ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF ANESTHESIA

SURVIVAL STATUS AND PREDICTORS OF EARLY NEONATAL MORTALITY AMONG ADMITTED TO NEONATAL INTENSIVE CARE UNIT IN ADDIS ABABA PUBLIC HOSPITAL, ETHIOPIA 2023: RETROSPECTIVE COHORT STUDY

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Certification

The undersigned witnesses that the study titled "Survival Status and Predictors of Early Neonatal Mortality among Admitted to Neonatal Intensive Care Units in Public Hospitals in Addis Ababa is my own original work, and any sources of information or data used in it were noted in the reference section. Any assistance provided during this time has also been acknowledged.

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Acronyms and Abbreviations

AHR:	Adjusted Hazard Ratio
ANC:	Antenatal Care
CHR	Crude hazard ratio
CI:	Confidence Interval
EDHS:	Ethiopia Demographic Health Survey
ENM:	Early Neonatal Mortality
GA:	Gestational Age
HIV:	Human Immunodeficiency Virus
HSDP:	Health Sector Development Plan
IDR:	Incidence Density Rate
LMIC:	Low- And Middle-Income Countries
LNM:	Late Neonatal Mortality
MDG:	Millennium Development Goals
NICU:	Neonatal Intensive Care Unit
NM:	Neonatal Mortality
NMR:	Neonatal Mortality Rate
SDGs:	Sustainable Development Goals

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Abstract

Background: The first week following birth is the time when there is a greater chance that a child will die. Early infant mortality is still a problem for worldwide public health, particularly in sub-Saharan African nations like Ethiopia. Most neonatal deaths—roughly 75%—occur within the first seven days of delivery, but there limited evidence on retrospective cohort follow-up studies and little evidence of how to determine the factors that may determine when someone die in Ethiopia, specifically in this study area.

Objective: The aim of the study was to assess survival status and predictors of early neonatal mortality among admitted to Neonatal Intensive Care Unit of Addis Ababa public Hospitals, Ethiopia, 2023

Methods In four public hospitals in Addis Ababa, Ethiopia, a retrospective cohort analysis was conducted. For a total sample size of 375 neonate's data collected through document review and checklists using conventional random selection approaches. Following coding, cleaning, and revision, the data were entered into Epic Data Version 3.1. Data then imported into SPSS 26 for analysis. The Kaplan-Meier survival curve with log rank test was applied to compare the survival rates between groups. Furthermore, bivariate and multivariate Cox proportional hazard regression analyses were conducted to identify the predictive components. The assumption of the model was verified. Figures and tables were used to describe the results.

Results The study included 375 eligible neonates in total. A total incidence rate of 37.1 deaths per 1000 was found (95% CI: 25.5, 40.9), with 75 of them (20%) died. Premature birth [AHR: 4 (with 95% CI: 1.234, 5.80)], preeclampsia [AHR: 2.4 (95% CI: 1.16, 4.98)], fifth-minute Apgar score [AHR: 3.93 (95% CI: 1.76, 8.77)], initiation exclusive of breast feeding [AHR: 3.69 (95% CI: 1.14, 9.02)], and low birth weight [AHR: 2.01 (95% CI; 1.28, 3.43***)***

Conclusion: Early neonatal mortality is high in NICU at Addis Ababa's public hospitals. Gestational age, preeclampsia, the five-minute Apgar score, the initiating of exclusive breast feeding, low birth weight were found to be independent predictors of early neonatal death. Magnificent care and attention to a neonate with a low Apgar score who is not breastfeeding, premature, has a low birth weight, and whose mother has pregnancy-induced hypertension.

Key words: Early neonatal death, Predictors, time to death, retrospective cohort study

Chapter One

1.1 Introduction

1.2Background

Neonates are young infants between the ages of birth and 28 days. The neonate is extremely susceptible during this time because significant physiological changes are required for extrauterine life (1). Neonatal death is the possibility of a live-born child dying within the first 28 days of life, regardless of gestational age at birth (mortality). Neonatal fatalities can also be divided into two categories: (a) early neonatal deaths, which happen between the day of birth and the seventh day of life (0 to 7 days); and (b) late neonatal deaths, which happen after the seventh day but before the 28th full day of life (7 to 28 days) .Neonatal survival during the first week of life is affected not only by the strains of intrauterine existence but also by the birth process, the adaptation to a new environment, nutrition, and infection. Thus, the first seven days of life after birth, known as the early neonatal phase, are the most crucial (2).

Ethiopia is the sixth among ten countries with highest neonatal death numbers with 87900 deaths annually and showed slow progress in reducing neonatal mortality rate (NMR) .According to the 2019 Ethiopia Mini Demographic and Health Survey (2019 EMDHS) report, Ethiopia's 2 neonatal mortality rate is 30 per 1000 live birth.

The majority of neonatal deaths occur in low- and lower-middle-income nations, where both the mother's and the child's survival depend on the on-going and improved availability of life-saving therapies. International and local attention must continue to be directed towards the health and survival of every infant (3) .In sub-Saharan Africa, infections, birth asphyxia, complications of preterm birth, and low birth weight are the most common cause of neonatal mortality. Five countries shared 50% of neonatal death in this region; Nigeria, the Democratic Republic of Congo, Ethiopia, Tanzania, and Uganda (4). Moreover, in East Africa, a study showed that home births practices and rural residency are predictors of neonatal mortality (5).

One of the top global priorities is reducing neonatal mortality, and the Sustainable Development Goals (SDGs) contain specific targets for doing so. As a result, the SDGs prioritise improving mother and child health, with the goal of lowering global newborn mortality to 12 deaths per 1,000 live births by 2030.

1.3 Statements of the problems

Regardless of the fact that since 2000, the likelihood of survival has increased for all age groups, not all childhood ages have seen the same progress. Kids are most likely to die in the first month of life, with an average global rate of 17 deaths per 1,000 live births in 2019, down 52% from 38 deaths per 1,000 in 1990, according to the United Nations Inter-agency Group for Child Mortality Estimation 2020 study (3, 4)

Around the world, 2.4 million children died in their first month of life in 2019, which is roughly 6,700 neonatal deaths every day. Nearly three-quarters of all neonatal deaths occurred within the first week of life, and about a third occurred within the first day after birth. The majority of these neonatal deaths (99%) occur in low-income nations, with nearly half taking place at home In 2019, Sub-Saharan Africa (which accounted for 42% of all newborn deaths) and Central and Southern Asia together accounted for nearly 80% of all neonatal deaths (which accounted for 37 percent) (4).

Preterm birth, problems during labour, maternal-related conditions, and birth abnormalities are the most frequent causes of neonatal mortality. The causes of more than 80% of neonatal mortality include infections and complications from premature birth (5-7).

About three fourth of the neonatal deaths in low and middle income countries (LMICs) can be prevented through effective schemes with existing simple and low cost tools, like kangaroo mother care for preterm babies, early breast feeding initiation, and sepsis, newborn resuscitation, skin-to-skin contact, clean water, use of disinfectant, and good nutrition along with access to well-trained healthcare providers(8-10).

An attempt has been made to lessen these problems, which have an impact on a neonate's quality of life, on a national and worldwide level. The Millennium Development Goals (MDGs) included it, and when the Sustainable Development Goals (SDGs) were later added, it remained on the MDGs' "unfinished agenda." SDG 3's Target 2 calls for all nations to make an effort to lower neonatal mortality to at least 12 per 1,000 live births by 2030 in order to reduce newborn deaths that can be spared (11).

In Ethiopia, neonatal mortality rates have been continuously declining from 39 deaths per 1000 live births in 2005 to 29 deaths per 1000 live births in 2016, but have not been in progress since 2016 (12, 13).

According to the Ethiopia Mini Demographic and Health Survey 2019, the neonatal mortality rate is 30 deaths per 1,000 live births (12)

Ethiopia had further planned to reduce the neonatal mortality rate from 29 deaths per 1000 live births in 2015/16 to 10 deaths by 2019/2020. To do so, plans and strategies like the Integrated Management of Newborn and Childhood Illness (IMNCI) strategy, Kangaroo Mother Care (KMC), and Health Sector Development Plan (HSDP) have been formulated (14, 15)

Ethiopia is currently among the nations with a high reported number of neonatal fatalities in Africa and internationally, despite this legislation and intervention measures. Although the NMR in Ethiopia dropped from 49 in 2000 to 29 in 2016, the decline was substantially slower (41% compared with 85%) than that of post-neonatal under-five mortality between 2000 and 2016. The majority of neonatal deaths—75% of them— occur during the first week of life, according to national and international studies. In Ethiopia, out of 29 deaths per 1000 live births, about 21 deaths per 1,000 live births occur during the early neonatal periods (12, 16).

Therefore, representative and methodologically sound investigations must be conducted in order to pinpoint the root causes of the challenges and gaps mentioned. This is especially important in the public hospitals in Addis Ababa, where several socio-demographic factors are suspected. In light of this, a study was carried out to determine the incidence, time to death, and predictors of early neonatal mortality among newborns admitted to Ethiopia's chosen public hospitals in Addis Ababa Ethiopia, 2023.

1.4. Rationale of the study

The research on survival and early new born mortality predictors is now of extreme significance because it may be regarded as one of the best quality indicators for healthcare as well as for the social and economic welfare of the population. Additionally, studies on early neonatal mortality and time to death are uncommon, particularly in the country's central region, despite the fact that roughly 75% of neonatal deaths occur during the first week of life (17, 18).

In order to better understand the incidence, predictors, and gaps preventing nations from achieving the Sustainable Development Goals (SDGs), which include a plan to eliminate preventable new born deaths in all countries and reduce neonatal mortality to as little as 12 per 1000 live births, the study will look into these issues. Therefore, from this outcome, organisations working on the SDGs can learn crucial information (11).

Evidence from this study will also give program implementers and policymakers stimulating information for monitoring and evaluation operations. This outcome is advantageous for health professionals, particularly those who work in clinics for maternal and child health. Additionally, the results of this study will serve as a starting point for upcoming researchers conducting additional research on the same subject.

Chapter Two

2.1 Literature review

2.2 magnitude of neonatal *mortality*

Children are the most vulnerable throughout the neonatal period, particularly the early neonatal period. Since 1990, the number of newborn deaths has declined more slowly, falling by 42.4% in 2015. According to the most recent UN statistics, there were an estimated 6,700 neonatal death each day in 2019, equivalent to a death rate of 17 per 1,000 live births. Three-fourths of this mortality happened within the first seven days, and one-third occurred during the first 24 hours (5, 19, 20) .

The number of neonatal deaths reduced from 5.0 million in 1990 to 2.4 million in 2019, a reduction of 52 percent in the global neonatal mortality rate from 37 deaths per 1,000 live births in 1990. The neonatal mortality rate, however, dropped more slowly than the mortality rate for children 1 to 59 months old. Neonatal deaths now account for 47% of all under-five mortality, up from 40% in 1990 due to the different rates of decline for and children aged 1-59 months (5). Regionally, sub-Saharan Africa and Central and Southern Asia had the greatest neonatal mortality rates, accounting for approximately half of all neonatal deaths, while Europe and Northern America recorded only 3 and 4 deaths per 1000 live births, respectively (21).

In Guatemala, the Democratic Republic of the Congo, Zambia, and Pakistan, the early newborn mortality rate was 25 deaths per 1000 live births, according to a community-based prospective observational multicenter study. Additionally, it showed that 80% of these fatalities took place in the first three days of a new-born's existence (22). The incidence density rate of neonatal mortalities (IDRs) of in neonatal intensive care units (NICU) and in the community, respectively, was 24.53 and 12.1 per 1000 person-days, according to a systematic review and meta-analysis study carried out in Sub-Saharan Africa. Additionally, it demonstrates that early neonatal mortalities in neonatal intensive care units had IDRs of 22.51 per 1000 live births, but late neonatal mortalities had IDRs of 5.09 per 1000 live births.

Neonatal mortality among patients admitted to the NICU unit was found to be 20.7% in Guinea, with the majority of deaths (71.4%) taking place within 7 days of admission (23). The neonatal mortality rate in the three districts was 34 per 1000 live births, according to a cross-sectional study on neonatal mortality and its causes in rural communities in eastern Uganda. A majority of

these deaths (44.7%) occurred within the first six hours after delivery, followed by 30.9% within the first seven hours to six days later, and 24.5% within the next seven to twenty-eight days (6, 21, 23, 24).

Although neonatal mortality in Ethiopia decreased from 2000 to 2016 (from 29 deaths per 1000 live births to 30 deaths per 1000 live births over three years, there has been no decrease in neonatal mortality since 2016, and it even increased from 2016 to 2019 by 1 death per 1000 live births. Neonatal mortality in Ethiopia is estimated to have a composite national incidence of 16.3%, with the Amhara area having the greatest prevalence at 20.3% and the Oromia region having the lowest prevalence at 18.8%, according to a recent systematic review and meta-analysis study (12, 16).

Neonatal mortality in the district was 41 per 1000 live births, according to a community-based prospective follow-up research done among a cohort of term expectant mothers and delivered in southern Ethiopia's Aroresa district. Sixty-two.5percentage of these neonatal deaths happened within the first week of life. Additionally, a prospective follow-up study carried out at public hospitals in the southern Ethiopian cities of Gamo and Gofazones reveals that the region's neonatal mortality incidence rate was 9.6 per 1000 live births. 46.2% of these fatalities happened during the first 24 hours, and 50% happened between day one and day seven (25).

According to Mengistu et al., there were 27 neonatal deaths for every 1000 newborns admitted to Amhara regional state referral hospitals. Nine-tenths (90.35%) of the who were dead at birth died within 24 hours, and more than half (56.14%) of them did so within the early neonatal period (33). Further research revealed that the neonatal mortality rate was 25.8 deaths per 1000 neonate days among newborns admitted to the neonatal critical care unit of the Debra Markos Referral Hospital, from which most of the neonatal deaths (83.5%) occurred in the early phase of the neonatal period or the first 7 days of age (27)

2.2.1 Predictors of neonatal mortality

The international community must continue to place a high priority on the survival and health of newborns. To address the primary causes of neonatal mortality internationally, the emphasis should be on maintaining high coverage of high-quality antenatal care, postnatal care for mother and baby, and treatment of small and ill infants. Preterm birth, intrapartum problems (birth

hypoxia or lack of breathing at birth), infections, and birth defects are the main causes of newborn death globally (28-30).

2.2.2. Socio demographic factors

Gestational age and place of residency are two characteristics linked to neonatal mortality, according to a systematic study on predictors of neonatal mortality in Ethiopia. It became known that preterm babies had a greater mortality rate than term babies after they are born. Additionally, compared to born in urban settings, the collective impact of neonatal deaths in rural areas is nearly two times larger (28, 31, and 32)

Prematurity was found to be a significant predictor of neonatal death in an analysis of data from population surveillance sites in low- and middle-income countries (India, Nepal, and Bangladesh).breech delivery, and male, which are linked to neonatal death, were less strong predictors in the sites but were still effective.(28, 31, 33, 34) One global review study on under-five mortality from 2000 to 2015 indicated that about one million, or 16%, of died of preterm birth complications, which is one of the leading causes of neonatal mortality

According to Yadeta TA et al., perinatal mortality was negatively associated in parents' educational level, a longer birth interval, and the female being the head of the household, while positively associated with maternal age, rural residence, history of terminating a pregnancy, and place of delivery (35).Numerous studies also indicated that living in a rural area increased the chance of newborn death. That is, compared to their peers, whose parents stay in rural areas have a higher chance of dying . The sex of the child was found to be a modest predictor of newborn death according to data taken from EDHS 2016 and several other researches. Male are more likely than female ones to be at danger of dying (16, 35, 36)

2.2.3 Maternal health related problems

In sub-Saharan Africa, a pooled analysis found that multiple births, mother illnesses during pregnancy, and failure to initiate nursing within an hour of birth were predictors of neonatal mortality (14). According to a thorough examination of under-five mortality rates that has implications for the Sustainable Development Goals, intrapartum-related events were one of the top causes of neonatal death (0.637 million fatalities, or 10%) (23). Multiple birth types and the use of prenatal care (ANC) were found to be strongly linked with new-born mortality, according

to data taken from the EDHS 2016 (22). Additionally, Belliz s. et al. discovered that compared to a single pregnancy, several pregnancies put the neonate at a 10-fold greater chance of dying (11)

Besides, Recently one longitudinal study conducted in Southwest Ethiopia and identified that attending ≥4 ANC visits, having good knowledge on key danger signs, and having a skilled attendant at birth were significantly associated with a reduction of perinatal mortality while Being a primipara, twin births, previous history of perinatal mortality, and obstetric complication during labour were significantly increased perinatal mortality (37).

Furthermore, Predictors of neonatal mortality in Neonatal intensive care unit at referral Hospital in Southern Ethiopia were: multiple birth, mothers who did not attend antenatal care visits, born by caesarean section, not initiated breast feeding within 1 h of birth, resuscitated, and perinatal asphyxia (26). Hazards of neonatal mortality was high for who had initiated exclusive breast feeding (EBF) after 1 hour mothers who had no postnatal care(38). Another prospective study conducted in Amhara region referral hospitals shows that maternal age ≥ 35 years,, multiple pregnancy and positive maternal HIV status were predictors of neonatal mortality (39). Another study conducted at southern part of Ethiopia found that age of the mother; number of antenatal care visits, presentation, and gestational age were identified as associated with neonatal death (27)

2.2.4 Neonatal related factors

Low birth weight, birth asphyxia, and preterm delivery problems were found to be the leading predictors of dying during the first week after birth in sub-Saharan Africa and developing nations, according to numerous individual research and systematic reviews on early newborn death. Additionally, it showed that the majority of preterm and birth asphyxia-related deaths happen in the first week of life, as do roughly half of all neonatal deaths from sepsis (37, 40)

Low first and fifth minute Apgar scores, multiple births, being preterm, sepsis, asphyxia, and respiratory distress syndrome [RDS] were found to be independent predictors of time to neonatal mortality in a systematic review study on the incidence density rate of neonatal mortality and its predictors in sub-Saharan Africa (25, 37, 40).

In comparison to singular, early newborn mortality among twins was considerably greater in the 60 low- and middle-income nations studied by Bellizzi et al. In a subgroup analysis of those

nations with data on birth weight, early newborn mortality was also higher among twins than singletons when birth weight was adjusted (28).

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Preterm , with fever upon admission, low birth weight infants, and newborns with a poor 5-minute APGAR score are more likely to pass away, according to a prospective follow-up research among admitted to neonatal intensive care units at public hospitals in eastern Ethiopia.

Low birth weight, preterm, RDS, perinatal hypoxia, and congenital abnormalities were discovered by Seid et al. to be preventable variables linked to neonatal death (44)

2.3 Conceptual framework for predictors early of neonatal mortality

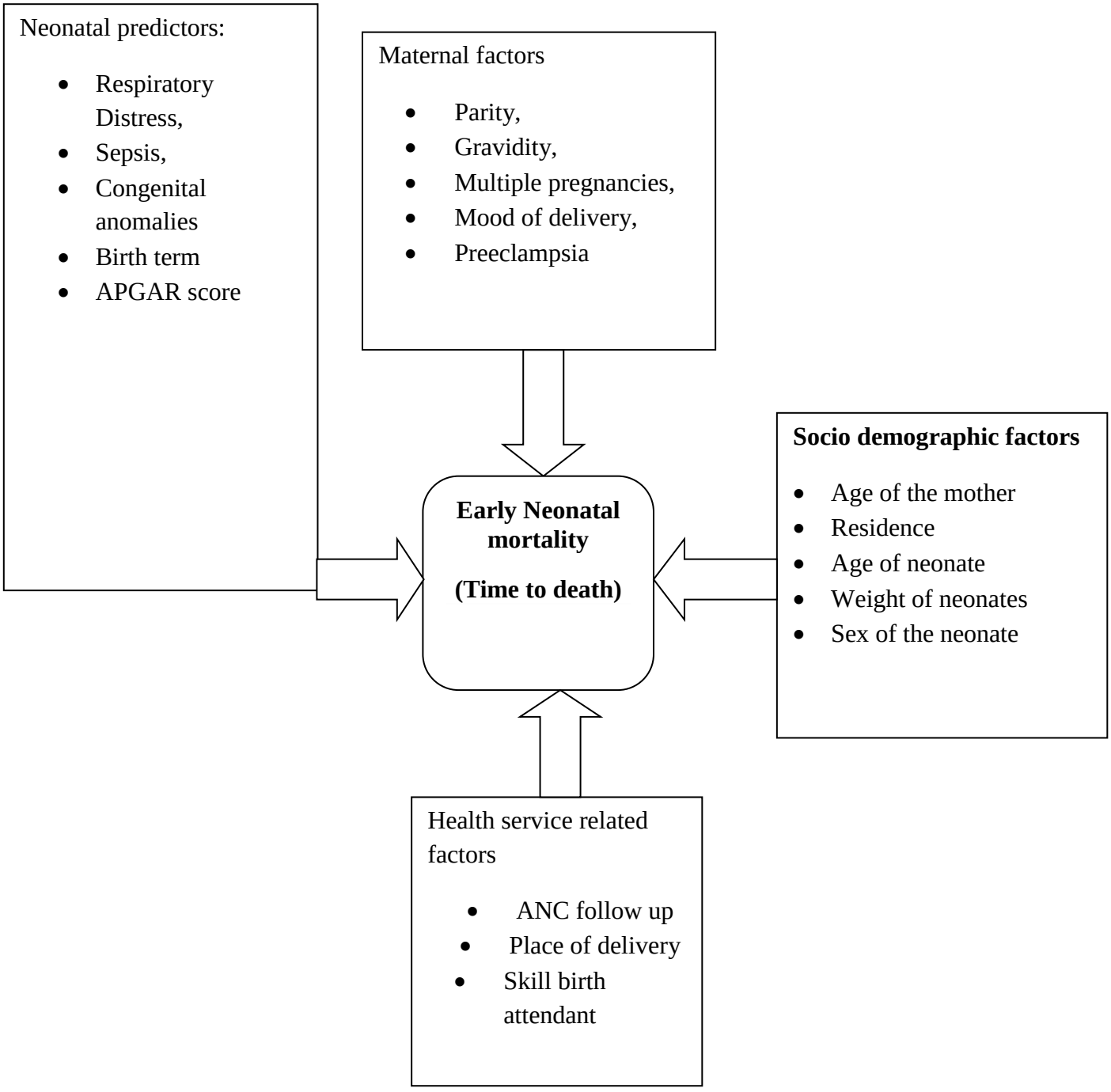


Figure 1: conceptual framework of early neonatal mortality

Source: developed from different literatures (3, 7, 12, 16, 26, 27 and 38).

Chapter Three

Objective

3.2 General objective

To assess survival status and predictors of early neonatal mortality among admitted to the NICU of Addis Ababa public hospitals, Ethiopia, from January 1, 2022, to January 1, 2023, G.C.

3.3 Specific objectives

1. To determine the incidence of early neonatal mortality among admitted to the NICU
2. To identify factors associated with early neonatal mortality among admitted to the NICU
3. To determine the time to death of an early neonate admitted to the NICU in Addis Ababa, Ethiopia,

Chapter Four

4.1 Methodology

4.2 Study area

A retrospective cohort study was conducted at NICU in Addis Ababa public hospitals in Ethiopia, 2023.

The study was carried out in four public hospitals that have their own neonatal intensive care unit (NICU). Gandhi Memorial Hospital, St. Paul Millennium Medical College Hospital, Zebditu Memorial Hospital, and Tikur Anbessa Specialised Hospital.

St. Paul's Hospital Millennium Medical College receives 225 NICU admissions per month on average, Gandhi Memorial Hospital receives 180, Zebditu Memorial Hospital receives 75, and Tikur Anbessa Specialized Hospital receives 150.

4.3 Study design and period

A multi-center retrospective cohort study was carry out in Addis Ababa's selected public hospitals from January 1, 2022 to January1, 2023.

Data collection was assessed from January 30-2023 to March 30- 2023 G.C

4.4 Population

4.3.1 Source population

All age less than seven days admitted to the NICU of Addis Ababa public Hospitals

4.3.2 Study population

During the study period, all aged less than seven days admitted to the NICUs of Addis Ababa's selected hospitals from January 1st, 2022to January 1st, 2023.

4.3.3 Study unit

Each selected early neonate cards from January 1, 2022 to January1, 2023 G.C based on inclusive criteria4.4 Eligibility criteria

4.4.1 Inclusion Criteria

All less than seven-day-old whom were admitted to the corresponding neonatal intensive care unit (NICU) of each selected hospital and fulfilled medical record criteria

4.4.2 Exclusion Criteria

Incomplete medical record chart data information.

Age >7 days old

4.5 Sample Size Determination

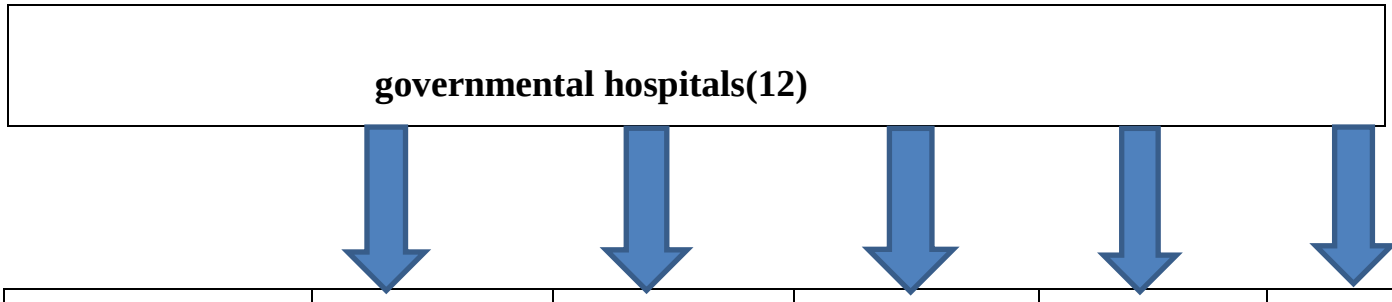
4.5.1 Sample size for single proportion

A single population proportion formula was used to estimate the sample size for the survival status (outcome) of neonates, by using: P = the proportion of neonatal mortality among neonates admitted in NICU, 34% from Amhara regional state Referral Hospital ,Ethiopia (45) Z α/2 = the resultant Z score of 95% CI and d= a tolerable margin of error (5%) and N= the minimum sample size required N= $(Z\alpha/2)2\times P(1-P)$ $(d)2$

N= (1.96)2 × 0.34×0.66/ (0.05)2 = 341. After taking a 10% by considering lost or incomplete sheets, the final sample size was 375

4.6 Sampling technique and sampling procedure

Simple random sampling method was used to select four hospitals from 12 governmental hospitals and early neonatal cards selected proportionally according to their total early neonatal admission at NICU.



Total number of admission from Jan1,2022 to 2023 to four hospitals estimation	**St. Phawulos Hospital**	**Gandhi Hospital**	**Tikur Anbessa**	**Zebditu Hospital**	**Total sample size**
Ni=7560	2700*375/7500	2160*375/7560	1800*375/7560	900*375/7560	

Allocated samples , n	n=134	n=106	n=91	n=44	**375**

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Figure 2: schematic presentation of sampling procedure for the study that conducted in Addis Ababa public hospitals.

4.7 Variables

4.7.1 Dependent variables

Time to death of neonatal mortality

4.8. Independent variables

Socio demographic characteristics of the neonate and the mother (Maternal age, Newborn sex and Neonatal Age at admission)

Neonatal factors (gestational age, birth weight, Apgar score, multiple gestations, neonatal medical issues, congenital anomalies, and start of breastfeeding).

Maternal and health related factors (Parity, ANC follow-up, HIV status, Mode of Delivery, Maternal Problems and Place of Delivery,)

4.8 Operational Definitions

Time: - The period from starting of observation until the occurrence of outcome of observation (death or censored)

Event: - Death of a neonate at a specific time (day) within the 7 days

Censored: study subjects who does not experience event of interest during the follow-up period.

Discharged: with improvement or **stayed** with admission **beyond** 7 days of neonatal age.

4.9 Data Collection Technique

Moreover, each piece of data collected was checked against the questionnaires and checklists for completeness before leaving each **study participant.** Supervisors and the principal investigator to check for completeness and clarity then reviewed each questionnaire and checklist daily

4.9.10 Data quality control and management

A pre-assessment was conducted on 5% of the total sample sizes in the hospital found in Addis Ababa, a non-selective hospital. There were four data collectors, two midwives and two nurses. Training was given for data collectors and supervisors regarding ethical issues, general approaches, and strategies to minimise information bias.

Moreover, each piece of data collected was checked against the questionnaires and checklists for completeness before leaving each study participant. Each questionnaire and checklist was then reviewed daily by supervisors and the principal investigator to check for completeness and clarity.

4.11 Data Entry and Analysis

Data were coded, cleaned, edited, and entered into Epi Data version 3.1 and then exported to SPSS software for analysis. Descriptive statistics like percentage mean and standard deviation were employed. Tables and figures were used to present the results.

A necessary assumption of the Cox proportional hazard regression model was checked. Both bivariate and multivariable Cox proportional hazard regression analyses were computed. Moreover, the Kaplan-Meier survival curve was used to estimate survival time.

All variables having a P-value 0.25 in the variable analysis were then further fitted to the final model to identify independent predictors of early neonatal mortality, and then the variables that had an independent association with an outcome variable were identified based on AHR with a 95% CI and a p-value 0.05. Accordingly, in the multivariable analysis, variables with a P-value 0.05 were considered significant predictors of early neonatal mortality.

4.12 Ethical Considerations

This project was conducted after being approved by the Addis Ababa University College Health Science Institutional Review Board (IRB). Data was collected after getting official permission from the Addis Ababa City Health Bureau and each selected hospital administration office.

4.13 Dissemination of the result

The final report will be presented and discussed at Addis Ababa University College of Health Sciences, Department of Anaesthesia, as partial fulfilment of the degree of master's in anaesthesia.

The results of this study will be sent to the Addis Ababa Health Bureau and to each hospital where data was collected. Preliminary efforts will be made to present the findings to different concerned bodies and to publish them in local or international journals.

Chapter 5

Results

Data were extracted from medical records of 375 study participants born between January 1, 2022 to January 1, 2023 admitted to the neonatal intensive care unit.

5.1 Socio-demographic characteristics of mothers and Neonates

Of total 375 study participants, 199 (53.1%) were male. More than half of the participants, 281 (74.9%), came from urban areas. Most neonates 362(96.1%) were admitted to the NICU within the first three days or in 72 hours of age. The majority of mothers, 279 (74.4%), were aged between 21–35 years. Among admitted mothers 146(38.9%) of them were in the GA group of premature (<37 weeks). The minimum birth weight was 900 gram and the maximum was 4500 gram, among, 131 (35%) were born with a birth weight of less than 2500 grams.

Table 1: Socio-demographic characteristics of neonate and their mothers at Addis Ababa public hospital central Ethiopia /2023

Variables	Category	Frequencies	Percentage
Sex of the neonate	Male	199	53.1
	Female	176	46.9
place of residences	Urban	281	74.9
	Rural	94	25.1
Neonatal age at admission	<24hr	159	42.4
	1-3 days	203	54.1
	More than 3 days	13	3.5
weight of the neonates	<1000	7	1.9
	1000-1500	16	4.3
	1500-2500	108	28.8
	2500-4000	236	62.9
	>4000	8	2.1
maternal age	<=20	32	8.5
	21-35	279	74.4
	>35	64	17.1

5.2 Maternal Obstetric related Characteristics

Of total 328 mothers (or 87.5%) of were multiparous. 24 mothers (6.4%) were primiparous whereas 23 (6.5%) were grand multiparous. 326(86.9) of the mother had ANC follow up while 49 mothers (13.1%) had no prior history of ANC. Sixty-two (16.5%) were born at home, 313 (83.5%) and were born in a health care facility. Regarding the method of delivery, roughly half of the mothers—179 (46.7%)—had a spontaneous vaginal delivery (SVD); roughly one-third—141 (37%)—had a caesarean section or other type of operation; and 55 (14.7%)—had an instrumental birth.291 (77.6%) of the newborns delivered were of the single type. (Table 3).

Pregnancy-induced hypertension was the most frequent obstetrical complication experienced during the previous pregnancy, followed by anaemia during the current pregnancy 22(5.9%), premature membrane rupture 35(9.3%), antepartum haemorrhage 12(3.2%), HIV infection 62 (16.5%), diabetic mellatus 17(4.5%), and others (8.5%).

Table 2: Maternal and health services related characteristics of mothers of admitted to Neonatal Intensive Care Unit of Public Hospitals in Addis Ababa, Ethiopia, 2023 [n = 375]

Variables	Category	Frequencies	Percentage
ANC follow up	Yes	326	86.9
	No	49	13.1
Numbers of visited	No visit	47	12.5
	One visit	28	8.5
	Two visit	78	23.8
	Three visit	111	33.8
	Four and more visit	111	33.8
Parity	Primiparous	24	6.4
	Multiparous	328	87.5
	Grandmultiparous	23	6.1
Place of delivery	Health institution	313	83.5
	Home	62	16.5
Type of pregnancy	Single	291	77.6
	Multiple	84	22.4
Mode of delivery	Spontaneous vaginal	179	47.7

	deliver		
	instrumental delivery	55	14.7
	Caesarean section	141	37.6
HIV status	Positive	62	16.5
	Negative	313	87.7
Pregnancy induced hypertension	Yes	46	12.3
	No	329	87.7
Any other maternal complication	No other complications	267	71.2
	CARDIAC	15	4.0
	DM	17	4.5
	ASTHMA	7	1.9
	PROM	35	9.3
	ANEMIA	22	5.9
	APH	12	3.2
Gestational age	Term	229	61.1
	Preterm	146	38.9
Resuscitation status	Yes	361	96.3
	No	14	3.7

5.3. Neonatal characteristics

Among the admitted to neonatal intensive care units; 158 (40.4%) and 80 (20.5%) of them had low first and fifth minute Apgar score respectively. Concerning the method of delivery, roughly half of the neonates or one hundred seventy nine (46.7%)—had a spontaneous vaginal delivery (SVD); around one-third or one hundred fourty one neonates (37%)—born through caesarean section. Throughout the admission stage to the newborn intensive care unit, various neonatal problems were identified. Early neonatal sepsis (208 cases; 55.5%), respiratory distress syndrome (111 cases; 29.6%), perinatal asphyxia (169 cases; 45.1%), neonatal jaundice (86 cases; 22.9%), congenital anomalies (25 cases; 9.4%), and preterm births (146 cases; 38.9%) were among the common neonatal complications identified at admission (Table 4).

Table 3: Neonatal characteristics of admitted to Neonatal Intensive Care Unit of Public Hospitals in Addis Ababa, Ethiopia, 2023 [n = 375]

Neonatal characteristics	Category	Frequencies	Percentage
Time of breast feeding started	within one hour	49	13.10
	after one hour	326	86.90
Feeding of the neonate	only breast milk	21	6.1
	breast with addition	125	33.3
	Formula	227	60.5
respiratory distress syndrome	Yes	111	29.6
	No	264	70.4
Did the neonate have a sepsis?	Yes	208	55.5
	No	167	44.5
Presence of prenatal asphyxia	Yes	169	45.1
	No	206	54.9
Presence of jaundice	Yes	86	22.9
	No	289	77.1
Congenital anomaly	Yes	19	5.1
	No	356	94.9
Specify types of anomaly	No other complication	349	93.1
	Cardiac	16	4.3
	Other	10	2.6

5.4 Survival status of early neonatal

At the end of the seventh day of total, 375 participants', 75 (20%) were dead (95% C.I., 15.7%, 24%). In addition, 293 (78.1%) neonates were released from the hospital, and 7(1.9%) were kept on therapy. With a median follow-up time of 4 days and a mean follow-up time of 3.4 were

recorded for a minimum of one day and a maximum of seven days. Neonatal mortality is typically measured over a period of 2025 person days, incidence rate of 37.1deaths/1000 total person days.

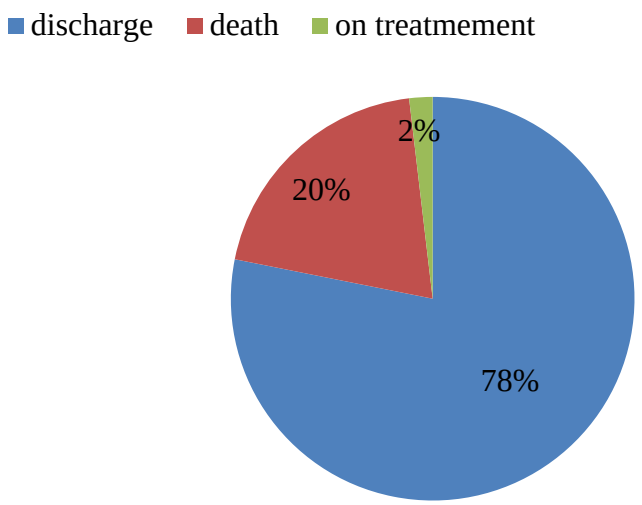
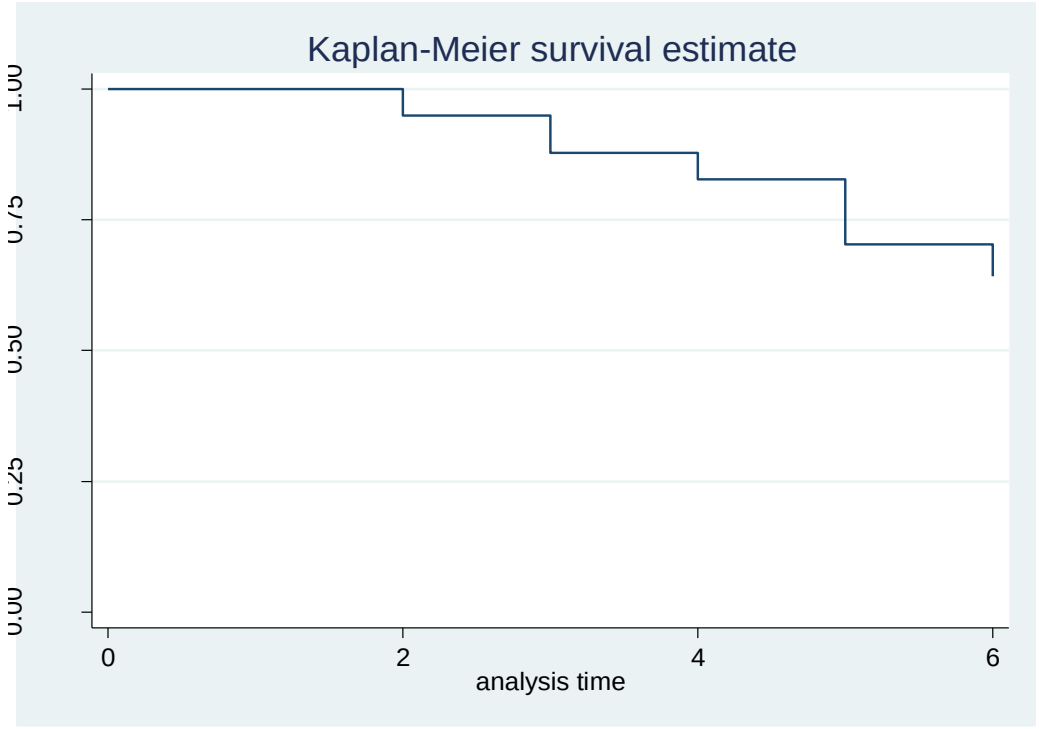


Figure 3: Survival status of early neonate admitted to Neonatal intensive care of Addis Ababa Public Hospital 2023

The survival rate of during the first 24 hours was 95%. The survival rate of during the first three days was 86%. Moreover, the survival rate of during the first seven days was 65%.

Additionally, according to our data, 32(42.7%) died within the first 24 hours of follow-up, 40 (or 53%) between the first and third days, and 3 (or 4%) after the third day. This finding shows that 62 (95%) were passed away did so within the first 72 hours (or three days) of follow-up.



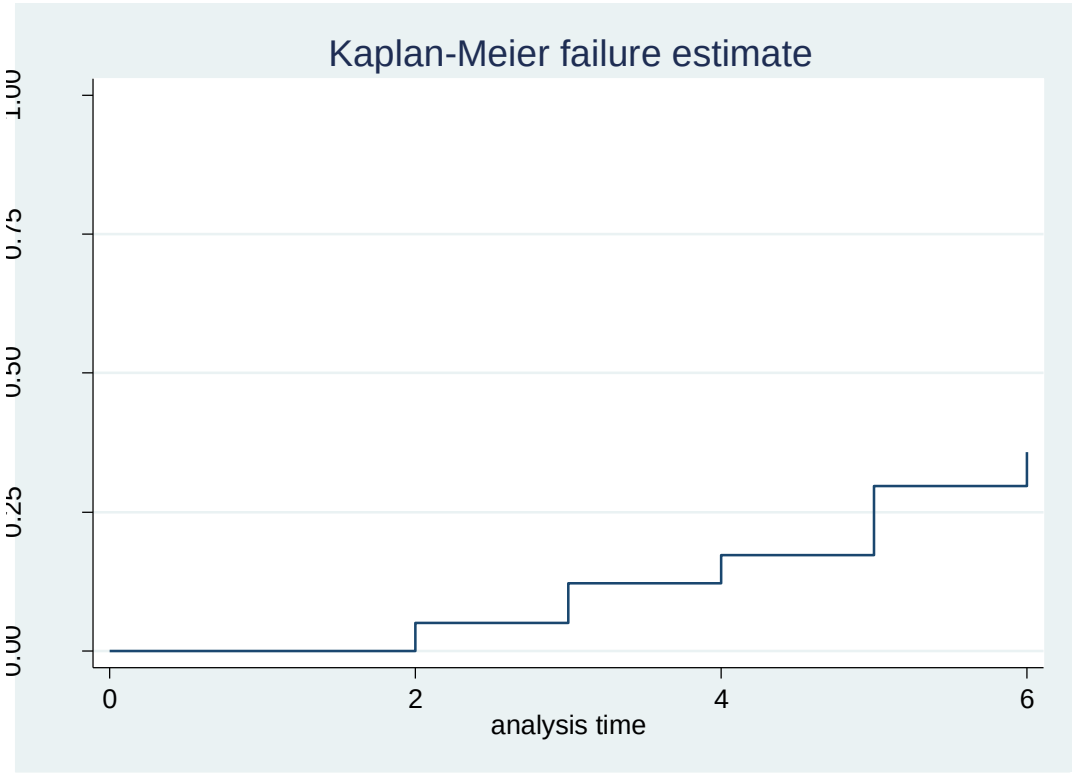


Figure 4: Cumulative failure function and survival function of Kaplan Meier of early neonatal admitted to NICU of Addis Ababa Public hospitals, 2023

Table 4: Comparisons of death among different levels of predictor variables using the log-rank test for neonate admitted to NICU of Addis Ababa public hospitals, Ethiopia, 2023

Variable	Log-rank ($\chi 2$)	p-Value
Gestational age	**70.**	**<0.001**
Preeclampsia	**25.69**	**<0.001**
5th, APGAR score	**49.70**	**<0.001**
Initiate EBF	**62.79**	**<0.001**
1st min. APGAR	**109.74**	**<0.001**

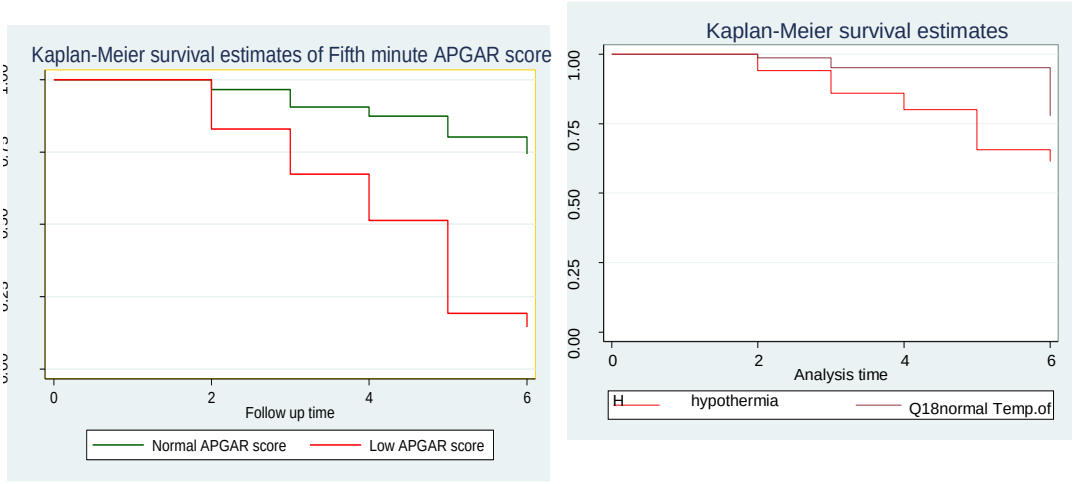


Figure 5: Kaplan-me ire survival estimate of the Apgar score and temperature of early neonate admitted to Neonatal intensive care unit of Addis Ababa Public Hospital, 2023

5.5 Predictors of early neonatal mortality

In the bivariate analysis of the chosen variables, the following factors were associated with time to death at a p-value of 0.25: gestational age, ANC visit, preeclampsia, mother HIV status, type of birth, , first minute APGAR score, five minute APGAR score, birth weight at admission, start of exclusive breastfeeding, neonatal RDS, presence of birth asphyxia, and parity. The five-minute Apgar score, gestational age, preeclampsia, the start of exclusive breastfeeding, and low birth weight at admission were

discovered to be independent predictors of newborn death in the multivariable Cox proportional hazard model.

Table 5: predictors of time to death among admitted to NICU in Addis Ababa public Hospitals (n =375), results of bivariate and multivariate analysis using Cox regression model for predictors, Ethiopia, 2023

variables	category	Survival status		CHR	AHR
		(Death %)	(Censored %)		
Sex of neonate	Male	34(17.1)	165(82.9)	0.65 (0.43, 1.03)	0.68 (0.43,1.09)
	Female	41(23.3)	135(76.7)	1	1
Weight of neonates	2500g or more	36(14.8)	208(85.2)	1	1
	Low birth weight	39(29.8)	92(70.2)	2.26 (1.34, 3.36)	2.10 (1.28,3.43)
Gestational age	term	49(17.8)	226(82.2)	1	1
	preterm	26(26.0)	74(74.0)	7.02 (4.1,12.04	4 (1.234, 5.80)
HIV status	Positive	16 (25.8)	46(74.2)	2.77 (1.02, 3.09)	1.83(0.75, 3.20)
	Negative	59 (18.8)	254(81.2)	1	1
Pregancy induced hypertension	Yes	14(30.4)	32(69.6)	3.34 (2.02,5.52)	2.41 (1.16,4.98)
	No	61(18.5)	268(81.5)	1	1
Type of birth	multiple	23(27.4)	61(72.6)	0.65(0.398,1.063)	1.15 (0.59,2.56)
	single	52(17.9)	239(82.1)	1	1
Parity	Primipara	10(16.7)	20(83.3)	1.45 (0.9,2.35)	1.47 (0.71, 3.07)
	multipara	65(19.8)	263(80.2)	1	1
1st min. AGPAR	>=7	21(6)	196(94)	1	1
	<7	54(34.2)	104(65.8)	6.17 (3.43,11.10)	1.10 (0.48,2.57)
	>=7	25(8)	270(92)	1	1

5th min.APGAR	<7	50(53.8)	30 (46.3)	8.72(5.32,14.3)	3.93 *(1.5,6.77)*
Initiate EBF	Yes	14(6.4)	188(93.6)	1	1
	No	61(31.2)	112(68.8)	5.2 (2.94,9.52)	3.69 (1.14,9.45)
ARDS	Yes	30(27.0)	81(73.0)	2.34(1.42,3.85)	1.16 (0.6,1.75)
	No	45(17.0)	219(83.0)	1	1
Birth asphyxia	yes	41(24.3)	128(75.7)	2.09 (1.25,3.50	1.1 (0.56,2.15)
	No	34(16.5)	172(83.5)	1	1

Significant at a p-value <0.05.

Premature neonates had a four times greater risk of dying than term [AHR: four (with 95% CI 1.234, 5.80)]. New born from preeclampsia mother had a 2.41-times higher risk of dying than those born to normotensive mothers [AHR: 2.41 (95% CI: 1.163, 4.980)]. With poor fifth-minute Apgar scores had a 3.93 times higher chance of passing away than those with normal Apgar scores [AHR: 3.93 (95% CI: 1.76, 8.771)]. The risk of mortality was 3.693 times [AHR: 3.69 (95% CI: 1.135, 12.015)] greater in who started exclusive breastfeeding than in those who did not, and the risk of death in with low birth weight was 2.01 times [AHR: 2.01 (95% CI: 2.10 (1.28, 3.43) higher than those with normal weight.

Assessment of model adequacy

The overall global test of the full cox model was checked for proportional hazard assumption and it was met (p-value = 0.313). All covariates are met the proportional-hazard assumption.

Chapter 6

6. 1 Discussion

This study aimed to determine the occurrence rate of early neonatal mortality and its predictors among neonates admitted to the neonatal intensive care unit of Addis Ababa public hospitals.

The results of our study showed that throughout the study period, 75(20%) of the newborn hospitalised to neonatal intensive care units passed away. Within the hospitalised new-borns in the present study, the incidence density rate was 37.1 per 1000 neonate days of observation (95% CI 25.5, 40.9). This is greater than the study done in the general and comprehensive speciality hospitals in Mekelle , which found that there were 22.45 deaths per 1000 new-borns-days of monitoring (48) .The sample size, study methodology, or population living standards could all be contributing factors to the difference. Additionally, hospitals outside of Addis Ababa may refer other critical cases to Addis Ababa hospitals as well as health centres. Since some cases might pass away after being referred to the study area, this may raise the incidence rate in referral hospitals.

This finding, however, is consistent with research carried out in Amhara regional state referral hospitals, where early neonatal deaths were reported at a rate of 34 per 1000 -days of observation and Debre Markos referral hospital, where early neonatal deaths were reported at a rate of 39.6 per 1000 -days (26, 28). Additionally, Wolayita Sodo observed a higher incidence rate (77 new-born fatalities per 1000 neonate-days) (44). Variations in the population's living standards could be one explanation for this difference. There are two areas where a society's general standards for income and services may vary.

This finding also indicated that among those dead, about 42.7% was dead within the first twenty-four hours, and about 53% of them died during the first and third days. In other words, 95% of the neonatal deaths occurred within the first 72 hours (three days) of follow-up. This finding is higher than the study conducted in Ghana, in which the highest death rate (76%) was reported within the first three days of follow-up (49); however, it is lower than the study conducted in Amhara regional state referral hospitals, Ethiopia, in which more than half (56.14%) of the deaths were within 24 hours of the predictors of neonatal death.

Additionally, it is lower than a research done in public hospitals in the southern Ethiopian regions of Gamo and Gofa, which found that 46% of neonatal deaths happened within the first

24 hours and 44% happened between the first and third days (50)**.** However, Tigray reported fewer fatalities than this amount, with around half (56%) of the fatalities occurring within the first 72 hours. This discrepancy may be caused by the fact that roughly of the admissions were referred from other facilities and that they often arrive later than naturally born infants. The second reason might be that the initial treatment given to new-borns after their admission to the NICU likely keeps them alive for longer than the first 24 hours of their life.

Neonatal death is reported to be more likely with low Apgar scores in the first and fifth minutes following birth. Neonatal infants in this study who had low fifth-minute Apgar scores had a 4 times higher risk of dying than infants who had normal Apgar scores. A recent discovery that showed low Apgar scores have a stronger prognostic value of neonatal morality supports this finding. (32, 51, 52) .The connection between the two is justified by the fact that obstetric problems lead to poor Apgar scores. The newborn may exhibit symptoms like a slow heartbeat or no heartbeat, weak respiration or no breathing, little flexion or no flexion if the baby has a low Apgar score, which is defined as seven or lower.

If they did not begin exclusive breastfeeding, the risk of early infant mortality was almost four times higher than in those who did. This result is coherent with findings from other investigations carried out at various locations and periods (53, 54). This might be because immediate exclusive breastfeeding serves as the starting point for on-going mother and infant care, which can have long-lasting impacts on development and health.

In order to prevent hypothermia, bacterial infection, and hypoglycaemia, early breastfeeding beginning offers necessary nutrition at the proper time as well as immunological value from the first milk (colostrum). The risk of new-born death was also shown to be lowered by 16% if breastfeeding was started within the first day of birth and by 22% if it was started within an hour (38).It is important to keep in mind, though, that unwell new-borns may not be able to suck breast milk as well as new-borns who are in better health.

Unlike many of the factors that take children's lives, the risk to children from premature birth continues to affect all nations globally(41, 55). The same thing is found in this study, which showed that the hazard of death for preterm babies was higher (about three times) than born on the deadline. This result is consistent with findings from other investigations (56)**.** This may be because preterm infants are more likely to die due to physiologic and anatomical immaturities,

which increase their chance of dying. Health issues caused by the underdevelopment of organs, muscles, and immune systems increase the risk for infants born preterm (before 37 weeks). As a result, they were more likely to experience difficulties such birth asphyxia, infections, and hypothermia, which led to tissue hypoxia and multiple organ failure (37, 57).

Pregnancy-induced hypertension was another factor in this study that predicted early new born death. Neonatal survivors of preeclampsia mothers suffered a death risk that was 2.4 times greater than that of survivors of normotensive mothers. This result is in line with findings from other investigations (58, 59) **.**Pregnancy-induced hypertension has been linked to an increased risk of low birth weight, small for gestational age (SGA) new born, neonatal mortality, preterm, and other neonatal problems, according to a study **.**

What is more, unlike many studies conducted in different parts of Ethiopia and other sub-Saharan Africa, ANC visits (25, 44, 60)), multiple pregnancies (39, 40, 61) (and place of residence (6, 62) did not significantly predict neonatal death in this study area. This could be due to the highest ANC coverage in Addis Ababa city. ANC coverage from a skilled provider may play a role in reducing neonatal deaths due to pregnancy complications like multiple births. The contrary may also be due to socio demographic variation between Addis Ababa and other sites (16, 22, and 33)

Strengt*h*

The data were gathered by nurses who were given NICU-specific training, which is crucial in ensuring the accuracy of the information. Data were collected from one continuous year of admission with proportional allocation as part of a multi-centre study, which may have increased the number of incidents and reduced variability. This study's consideration of censored observations contributed to another significant strength by giving a more precise estimate for the survival analysis. It offers researchers insight, particularly for a future study. The predictor variables, which were recorded at admission, and the outcome covariate (death), were simple to sequentially associate.

Limitations

Since secondary sources were used to perform the study, some crucial factors obtained from the mother were not included. These factors, including birth interval, history of abortion, history of stillbirth, educational level, employment status, nutritional status, marital status, and economic position, may be important predictors of newborn death. At the time of data collection, medical records that were missing or incomplete were excluded. These could introduce selection bias and cause the study's findings to be underestimated or exaggerated. Lack of a reference study for the characteristics that were independent predictors of death in this study and the median survival time of admitted to the NICU.

Chapter 7

Conclusion and Recommendation

7.1 Conclusion

Early neonatal mortality was higher in the public hospitals of Addis Ababa. In the Addis Ababa public hospital, the five minute Apgar score, preterm birth, low birth weight, beginning of exclusive breastfeeding, and pregnancy-induced hypertension were factors that predict early ’ time to death.

7.2. Recommendation

To Addis Ababa city health Bureau and other stakeholders

Designing methods that can address all of these avoidable factors is advised in order to lessen the high burden of early death among '. Encourage and prepare mothers, families, and communities to get involved in and demand quality care for pregnant women with high blood pressure, new born with low Apgar scores, low birth weights, and babies who are not starting to breastfeed right away, as well as preterm infants.

To health workers

Immediate assessment of the neonate at birth and attention to neonate with low Apgar score, low birth weight, not start early breast feedings, and premature. Post-natal care is vital during and after birth and important throughout the first week of life. Furthermore, throughout prenatal care and delivery, attention should be paid to mothers who have developed hypertension because of pregnancy.

To a researcher

To discover all potential issues that obstruct neonatal survival in Addis Ababa, I advise conducting prospective longitudinal research in the relevant Addis Ababa, Ethiopia city, including those who are not admitted to the neonatal intensive care unit. It will also be critical to do more research to verify the predictors at the community level. Additionally, it is preferable to assess skills and competence in healthcare.

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Appendix- Information sheet

Title of the Research Project: Survival status and predictors of early neonatal mortality among admitted to NICU from (2022-2023) at Addis Ababa Public Hospital, Ethiopia, 2023

Name of Investigator: Gemechis Kabe (BSc in Anaesthesia, Assistant Lecturer)

Name of the Organisation: Addis Ababa University College of Health Science, Department of Anaesthesia

Name of the Sponsor: Addis Ababa University

Introduction: This information sheet is prepared for the Addis Ababa Public Hospital administration and NICU coordinating office. The aim of the form is to make the above-concerned office clear about the purpose of research, data collection procedures and get permission to conduct the research.

Purpose of the Research Project: To determine survival status and predictors of early neonatal mortality among admitted to the NICU from 2022–2023 at Addis Ababa Public Hospital, central Ethiopia, in 2023. In order to achieve the above objective, information which is necessary for the study was taken from neonatal medical records.

Risk: Since the information was collected from medical charts, it will not

Cause any harm to the patients. The name or any other identifying information were not

Documented on the questionnaire and kept firmly private and in a safe dwelling. The information

Retrieved were only used for study purposes.

Benefits: The study has no direct profit for those whose documents are involved in it.

However, the indirect profit of the study for the participant in the programme is obvious. The reason is that if programme developers are formulating predicted strategy there is a profit for clients in program of attaining proper care and treatment for clients survived and other new-born's. In all, the study work has a principal direct profit for health care organizers and administrators.

Confidentiality: To assure privacy the information on the charts was collected by excluding

The names of the clients and the information collected from this study's development were kept private and stored in a file cabinet. In addition, it was not shown to anyone except the

Investigator and it has been kept in a locked system with a computer password.

Person to contact: This study's development was revised and approved by Addis Ababa.

University, College of Health Science, Department of Anaesthesia If you have any

For questions, you can contact any of the following individuals: investigators and advisors.

Gemechis Kabe, Addis Ababa University, College of Health Science, Department of

Anaesthesia: principal investigator

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Mr. Ashenafi Saifu (MSC, Lecturer) Addis Ababa University, College of Health Science, Department of Anaesthesiology: main advisor

Mrs Merion Abraham (MSc, Lecturer) Addis Ababa University, College of Health Science, Department of Anaesthesia: co-advisor

Appendix II Checklist

This checklist is organised for the gathering of socio-demographic, maternal medical and

Obstetrics and gynaecology, neonatal medical and other key predictors and outcomes related data

That is significant for the valuation of survival status and predictors of mortality among early admitted to NICU in Addis Ababa public Hospital. All this information was retrieved from the client's registration book and from an individual patient card without including the name of the clients from (2022-2023)

Data collection Tool

English version questionnaire for the assessment of survival status and predictors of early neonatal mortality among admitted to Neonatal Intensive Care Unit of Public Hospitals of selected Addis Ababa, Ethiopia (2022-2023)

- Date of Admission ----------/----------/----------
- Date of child death ----------/----------/----------
- Date of withdraw the treatment_____/_____/_____
- Date of transferred out_____/_____/_____
- Total No of days the had been followed_____ Day

Part I: Socio demographic characteristics

S.No	Variables	Coding Categories	
101	Age of Neonate at admission	----------(in Days)	
102	Sex of Neonate	1. Male 2. Female	
103	Weight of the neonate at admission	_____kg.	
104	Age of the Mother	_____	
106	Place of residence	1. Urban	

		2. Rural	
107	Maternal habit of alcohol intake	1. Yes 2. No	

PART-II; Maternal and health services related Factors

S.No	Variables	**Coding Categories**	
201	Did the mother have ANC f/up for this birth?	1. Yes 2. No	
202	How many visits did she attended?	1. One visit 2. Two visits 3. Three visits 4. Four visits	
203	Did the mother have the previous history of pregnancy?	1. Yes 2. No	
204	How many Total pregnancies does she have (Gravidity)?	_____	
205	How many alive births does she have (Parity)?	_____	
206	Where did the mother deliver?	1. Health institution 2. Home	
207	Types of pregnancy	1. Single 2. Multiple pregnancy	
208	What was the mode of delivery?	1. Spontaneous vaginal delivery 2. Assisted instrumental delivery 3. Cesarean section	
209	What was the gestational age of the newborn?	_____ (in weeks)	
210	Did the mother have diagnosed HIV infection?	1. Yes 2. No	

211	Any other maternal complications?	_____	
212	Preeclamsia	1.yes 2.no	

PART-III Neonatal Factors

S.No	**Variables**	**Categories**	
302	What is the score of the first minute APGAR score?	_____	
303	What is the score of the 5th minute APGAR score?	----------	
304	The temperature of the neonate at admission in °C	___	
305	Did the newborn resuscitate at birth?	1. Yes 2. No	
306	When did the neonate start EBF?	1. Within 1 hour 2. After 1 hour	
307	What was the feeding of the newborn within the first 7 days?	1. Only breast milk 2. With additional food	
308	Does the newborn have a sepsis?	1. Yes 2. No	
309	Does the newborn have respiratory distress syndrome?	1. Yes 2. No	
310	Does the newborn have asphyxia?	1. Yes 2. No	
311	Does the newborn have jaundice?	1. Yes 2. No	
312	Does the newborn have congenital anomaly?	1. Yes 2. No	
313	If yes for question 312, specify the anomaly.		
314	Any other neonatal complications? Specify	_____	