypothermia that is the risk of dying within 7-28 days of age is 1.87 times more likely when compared with neonates no hypothermia on admission for the same age of neonates. Similarly, the risk of dying from sepsis on admission is 1.49 times more likely comparing with the neonates with no sepsis on admission for the neonates of the same age, within 7-28 days. Again the risk of dying from sepsis as possible cause was 1.97 times more likely for neonates with record of sepsis as the cause of death comparing for neonates with no record of sepsis as cause of death within 7-28 days of age. In summary only two variables hypothermia and sepsis as possible cause of death is found to be significant with neonatal mortality. Then when we compare the risk of dying from the similar variables within the first and within 7-28 days, the likely of dying of neonates within 7-28 days was more likely for the two significant variables. Likewise, the risk ratio (adjusted odds ratio) of hypothermia and sepsis (recorded cause of death) within 7-28 days to within first week is 1.68(1.054-2.67) and 1.8(1.12-2.93) at 95% confidence interval respectively.

Table 7: Odds of dying of neonates within the 7-28 days of life in Neonatal Intensive Care Units of Addis Ababa Governmental Hospitals, from 2011-2015 GC, Addis Ababa, 2016.

Variables		Crude OR	Adjusted OR
Weight <1000gm	Yes	0.462(.225-.950)*	.642(.299-1.37)
	No	1.0	1.0
Hypothermia on admission	Yes	1.87(1.39-2.662)*	1.68(1.054-2.67)*
	No	1.0	1.0
Sepsis on admission	Yes	1.42(1.02-1.983)*	1.3(.82-2.11)
	No	1.0	1.0
Recorded causes of death Sepsis	Yes	1.97(1.19-3.100)*	1.81(1.12-2.93)*
	No	1.0	1.0

*p-value<0.05

CHAPTER 6: DISCUSSION

The two variables with significant association with neonatal mortality were hypothermia on admission and sepsis (from all recorded cause of death). Accordingly, those neonates with no hypothermia on admission were less likely to die from hypothermia as compared with those diagnosed hypothermia on admission. In similar way, using the adjusted odd ratio (AOR) the neonates died within the 7-28 days were 1.68 more likely to die from hypothermia when compared with those within the first week of life (**AOR=1.68, 95%,CI: 1.054-2.67, p=0.029**). The result was inconsistent with finding of the study conducted in Brazil at 9 centers of Brazilian Network on Neonatal Research between August 2010 and April 2012, which pointed out that the chance of neonatal mortality from hypothermia increases by 1.64 folds when compared with late neonatal death(39). The first rationale may be due to his study included 1764 inborn neonates of 22-33 weeks, which were very extremely preterm babies and from the point that the risk of hypothermia is inversely proportional with gestational age as the skin is thin and susceptible for insensible heat loss. The second rationale may be from the point of cardiovascular, which is whenever the baby is extremely preterm it will be difficult to establish the respiration which could cause asphyxia. Once asphyxia is developed, the circulation will be directed establishing circulation toward the vital organs like brain, kidney, and heart by decreasing the blood flow to skin, intestine and adrenal gland. It is obvious that the body temperature is the result of blood flow to skin and hence could not maintain normal body temperature resulting in hypothermia. The third rationale may be due to almost all mothers being from urban having a regular ANC follow up and institutional delivery which could have been reduced maternal factors or complications that could put the baby prone to hypothermia in the early neonatal period. The other study conducted in rural setting of Nepal in community also revealed that risk of dying from hypothermia within the first week of life is 4.8 more likely as compared to late neonatal period(43). The rationale is neonates born in community are at high risk of dying from hypothermia as explained above.

The neonates died from sepsis within 7-28 days were 1.80 more likely to die when compared with those died within the first week of life (**AOR=1.81, 95% CI: 1.119-2.934, P=0.016**). In

other word, the neonates died within the first week of life were 55% less likely to die from sepsis when compared with those died within 7-28 days of age. The finding is similar with the study conducted in Colombia University neonatal Intensive Care Unit, which revealed the overall risk of dying from late onset sepsis as 17%(40). The rationale for the increased risk of late onset sepsis (7-28 days) is it has no maternally related factors but from the environment, and directly related to length of stay in hospitals. Almost all deliveries were at facilities and we don't expect early neonatal sepsis which is the case for home delivery.

6.1. Conclusion

The study has described different variables such as sociodemographic factors, obstetric factors diagnosis on admission and possible causes of death. From the variables identified, RDS, sepsis, sepsis plus RDS are the three leading repeatedly recorded possible causes of deaths. The study concluded that, neonatal mortality in general have significant association with diagnosis of hypothermia on admission but due to different heat sources used the neonatal mortality was less in the first week of life but higher(1.68 times) more likely after the first week of life. This means the heat sources used at facility has prolonged the life of hypothermic babies for the first week of life.

The finding also revealed that, there is increased risk of dying from sepsis within 7-28 days of life (1.80 times more likely when compared with risk of dying within the first week of life). Normally there is increased risk of dying within the first week of life if there are maternal related factors like complications during pregnancy, prolonged rupture of membrane and home deliveries were significant with neonatal mortality. But as there is no maternal factors significant to neonatal mortality and majority of the deliveries were at facilities, it is concluded that the neonatal mortality is due to care related or nosocomial hospital acquired sepsis due to long hospitalization of the neonates. In summary both hypothermia and sepsis which have significant association with neonatal mortality are potentially preventable causes of death.

6.2. Recommendations

To reduce the risk of dying from hypothermia, better to focus on general mechanism of preventing hypothermia and sepsis. Therefore the following concerned bodies are responsible and recommended as per below.

1. It is better if health professionals

- Attending the delivery could identify those newborns at risk of hypothermia, check for heat sources if they are ready and functioning before conducting delivery.
- Beware of adjusting the room temperature of delivery ward, immediately drying and wrapping up babies and take special consideration in to account for premature babies as they are at high risk developing hypothermia.
- Teach mothers not to give bath to newborns within the first 24 hours to prevent hypothermia additionally, help them know and practice method of preventing hypothermia like over dressing of the neonate and put hats on baby's head as great deal of heat is lost from head.
- Better promote rooming in and skin to skin contact with mother all can prevent hypothermia.
- As early neonatal sepsis is maternally and delivery related, it can be prevented by increasing the awareness of ANC and plan of birth place for screening of complications during pregnancy and delivery respectively, then it would be better if focus is given for the area.
- The late neonatal onset of sepsis which is the associated factor increasing the neonatal death after first week of life, the risk can be minimized by following sterile procedures. Limit access to central line, sterilization of mask and bags for resuscitation, special skin care for extremely low birth weight.
- Be familiar with early sign and symptoms of sepsis to do sepsis work out for early diagnosis and treatment.
- The health professional with infection or lesion should not directly involve in care of neonates in NICU and delivery ward.

- Should remove watches, rings, avoid finger polish and artificial nails before entering the obstetric area and Neonatal Intensive care units
- The department head of Neonatal Intensive Care Unit and delivery ward should promote hand washing practice and provide the equipments like gloves and prepare the hand rub to reduce cross contamination during care provision.

2. It is better if the policy makers

- ✓ Incorporate the need of training for health professionals on general prevention of hypothermia and sepsis, and develop standard protocols for all facilities to aware all health professionals attending delivery and working in NICUs in general.
- ✓ Training of neonatology nurses can also be the gate in reducing the both hypothermia and sepsis in general.
- ✓ To assess the general adequacy and functioning level of heat sources used by hypothermic babies in delivery wards and Neonatal Intensive Care Units.
- ✓ Availability and proper functioning of sterilizing machine should also be supervised.

6.3. Challenge and Limitation of the study

The challenge of the study is incomplete medical records which took time trace charts for replacement. A few variables of interest were not recorded in general from all study sites. For example immunization status of the mothers, ethnicity of the mothers, educational status of the mothers, substance and alcohol use were not recorded at all. The limitation of study is lack of local research conducted in Neonatal Intensive Care Units which were helpful for comparing results. Finally limitation of time faced as persons in charges were not available as required.

6.4. Strength and weakness of the study

The study has no response bias and generated the accumulated data and hopefully contributed knowledge to neonatal mortality which about is little known. The weakness of the study is some variables of interest has been missed, eventhough the chart was legible for study.

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Annex1 Informed consent

I am Lalisa Chewaka Gamtessa, post graduate student at Black lion Hospital, College of Allied Health sciences, department of Nursing and mid wifery in pediatrics and child health nursing track. Now am conducting my thesis on **preventable causes of neonatal mortality and associated factors among neonates admitted to Intensive Care Units of Governmental hospitals in Addis Ababa using secondary data from 2011-2015**. The objective of the study is to assess preventable causes of neonatal mortality and associated factors among neonates admitted to Neonatal Intensive Care Units. I hope study will have no risk but there is no doubt that the study will have the positive impact on survival of neonates.

I ensure confidentiality by protecting the medical records that could identify study participants, the individual identifiers will be removed and not to be presented at all, privacy and confidentiality rules in accordance with the applicable regulatory requirements are all respected during the data collection through the presentation of the finding.

As purpose of the study has been explained for me in the language I can understand, on behalf of NICU department of this hospital for safeguarding the registration book and patients' data, I agree to allow the data collection process and ensure with my signature below.

Name

Qualification

Date.....

Signature.....

With regards, Lalisa Chewaka.

Annex 2 Data extraction checklist

Name of the data collector _____ Tel _____

Place of residence: urban _____ Rural _____ code _____

Facility name _____ sex of baby _____

1. Level 1 & 2 (maternal related and associated factors)

1.1. Age of mother (years) _____

1.2. Educational level _____

1.3. State of Parity _____

1.4 previous pregnancy out come if recorded _____

1.5. Antenatal care attendance _____

1.6. Screened for infectious disease

1.6.1 for HIV

a) Yes

b) No

1.6.11. If Yes to (1.6.1) what was the result?

a) positive

b) Negative

1.6.12 If the result was positive, what was treatment given (specify) _____

1.6.2. for syphilis

a) Yes

b) No

1.6.21. If Yes to (1.6.1) what was the result?

a) positive

b) Negative

1.6.22. If the result was positive, what was treatment given (specify) _____

1.7. Any medical condition (complication) during pregnancy?

a) Yes

b) No

1.7.1. If yes to (1.7) Specify _____

1.8. Labor and delivery

a) Place of delivery _____

b) How long was rupture of membrane before delivery specify it _____

c) Any treatment (antibiotic given) specify _____

d) Who attended the delivery? Specify _____

1.9. State of delivery

a) Normal

b) Complicated

1.9.1 If complicated Specify _____

1.10. Type of delivery

a) Svd

b) C/S

c) Instrumental

2. Level 3 factors (Related to Neonate)

2.1. Was baby preterm?

a) Yes

b) No

c) State in weeks _____

2.2. Weight of the baby at birth _____

2.3. Baby was

a) SGA

b) AGA

c) LGA

2.4. Apgar score

a) At 1 minute _____

b) at 5 minute _____

2.5. Any Congenital malformation recorded?

a) Yes

b) No

2.5.1. If yes to (2.5), specify _____

3. Level 4 (Other factors)

3.1. Was artificial source of heat used on infant?

a) Yes

b) No

3.2. If Yes to (3.1), what source was used? _____

3.3. Was baby breastfed after birth?

a) Yes

b) No

If no to (3.3) state reason _____

3.4. Among the following, with which of one following was baby diagnosed on admission? (mark all that apply)?

a) Hypoglycemic

b) Hypothermic

c) Sepsis

d) RDS

Other specify _____

3.5. When did the baby die?

a) Within 7 days of birth

b) Between 7 and 28days of birth

3. 6. What was the recorded (possible) cause(s) of death? (Specify) _____

The end Thank you!

Annex 3 Declaration

The researcher, undersigned, declare that this is my original work and has not been presented in this or any other University and all sources of materials used for this thesis have been fully acknowledged.

Name: Lalisa Chewaka Gamtessa(BSc) .

Signature: _____

Date: _____

Place: Addis Ababa University, College of Health Sciences, Department of Nursing and midwifery

The thesis has been submitted with my approval as University advisor

Mr. Fekadu Aga, MSc, Assistant Prof., PhD St.

Signature: _____

Date: _____

Place: Addis Ababa University, College of Allied Health Sciences, Department of Nursing and midwifery

Examiner (Reviewer)

Name: _____

Signature: _____

Date: _____

Place: Addis Ababa University, College of Allied Health Sciences, Department of Nursing and midwifery