ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF NURSING AND MIDWIFERY

DETERMINANTS OF RESPIRATORY DISTRESS AMONG NEWBORNS ADMITTED TO THE NEONATAL INTENSIVE CARE UNIT AT PUBLIC HOSPITALS OF ADDIS ABABA, ETHIOPIA, 2024. UNMATCHED CASE-CONTROL STUDY.

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A RESEARCH THESIS TO BE SUBMITTED TO THE SCHOOL OF NURSING AND MIDWIFERY, COLLEGE OF HEALTH SCIENCES, ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN NEONATAL NURSING.

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APPROVAL BY THE BOARD OF EXAMINATION

THIS THESIS BY TENAW BELAY IS ACCEPTED IN ITS PRESENT FORM BY THE BOARD OF EXAMINERS AS SATISFYING THE THESIS REQUIREMENT FOR THE DEGREE OF MASTER'S IN NEONATAL NURSING.

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LIST OF ABBREVIATIONS AND ACRONYMS

ANC	Antenatal care
AGH	Abebech Gobena Hospital
AOR	Adjusted odds ratio
BW	Birth weight
CI	Confidence interval
CS	Cesarean section
GA	Gestational age
GDM	Gestational diabetes mellitus
GMH	Gandhi Memorial Hospital
MAS	Meconium aspiration syndrome
MSAF	Meconium-stained amniotic fluid
NICU	Neonatal Intensive Care unit
NMR	Neonatal mortality rate
PPHN	Persistent Pulmonary Hypertension of the Newborn
PROM	Premature rapture of membrane
RD	Respiratory distress
RDS	Respiratory distress syndrome
SPHMMC	St. Paul's Hospital Millennium Medical College
TTN	Transient tachypnea of newborns
ZMH	Zewditu Memorial Hospital

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ABSTRACT

Background: Respiratory distress (RD) is the most common problem in newborns and it is the main factor contributing to newborn mortality worldwide. It remains the major reason for NICU admission, morbidity, and mortality among newborns in Africa. Preventing neonatal respiratory distress by anticipating its determinant factors is crucial for low-resource countries like Ethiopia.

Objective: To identify the determinants of respiratory distress among newborns admitted to the NICU at public hospitals in Addis Ababa, Ethiopia, 2024.

Methods: An institution-based unmatched case-control study was conducted with a total sample size of 489 (163 cases and 326 controls) at public hospitals of Addis Ababa, from March 1, - April 1, 2024. To choose the cases and controls, systematic random sampling was applied. Data was collected through face-to-face interviews using a structured pre-tested questionnaire from mothers and a data extraction checklist for mothers and neonatal medical records. Data was collected by online Kobo Toolbox and exported to SPSS software version 26 for analysis. Binary logistic regression was used to conduct both bi-variable and multivariate analyses. Statistically significant associations were declared at p-value <0.05.

Result: - In this study, 163 cases and 326 controls with their mothers were included with an overall response rate of 100%. After doing multivariable logistic regression analysis, significantly associated variables with respiratory distress were: emergency cesarean section (AOR=3.074, 95% CI: 1.016, 9.302), meconium-stained amniotic fluid (AOR=5.103, 95% CI: 1.739, 14.974), low birth weight (<2500grams) (AOR=3.592, 95% CI: 1.293, 9.978), and low first-minute APGAR score < 7 (AOR=9.693, 95% CI: 3.945, 23.817).

Conclusion and recommendation: The significant variables identified in the analysis such as meconium-stained amniotic fluid (MSAF), emergency cesarean sections (CS), low birth weight (<2500grams), and low first minute Apgar scores were found to be the determinants of respiratory distress among newborns. According to our findings, this would likely include improved neonatal resuscitation and addressing ways to decrease the need for frequent emergency cesarean sections. Health professionals should increase prenatal care and continuously monitor fetal heart rates during labor to detect and manage fetal distress early.

Keywords: Determinants, Respiratory distress, NICU, newborns

1. INTRODUCTION

1.1 Background

Neonatal respiratory distress is a breathing problem that affects both preterm and full-term newborns (1, 2). Thirty to forty percent of admissions to the Neonatal Intensive Care Unit (NICU) are caused by respiratory distress (RD), a typical issue for newborns in the immediate neonatal period (3). Worldwide, respiratory distress affects 2.2% to 7.6% of all term deliveries and 50%, 75%, and 90% of newborns born at 30 weeks, 28 weeks, and 26 weeks, respectively (4). Fifteen percent of term infants and twenty-nine percent of late preterm infants in the newborn critical care unit suffer from respiratory morbidity; the prevalence is much higher for infants delivered before 34 weeks of pregnancy (5).

Because of the high danger of potentially fatal illnesses and the complex nature of the newborn's adaptation process, the newborn period is an essential period of life (6). Globally, each year 10 % of babies require simple stimulation at birth to help them breathe (drying and stimulation, airway clearing or positioning), 3%–6% need basic neonatal resuscitation (bag and mask ventilation), and <1% need advanced resuscitation (endotracheal intubation, chest compression, and drugs) (7).

Respiratory distress can be the clinical manifestation of various neonatal conditions (8). The clinical assessment alone may make identifying specific underlying etiology of respiratory distress challenging. More common respiratory diseases, such as TTN, RDS, perinatal asphyxia, MAS, and persistent pulmonary hypertension of the newborn (PPHN), result from complications during the prenatal to postnatal transition period (9).

Respiratory distress in the neonate is a symptom complex that results from diverse underlying neonatal conditions, originating from pulmonary/ extrapulmonary disorders (8). A newborn is considered to be in respiratory distress if they exhibit one or more signs of increased work of breathing, including any sign of difficulty breathing, tachypnea (taking more than 60 breaths per minute), bradypnea < 30 breaths/min, intercostal retractions, Subcostal retractions, nasal flaring, expiratory grunting, and apnea or breathing pause with or without cyanosis (10).

As stated in different literature, maternal and fetal risk factors associated with respiratory distress are higher gravidity and parity, cesarean section, premature rupture of membranes (PROM), meconium-stained amniotic fluid (MSAF), maternal hypertension, maternal infection, obstructed labor, and gestational diabetes mellitus (11-13). Fetal factors like male sex, low birth weight, gestational age, Apgar scores, and fetal distress, are some predictors identified in previous studies (13, 14).

1.2 Statement of the Problem

Worldwide, respiratory distress (RD) in neonates is a significant cause of morbidity and mortality and a common condition requiring admission to the neonatal intensive care unit (NICU) (15, 16). Most neonatal deaths worldwide occur in low- and middle-income nations (2). Neonatal respiratory distress is a frequent neonatal emergency worldwide and the highest neonatal death rates are seen in South Asia and sub-Saharan Africa with reported incidence rates in India being 19.2% (17), in Rwanda 60% (18), in Cameroon 47.5% (19), in Nigeria 58.4% (20). In Ethiopia, different regional research varies between 11.5% to 42.9% (12, 15).

Globally, neonatal mortality remained relatively unchanged, especially in developing countries (21). In 2019, around one million infants died in the first 24 hours of life, according to the World Health Organization (WHO), which also reports that 75% of neonatal deaths occur in the first week of life. Of these, the main cause of early neonatal death is respiratory distress (22, 23).

Ethiopia aimed to reduce the Neonatal Mortality Rate (NMR) from 29 to 1000 live births in 2016 to 11 per 1000 live births in 2019/2020. Despite the government's aim of reducing Neonatal Mortality (NM), paradoxically it had increased to 33/1000 live births in 2019 (24). from this, the mortality of neonates in respiratory distress is a major public health problem (25, 26). Most of the causes of neonatal respiratory distress are preventable, regardless of the cause, if not recognized and managed quickly, the respiratory disease can progress to heart arrest, respiratory failure, and death (27).

Globally, different policies, strategies, and programs work on or advocate for the prevention and care of preterm neonates and their birth outcomes, including respiratory distress, as the Sustainable Development Goal (SDG 3) focuses on reducing neonatal mortality to below 12 per 1000 live births by 2030 (28). In Ethiopia, there is also a strategy called basic emergency obstetric and newborn care (BEmONC) (29). Despite these efforts, neonatal respiratory distress remains the leading cause of NICU admission, morbidity, and mortality among newborns in Ethiopia (30). Ethiopia currently, planned to reduce neonatal mortality from 33 to 1000 live births to 21 per live births by the year 2024/2025 (31). This could be achieved by identifying the contributing variables and starting treatments on time, which can dramatically lower newborn respiratory distress-related mortality and morbidity.

In Ethiopia, despite efforts to improve neonatal health, including the establishment of NICUs in public hospitals, respiratory distress remains a major challenge. Limited resources, including access to surfactant therapy and mechanical ventilation, further complicate the management of respiratory distress in these settings. Understanding the determinants of respiratory distress is essential for developing targeted interventions to reduce morbidity and mortality associated with this condition.

Thus, a few factors make this study necessary. Firstly, respiratory distress is a major cause of illness and mortality among newborns worldwide, and it is especially concerning for countries with limited resources like Ethiopia. Even though a limited study has identified risk factors for respiratory distress in newborns, the incidence and mortality of newborns through respiratory distress are significantly rising. Furthermore, the risk variables are not verified, especially in this study area. In addition, this study adds more predictors such as indication for cesarean section and birth intervals more detail than other studies conducted in Ethiopia. Therefore, this study aims to identify the determinants of respiratory distress among newborns admitted to the NICU in Addis Ababa public hospitals, Ethiopia.

1.3 Significance of the study

Determining the factors that contribute to newborn respiratory distress can help with timely intervention and improve the prognosis for these cases.

The results of this study will support the provision of evidence-based preventive strategies for high-risk neonates by medical professionals. Furthermore, it will serve as a source of information by providing data for non-governmental or governmental organizations such as the Ministry of Health, designing appropriate interventions to improve the outcome of neonates in healthcare settings.

This study will be useful for health professionals working in labor and delivery wards and prenatal care by identifying determinant factors and taking interventions accordingly. It also improves mothers' awareness of predictors of neonatal respiratory distress and the importance of early care-seeking behavior and birth preparedness.

This study will be used as baseline information for future researchers who will be interested in doing their research on related topics. Additionally, this study will also increase the nursing knowledge and nursing practice, and promote nursing education and research.

2. LITERATURE REVIEW

2.1 Introduction

Respiratory distress (RD) is a common presentation among ill neonates and is associated with prolonged hospitalization and death. When compared to vaginal birth, the prevalence of newborn morbidities, particularly respiratory problems, increased significantly after cesarean section (32). Literature review searching different search engines such as BMC, PubMed, Cochrane Library, Google Scholar, Elsevier, and other journals are used and used sources are cited.

2.2 Determinants of Respiratory Distress in Newborns

2.2.1 Sociodemographic characteristics

Particularly in low and middle-income nations, maternal socioeconomic differences have a significant impact on child health. According to a study in Italy, compared with low-level educated mothers, those with high education had reduced odds of respiratory distress (33).

2.2.2 Obstetric-related factors of RD in Newborns

A cross-sectional study, conducted in eastern India showed that Caesarean section (CS) prolonged rupture of membranes, meconium-stained liquor, and pregnancy-induced hypertension were commonly associated with respiratory distress (34). According to a retrospective study in Japan, a cesarean delivery is a risk factor for neonatal RDS in women with preterm premature rupture of membranes (35). Another study in Japan showed that early-term birth is associated with a high risk of respiratory distress in births involving cesarean delivery without indication for early delivery (36).

A study in London, Ontario showed that the main indications for elective CS were previous CS (59.3%) and malpresentation (24.2%), and at ≤38 weeks as opposed to ≥39 weeks, the relative risk of respiratory morbidity with elective CS was 2.14 ($P = 0.0110$) (37). A study in Hong Kong showed that cesarean delivery (both elective and emergency cesarean section) before 38 weeks of gestation is associated with a significantly increased risk of neonatal respiratory morbidity (38, 39). A case-control study in China revealed that early gestational age, maternal-fetal infection, and PROM were independent predictors of respiratory distress (40). A cross-sectional

study in Thailand showed that no antenatal care, meconium-stained amniotic fluid (AOR =2.85), and large gestational age were significantly associated with respiratory distress (41).

A Retrospective Study in a Tertiary Care Hospital in Oman and a case-control study in Korea showed that higher gravidity parity and low birth weight were significantly associated with respiratory distress (13, 14). A prospective cohort study in Iraq showed that previous CS was the commonest indication for elective cesarean section and the rate was 99% for those with RD and malpresentation, reported in 70% of infants with RD (42). A retrospective cross-sectional study in Afghanistan showed that PROM (AOR=4), antepartum hemorrhage (AOR 6.9,), extremely low birth weights (AOR=8.2), and early and extremely preterm births were significantly associated with respiratory distress (43). According to a prospective observational study conducted in Egypt, fetal immaturity and premature rupture of membranes (PROM) were the two biggest risk factors for the development of respiratory diseases in newborns (44).

A case-control study finding in southern Ethiopia revealed that neonates delivered with meconium-stained amniotic fluid were 12.56 times (AOR=12.56; CI: 5.47-28.84) more likely to develop respiratory distress, and neonates born to mothers with the nonvertex presentation were 4 times more likely to develop respiratory distress and those neonates born from mothers who had premature rupture of the membrane were 3 times more likely to develop respiratory distress, and obstructed labor (AOR = 3.04; CI: 1.477–6.28), and neonates born from mothers who had infection were 7.12 times more likely to develop RD (12). Another study in southwest Ethiopia showed that being a multiple (twin) AOR = 1.8(1.05–3.09), the non-cephalic presentation was significantly associated with respiratory distress (45).

2.2.3 Neonatal-related factors of RD in Newborns

A study in France showed that Gestational age was a significant risk factor ($p = 0.01$), especially newborns delivered before 36 weeks were associated with respiratory distress (46). A study in Poland showed that female gender and fetal distress (OR=2.33; 95%CI:1,16-4,71) were significant risk factors for respiratory distress (47).

According to a case-control study in Southern China, intrauterine fetal distress was an independent risk factor for neonatal respiratory distress syndrome (NRDS), whereas longer gestational age served as a protective factor (48). A retrospective study in Calgary and a case-control study in Cyprus showed that the male gender was a significant risk factor for respiratory distress (49, 50). Similarly, another study in China showed that the male sex (AOR: 2.641; 95% CI: 1.721-4.053), and low birth weight were the independent factors of respiratory distress (40). The study's findings in Cameroon showed that acute fetal distress, APGAR score < 7 at the 1st minute, male gender, and macrosomia were independent predictors of neonatal respiratory distress (19).

A study finding in southwest Ethiopia revealed that an APGAR of <7 at 5-min, and gestational age between 31 and 34 weeks were independent predictors of respiratory distress (45). A similar study in Southern Ethiopia showed that neonates with an Apgar score of less than 7 in the first minute were 7 times more likely to develop respiratory distress than an Apgar score greater than 7 in the first minute (12). A prospective cohort study in Nekemte town, Ethiopia revealed that newborns of women with short birth intervals had a higher risk of respiratory distress when compared to babies born from women with normal birth intervals (51).

2.2.4 Maternal Health Condition-Related Factors of RD in Newborns

A Finding of a study in Thailand states that maternal pregnancy-induced hypertension was a significant risk factor for respiratory distress (41). A Prospective cohort study in Beijing, China showed maternal hypertension and preeclampsia are risk factors for neonatal respiratory disorders in full-term and preterm newborns (52). A prospective cohort study in France revealed that neonates born from women diagnosed with gestational diabetes were more likely to develop respiratory distress as compared to neonates born from non-diabetes women 12 (20%) vs. 20 (5.2%) respectively ($p < 0.001$) (53).

A meta-analysis of maternal diabetes mellitus and the risk of neonatal respiratory distress in China showed that both gestational diabetes and Pregestational diabetes are associated with an increased risk of respiratory distress and emphasizes the importance of glycemic control during pregnancy (54).

A prospective cohort study in Iraq investigated the association between maternal anemia and neonatal respiratory distress and showed that maternal anemia during pregnancy was found to be a significant risk factor for respiratory distress (55). A retrospective cohort study in Addis Ababa, Tikur Anbessa specialized Hospital showed that maternal diabetes mellitus was significantly associated with respiratory distress (15).

Conceptual frameworks

Below are the conceptual frameworks of the study which show the interaction of different variables with outcome variables that contain sociodemographic factors, obstetrics-related factors, maternal medical factors, and neonatal factors adapted in different research.

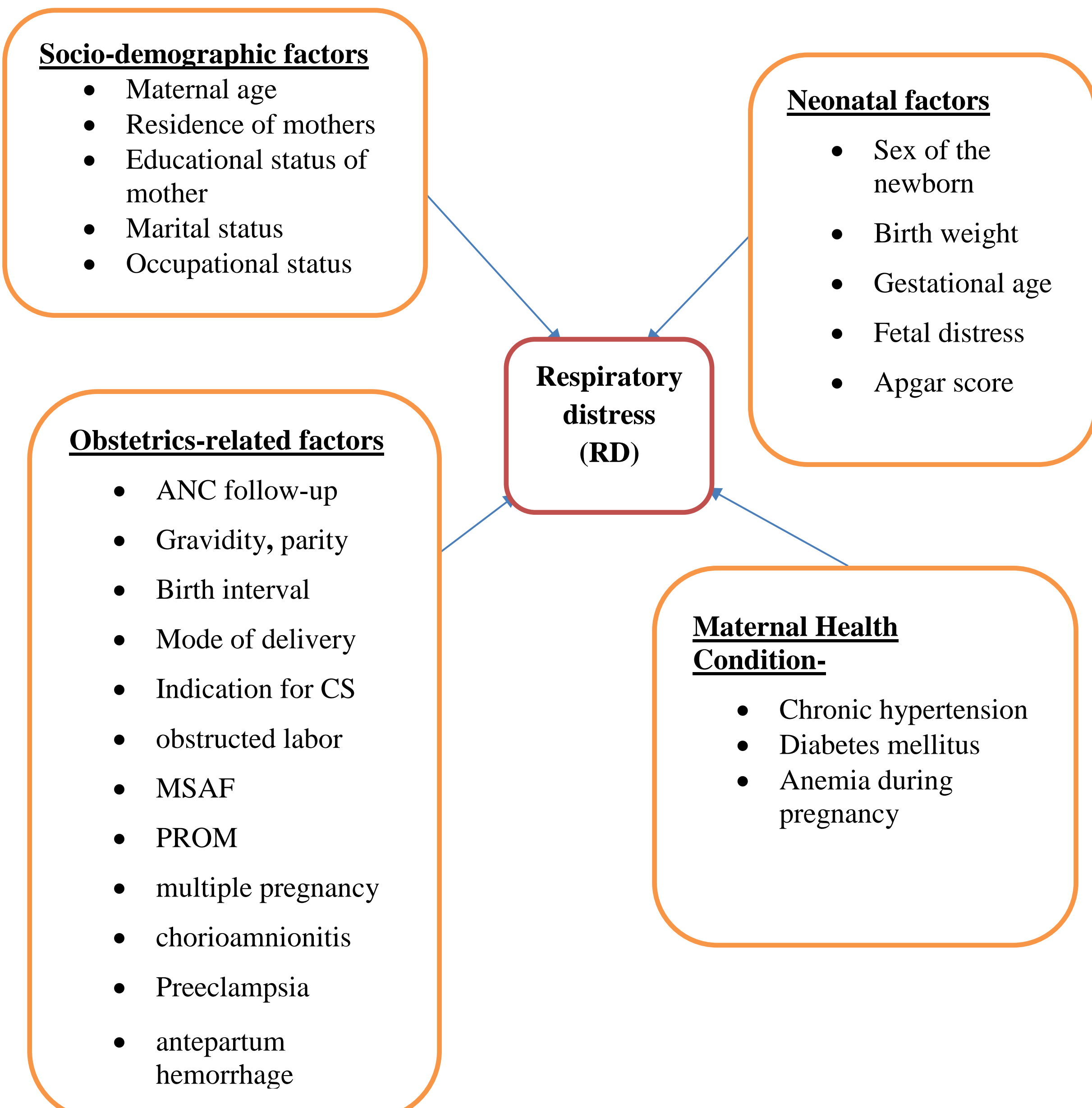


Figure 1: Schematic presentation of the determinant factors of respiratory distress in newborns (12, 13, 15, 19, 37, 51)

3. OBJECTIVE

3.1 General Objective

- To identify the determinants of respiratory distress among newborns admitted to the NICU at public hospitals of Addis Ababa, Ethiopia, 2024.

4. METHODS

4.1 Study Area

The study was conducted in Addis Ababa, Ethiopia's capital city, the Seat of the African Union, and the United Nations World Economic Commission for Africa. It covers an area of 527 square kilometers and there are 11 sub-cities in the city. The city's expected population in 2023 was 5.46 million (56). In Addis Ababa, there are 13 public Hospitals, of which, one university hospital (Tikur Anbessa Specialized Hospital), six federal hospitals, and six were in Addis Ababa City Administration Health Bureau among these 11 hospitals have neonatal intensive care units.

The study was conducted in four Addis Ababa public Hospitals selected by lottery method. These selected Hospitals are St. Paul's Hospital Millennium Medical College (SPHMMC), Gandhi Memorial Hospital (GMH), Zewditu Memorial Hospital (ZMH), and Abebech Gobena Hospital (AGH). Those four selected hospitals have neonatal intensive care units and the number of admitted neonates varies from time to time in each hospital.

Gandhi Memorial Hospital (GMH) is a public hospital maintained by the Health Bureau of the Addis Ababa City Administration. On average each year, 2,280 newborns are admitted, and 190 are admitted on average each month. Annually 2400 newborn admissions and 200 average monthly admissions to the neonatal intensive care unit occur at Abebech Gobena Hospital (AGH).

St. Paul's Millennium Medical College Hospital (SPMMC) is under the Ministry of Health, The Hospital has 3,000 annual admissions of neonates and 250 average monthly admissions of neonates. Zewditu Memorial Hospital (ZMH), has 210 neonates on average monthly admission and the Hospital has 2520 annual admissions of neonates.

4.2 Study Design

An Institution-based unmatched case-control study design was conducted.

4.2.1 Study Period

The study was conducted from March 1, - April 1, 2024

4.3 Population

4.3.1 Source population

All neonates admitted to the NICU at public hospitals in Addis Ababa were the source of the population.

4.3.2 Study population

For cases

All neonates who were diagnosed with respiratory distress and admitted to the NICU at selected public hospitals in Addis Ababa during the study period (March 1, - April 1, 2024).

For controls

All neonates were diagnosed without respiratory distress and admitted to the NICU at selected public hospitals in Addis Ababa during the study period.

4.4 Inclusion and Exclusion Criteria

4.4.1 Inclusion Criteria

For cases

Neonates who were admitted to NICU with the diagnosis of respiratory distress documented on the neonate's chart

For controls

Neonates who were admitted to the NICU at selected public hospitals in Addis Ababa, without the diagnosis of respiratory distress.

4.4.2 Exclusion Criteria

Exclusion criteria for cases

- ✓ Data with incomplete documentation.
- ✓ Newborns with congenital malformations sign of respiratory distress.
- ✓ In the case of twin or triple newborns, one was taken by lottery method.

Exclusion criteria for controls

- ✓ Data with incomplete documentation.
- ✓ Newborns with congenital malformations sign of respiratory distress.
- ✓ In the case of twin or triple newborns, one was taken by lottery method.

4.5 Sample size and sampling procedure

4.5.1 Sample Size Determination

The sample was determined by EpiInfo-7 Stat Calc using the double population proportion exposure difference formula, by considering the assumption that the percentage of cases with exposure is 57.3% (MSAF-main exposure variable), and the percentage of controls exposed 42.7% and odd ratio of 1.8 from an unmatched case-control study (12), with 95% CI, 80% power of the study, and a 1:2 ratio of the case-to-controls. A 10% non-response rate was added, resulting in a final sample size of 489 (163 cases and 326 controls).

Table 1: Sample size calculation to assess the determinant of respiratory distress among newborns admitted to the NICU at the public hospitals of Addis Ababa, Ethiopia, 2024.

Variables	**Proportion of controls**	**Proportion of cases**	**Odd ratio (OR)**	**Power**	**Case to control ratio**	**Sub total**	**Adding 10%**	**Final sample size**
Meconium stained amniotic fluid (MSAF)	42.7%	53.7%	1.8	80%	1:2	443	489	**489(163 cases, 326 controls)**

4.5.2 Sampling technique and procedures

Among 13 governmental hospitals, four (30%) of the hospitals were selected using a simple random sampling technique (SPHMMC, Y12HMC, ZMH, and GMH). Then the calculated sample size was proportionally allocated to each hospital based on the previous month's admission reports. Then two controls were taken for each case from the same hospital to make cases and controls homogenous. Cases and controls were selected using a systematic random sampling technique by getting the K value.

Table 2: Proportional allocation of the total sample size to the hospital based on the previous 2 months' admission report.

Name of selected hospital	**Previous 2 months Total admission**			**Proportional allocation**		
	Cases	**Control**	**Total**	**Cases**	**Controls**	**Total**
SPHMMC	196	448	542	56	112	166
ZMH	132	366	406	38	76	114
AGH	140	348	376	40	80	120
GMH	102	308	334	29	58	87
Total	570	1,470	1,658	**163**	**326**	**489**

K for controls= total number of controls from each hospital monthly report =

The required number of controls

K for cases = total number of cases from each hospital monthly report =

The required number of cases

Selection of cases and controls by using a systematic random sampling technique

HOSPITALS	K- value for cases	K-value for controls
SPHMMC	196/56=4	448/112=4
ZMH	132/38=3	366/72=5
AGH	140/40=4	348/80=4
GMH	102/29=4	308/58=5

Thus, every Kth chart was selected and the first chart was chosen randomly.

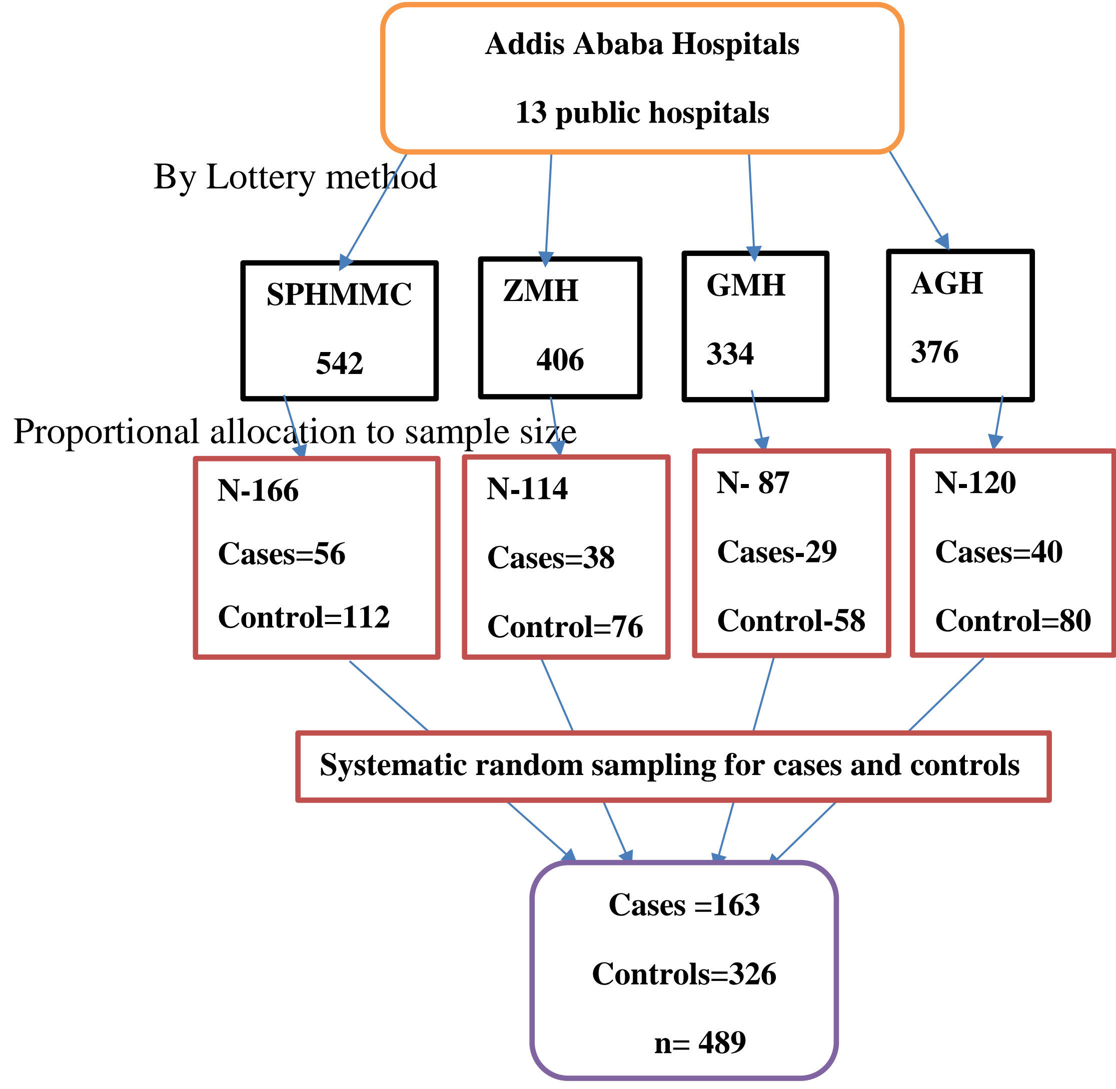


Figure 2: Architecture of sampling procedure on determinants of respiratory distress among newborns admitted to the NICU in Addis Ababa public hospitals 2024.

4.6 Operational Definitions

Case definition

Respiratory distress - Neonates who were admitted to NICU for the diagnosis of respiratory distress as per neonate's chart information documented by physicians.

Control definition

Neonates who were admitted to the neonatal intensive care unit without a diagnosis of respiratory distress such as low birth weight, sepsis, hypothermia, hypoglycemia, Jaundice, or congenital disease did not have any sign of respiratory distress will be under control.

Cesarean section- Cesarean section is the delivery of the fetus, membrane, and placenta through abdominal and uterine incisions after fetal viability (57).

4.7 Study Variables

4.7.1 Dependent variable

- ✓ Respiratory distress (RD)

4.7.2 Independent variables

Socio-demographic characteristics

- ✓ Maternal age
- ✓ educational status of the mother
- ✓ marital status of mother
- ✓ occupational status of the mother

Obstetrics-related factors

- ✓ ANC follow-up, Gravidity, parity, prolonged labor, obstructed labor, mode of delivery, oligohydramnios, MSAF, indication for CS (maternal and fetal), multiple pregnancy, PROM, chorioamnionitis, preeclampsia, antepartum hemorrhage, birth interval

Maternal health condition-related factors

- ✓ Chronic hypertension, Diabetes mellitus, anemia

Neonatal related factors

- ✓ Sex of the newborn, Birth weight, Gestational age, fetal distress

4.8 Data collection instrument and procedures

Data collection tools were adapted after reviewing different related literature to address the study objectives (12, 13, 15, 19, 37). Both primary and secondary data (chart review) were used. Data was collected through face-to-face interviews using a pre-tested questionnaire from mothers and a data extraction checklist for mothers and neonatal medical records. Respiratory distress was confirmed by reviewing the neonate's medical chart. The data collection tool contains socio-demographic characteristics, obstetric-related factors of mothers, maternal health condition-related factors, and neonatal-related factors.

4.9 Data Quality Control

The questionnaire was prepared in English version and translated to Amharic (the national language) and retranslated to English to check for inconsistency. Two weeks before the data collection, to ensure consistency and clarity, the tool was tested in (5%) of the samples 24 (8 cases and 16 controls) at Tikur Anbessa Specialized Hospital, and unclear items were modified accordingly. The tool was given to experts to check validity. The questionnaire reliability was checked using Cronbach's alpha. Four BSc experienced nurses and 2 experienced MSc nurse supervisors were given training for 1 day and each was assigned to hospitals and collect the data. During the data collection time, close supervision and monitoring were carried out by supervisors and investigators to ensure the quality of the data. Finally, the supervisor and investigator checked all the collected data for completeness and consistency during the data management, storage, and analysis.

4.10 Data processing and analysis

Data was checked for completeness and consistency and it was exported to SPSS software version 26 for analysis from the online Kobo Toolbox. Cross-tabulation was done among the dependent variable and independent variables. Binary logistic regression is used to conduct both bi-variable and multivariate analyses. The model fitness to the data was checked using the Hosmer and Lemeshow test and Multi Collinearity was checked with VIF <10. In the bi-variable analysis, variables with p-values <0.25 are analyzed and fitted to multivariate analysis to identify the independent effects of each covariate on the outcome variable. In the final logistic regression model, the statistical significance was declared at $p<0.05$, and the presence and strength of

associations were summarized using an adjusted odds ratio with 95% confidence intervals. Finally, study findings are presented in texts, graphs, and tables.

4.11 Ethical Consideration

Ethical clearance was obtained from Addis Ababa University, College of Health Science Department of Nursing, Institutional Review Board (IRB) of the college with protocol Number SNM/19/2024. The supporting letter was obtained from Addis Ababa Health Bearu and permission was obtained from the clinical director relevant department and unit heads of the hospitals. The name or any other identifying information was not recorded on the instrument and all information taken from primary and secondary was kept strictly confidential and in a safe place. Following these approvals, access to the medical charts was provided to maintain participant confidentiality by storing them in a file cabinet and keeping them in a key and lock system with a computer pass ward.

4.12 Dissemination of the Study

The result of the study will be submitted and presented to Addis Ababa University, School of Nursing and Midwifery as partial fulfillment of a master's of science in neonatal nursing. The study result will also be submitted to Addis Ababa Health Bearu and each hospital at which the study will be conducted and the findings will also be presented in locally or internationally held seminars and will be published in internationally or nationally recognized journals.

5. RESULTS

5.1 Descriptive Statistics Results

5.1.1 Sociodemographic characteristics

This study intended to assess the determinants of respiratory distress among newborns admitted to the NICU at public hospitals in Addis Ababa. Four hundred eighty-nine newborns (163 cases and 326 controls) admitted at public hospitals of Addis Ababa with their mothers were included with an overall response rate of 100%. The mean age of mothers of newborns was 26.94±4.95 years, and the majority of participants fall within the 25-29 age range, with 49.7% of cases and 42.6% of controls, making up 45.0% of the total sample. Regarding residence, a higher proportion of cases reside in rural areas 66 (40.5%) compared to controls 90 (27.6%), while a majority of controls 236 (72.4%) live in urban areas. Marital status shows minimal variation between the groups, with a predominant number being married (95.1% of cases and 95.7% of controls).

Educational status reveals that the proportion of women with no formal education is slightly higher among cases 64 (39.3%) than controls 123 (37.7%). Conversely, primary and secondary education levels are more common among controls, whereas tertiary education (college and above) shows similar distributions in both groups (16.6% of cases and 15.0% of controls). Occupational status indicates that the majority of participants are housewives, particularly among controls 236 (72.4%) compared to cases 106 (65.0%). Government employment is more frequent among cases (10.4%) than controls (8.6%), while private employment is more common among controls (11.7%) compared to cases (17.2%). Merchant employment remains consistent across both groups at 7.4% (Table 2).

Table 3: Socio-demographic characteristics of the mothers of newborns for the study of determinants of respiratory distress among newborns admitted to the NICU in Addis Ababa Public Hospital, Ethiopia, 2024.

Variables	Category	Disease status (RD)		Total (=489) Frequency (%)
		Cases (=163) Frequency (%)	Controls (=326) Frequency (%)	
Maternal Age	<=19	16 (9.8)	11 (3.4)	27 (5.5)
	20-24	36 (22.1)	98 (30.1)	134 (27.4)
	25-29	81 (49.7)	139 (42.6)	220 (45.0)
	30-34	21 (12.9)	41 (12.6)	62 (12.7)
	>=35	9 (5.5)	37 (11.3)	46 (9.4)
Residence	Rural	66 (40.5)	90 (27.6)	156 (31.9)
	Urban	97 (59.5)	236 (72.4)	333 (68.1)
Marital status	Single	8 (4.9)	14 (4.3)	22 (4.5)
	Marriage	155 (95.1)	312 (95.7)	467 (95.5)
Educational status	No formal education	64 (39.3)	123 (37.7)	187 (38.3)
	Primary school	34 (20.9)	82 (25.2)	116 (23.7)
	Secondary school	38 (23.3)	72 (22.1)	110 (22.5)
	Collage and above	27 (16.6)	49 (15.0)	76 (15.5)
Occupational status	Housewife	106 (65.0)	236 (72.4)	342 (69.9)
	Government employee	17 (10.4)	28 (8.6)	45 (9.2)
	Private employee	28 (17.2)	38 (11.7)	66 (13.5)
	Merchant	12 (7.4)	24 (7.4	36 (7.4)

5.1.2 Obstetrics-related factors

Among all mothers enrolled in this study, 309 (63.2%) were multiparous and most of the mothers 473 (96.7%) had a history of antenatal care follow-up during the current pregnancy, 158 (96.9%) were in the case group, and 315 (96.6%) were in the control group. At the same time, 5 (3.1%) of cases and 11(3.4%) of controls had never gotten ANC service during the pregnancy of the current neonate.

The finding of this study revealed that the proportion of short birth intervals was nearly three times higher in cases 33 (36.3%) than in controls 26 (11.9%). The proportion of mothers with premature rupture of membranes among the case group was 62 (38.0 %), which is higher than the control group of 85 (26.1%). Similarly, the proportion of neonates with meconium-stained amniotic fluid 60 (36.8%) of the cases of neonates was 2.9 times higher than the control group 52 (16.0%). This study showed that newborns of maternal chorioamnionitis in cases was 17 (10.4%) which is 2 times higher in control groups 14 (4.3%). Regarding the place of delivery, the study showed that the majority of the mothers delivered their neonates at health institutions 485 (99.2%) and only 4 (0.8 %) of the mothers conducted home deliveries. Furthermore, more than half of the mothers 272 (55.6 %) delivered by cesarean section, with 103 (63.2 %) being cases and 169 (51.8%) controls. Regarding types of CS, the majority of cases were delivered by emergency section 87 (84.5 %) which is higher than the control group 85 (50.3%). Twenty-eight (21.4%) of cases and fifty-two (21.5%) of controls were delivered by induction. The proportion of prolonged labor was also higher in cases 61 (37.4%) than in controls 83 (25.5%).

Regarding indication for cesarean section, this study revealed that 18 (17.5%) cases of newborns were delivered for an indication of failed induction of labor which is 2 times higher than controls 14 (8.3%). Similarly, the proportion of fetal distress was also higher in cases 50 (48.5 %) than in controls 53 (31.4 %). In addition, eighteen (17.5 %) of cases and 75 (44.4 %) of controls of newborns delivered for an indication of previous cesarean section. Regarding the pregnancy-induced hypertension of the mothers, the proportion of mothers with preeclampsia was higher among cases 26 (25.2%) than among controls 25 (14.8%). The findings revealed that 16 (15.5%) of the mothers of the cases and 26 (15.4%) of the mothers in the control group had a history of antepartum hemorrhage during the pregnancy of the current neonates (Table 3).

Table 4: Obstetrics characteristics of mothers of newborns admitted to the NICU for the study of determinants of respiratory distress at Public hospitals in Addis Ababa, Ethiopia, 2024.

		Disease status (RD)		
Variables	Category	Cases (163) Frequency %	Controls (326) Frequency %	Total (489) Frequency %
Gravidity	Primigravida	71 (43.6)	101 (31.0)	172 (35.2)
	Multigravida	92 (56.4)	225 (69.0)	317 (64.8)
Parity	Primipara	72 (44.2)	108 (33.1)	180 (36.8)
	Multipara	91 (55.8)	218 (66.9)	309 (63.2)
Birth interval	< 24 months	33 (36.3)	26 (11.9)	59 (19.1)
	>=24 months	58 (63.7)	192 (88.1)	250 (80.9)
ANC follow up	Yes	158 (96.9)	315 (96.6)	473 (96.7)
	No	5 (3.1)	11 (3.4)	16 (3.3)
ANC visits	<=2 visits	7 (4.4)	4 (1.3)	11 (2.3)
	3 visits	51 (32.3)	39 (12.4)	90 (19.1)
	>=4 visits	100 (63.3)	272 (86.3)	372 (78.6)
Pregnancy type	Single	153 (93.9)	317 (97.2)	470 (96.1)
	Twin	10 (6.1)	9 (2.8)	19 (3.9)
PROM	Yes	62 (38.0)	85 (26.1)	147 (30.1)
	No	101 (62.0)	241 (73.9)	342 (69.9)
Prolonged ROM	Yes	12(19.4)	40 (47.1)	52 (35.4)
	No	50 (80.6)	45 (52.9)	95 (64.6)
Oligohydramnios	Yes	10 (6.1)	41 (12.6)	51 (10.4)
	No	153 (93.9)	285 (87.4)	438 (89.6)
Maternal chorioamnionitis	Yes	17 (10.4)	14 (4.3)	31 (6.3)
	No	146 (89.6)	312 (95.7)	458 (93.7)
Place of delivery	Home delivery	2 (1.2)	2 (0.6)	4 (0.8)
	Health institution	161 (98.8)	324 (99.4)	485 (99.2)
Labor started	Spontaneous	103 (78.6)	190 (78.5)	293 (78.6)
	Induction	28 (21.4)	52 (21.5)	80 (21.4)

Meconium stained Amniotic fluid	Yes	60 (36.8)	52 (16.0)	112 (22.9)
	No	103 (63.2)	274 (84.0)	377 (77.1)
Prolonged labor	Yes	61 (37.4)	83 (25.5)	144 (29.4)
	No	102 (62.6)	243 (74.5)	345 (70.6)
Mode of delivery	SVD	55 (33.7)	142 (43.6)	197 (40.3)
	Instrumental	5 (3.1)	15 (4.6)	20 (4.1)
	CS	103 (63.2)	169 (51.8)	272 (55.6)
Type of CS	Emergency CS	87 (84.5)	85 (50.3)	100 (36.8)
	Elective CS	16 (15.5)	84 (49.7)	172 (63.2)
Cephalopelvic disproportion	Yes	3 (2.9)	6 (3.6)	9 (3.3)
	No	100 (97.1)	163 (96.4)	263 (96.7)
Failed induction of labor	Yes	18 (17.5)	14 (8.3)	32 (11.8)
	No	85 (82.5)	154 (91.7)	239 (88.2)
Fetal distress	Yes	50 (48.5)	53 (31.4)	103 (37.9)
	No	53 (51.5)	116 (68.6)	169 (62.1)
Previous CS	Yes	18 (17.5)	75 (44.4)	93 (34.2)
	No	85 (82.5)	94 (52.6)	179 (65.8)
Malpresentation	Yes	10 (9.7)	24 (14.2)	34 (12.5)
	No	93 (90.3)	145 (85.8)	238 (87.5)
Preeclampsia	Yes	26 (25.2)	25 (14.8)	51 (18.8)
	No	77 (74.8)	144 (85.2)	221 (81.2)
Antepartum hemorrhage	Yes	16 (15.5)	26 (15.4)	42 (15.4)
	No	87 (84.5)	143 (84.6)	230 (84.6)
Maternal request	Yes	1 (1.0)	1 (0.6)	2 (0.7)
	No	102 (99.0)	168 (99.4)	270 (99.3)
Type of Anesthesia	Spinal	101 (98.1)	168 (99.5)	269 (98.9)
	General	2 (1.9)	1(0.5)	3 (1.1)
Other CS indications	Yes	6 (6.7)	13 (7.1)	19 (7.0)
	No	84 (93.3)	169 (92.9)	253 (93.0)

Other CS indications (cord prolapse, failed vacuum, IUGR with absent/reversed end diastolic flow, scar dehiscence, macrosomia, twin px non-vertex, RH negative sensitized, eclampsia).

5.1.3 Neonatal-related risk factors

This study revealed that more than half 273 (55.8%) were males. The proportion of cases and controls by sex of the newborns was slightly different, where males were in cases 92 (56.4%) and in controls 181 (55.5 %). Regarding the gestational age, most of the mothers 335 (68.5%) were delivered between 37 and 42 weeks of their pregnancy, 83 (50.9%) in the case group and 252 (77.3%) in the control group. Concerning birth weight, the majority of newborns 350 (71.6%) had a birth weight range of 2500-4000grams of 92 (56.4%) were cases and 258 (79.1%) controls. The proportion of preterm was approximately two times higher among cases 74 (45.4%) than among controls 67 (20.6%).

The study findings showed that neonates in the first minute with low APGAR scores were recorded among the neonates with cases of a higher proportion of 124 (76.1%) than in the control group 60 (18.4%). Similarly, the proportion of recorded less than 7Apgar score in the 5th minute of the newborns among the cases group 32 (19.6%) was higher than the control group 8 (2.5%) (Table 4).

Table 5: Characteristics of newborns admitted to the NICU for the study of respiratory distress in Addis Ababa Public Hospitals, Ethiopia, 2024.

Variables	Category	Disease status (RD)		
		Cases (163) %	Control (326) %	Total (489) %
Sex of the newborn	Female	71 (43.6)	145 (44.5)	216 (44.2)
	Male	92 (56.4)	181 (55.5)	273 (55.8)
Gestational age	< 37 wks.	74 (45.4)	67 (20.6)	141 (28.8)
	37-42 wks.	83 (50.9)	252 (77.3)	335 (68.5)
	>=42 wks.	6 (3.7)	7 (2.1)	13 (2.7)
Birth weight	1000-1500	31 (19.0)	2 (0.6)	33 (6.7)
	1500-2500	36 (22.1)	57 (17.5)	93 (19.0)
	2500-4000	92 (56.4)	258 (79.1)	350 (71.6)
	>= 4000	4 (2.5)	9 (2.8)	13 (2.7)
APGAR 1st minute	<7	124 (76.1)	60 (18.4)	184 (37.6)
	>=7	39 (23.9)	266 (81.6)	305 (62.4)
APGAR 5th minute	<7	32 (19.6)	8 (2.5)	40 (8.2)
	>=7	131 (80.4)	318 (97.5)	449 (91.8)

Abbreviation: APGAR, Appearance, pulse, grimace, Activity, respiratory

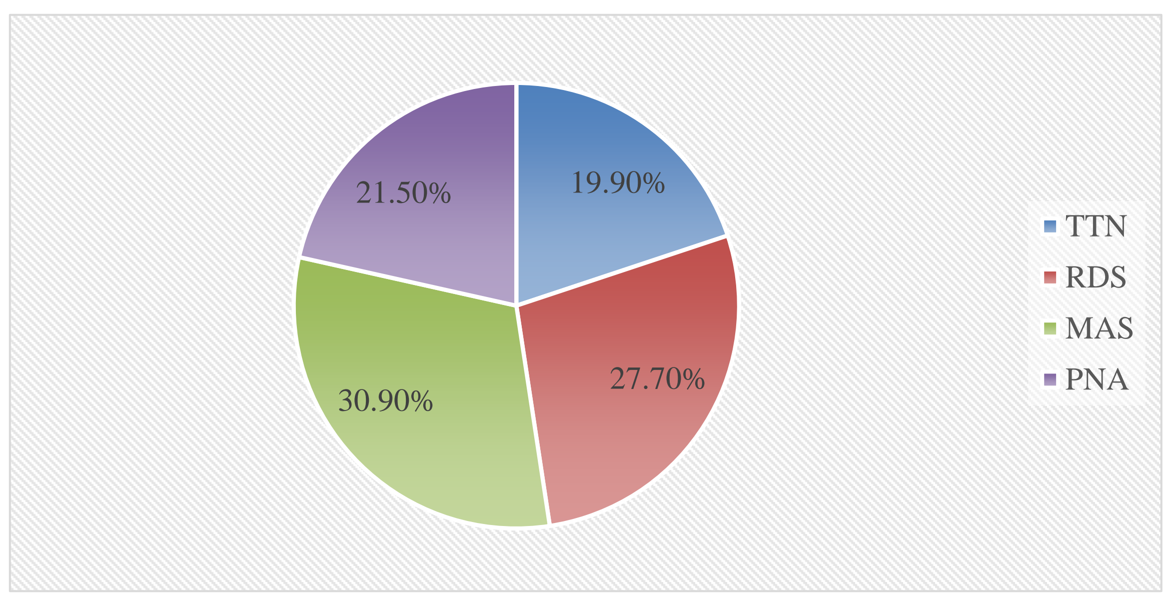
5.1.4 Maternal Health Condition--related factors

Maternal chronic hypertension was present in 8 (4.9%) of cases and 12 (3.7%) of controls, and six (3.7%) of the cases and fifteen (4.6%) of the controls had gestational diabetes. Anemia during pregnancy was observed in 1.2% of cases and 0.9% of controls, respectively. Pregnancy-induced hypertension was detected in 2.5% of cases and 4.3% of controls (Table 5).

Table 6: Maternal medical illness-related factors of newborns for the study of determinants of respiratory distress among newborns admitted to the NICU of Addis Ababa Public Hospitals, Ethiopia, 2024.

Variables	Category	Disease status (RD)		Total (489)%
		Cases (163) (%)	Controls (326) %	
Maternal Chronic hypertension	Yes	8 (4.9)	12 (3.7)	20 (4.1)
	No	155 (95.1)	314 (96.3)	469 (95.9)
Gestational diabetes	Yes	6 (3.7)	15 (4.6)	21 (4.3)
	No	157 (96.3)	311 (95.4)	468 (95.7)
Pregestational diabetes	Yes	1 (0.6)	2 (0.6)	3 (0.6)
	No	162 (99.4)	324 (99.4)	486 (99.4)
Anemia during pregnancy	Yes	2 (1.2)	3 (0.9)	5 (1.0)
	No	161 (98.8)	323 (99.1)	484 (99.0)
Pregnancy-induced hypertension	Yes	4 (2.5)	14 (4.3)	18 (3.7)
	No	159 (97.5)	312 (95.7)	471 (96.3)
Others	Yes	4 (2.5)	2 (0.6)	6 (1.2)
	No	159 (97.5)	324 (99.4)	483 (98.8)

Others – (Acute kidney infection (AKI), hyperthyroidism, cardiac problems, asthma)



TTN- Transit tachypnea of the newborn, RDS- respiratory distress syndrome, MAS- meconium aspiration syndrome, PNA- perinatal asphyxia.

Figure 3: Common types of respiratory distress among newborns admitted to the NICU of Addis Ababa Public Hospitals, Ethiopia, 2024.

5.2 Bivariate and multivariable analysis results

Using a bivariate logistic regression analysis, every independent variable was examined for a relationship with respiratory distress. The variables found to be associated with respiratory distress in bi-variate analysis (P-value <0.25) were: maternal age, maternal residence, birth interval, maternal chorioamnionitis, duration of labor, types of CS, failed induction of labor, meconium-stained amniotic fluid, gestational age, birth weight, fetal distress, and, neonates who have low APGAR score in the first one and five minutes and were collectively entered to the multivariate logistic regression model.

After adjusting for possible effects of confounding variables, multivariable logistic regression analysis showed that emergency cesarean section, meconium-stained amniotic fluid, low birth weight, and low first-minute APGAR score showed statistically significant association with respiratory distress of the newborn at p-value ≤0.05.

The multivariable analysis result showed that those mothers of newborns delivered through the emergency cesarean section were 3 times more likely to develop respiratory distress than those delivered through elective cesarean section (AOR=3.074, 95% CI: 1.016, 9.302).

The result of this study showed that neonates delivered with meconium-stained amniotic fluid were 5.1 times (AOR=5.103, 95% CI: 1.739, 14.974) more likely to have respiratory distress than those who had not been meconium-stained. The results of this study showed that newborns born with low birth weight were 3.6 times more likely to develop respiratory distress than those with normal birth weight (AOR=3.592, 95% CI: 1.293, 9.978). Likewise, newborns with Apgar scores less than 7 in the first minutes were 9.7 times more likely to have respiratory distress than their counterparts (AOR=9.693, 95% CI: 3.945, 23.817) (Table 6).

Table 7: Bi-variable and multivariate logistic regression analysis for determinants of respiratory distress among newborns admitted to the NICU of Addis Ababa Public Hospitals, Ethiopia, 2024. (N=489)

Variable	Category	**Respiratory distress (RD)**		**COR (95%CI)**	**AOR (95% CI)**	**P-Value**
		Cases	**Controls**			
Maternal age	<=19	16 (9.8)	11 (3.4)	**5.98(2.075, 17.230)**	2.13 (0.126, 36.159)	0.601
	20-24	36 (22.1)	98 (30.1)	1.51 (0.663, 3.438)	1.826 (.252, 13.251)	0.551
	25-29	81 (49.7)	139 (42.6)	**2.396 (1.100, 5.217)**	2.719 (.429, 17.230)	0.288
	30-34	21 (12.9)	41 (12.6)	2.106 (0.857, 5.171)	2.961 (.291, 30.136)	0.359
	>=35	9 (5.5)	37 (11.3)	1	1	
Maternal residency	Rural	66 (40.5)	90 (27.6)	**1.784 (1.201, 2.651)**	1.516 (0.558, 4.117)	0.414
	Urban	97 (59.5)	236 (72.4)	1	1	
Birth interval	<24 months	33 (36.3)	26 (11.9)	**4.202 (2.325, 7.594)**	2.771 (0.852, 9.017)	0.090
	>=24 months	58 (63.7)	192 (88.1)	1	1	
Maternal chorioamnionitis	Yes	17 (10.4)	14 (4.3)	**2.595 (1.245, 5.407)**	0.593 (0.062, 5.689)	0.650
	No	146 (89.6)	312 (95.7)	1	1	
MSAF	Yes	60 (36.8)	52 (16.0)	**3.069 (1.987, 4.742)**	**5.103 (1.739, 14.974)**	**0.003**
	No	103 (63.2)	274 (84.0)	1	1	
Type of CS	Emergency	87 (84.5)	85 (50.3)	**5.374 (2.912, 9.914)**	**3.074 (1.016, 9.302)**	**0.047**
	Elective	16 (15.5)	84 (49.7)	1	1	
NRFHRP	Yes	50 (48.5)	53 (31.4)	**2.065 (1.246, 3.421)**	0.832 (0.290, 2.393)	0.734
	No	53 (51.5)	116 (68.6)	1	1	
Failed induction of labor	Yes	18 (17.5)	14 (8.3)	**2.329 (1.104, 4.916)**	0.902 (0.185, 4.407)	0.899
	No	85 (82.5)	154 (91.7)	1	1	
Prolonged labor	Yes	61 (37.4)	83 (25.5)	**1.751 (1.170, 2.621)**	1.135 (0.343, 3.756)	0.836
	No	102 (62.6)	243 (74.5)	1	1	

Birth weight	<2500 grams	67 (41.1)	59 (18.1)	**3.158 (2.074, 4.809)**	**3.592 (1.293, 9.978)**	**0.014**
	>=2500 grams	96 (58.9)	267 (81.9)	1	1	
Apgar 1st minute	< 7	124 (76.1)	60 (18.4)	**14.096 (8.93, 22.20)**	**9.693 (3.945, 23.817)**	**0.000**
	>=7	39 (23.3)	266 (81.6)	1	1	
Apgar 5th minute	< 7	32 (19.6)	8 (2.5)	**9.710 (4.359, 21.63)**	3.655 (0.545, 24.533)	0.182
	>=7	131 (80.4)	318 (97.5)	1	1	

MSAF - Meconium stained amniotic fluid, CS- cesarean section, NRFHRP- non-reassuring fetal heart rate pattern, Apgar- Appearance, pulse, grimace, Activity, respiratory

- **Overall Significant Variables**

	B	S.E.	Wald	Sig.	AOR 95% CI
Meconium stained amniotic fluid (MSAF)	1.630	0.549	8.807	0.003	5.103 (1.739, 14.974)
Emergency cesarean section	1.123	0.565	3.951	0.047	3.074 (1.016, 9.302)
Low birth weight (<2500 grams)	1.279	0.521	6.019	.014	3.592 (1.293, 9.978)
First minute Apgar score <7	2.271	0.459	24.524	0.000	9.693 (3.945, 23.817)

- AOR- adjusted odds ratio; CI- confidence interval; COR- crude odds ratio; 1=Reference Category
- Statistically significant variables at p-value <0.05; Hosmer and Lemeshow goodness-of-fit **0.447**

6. DISCUSSION

The current study intended to investigate the determinants of respiratory distress among newborns admitted to the NICU at Addis Ababa public hospitals. According to the study findings, meconium-stained amniotic fluid (MSAF), emergency cesarean section (CS), low birth weight (<2500 grams), and first-minute Apgar score <7 were determinants of respiratory distress among newborns.

According to the study's findings, newborns born with meconium-stained amniotic fluid (MSAF) were 5.1 times more likely to develop respiratory distress compared to those who delivered with clear amniotic fluid (more prevalent among cases than controls). This finding was supported by studies conducted in Thailand (41), India (34), and Southern Ethiopia (12) showed a significant association between respiratory distress and MSAF. There could be a rationale for this since neonates born from mothers with MSAF were more likely to aspirate the meconium, which can affect the alveolar gas exchange negatively, and decrease alveolar recruitment for gas exchange due to alveolar space occupied by meconium. In addition, inhaled meconium may cause a mechanical blockage of the small airways, which could result in an imbalance between ventilation and perfusion because of increased dead space, inflammation, and infection, all of which impair the lung's ability to function as a surfactant (58). This suggests that neonates exposed to MSAF are at a higher risk of developing respiratory complications, emphasizing the need for close monitoring and intervention in such cases.

The odds of respiratory distress increased 3 times in newborns born from mothers with emergency cesarean section than in newborns born from mothers by elective cesarean section (more common in cases compared to controls). This finding is supported by a study in China (39). The possible explanation could be an emergency cesarean section might be done due to maternal and fetal indications that might be fetal distress and labor dystocia. In addition, the possible reason might be poor labor follow-up and late detection of abnormal labor by health professionals and the decision for a cesarean section might be late after they develop complications. Furthermore, this might be higher proportions of referred pregnant mothers with obstetric complications, and severe forms of cesarean indications such as (NRFHRP, cord prolapse, and obstructed labor) (59).

Low birth weight (<2500 grams) was another neonatal characteristic that was found to be significantly linked with respiratory distress. More specifically, compared to newborns with a normal birth weight, newborns who had low birth weights were 3.6 times more likely to develop respiratory distress. (more frequently observed in cases than in controls). This finding is consistent with the studies conducted in Korea (14), Afghanistan (43), and China (40). One possible explanation for this could be that the majority of low birth-weight newborns are preterm infants, meaning that their bodies are unable to create adequate surfactant, which exacerbates breathing difficulties and respiratory distress (60). Which emphasizes how crucial prenatal care is for ensuring healthy fetal growth.

Compared to newborns with an Apgar score of equal to or more than 7, those who had a score of less than 7 in the first minute were 9.7 times more likely to experience respiratory distress. This finding was compatible with studies conducted in Cameroon, TASH, and South Ethiopia (15, 19, 45) respectively. The one possible explanation for the situation could be that babies that were delivered with meconium-stained amniotic fluid, which resulted in aspiration, had low Apgar scores during the first minute of life. The second possible explanation could be newborns delivered from mothers who underwent emergency caesarian sections. This may be because most mothers may have complications, and the third possible explanation could be low birth weight, this could be explained by the fact that small babies might suffer difficulty breathing and might develop difficulty in cardiopulmonary transition and respiratory distress which predisposes the newborn to different complications including a low fifth-minute Apgar score (60). This emphasizes the need for immediate and effective resuscitation efforts for these infants to improve their outcomes.

Despite different studies showing that birth interval, maternal chorioamnionitis, fetal distress, and prolonged labor (51), (43), (50), (53)) were risk factors of respiratory distress, this study did not find any significant association with these factors in multivariable logistic regression analysis. This discrepancy may be attributed to methodological variations, such as differences in sample size and population characteristics, study design, measurement and definitions of variables, data quality and accuracy, statistical methods, geographical and environmental factors, and temporal factors.

7. STRENGTHS AND LIMITATION OF THIS STUDY

7.1 Strength of the study

1. Multi-center Setting: The study was conducted across multiple centers, enhancing the generalizability of the findings.
2. Data Collection Method: Using both face-to-face interviews and chart reviews reduced the risk of information bias.
3. This study adds variables that were not studied in previous studies (indication for cesarean sections, Birth interval).

7.2 Limitations of the Study

- This study did not address the outcome and the survival status of neonates with respiratory distress.

8. CONCLUSION AND RECOMMENDATION OF THE STUDY

8.1. Conclusion

Respiratory distress was found to be a major public health problem for newborns who were admitted to the NICU of Addis Ababa public Hospitals. There are different factors which are the causes of respiratory distress. This study identified key determinants associated with respiratory distress among newborns, including emergency cesarean sections (CS), meconium-stained amniotic fluid (MSAF), low birth weight (<2500 grams), and low first-minute APGAR scores <7.

8.2. Recommendation

While the quality of health care services has improved, particularly for the care of mothers and newborns, neonatal death from respiratory distress remains a significant concern in all of Ethiopia's studied areas. Based on the study's conclusions, several stakeholders have been recommended to consider the following recommendations:

For health professionals

- ✓ Increased prenatal care, fetal heart rate monitoring, early decision-making when the fetus is in distress, and follow-up during labor and delivery are all necessary for health professionals.
- ✓ Early detection of Post-term pregnancy and prolonged labor reduces the occurrence of meconium-stained amniotic fluid.
- ✓ Ensure continuous and effective intrapartum monitoring to detect and manage complications such as meconium-stained amniotic fluid (MSAF). Training for healthcare providers on early detection and intervention for MSAF can reduce the risk of respiratory distress.

- **For the Ministry of Health and health service organizations**
  - ✓ The government should improve the priority given to respiratory distress by improving awareness of the medical, psychosocial, and economic burden of respiratory distress. Primary care organizations would better increase their support towards antenatal care services, and maternal education programs and improve routine fetal heart rate monitoring in labor.
  - ✓ Implement strategies to reduce the rate of emergency cesarean sections. Encourage timely and appropriate decision-making for cesarean deliveries to prevent complications that may lead to respiratory distress in newborns
- **For Researchers**

Healthcare System Factors:

- ✓ Access to and Quality of Care: Examining the availability and quality of prenatal and perinatal healthcare services can highlight areas for improvement.
- ✓ Referral Systems: The efficiency of referral systems for high-risk pregnancies should be evaluated.
- ✓ Uterine stimulants, particularly misoprostol (for induction), are associated with the occurrence of meconium-stained amniotic fluid and should be examined.
- ✓ Longitudinal studies can provide deeper insights into the long-term outcomes of interventions aimed at reducing respiratory distress among newborns.

Incorporating these additional variables into future studies will help create a more comprehensive understanding of the factors contributing to respiratory distress in newborns, ultimately aiding in the development of targeted interventions and improving neonatal health outcomes.

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APPENDIX

Appendix I: Information Sheet

Good morning/ afternoon. My name is ____________ Currently, at Addis Ababa University, I am a graduate student at the School of Nursing and Midwifery, College of Health Sciences. I am conducting a study to assess determinants of respiratory distress in newborns admitted to the NICU at public hospitals in Addis Ababa, Ethiopia, in 2024.

Title of the research: Determinants of respiratory distress among newborns admitted to the NICU at public hospitals of Addis Ababa, Ethiopia, 2024.

Objective: This study will be aimed at identifying determinants for respiratory distress among newborns.

Participants: Newborns at four public hospitals and their index mothers.

Potential Risks: There is no foreseen risk by being involved in this study.

Benefits: There are no financial gains associated with this research. Most significantly, taking part in this research will help in developing efficient preventative and control strategies for newborn respiratory distress. As a result, in this way, you are also helping society and other patients indirectly. I have a few questions for you. Your truthful answers to the questions can aid in the study's goal-achieving. Every piece of information you provide will be kept private and secret. The information will only be accessible to the interviewer and the lead investigator. We respectfully ask that you reply voluntarily. You can also decide not to take part in this study at all, and you are free to leave the interview if you feel uncomfortable at any time. At any time that you have questions, you can contact me by using the following Addresses.

Principal investigator, Tenaw Belay 0921202949

Email, tenawbelay9@gmail.com

Appendix II: Consent Form

In signing this document, I am consenting to participate in the study entitled "Determinants of respiratory distress among newborns admitted to the NICU at Addis Ababa public hospitals, Ethiopia". I have been informed that this research aims to determine the risk factors that neonates face when they experience respiratory distress. I am aware that taking part in this study is completely optional. I have been assured that no one else will receive my answers to the questions, and no reports from this study will ever contain any information that could identify me. Additionally, I've been told that it won't harm me if I participate, don't participate, or decline to answer questions. I am aware that there are no risks associated with taking part in this study.

Respondent's signature________________________________

Date of interview: ______________ Time started: ________ Time finished: ________

Interviewer Name________________________Signature__________Date___________

Supervisor's name _______________ signature _____________

Results of the interview questionnaire

1. Completed

2. Refused

3. Partially complete

Appendix III: Extraction Checklist and Questionnaire

Title of the Research Project: Determinant of respiratory distress among newborns admitted to the NICU at public hospitals of Addis Ababa, Ethiopia, 2024.

Name of Investigator: Tenaw Belay (BSc in Midwifery)

Name of the Organization: Addis Ababa University, School of Nursing and Midwifery, College of Health Science.

Name of the Sponsor: SPHMMC.

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

Purpose of the Research Project: To identify the determinants of respiratory distress among newborns admitted to the NICU at public hospitals in Addis Ababa, Ethiopia, in 2024.

Procedure: To achieve the above objective, information necessary for the study will be taken from both maternal and neonatal medical record forms.

Risk and /or Discomfort: The patients will not experience any harm from the study because it will be carried out using the relevant data from the medical chart. All information obtained from the chart will be kept confidential and in a secure location. No name or other identifying information will be included in the questionnaire. The data collected will only be utilized for research.

Benefits: The person whose document or record is included in this research and has already passed away will not directly benefit from it. This is because program planners will assist participants by providing adequate care and treatment services for both those who survive and other newly born ones. All things considered, healthcare managers and planners will greatly profit directly from the research effort.

Confidentiality: To maintain client confidentiality, the data on the chart will be gathered anonymously, and the data gathered for this research project will be kept private and maintained in a filing cabinet. Furthermore, it is going to be kept in a secured system with a computer pass ward, and no one else will be able to access it except the investigator.

Person to contact: The institutional review board of Addis Ababa University's College of Health Science, School of Nursing and Midwifery, examined and approved this research project. If you have any questions you can contact any of the following individuals and you may ask at any time you want.

Principal investigator: Tenaw Belay, Addis Ababa University, College of Health Science, School of Nursing and Midwifery. Cell phone: -0921202949, E-mail: tenawbelay9@gmail.com

Checklists and Questionnaires for the data collection on determinants of respiratory distress among neonates admitted to the NICU at Addis Ababa public hospitals, Ethiopia, 2024.

Name of hospital		---------------------------------	
Status		1. Case 2. Control	
I. Face-to-face interview questionnaires for the Mothers		Possible answers	
1. Socio-demographic characteristics			skip
101	Age of the mother?	------------------------	
102	Where is your residence?	1. rural 2. urban	
103	What was the marital status of the mother?	1. Single 2. Married 3. Divorced 4. Widowed	
104	What is your educational status?	1. no formal education 2. primary school 3. secondary school 4. college and above	
105	What is your occupation?	1. Housewife 2. Governmental employee 3. Private employee 4. Merchant 5. Student	
	2. Obstetrics-related factors		
201	Number of Gravidity	----------------------	
202	Number of Parity	----------------------	
203	If para II and above mother, how many years/months between your consecutive last two alive babies?	------------------------	
204	Does the mother have an ANC follow-up for this neonate?	1. Yes 2. No	
205	If yes, how many times did you receive antenatal care during your time of pregnancy for this neonate?	------------------ times	
206	How was the pregnancy type?	1. Single 2. Twin 3. Triple and above	
II	Checklists from Maternal and their neonates' medical charts		

207	Which among the following do you have diagnosed before delivery?		
	premature rupture of membranes (PROM)	1. Yes 2. No	
	If yes, the duration of rupture of the membrane	1. <18 hrs. 2. >=18hrs.	
	Oligohydramnios	1. Yes 2. No	
	Maternal chorioamnionitis	1. Yes 2. No	
208	How was the labor started?	1. Spontaneous 2. induction	
209	Where was the delivery?	1. Home delivery 2. Health facility	
210	What was the mode of delivery?	1. SVD 2. CS 3. Instrumental delivery	
211	If delivery was via SVD, how many hours does labor last?	1. <12 hours 2. >12 hours	
212	Was meconium-stained amniotic fluid (MSAF) diagnosed in labor?	1. yes 2. No	
213	If CS delivery, what types of CS delivery?	1. Elective cs 2. Emergency cs	
214	If CS delivery, what was the indication for CS?		
	Cephalopelvic disproportion (CPD)	1. yes 2. No	
	Failed induction of labor	1. yes 2. No	
	fetal distress	1. yes 2. No	
	Previous cs	1. yes 2. No	
	Malpresentation	1. yes 2. No	
	Obstructed labor	1. yes 2. No	
	Preeclampsia	1. yes 2. No	
	Antepartum hemorrhage	1. yes 2. No	
	maternal request	1. yes 2. No	
	Others, specify-----------------------		
215	What types of anesthesia are used?	1. Spinal anesthesia 2. General anesthesia	
3. Maternal health condition-related factors			

Did the mother suffer from any of these conditions which are medically confirmed during pregnancy?			
	maternal chronic hypertension	1. yes 2. No	
	Pregestational diabetes	1. yes 2. No	
	gestational diabetes	1. yes 2. No	
	Anemia	1. yes 2. No	
	Pregnancy-induced hypertension	1. yes 2. No	
	If other, specify	-------------------	
4. Neonatal-related factors			
402	Sex of the newborn	1. Male 2. Female	
403	Gestational age at birth	---------------------	
404	Birth Weight in grams	1. 1000-1500 grams 2. 1500-2500grams 3. 2500 -4000 grams 4. > 4000 grams	
405	APGAR score at one minute	1. <7 2. ≥7	
406	APGAR score at five minutes	1. <7 2. ≥7	
407	Is the neonate diagnosed with RD?	1. yes 2. no	
408	Respiratory distress secondary to?	1. TTN 2. RDS 3. MAS 4. Perinatal Asphyxia 5. Others specify------------	

Appendix IV: የተሳታፊዎች የመረጃ ቅፅ በአማረኛ

እንደምን አደሩ/ዋሉ?

ሥሜ____________________ እባላለው፤ በአዲስ አበባ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮሌጅ፣ ነርሲንግና ሚድዋይፍሪ ትምህርት ክፍል በጨቅላ ህጻናት ጤና የ2ኛ ዓመት የማስትሬት ድግሪ ተመራቂ ተማሪ ነኝ፡፡ በአሁኑ ሰዓት በአዲስ አበባ ውስጥ በሚገኙ የመንግስት ሆስፒታሎቸ ውስት የጨቅላ ህጻናት የመተንፈስ ችግር አጋላጭ ሁኔታዎችን ለመለየት በማጥናት ላይ ነኝ፡

የጥናቱ ርዕስ፡ - በአዲስ አበባ ውስጥ በሚገኙ የመንግስት ሆስፒታሎች ውስጥ የጨቅላ ህጻናት የመተንፈስ ችግር አጋላጭ ሁኔታዎችን መለየት ፣ ኢትዮጵያ፣ 2016 ዓ.ም፡፡

ተሳታፊዎች፡ - በአዲስ አበባ በሚገኙ በአራት ሕዝብ ሆስፒታሎች ውስጥ ያሉ ጨቅላ ህፃናት እና የእነርሱ እናቶች፡፡

የጎንዮሽ ጉዳት፡ - በዚህ ጥናት መሳተፍ ምንም አይነት ጉዳት የለውም፡፡

ጥቅማጥቅም፡ - በጥናቱ ለሚሳተፉ ፍቃደኛ ተሳታፊዎች ምንም አይነት የገንዘብ ክፍያ የለም፣ነገር ግን የጥናቱ ውጤት የጨቅላ ህጻናት የመተንፈስ ችግር ለመከላከል ስለሚጠቅም በተዘዋዋሪ መንገድ ሌላ ህመምተኛ እንዲሁም ህብረተሰቡን የመጥቀም እድል ያገኛሉ፡፡ ስለዚህ የተወሰኑ ጥያቄዎችን ልጠይቅዎት እወዳለሁ፡፡ የእርስዎ በእውነት ላይ የተመሰረተ መልስ ለዚህ ጥናት መሳካት አስተዋፅኦ ያደርጋል፡፡ እርስዎ የሚሰጡት መረጃ ከአጥኚውና ቃለመጠይቅ አድራጊው በስተቀር በማንኛውም መልኩ ለሌላ 3ኛ ወገን ተላልፎ አይሰጥም፡፡ በሙሉ ፈቃደኝት እንዲሳተፉ እየጠየቅሁ ያለመሳተፍ ወይም በማንኛውም ጊዜ ራስዎን ከጥናቱ የማግለል ሙሉ መብት አለዎት፡፡ ማንኛውም ጥያቄ ካለዎት በሚከተለው አድራሻዬ ማግኘት ይችላሉ፡፡

ጤናዉ በላይ

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Appendix V: የስምምነት መግለጫ ፎርም - በአማርኛ

አዲስ አበባ ዩኒቨርሲቲ፤ጤና ሳይንስ ኮሌጅ፤ነርሲንግ ትምህርት ክፍል፤ድህረ ምረቃ ፕሮግራም እኔ ለዚህ ጥናት የስምምነት ፊርማዬን ስሰጥ፤የዚህ ጥናት ዓላማ በደንብ የተብራራልኝ ሲሆን የጥናቱንም ዓላማ ተረድቻለሁ፡፡ በዚሁ ጥናት ላይ መሳተፍ በሙሉ ፈቃደኝነት ላይ የተመሰረተ መሆኑን በሚገባ የተረዳሁ ሲሆን በማንኛውም ጊዜ ከጥናቱ ራሴን የማግለል መብት እንዳለኝ አውቄአለሁ፡፡ ስለሆነም የምሰጠው መረጃ እስከተጠበቀ ድረስ በዚህ ጥናት ለመሳተፍ ተስማምቻለሁ፡፡ በጥናቱ ስሳተፍ በህጻኑ/ኗ ወይም በኔ ላይ ምንም አይነት ጉዳት እንደሌለው በግልጽ ተረድቻለሁ፡፡በዚህ ጥናት ለመሳተፍ ስምምነቴን ስገልፅ ለምጠቀው ጥያቄ በእውነት ላይ የመሰረተ መልስ ለመስጠት የተስማማሁ መሆኔን አረጋግጣለሁ፡፡በመብቴ ዙሪያም ሆነ ስለ ጥናቱ መንኛውንም ያልገባኝን ጥያቄ መጠየቅ እንደምችል ተገልጾልኛል፡፡

የመረጃ ሰጪ ፊርማ ________________________________ቀን _______________

የተጀመረበት ሰዓት ______________________ ያለቀበት ሰዓት______________

የጠያቂው ስም ______________________ፊርማ____________ቀን______________

የተቆጣጣሪ፤ስም__________________ፊርማ___________________ቀን____________

የመጠይቁ ውጤት

1. ሙሉ በሙሉ የተሞላ

2. ያልተስማሙ

3. በከፊል የተሞላ

Appendix VI: መጠይቅ - አማርኛ ቅጽ

አዲስ አበባ ዩኒቨርሲቲ፤ ጤና ሳይንስ ኮሌጅ ፤ነርሲንግ ዲፓርትመንት፤ ድህረ ምረቃ ፕሮግራም

- ይህ መጠይቅ የተዘጋጀው በአዲስ አበባ በሚገኙ የህዝብ ሆስፒታሎች ውስጥ ለጨቅላ ህጻናት የመተንፈስ ችግር የሚያጋልጡ ሁኔታዎችን ለመለየት ነው፡፡

የመጠይቁ መለያ ቁጥር___________የተቋሙ ስም__________

Status 1. Case 2. Control

ክፍል አንድ፡- የወላጅ የጨቅላ ህጻኑ እናቱ አጠቃላይ ሁኔታ

ተ.ቁ	ጥያቄ	መልስ	ይዝለሉ
101	እድሜዎ ስንት ነው?	_______(በዓመት)	
102	የጋብቻ ሁኔታ?	1. ያላገባች 2. ያገባች 3. ባሏ የሞተባት 4. ባሏን የፈታች	
103	የመኖሪያ ቦታዎ የት ነው?	1. ከተማ 2. ገጠር	
104	የትመህርት ደረጃዎ ስንት ነው?	1. ያልተማረች 2. የመጀመሪያ ደረጃ 3. ሁለተኛ ደረጃ የተማረች 4. ኮሌጅና ከዛ በላይ	
105	የርስዎ የስራ ሁኔታምንድነው?	1. የቤት እመቤት 2. የመንግስት ሰራተኛ 3. በግል ተቋም 4. ነጋዴ 5. ተማሪ	
	ክፍል ሁለት፤ ከ እርግዝና ጋር የተያያዙ ኢጋላጭ ሁኔታዎች		
201	ስንተኛ እርግዝናሽ ነው?	_________(በቁጥር)	
202	ስንት ህጻናት 7 ወር ከሞላቸው በኋላ ወልደዋል (ሞተው የተወለዱትንም ጨምሮ)?	_________(በቁጥር)	
203	በሂዎት ካሉት ሁለት የመጨረሻ ልጆችሽ የስንት አመት ልዩነት አለ? (አሁን በተዎለደው እና ከሱ በፊት)	1 ከ ሁለት አመት በታች	

		2 ሁለት አመት እና ከዛ በላይ	
204	የቅድመ ወሊድ ክትትል አግኝተዋል?	1. አዎ 2. አላገኘሁም	አላገኘሁም ካሉ ወደ ጥያቄ 206 ይሂዱ
205	አዎ ከሆነ መልስዎ ስንት ጊዜ የቅድመ ወሊድ ክትትል አድርገዋል ?	_____ ጊዜ	
206	የእርግዝናዉ ሁኔታ ሚን ነበር?	1. አንድ 2 ሁለት 3 ሶስት እና ከዛበላይ	

አመሰግናለው!