

ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT STUDY
CENTER FOR POPULATION STUDY/REPRODUCTIVE HEALTH



**MAGNITUDE OF NEONATAL MORTALITY AND ITS ASSOCIATED
FACTORS AMONG NEONATES ADMITTED TO NEONATAL
INTENSIVE CARE UNIT AT MENELIK II COMPREHENSIVE
SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, 2022**

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**A THESIS TO BE SUBMITTED TO ADDIS ABABA UNIVERSITY COLLEGE OF
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Addis Ababa, Ethiopia

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in this or another university and that all sources of materials used for this proposal have been fully acknowledged.

Ereda Belete (BSc)

Signature: _____

Date _____

APPROVAL SHEET

I, the undersigned MSc student, declare that I have submitted my original thesis work on a title “MAGNITUDE OF NEONATAL MORTALITY AND ITS ASSOCIATED FACTORS AMONG NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNIT AT MENELIK II COMPREHENSIVE SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, 2022” for the examination.

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This thesis work has been submitted for examination with my approval as an advisor.

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Acknowledgment and / or Dedication

Above all, I am very pleased to thank Addis Ababa University in special & heart Felt gratitude for providing me this chance. Next, I am very glad to thank my Advisor Yibeltal Tebekaw (PhD) for his continuous and unreserved advice, support, guidance, and correction through my work.

Further, may thank Extended to Addis Ababa health Beuro and Minilik II comprehensive specialized hospital leader and staffs for their cooperation during data collection.

Abstract

Background: Since 2000, Ethiopia has seen an exceptional decrease in infant and child deaths. However, the main cause of death in children under the age of five is still neonatal mortality. Hospital service quality can vary and affect how much newborn death occurs.

Objective: To determine the frequency and contributing variables of neonatal mortality among newborns admitted to Minelik II Comprehensive Specialized Hospital in Addis Ababa, Ethiopia, in 2022.

Method:retrospectivedocument review was carried out from March 2017 to March 2022. The study used a sample of one out of every two admitted patients. Neonatal patients without neonatal medical records or discharge status charts met our exclusion criteria. To choose the study participants, the systematic random selection technique was employed. The variables that had a P-value of 0.05 in the multivariable model were deemed statistically significant in the a binary logistic regression model.

Result: The study included 316 neonates in total and neonatal mortality was 18% (95% CI: 14.2, 22.2). Low birth weight [AOR=4.40(1.73-11.21)], small for gestational age [AOR=3.27(1.50-7.14)], Neonates with age less than 24 hours [AOR = 6.328 (1.83-21.88)] and Apgar score [AOR=3.46(1.14-10.50)] were factors significantly associated with neonatal mortality.

Conclusion: Neonatal death was a common occurrence (higher prevalence) at Minelik II Comprehensive Specialized Hospital. Newborns that were low birth weight and those who are under 24 hours old have a higher risk of neonatal mortality. Therefore, neonates with low birth weight, small for gestational age, poor APGAR scores, should receive special attention from physicians, legislators, and program administrators.

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Abbreviations and Acronyms

ANC- Anti Natal Care

APGAR- Appearance, Pulse, Grimace, Activity, Respiration

CI -Confidence Interval

DM- Diabetes Mellitus

EDHS- Ethiopian Demographic Health Survey

GA- Gestational Age

NICU- Neonatal Intensive Care Unit

LBW- Low Birth weight

MAS- Meconium Aspiration Syndrome

NICU- Neonatal Intensive Care Unit

NMR -Neonatal Mortality Rate

NM – Neonatal Mortality

PPROM- Prolonged Premature Rupture of Membrane

PP- Postpartum hemorrhage

PROM- Premature Rupture of Membrane

SDGs- sustainable development goals

WHO- World health organization

IUGR- intra uterine growth restriction

1. INTRODUCTION

1.1. Background

The neonatal phase, which lasts for the first 28 days of a child's existence, is when it is most at risk for survival (Seid et al., 2019). The newborn period is split into early and late neonatal phases, with the early neonatal phase accounting for the bulk of neonatal mortality (first 7 days) and late neonatal phase (last 21 days) (Mengistu et al., 2020). The UN member states endorsed [Each Infant Action Plan \(ENAP\)](#) in 2014 with the intention of eradicating avoidable newborn deaths and stillbirths. (Moran & Requejo, 2021).

In the first 28 days of life, 2.4 million children worldwide died in 2019. The first day of life accounts for about 33% of the estimated 6700 neonatal deaths every day, and the first week accounts for 75%. Most baby deaths happen in low- and middle-income countries, whereas about 80% of neonatal deaths take place in South Asia and Sub-Saharan Africa. Nearly 50% of newborn mortality in Sub-Saharan Africa are attributable to Ethiopia, Nigeria, the Democratic Republic of the Congo, Uganda, and Tanzania. Ethiopia is one of the 10 nations that account for around 66 percent of newborn mortality and one of the ten nations that account for about half of all fatalities in children under the age of five (Berhanu et al., 2021a). There is a considerable disparity in mortality rates, with over three-quarters of neonatal deaths occurring in the first week of life and a third occurring on the day of delivery. According to these results, focusing on the life-threatening moments right before and after delivery is essential for saving more infant lives. The proportion of neonatal fatalities among all deaths under five has increased, and the rate of decline in newborn mortality is less than that of adult mortality. Therefore, in order to achieve universal health coverage and fulfill SDG 3 by 2030, nations must scale up evidence-based interventions, particularly for newborn health (Tekola et al., 2021a). Because neonatal mortality accounts for 44 percent of all deaths in children under the age of five, infant and neonatal mortality remains a significant priority for the national government. As Ethiopia transitions from Millennium Development Goals to Sustainable Development Goals, neonatal mortality becomes a constant challenge. All countries must cut the newborn mortality rate to 12 per 1000 live births by 2030 in order to meet the SDG goal of ending preventable neonatal deaths.

In Ethiopia, according to the recent demographic and health survey (EDHS, 2016), the neonatal mortality rate has declined over the past five years, giving the nation the hope of achieving the SDGs by 2030. This success is due mainly to the various child survival strategies. However, there has been a very small decline in the neonatal mortality rate (NMR) during the same period. Infant and child mortality rates are basic indicators of a country's socio-economic situation and quality of life (Tekola et al., 2021b). Ethiopia had one of the world's highest neonatal mortality

rates (NMR) (28.1 per 1000 live births) in 2016(Orsido et al., 2019a). End preventable newborn and child deaths by 2030, with all countries aiming to reduce neonatal mortality to at least 12 per 1,000 live births and under-5 mortality to at least 25 per 1,000 live births. Under SDGs targets 3, and 3.2 by 2030, they aim to end preventable deaths of newborns and children under five years of age (Orsido et al., 2019a). By 2030, countries are aiming to reduce neonatal mortality to at least as low as 12 per 1000 live birth (Ethiopian Public Health Institute Addis Ababa, 2019). Neonatal mortality decreased from 39 to 29 between the 2005 and 2016 EDHS but has remained stable since the 2016 EDHS (Ethiopian Public Health Institute Addis Ababa, 2019). Neonatal mortality remains a significant public health burden worldwide, with about a million deaths per year.

Similarly, according to a 2019 EMDHS data, the neonatal death rate is 30/1000 Live Birth (LB), which means that higher than prior report (EDHS 2016)(Tekola et al., 2021a). A variety of strategies and policies have been tested worldwide to reduce neonatal and infant mortality. In Ethiopia, the Ministry of Health has developed a national strategy to address maternal and newborn health problems using primary care approaches and health care delivery packages that have been in place since the 1990s (Hug et al., 2019a).

1.2. Statement of the problem

Neonates are defined by the WHO as live-born infants whose age is within 28 days of birth(Mitiku, 2021a).While the risk of dying after turning one but before turning five years old was estimated to be 0.01 fatalities, the likelihood of dying after turning one but before turning five years old was anticipated to be 11 deaths per 1,000 in 2019. In 2019 was seen that 2.4 million infant deaths worldwide, with 6,700 neonatal deaths every day. Nearly a third of newborn deaths were occur on the first day of life, and nearly three-quarters were occur within the first week (Berhanu et al., 2021a).

According to a recent UNICEF report, South Asia and East Africa were the countries with the highest rates of newborn death, with rates of twenty-seven and twenty-five fatalities in 1,000 neonates on live birth, respectively, in 2019(Mitiku, 2021a).

In Sub-Saharan Africa, a meta-analysis of health and demographic surveys on perinatal death was conducted revealed a pooled estimate of the perinatal death rate in Eastern Africa (34.5%), Tanzania (39.5%), and South Africa (39.5%). Burundi has a score of 38.2 while Mozambique has a score of 37.8. The stated rate, on the other hand, was not significant. Because their confidence intervals overlapped with the pooled sub-regional estimate, they were eliminated. Whereas Kenya has the lowest perinatal death rate in the sub-region at 28.7% (Weddih et al., 2019).

According to a 2016 population health study, neonatal mortality in Ethiopia has reduced by 41% since 2000, from 49 deaths per 1,000 live births in 2000 to 29 deaths per 1,000 live births in 2016. Neonatal mortality hasn't achieved as much of the MDG (millennium development target) as infant and childhood deaths, which have both fallen by 50% and 60%, respectively (Kaewkiattikun, 2017).

Neonatal mortality climbed from 29 in 2016 to 30 in 2019, according to the most recent EDHS survey, necessitating immediate and escalated intervention to reduce neonatal mortality. This high rate of newborn mortality could be attributable to a lack of effective therapies and poor identification of contributory factors.

The survival of newborns is a major concern around the world, particularly in developing countries. In maternal and child health programs, neonatal care is frequently overlooked. Despite the Ethiopian government's efforts to reduce neonatal mortality, studies show that it remains high. As a result, it is critical to conduct additional research on this title, typically on associated factors. As a direct result, this study was conducted at MIIRH in Addis Abeba, Ethiopia, to ascertain the prevalence of newborn death and its associated determinants. Furthermore, it was giving to stakeholders the opportunity to reduce the problem by focusing on identified factors. The struggle to improve the NMR is strongly intertwined to identifying the factors associated with increased mortality. There have been few studies on predictors of neonatal mortality in SubSaharan Africa, and those that have been reported have used a small sample size. In the current study, I was analyzed a four-year newborn data set to describe the level of neonatal mortality and the factors associated with the rate of neonatal mortality.

Neonatal mortality is not the only determinant of a child's survival; it is also an essential sign of maternal health, neonatal status, and quality of life, which can be addressed by this study, by demonstrating a link between them (maternal and neonatal health, obstetrics, Quality of life and neonatal mortality).

In Menelik II Comprehensive Specialized Hospital, Addis Abeba, Ethiopia, this study aims to identify causes and it's associated with neonatal mortality and preventative interventions aimed at reducing neonatal mortality. As a result, identifying such factors/predictors have a major impact on reducing newborn mortality.

1.3. Research question

What are the factors of neonatal mortality?

1.4. Objectives

1.4.1. General objective

The overall objective of this study is to determine the magnitude and its associated factors that contribute to neonatal mortality in Menelik II comprehensive specialized hospital, Addis Ababa, Ethiopia April 10/2022 –May 30/2022

1.4.2. Specific objective

- Determine the magnitude of neonatal mortality among neonates admitted to MIIRH NICU in Addis Ababa, Ethiopia
- Identify significant factors associated with neonatal mortality in Minilik II Hosp, Addis Ababa, Ethiopia

1.5. The scope of study

This is an institution-based study that was over only one public hospital in Addis Ababa. The study was examined the net effects of the socio-demographic factors, maternal factors, neonatal and obstetric factors on the outcome variable i.e., the neonatal mortality. This study's analysis was based on data collected from neonates born alive and admitted in Menelik II comprehensive specialized hospitals between March 2017 and March 2022.

1.6. Rationale of the study

Neonatal mortality in Ethiopia is 30% per 1000 live births, according to the mini-Ethiopian Demographic and Health Survey (EDHS) report (Ethiopian Public Health Institute (EPHI) & ICF, 2021). Neonatal mortality rate is one of the key indicators of the development and the health service delivery of a country (UN Inter-agency Group for Child Mortality, 2019). So, conducting this study were help in achieving the SDGs especially SDG3 by informing and addressing common predictors of neonatal mortality (Eyeberu et al., 2021).

In present study, a cross-sectional study was analyzed the medical records of all neonates admitted to Minelik II hospitalcomprehensive specialized I's Neonatal Intensive Care Unit. This study looks at the most common reasons for neonatal admission and factors associated with neonatal mortality.

1.7. Significance of the study

The findings of this study can be used by health care practitioners to manage newborns in the NICU. By focusing on the determinant factors and defining recommendations for the management and prevention of newborn morbidity and mortality, hospital administrators and

clinicians can formulate effective neonatal care policies, the findings of this study can be used to inform future research.

2. LITERATURE REVIEW

2.1. Conceptual definition

The first phase of neonatal age is the time between birth and the first four weeks of life, and it's the most critical period of a child's survival (Tamene et al., 2020). Neonates are the future generations, and keeping their healthy growth, progress, and all the activities concerning them must be the anxiety of all individuals (Johnston, 2016). The neonatal period, which is defined as the period beginning at birth and ending at 28 completed days of life, is the most vulnerable time for a child's development, especially that of the 1st 7 days of life, which is the riskiest time for a child survival (Mitiku, 2021a). Neonatal mortality, which defined as "deaths among live births during the first 28 completed days of life; neonatal death more sub-divided into early neonatal death (deaths between 0 and 7 completed days of birth) and late neonatal death (deaths after 7 days to 28 completed days of birth) is a principal indicator for neonatal health and wellbeing and is becoming a noticeable component of overall under-five mortality," is a principal indicator for neonatal health and wellbeing(Abera et al., 2021).

Maternal, infant, and child well-being continues to be a major issue, posing two of the most difficult targets to attain among the Millennium Development Goals, primarily in low- and middle-income countries (Ogallo et al., 2020). Sub-Saharan Africa is the world's region with the highest under-five mortality rate (Hadgu et al., 2020). In 2018, the region's average mortality rate for children under the age of five was 78 deaths per 1,000 live births (UN Inter-agency Group for Child Mortality, 2019). This translates to 1 in 13 children dying before their fifth birthday, which is 16 times higher than the global average of 1 in 199. It is critical to accelerating progress in avoiding child deaths. Despite gains made in the previous quarter-century, millions of newborns, children, and young adolescents die each year from preventable or treatable causes such as infectious diseases and injuries (UN Inter-agency Group for Child Mortality, 2019). These deaths reflect children's and communities' limited access to basic health services like vaccination, infectious illness treatment, proper nutrition, and clean water and sanitation (SARS, 2020). As a result, death rates among children and young adolescents are important indicators not just of child and young adolescent well-being, but also of long-term social and economic development (Federal ministry of health, 2016).

Neonatal mortality is one of the highest rates in the world in Sub-Saharan Africa, although there are sub-regional and country-specific differences in its distribution. The perinatal death rate per 1000 newborns was estimated to be 34.7 across 21 nations in four sub-regions of SSA, Eastern Africa had 34.5 percent, Tanzania had 39.5 percent, Western Africa had 35.7 percent, Nigeria

had 40.9 percent, and Southern Africa had 30.3 percent, with Lesotho having 49.6 percent. Equatorial Guinea has the highest incidence in Central Africa, at 30.7 percent (Ogallo et al., 2020).

Ethiopia is one of the 10 nations that account for two-thirds of all newborn fatalities worldwide, as well as one of the six countries that account for half of all deaths of children under the age of five (Roro et al., 2019). According to the 2016 Ethiopian Demographic Health Survey (EDHS), neonatal, infant, and under-5 mortality rates were 29, 48, and 67 deaths per 1,000 live births, respectively, in the five years before the survey (Tessema & Tesema, 2020). Conversely, in Ethiopia, one out of every 35 children dies within the first month, one out of every 21 children dies before their first birthday, and one out of every 15 children dies before their fifth birthday (Seid et al., 2019).

2.3. Empirical Literature

2.3.1. Factors associated with neonatal mortality

2.3.1.1. Socio-demographic factors

It is a fact that socio-demographic factors influence the survival of a newborn. In an Afghan study, parental education levels were found to have a strong relationship with early newborn mortality, and the majority of the neonates in this study came from a neighborhood with a “low” education level (87.9%), which had a higher incidence of neonatal fatalities by chance (0.4 percent and 1.4 percent, respectively) in communities with higher levels of education. Moreover, rural infants were nearly twice as likely as urban infants to die (1.1–3.2). The probabilities of Northwestern (0.2–0.6) and Central-Western (0.4–0.9) deaths were much lower compared to the north-eastern part (Kibria et al., 2018).

According to a study conducted in Jimma, Ethiopia neonates from rural areas had a 1.89 times higher chance of mortality (1.4–2.5) than their city counterparts (Seid et al., 2019).

2.3.1.2. Neonatal factors

According to a study conducted in Afghanistan, male children have a higher risk of dying than female youngsters. Smaller and larger babies had greater mortality rates than babies of ordinary size (Kibria et al., 2018).

According to a study conducted in Indonesia, neonatal issues at birth, low Apgar scores, and neonatal complications at delivery, along with neonatal health problems reported by the mother, and low Apgar scores are all linked to early neonatal death (Sushma et al., 2021).

According to a study conducted in Egypt, fatality rates decreased as birth weight and gestational age increased. There were no survivors among newborns under the age of 27

weeks, and 96.1 percent of those weighing less than 1000 grams died. Respiratory distress and preterm were the most common causes of death in LBW infants (under 2500 g), and both of these factors decreased as the birth weight grew. The most common causes of death among individuals with normal birth weight (8.4%) were respiratory distress (90.4%), preterm (26.7%), congenital abnormalities (26.5%), hypoglycemia (14.5%), infections (8.4%), and brain injury due to hypoxia (Getiye& Fantahun, 2017).

In an Ethiopian study, preterm and low-birth-weight newborns accounted for 20.5 percent and 52.5% of neonatal fatalities, respectively (Farah et al., 2018). In another study from northern Ethiopia, Prematurity [23 (34%)] and asphyxia [21 (31%)], are the primary causes of mortality, accounting for two out of every three deaths. The remaining deaths (16%) were caused by infections (8%), congenital abnormalities (5%), and other causes (11%). The early neonatal period accounted for three-quarters of all deaths, mostly owing to prematurity. A study on the magnitude of neonatal mortality and associated determinants in neonates conducted at Arab Minch General Hospital found that newborns with a five-minute Apgar score of less than five were 4.4 times more likely to die than those with a score of greater or equal to five. Breastfeeding was initiated by 62.7 percent of newborns within one hour of birth (Aynalem, Shiferaw, et al., 2021). Prematurity, sepsis, meconium aspiration syndrome, and respiratory distress/perinatal asphyxia were the major causes of mortality in the Somali region, accounting for 31.1 percent, 24.4 percent, and 20 percent of deaths, respectively (Farah et al., 2018).

Neonatal mortality was strongly linked to newborn sickness. When compared to medium-sized neonates, small neonates were twice as likely to die at birth (Federal ministry of health, 2016).

A study was conducted in Northern Ethiopia, Ayder Compressive specialized hospital, 98.3 percent of all deaths happened within the first seven days of a baby's life. The percentage of neonatal death was 16.7% (Hadgu et al., 2020).

According to a study conducted at Black Lion Hospital, the size and determinants of early neonatal mortality oxygen treatment had a favorable association with neonatal mortality AOR 4.69(Woday Tadesse et al., 2021).

2.3.1.3. Obstetrical and Maternal factors on NM

Maternal knowledge or educational status (mothers' knowledge of risk and danger signs in pregnancy, childbirth, and newborns); maternal health status (mothers' reports of illness during pregnancy and complications noted in medical records); and maternal characteristics (age, previous pregnancies, and antenatal care) were all considered maternal factors that influence NM (Sushma et al., 2021).

According to a study conducted at Arba Minch General Hospital, neonates delivered from mothers who labored for more than or equal to 18 hours are 2.6 times more likely to die than those born from mothers who labored for less than or equal to 12 hours. Those born from moms with a time of membrane rupture greater than or equal to 12 hours had a 3.9 times higher chance of newborn mortality than those born from moms with a time of rupture less than 12 hours. Neonates with a birth order greater than or equal to a fifth are 19.5 times more likely to die than those with birth orders of first or second (Aynalem, Shiferaw, et al., 2021).

A hospital-based retrospective cohort study on admission patterns and predictors of newborn mortality in the Somali region, Ethiopia found that maternal variables were the majority of the predictors of neonatal mortality. Hence among primipara, 71 percent (89%) received ANC during their pregnancy, and 91 percent were primipara. Their pregnancy was still at term, they gave birth spontaneously (Farah et al., 2018).

A retrospective study conducted in an Iranian hospital found that the smallest surviving newborn was a 750 g female with GA is 30 weeks old and the youngest newborn is a 970 g female with GA 25 weeks + 2 days (Çelik&Öztürk, 2021). Another study in Malaysia analyzed using: Multiple logistic regression showing that multiple pregnancies increase the risk of preterm birth, the neonatal mortality rate is more than twice that of singles (Sutan et al., 2018). A study done in Ghana showed that the most common cause of intrapartum stillbirth obstetric complications were due to obstructed labor, cord prolapse, and mal-presentation (Der et al., 2016).

Another study conducted in Kenya and others identified that about 35% of mothers who delivered before term had a history of previous preterm delivery, compared to 16% of those who delivered at term and this was significant ($p = 0.010$) (16,33,37). Caesarean section, multiple pregnancies, PROM, APH, PIH prolonged PROM and labor and UTI were among predictors of preterm death identified in this study (Mwansa, 2020). Likewise, another study done in Kenya at Kenyatta national hospital indicated that, the risk of preterm death increased 5-fold if the neonate delivered from mother who had prolonged PROM (AOR: 5.319) and 4-fold with APH (AOR: 4.264) after controlling for confounders (Wagura et al., 2018).

According to a study conducted in southern Ethiopia, the overall neonatal mortality rate was 27 per 1000 neonates-days. Multiple births, moms who did not attend antenatal care appointments, neonates delivered by cesarean section, not starting breastfeeding within 1 hour of delivery, neonates who needed lifesaving support, hyaline membrane illness, and perinatal hypoxia were all predictors of neonatal death (Orsido et al., 2019b).

2.4 Conceptual framework

During the first 28 days of life, various factors have an impact on neonatal mortality. Due to the nature of the predictors, most of them are easily avoidable, while a few are unavoidable. Socio-demographic factors (such as educational status, mother age during pregnancy, parental monthly income and so on) have a significant impact on neonatal mortality. In addition, other neonatal mortality predictors include obstetrics and maternal, and neonatal predictors.

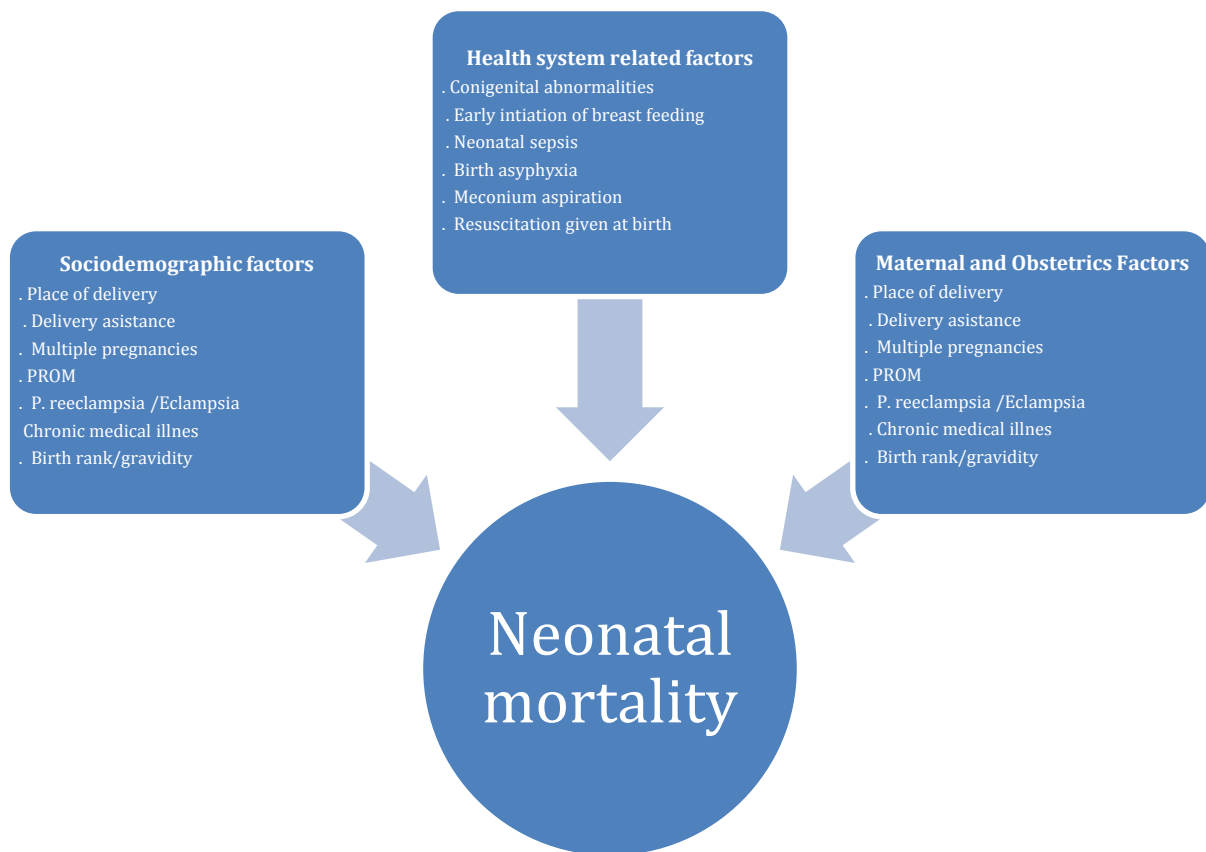


Figure 1: A conceptual framework adapted from a variety of sources(Aynalem, Mekonen, et al., 2021)(Aynalem, Shiferaw, et al., 2021)(Woday Tadesse et al., 2021)(Kibria et al., 2018)(Getabelew et al., 2018).

3. METHODOLOGY

3.1. Study area

The research was take place in Ethiopia's capital, Addis Ababa; there are twelve public hospitals in Addis Ababa. Among those, MIIRH is one of the Addis Ababa public hospitals that are newly opened NICU department in GYN-OBS department started in 2017. Menelikreferral Hospital is built in 1902 GC, has annual number of deliveries of 1976, among these the majority of them are a high-risk pregnancies, which are referred from different Health centers.The hospital has its own Neonatal Intensive Care Unit (NICU), which admits an average of 84 newborns per month. MIIRH has over 27 beds, 8 neonatal incubators in NICU. This study was conducted to retrieve four years of data, from March 2017 to March 2022.

3.2. Study design

A facility-based analytic retrospective study was employed to assess predictors affecting neonatal mortality among NICU admitted neonates in Menelik II referral hospital, Addis Ababa. Data was collected for live-born neonates admitted to the neonatal intensive care unit of MIIRH by reviewing chart records. Using a data checklist, variables on the predictors, causes, and trends of newborn death was collected from the neonatal registration book and patient cards.

3.3. Sample size determination and sampling process

The hospital is chosen specifically because it is a new affiliated hospital that provides GYN-OBS department and has a NICU services. The number of study subjects identified and the admissions register observed over the previous four years. Study participants were chosen using a systematic random selection approach (every Kth) after obtaining the "Kth" value by dividing the total number of neonates born in the past four years.The total number of neonates admitted to this hospital within four years is 5846(from neonatal admission register), hence the adjustment formula was employed.

Sample size for defined population proportion formula

$$n = \frac{D(Z_{\alpha/2})^2 P(1-P)}{L^2(N-1) + Z^2 P(1-P)} N$$

$L^2(N-1) + Z^2 P(1-P)$, Where, n = sample size, Z = the critical value of the normal distribution at $\alpha/2$ for a confidence level of 95%, i.e., 1.96

$L(ME)$ = margin of error, i.e., 5%

P = the prevalence of neonatal death was 11.4%, from the previous study conducted at the NICU of DilChora referral hospital, Dire Dawa city

Facility based, Ethiopia, 2021, $Q = 1-P$, N = population size (5846), D = design effect (2)

Sample size,

$$n = \frac{2 (1.96)^2 * 0.114(1-0.114)5846}{(0.05)^2(5846-1) + (1.96)^2 P(1-P)} =$$

$$(0.05)^2(5846-1) + (1.96)^2 P(1-P)$$

$$n = \frac{2 * 3.84 * 0.114 * 0.886 * 5846}{0.0025 * 5845 + 3.84 * 0.114(0.886)}, n = \frac{3401}{15} = 302$$

Then, the final sample size was **302**, Since its Finite Population, Use this finite population correction (FPC) when a sample from more than 5% of a finite population.

$$FPC = n/N = 302/5846 = 0.052 = 5.2\%$$

Since its Finite Population, Use this correction finite population correction (FPC) when sample with more than 5% of a finite population.

$$n' = 1 / (1/n + 1/N), \quad N = \text{size of population to be sampled}, \quad n = \text{estimate of sample size for infinite population}, \quad n' = 1 / (1/n + 1/N) = 1 / (1/302 + 1/5846) = 287$$

N.B: Then, by adding 10% of non-respondent rate, final desired sample size is 287+ 10% non - response rate, n=316.

Then, index medical record of newborn was selected using a lottery method from 1 to 14 in the hospital admission register. Accordingly, every 20th medical charts were selected using systematic random sampling technique from the admission registration book in the order of 4th, 24th, 44th, 64th, . . . until the required sample size reached. Besides, the corresponding maternal records was also retrieved from the delivery log-books. Since, finite sample size we used sampling without replacement.

3.3.1. Study period

This study was conducted between February-May/June 2022.

3.3.2. Source population

All neonates admitted to MIICSH NICU

3.3.3. Study population

All neonates admitted in neonatal intensive care unit at MIICSH from March 2017 to March 2022 based on inclusion criteria.

3.3.4. Eligibility criteria

3.4.1. Inclusion criteria

Neonates admitted to MIICSH from March 2017 to March 2022 with complete chart record/information. All the neonatal medical records/charts done from March 2017 to March 2022 in the study period was retrieved using a data extraction checklist which adopted from the national neonatal registration book.

3.4.2. Exclusion criteria

Neonates, who have incomplete charts, like undiagnosed and incomplete discharge summary.

3.5. Study variables

3.5.1. Dependent variable (outcome variable)

The dependent/outcome variable is neonatal mortality. The dependent variable was newborn admission result, which is divided into two categories: neonatal death and survival. Any newborn hospitalized to Menelik II Referral Hospital's NICU during the neonatal period who died within the unit considered a case of neonatal death/dying (during the first 28 days following live birth). Survivors are defined as newborns admitted to Menelik II comprehensive specialized Hospital's NICU who survived the first 28 days following delivery.

3.5.2. Independent variables

- Socio-demographic characteristics of the neonate (newborn sex and Neonatal Age at admission) and the mother (maternal age, residence, maternal education and household income).
- Neonatal factors: (gestational age, birth weight, Apgar score, multiple gestations, congenital abnormalities, and early initiation of breastfeeding).
- Obstetrics and maternal factors: parity, GA, maternal DM and GDM, previous history of stillbirth, pre-eclampsia, eclampsia, IUGR, pre-term, Gravidity, ANC follow-up, Time of ROM, Induction or augmentation, Labor duration, Mode of delivery, Maternal medical illness, Place of delivery, Birth attendant).

3.5.3 Operational Definition

Having ANC follow up-If the mother has a follow up of >4 times at her pregnancy period.

- Medical disorders in mother: Any history of medical diagnosis in the mother as it has been registered on the neonate's medical record.
- Neonatal death: occurs when a baby is born alive and dies within the first 28 days of life.
- Early neonatal death: is defined as a neonate's death within the first seven days (less than one week) of life.
- Late neonatal death: Death of a baby between the ages of 7 and 28 days.

3.6. Data collection approach and quality measures

A checklist derived from the WHO document of review and audit of neonatal death and registration book neonates was used to gather data from neonates' medical records. There were used a pre-tested checklist with three sections: socio-demographic factors like mother's age and residence; parity, and type of pregnancies; neonatal-related factors like neonatal illness, gestational age, birth weight, sex of neonate, APGAR score, and length of stay; and obstetrics-related factors like delivery complications, place of delivery, and mode of delivery. Three well-trained BSc Midwives were collecting the data, and supervised to ensure data quality.

3.7. Data processing analysis

Following the data collection, this study was review and arrange surveys. The data coded, edited, cleaned, and entered into Epi-info statistical software, after identifying variables, the data were entered and analyzed using SPSS v.26.0 statistical software. The binary logistic regression method was used. Using COR (crude odds ratio) for bivariate logistic regressions is less than 0.25, and a 95 percent confidence interval, the presence of a link between independent and dependent variables were determined. After that, multivariable binary logistic regression was used to lessen the impact of confounding factors. When the p-value for

multivariable binary logistic regressions is less than 0.05 and statistical significance is declared. The findings were presented using tables, text, and other visual forms.

3.8. Ethical Approval

No empirical data collection was started until we got written letter of permission and support letter from the Research Committee, Addis Ababa University, College of Development Study, Addis Ababa health bureau and Menelik II comprehensive specialized Hospital until the proper ethical approval has been received. Further permission was obtained from the medical director of MIIRH and the department head of pediatrics and gynecology for the utilization of medical records. The confidentiality guaranteed by excluding names or any other personal identifiers from data collection sheets and reports.

4. Result and discussion

4.1 Result

Between March 2017 to March 2022 5,846 neonates were admitted in NICU out of which 316 newborns below age 28 days admitted at NICU at Minelik II comprehensive specialized hospital over the past 4 years (February, 2019-june, 2022) were studied through random sampling. We were able to collect data from all the samples and health facility which gives 100% response rate without replacement method. The current study shows that neonatal mortality rate was 18%.

Socio-demography characteristics

The current study shows that 168(53.2%) of neonates were females. Of all, 176 (55.7%) of age of neonates were less than 24 hours, seventy one percent of neonates mother were Addis Ababa residents, above 311(98%) of mothers was attended by skilled health professional and 182(57.6%) of neonates were delivered at health center Table 1).

Table 1 Distribution of Socio demographic characteristics for neonates and mothers at Minelik II comprehensive specialized hospitals, Addis Ababa, Ethiopia, 2022

Variable	Category	Frequency (N = 316)	Percent
Sex of neonate	Male	148	46.8
	Female	168	53.2
Age of neonate	Less than one day	176	55.7
	2-7 day	77	24.4

	8-28 day	63	19.9
Age of mother	15-19	2	0.6
	20-25	17	5.4
	26-29	226	71.5
	30-34	47	14.9
	35-40	24	7.6
Residence	Addis Ababa	234	74.1
	Out of Addis Ababa	84	25.9
Birth attendant	Skilled birth attendant	311	98.4
	Untrained birth attendant	4	1.3
	Other	1	0.3
Place of birth	Health center	182	57.6
	Government hospital	126	39.9
	private hospital	5	1.6
	Home	3	0.9

Neonatal factors

Of all neonates 133(42.1) % of neonates were preterm and 73(23.1) % of neonates was low birth weight. Among admitted neonates (39.2%) respiratory distress was the leading causes of neonatal admission and (29.1%) neonates were initiated early breast feeding/within one hours of birth. Neonates admitted with APGAR less than 4 were (16.8%). See table 2 below.

Table 2 neonatal predictors characteristics for neonates and mothers at Minelik II comprehensive specialized hospitals, Addis Ababa, Ethiopia, 2022

Variables	Category	Frequency (N = 316)	Percent
	<2500	73	23.1
	2500-4000	243	76.9

Gestational age of the neonate	Preterm	133	42.1
	Term	150	47.5
	Post term	33	10.4
Reason for admission	Respiratory distress	124	39.2
	Meconium Aspiration	21	6.6
	perinatal asphyxia	19	6.0
	Meningitis	6	1.9
	Sepsis	18	5.7
	Prematurity	100	31.6
	neonatal jaundice	26	8.2
	congenital abnormality	2	0.6
Was the neonate initiated breastfeed within 1 hr.?	Yes	92	29.1
	No	224	70.9
APGARS at 1st and 5th Minute	Less than 4	53	16.8
	4-6	125	39.6
	7-10	138	43.7
Neonatal outcome	Died	57	18.0
	Survived/improved	259	82.0

Neonatal mortality rate

This study shows that the prevalence/magnitude of neonatal mortality rate in Ethiopia is 18% deaths per (1000 live births). This study indicates that 55.7% of neonatal mortality occurred during the first 24 hours of neonatal period/age. As this study revealed, of 316 neonates 57 (18%) neonates died in their neonatal period and 82% of them were alive. (Figure 1)

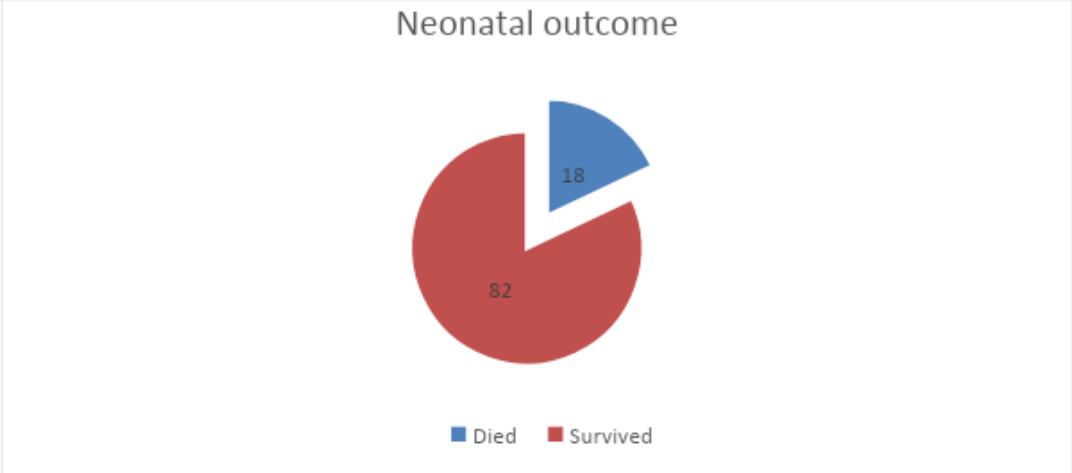


Figure 1
Prevalence of neonatal mortality outcome among neonates admitted in neonatal intensive care unit at Minelik II comprehensive specialized hospital, Addis Ababa, Ethiopia 2022.

As shown below, most neonates were diagnosed with respiratory distress 124(39.2%)

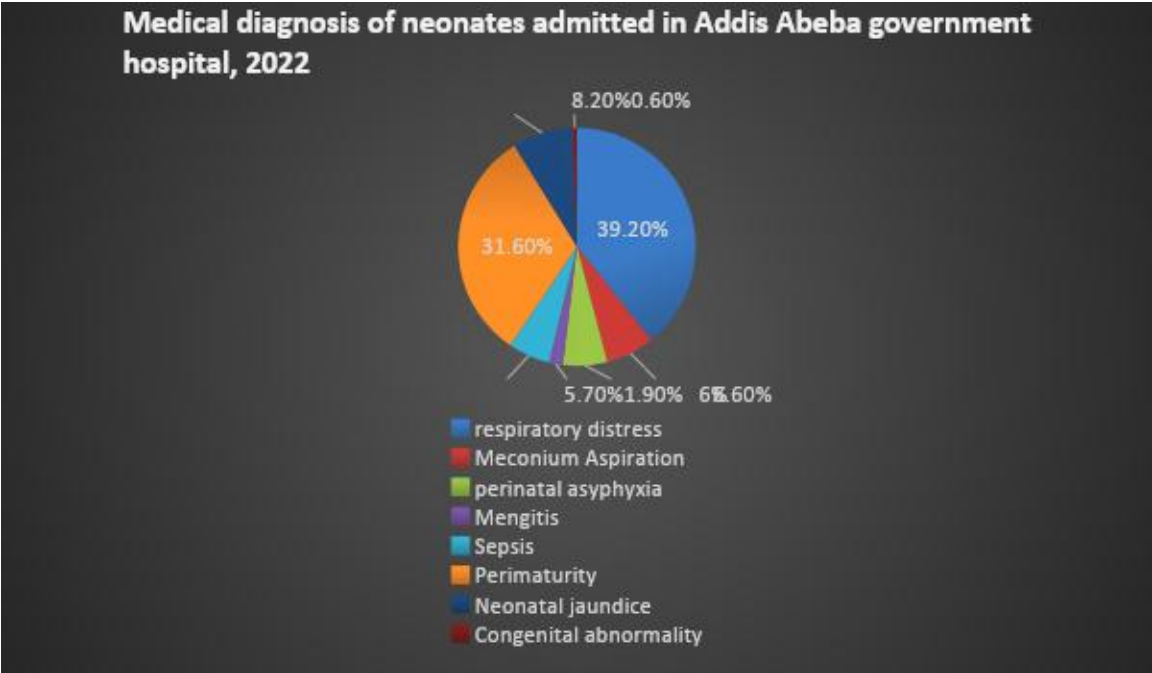


Figure 2. Neonatal medical diagnosis of neonates in Addis Ababa city selected governmental hospitals 2022.

Maternal and obstetric predictors

The study shows, 299(94.6%) mothers had at least one ANC follow-up and 67.7% of mothers had more than four ANC visits from skilled health worker. Among admitted neonates 14.9% of mothers have history of maternal medical illness and pre-eclampsia was accounts 29(9.2%), the main causes of the problem.

Table 3 maternal and obstetric characteristics for neonates and mothers at Minelik II comprehensive specialized hospitals, Addis Ababa, Ethiopia, 2022

List of Variables	Category	Frequency (N = 316)	Percent
Had ANC follow up for the neonate	Yes	299	94.6
	No	17	5.4
Number of ANC follow up visits	0	17	5.4
	1-3	85	26.9
	>4	214	67.7
History of maternal medical illness	Yes	47	14.9
	No	269	85.1
medical problem had the mother been Diagnosed during pregnancy	pre-eclampsia	29	9.2
	Eclampsia	2	3.2
	Diabetes	4	1.3
	HIV/AIDS	10	3.2
	Cardiac diseases	1	0.3
	Other	1	0.3
History of previous neonatal mortality	Yes	19	6.0
	No	296	93.7
Duration of labor for this last pregnancy	<12 hours	312	98.7
	>12 hours	3	0.9
Duration of rapture of membrane in	<12 hours	301	95.3

hour			
	>12 hours	14	4.4
Does the mother induced/augmented	Yes	51	16.1
	No	264	83.5
Mode of delivery	SVD	238	75.3
	Instrumental	5	1.6
	CS	73	23.1
Indication of C/S	CPD	2	0.6
	NRFHRP	29	9.2
	Failed instrumental Delivery	40	12.7
	Elective C/S	1	0.3
	Emergency	13	4.1
	Others	1	0.3

Factors/predictors associated with neonatal mortality

This study was conducted to identify different main predictors of newborn children based on data collected from 316 neonates from Dargawi Menelik comprehensive specialized hospital, Addis Ababa, Ethiopia. During this study, a different group of factors was assessed to identify their association to neonatal mortality. These were Socio-demographic factors, neonatal factors maternal and obstetric factors.

The associations of the independent and dependent variables were first tested by using bivariate analysis. Variables that were associated ($p < 0.05$) in the bivariate analysis were tested in the final multivariate analysis to see their significant association with neonatal mortality. Bivariate and multivariate logistic regression was done to see the association between independent variables with the dependent one. In binary logistics regression age of neonate, birth weight, APGAR score, gestational age, neonate early initiation of breastfeed and pregnancy type/multiple gestation were identified as having relationship with neonatal

mortality outcome. But, in multivariate analysis being age of neonate, low birth weight, low APGAR score and gestational age significantly associated with neonatal outcome.

LBW was significantly associated with the neonatal mortality. Those newborns weight less than 2500gm had 4.4 times higher odds to die than weight($\geq 2500\text{g}$) at birth neonates [AOR=4.40(1.73-11.21)]. Neonates born as small for gestational age had 3.2 times dying higher than those born on appropriate for gestational age($\geq 37\text{weeks}$) [AOR=3.27(1.50-7.14)]. Neonates with age less than 24 hours of birth were significantly associated with neonatal mortality. Those newborns having age less than 24 hours were 6.3 times more likely to die than neonates above 24 hours of age [AOR = 6.328(1.83-21.88)].

Apgar score had also significant association with neonatal mortality. Those newborns who were having Apgar score less than 4 were 3.46 times more likely to die than Apgar greater than 4 [AOR=3.46(1.14-10.50)].

(Table 4) Binary and Multivariate logistic regression analysis of magnitude and factors associated with neonatal mortality among neonates admitted in neonatal intensive care unit at Menelik II comprehensive specialized hospital, Addis Ababa, Ethiopia, 2022.

List of Variable	Category	Neonatal mortality outcome		COR (95%CI) for Exp (B)	P-value for COR	AOR (95%CI). For Exp (B)	P-Value for AOR
		died	survived				
Age of neonate	≤ 1 day	48	128	4.35(1.65-11.5)	0.03	6.328(1.83-21.88)	0.004
	2-7 day	4	73	0.64 (0.16-2.48)	0.51	0.467(0.10-2.11)	0.32
	2.8 day	5	58				
Sex of neonate	Male						
	Female						
Birth weight	<2500 gram	19	16	8.43(3.92-18.16)	0.00	4.40(1.73-11.21)	0.002

	≥2500 gram	8	30	1.893(.79-4.51)	0.15	7.742(2.16-27.76)	0.402
Gestational age	Term	12	139	4.63(2.30-9.33)	0.00	3.27(1.50-7.14)	0.003
	Preterm	38	95	3.24(1.16-9.04)	0.24	3.97(1.25-12.56)	0.019
	Post term	7	25				
APGAR Score	<4	19	34	5.37(2.41-11.97)	0.00	3.457(1.14-10.50)	0.029
	4-6	25	100	2.404(1.17-4.94)	0.17	1.45(0.66-3.12)	0.36
	7-10	13	125	4.35(3.65-12.53)	0.06	23.8(1.94-291)	0.013
Was the neonate initiated EBF	Yes	7	85	6.54(2.76-22.35)	0.07	16.32(7.64-28.52)	0.43
	No	50	174	3.489(1.52-8.02)	0.00	0.86(0.29-2.51)	0.78
Pregnancy type	Singleton	286	12	4.94(2.25-10.86)	0.00	1.90(0.67-5.41)	0.23
	Twin	30	8	204.1(9.8-4234.4)	0.00	172(9.62-3076)	0.00

4.2 Discussion

In this study, newborns admitted to the NICU at Minelik Comprehensive Specialized Hospital in Addis Ababa, Ethiopia, had their neonatal mortality rates and associated risk factors evaluated. In this study, the prevalence of neonatal mortality was 18% which is almost similar to a study done in (18.34%) East Wollega, Western Ethiopia (Berhanu et al., 2021a). This may be due to similarity in NICU setup, study methodology, similarity in policy accomplishment and setup, study period, treatment modality, manpower resources and facility distribution.

This study was relatively higher than 11.4% in Gondar, 11.4% in FHRH, 11.6% in Gedo zone referral hospital, 11.4% Dire Dawa and in other developing countries respectively (Desalew et al., 2020)(Thomas et al., 2022)(Eshete et al., 2021). In contrast, lower mortality of 20.7% in Tibebe Gion specialized hospital and 18.6% in Amhara regional state (Mitiku, 2021b) (Mengistu et al., 2020). In this study, neonatal mortality was significantly high. This might be due to different possible reasons. One possible source of variation in mortality might be difference in sample size and methodology. Further, possible reason might be the difference in study period as there were changes in treatment modality. This gap might be also due to facilities in the hospital, NICU setup and manpower.

Majority of this study reveals that low birth weight, preterm (premature neonates), age less than 24 hours neonate and low APGAR score were the major associated factors of neonatal mortality in which, 11.1% LBW, 42.1% preterm, 55.7% age less than 24 hours and 16.8% low APGAR score neonates were died respectively. In the present study, age less than one day (≤ 1) accounted 176(55.7%) of neonates. RDS (33.8%), newborn sepsis (17.7%), NEC (14.5%), and perinatal asphyxia (6.7%) were the leading causes of mortality. Studies conducted at UOG, Saint Paul Hospital, northern Ethiopia, Nigeria, South Africa, and India all agreed with the findings.

This may be due to similarity in NICU setup, study methodology, similarity in policy accomplishment and setup, study period, treatment modality, manpower resources and facility distribution.

Strengths and limitation of the study

Strengths:

Since the study was conducted on secondary data of admitted neonates it was easy to get documented neonatal medical, surgical problems or other important predictors which are diagnosed up to 28 days.

Data were collected by health professionals working in NICU which had an important role in the quality of the data and they were supervised.

Limitations:

This study was difficult to get important socio-demographic predictors like maternal occupation, maternal educational status, household income because it had not documented this information on nursing care plan. Because of the possibility that the hospital sample used for this study was different from the general population, it may not be applicable to newborns who passed away outside of a medical facility.

Conclusions

In the current study, the magnitude of preterm neonatal death was found to be high particularly in the early neonatal period and multivariate analysis showed that the major predictors of neonatal mortality. This study shows that the rate of neonatal mortality is still relatively higher than the national data record. Low birth weight, preterm, low APGAR score and age of neonates less than 24 hours were factors associated with neonatal mortality. Thus, the health care institution/facility should focus on low birth weight, preterm, low APGAR score, and neonates age less than 24 hours. Standard basic care for admitted neonates and needs early treatment.

Recommendation

Neonatal death was a common occurrence (higher prevalence) at Minelik II Comprehensive Specialized Hospital. According to our research, newborns that are low birth weight and those who are under 24 hours old have a higher risk of neonatal mortality. Therefore, neonates with low birth weight, small for gestational age, poor APGAR scores, and newborns with low birth weight should receive special attention from physicians, legislators, and program administrators. Community based longitudinal study would be helpful to get other unmeasured risk factors.

To health care provider of Minelik II comprehensive specialized hospital

A special emphasis and close follow up should be given to patients in neonatal period, since this is the time of a great number of mortalities in the current study. The health care provider should be able to closely screen and give follow-up for neonates particularly those identified with predictors of death in this study. It would be better to give special attention for patients with poor APGAR score, low GA, low birth weight and neonates age less than 24 hours.

To upcoming researchers

A longitudinal prospective cohort study is strongly recommended to follow neonates because it would be highly beneficial to identify the long-term outcomes of preterm births and the health needs of babies and to identify other predictors including socioeconomic, educational, occupational, genetic and environmental and other factors as well as reason specific predictors. Further community-based study should be conducted on magnitude of neonatal mortality and its predictors.

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Check list to assess the magnitude of neonatal mortality and its associated factors among neonates admitted to intensive care units (NICU) at MIIRH, Addis Ababa, Ethiopia

Annex I: Questionnaire

Introduction

My name is Ereda Belete, Post graduate student at Addis Ababa University, college of development, department of Population study/Reproductive health in neonatal nursing track. Now is conducting my thesis on the **magnitude of neonatal mortality and its associated factors among neonates admitted to neonatal intensive care unit at Menelik ii referral HOSPITAL, Addis Ababa, Ethiopia** by using secondary data from 2019-2022, the objective of the study is to assess neonatal mortality and associated factors among neonates admitted to neonatal intensive care unit. 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.

- 1. Code

- 2. Date of data collected

- 3. Name of data collector and Signature

- 4. Supervisor name and Signature

I-Socio-demographic data

code	Question	Responses
100	Age of neonate (in days)	1. <u>Less than 1</u> days 2. 2- 7 day 3. 8-28 day
101	Sex of neonate	1. Male 2.Female
102	Residence	1. Addis Ababa 2. Out of Addis Ababa
103	Age of the mother at first birth	1.15–19 2.29–24 3.25–29 4. 30–34 5.35–39
104	Marital status	1.Currently married 2.Divorced/windowed/separated 3.Never-married
105	Place of birth	1. Health center 2. Governmental hospital 3. Private hospital 4. Home 5. Other
106	Birth attendant	1. Skilled health professional 2. Health extension worker 3. Untrained birth attendant 4. Other
II -Neonatal related predictors		
201	Birth weight of the neonate	1.Less than 1500gram 2. 1500- 2500gram 3. 2500- 4000grams 4.>4000 gram
202	Gestational age of the neonate	1. Pre-term 2. term 3. Post term 4. unknown

203	Reason for admission	1. respiratory distress syndrome 2. Meconium aspiration syndrome 3. PNA (perinatal asphyxia) 4. Meningitis 5. Congenital abnormality 6. Sepsis 7. Other
204	Was the neonate initiated breastfeed within 1 hr.?	1. Yes 2. No
206	Was current pregnancy multiple	1. Singleton 2. twin
208	APGARS at 1 st and 5 th Minute	1. Less than 4 2. 4-6 3. 7-10 4. Unknown
209	Outcome of the neonate by the time of discharge	1. Survived 2. Died

III –Obstetrics and Maternal related predictors/ factors

302	Parity of the mother (write the gravidity of the mother)
303	Number of pregnancy (gravidity)
304	Had ANC follow up for the neonate	1. yes 2. No
305	Number of ANC follow up visits (if Q303 is yes)	Write Number of visits _____
307	History of maternal medical illness	1. yes 2. No
308	If question number 306 is yes Which medical problem had the mother been Diagnosed during	1. pre-eclampsia 2. Eclampsia

	pregnancy?	3.Diabetes 4.HIV/AIDS 5.Cardiac diseases 6. Other specify
309	History of previous neonatal mortality	1. Yes 2. No
310	Duration of labor for this last pregnancy	1. Less than 12 hrs. 2. ≥12 hrs.
311	Duration of rapture of membrane in hour	1. < 12 hour 2. ≥ 12 hours
312	Does the mother induce	1. Yes 2. No
313	Does the mother augment	1. Yes 2. No
314	Mode of delivery	1. SVD 2. Instrumental 3. CS
315	If the answer for Q 314 is 2 what was the indication?	1.Poor maternal uterine contraction 2. Prolonged 2nd stage of labor 3. Other specify
316	If the answer for Q 314 is 3 what was the indication?	1. CPD 2. NRFHRP 3. Failed instrumental delivery 4. Elective C/S 5. Others....