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The Proportion of Neonatal Sepsis and its Associated Factors Among Neonates Admitted in Neonatal Ward at Tibebe Ghion Specialized Hospital in Bahirdar City, North West Ethiopia 2022

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BAHIRDAR UNIVERSITY
COLLEGE OF MEDICINE AND HEALTH SCIENCES
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DEPARTMENT OF Pediatrics and Child Health

**The Proportion of Neonatal Sepsis and its Associated Factors
Among Neonates Admitted in Neonatal Ward at Tibebe Ghion
Specialized Hospital in Bahirdar City, North West Ethiopia
2022**

By
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October, 2022
BahirDar, Ethiopia

BAHIR DAR UNIVERSITY
COLLEGE OF MEDICINE AND HEALTH SCIENCES
DEPARTMENT OF PEDIATRICS AND CHILD HEALTH

**NEONATAL SEPSIS AND ITS ASSOCIATED FACTORS AMONG NEONATES
IN NEONATAL WARD AT TIBEBE GION SPECIALIZED HOSPITAL IN
BAHIRDAR CITY, NORTH WEST ETHIOPIA**

BY
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**A RESEARCH THESIS SUBMITTED TO BAHIR DAR UNIVERSITY
COLLEGE OF MEDICINE AND HEALTH SCIENCES DEPARTEMENT OF
PEDIATRICS AND CHILDHEALTH IN PARTIAL FULFILMENT OF
CERTIFICATE OF SPECIALITY IN PEDIATRICS AND CHILD HEALTH**

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Declaration

This is to certify that the thesis “neonatal sepsis and its associated factors among neonates in neonatal ward admitted at TGSB in Bahir Dar city, north west Ethiopia”, submitted in partial fulfillment of the requirements for the postgraduate of pediatrics and child health, in Bahir Dar University, is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates. The assistance and help I received during the course of this investigation have been duly acknowledged.

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I hereby certify that I have supervised, read, and evaluated this thesis titled " neonatal sepsis and its associated factors among neonates admitted to neonatal ward of IC&HD in Bahigouab city " by Dr. Hegabeh Akber prepared under my guidance. I recommend the dissertation be submitted for oral defense.

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ABSTRACT

Background: Although lacks an exact definition, neonatal sepsis can be defined as systemic inflammatory response syndrome in the presence of an infectious process occurring within 28 days of life. Every year an estimated 2.9 million deaths worldwide were due to sepsis (44% of them in children under 5 years of age) and one-quarter of these are due to neonatal sepsis. It is a global problem, particularly in resource-limited countries like Ethiopia resulting in significant neonatal morbidity and mortality. This study showed continued high burden of neonatal sepsis and its significant contributors are not consistently the same requiring continuous research to be done in different places.

Objectives: The objective of this study is to assess neonatal sepsis and associated factors of neonates admitted to the neonatal ward at Tibebe Ghion specialized hospital in BahirDar city, Northwest Ethiopia from February 1, 2022, to May 30, 2022.

Methods: Institution-based cross-sectional study was conducted among 357 neonates from February 1 to May 30, 2022. The Participants were selected using a systematic random sampling technique. The interviewer-administered structured questionnaire and checklist were used to collect the data. The collected data was entered into EPI data version 4.6 and exported to SPSS version 25 for analysis. Descriptive and binary regression analysis was done. A binary logistic regression model was used to recruit regression analysis. On the multivariable analysis, variables with a p-value <0.05 were considered statistically significant.

Results: The proportion of neonatal sepsis was 35.6%, 95%CI (30.7-40.5). Being male, [AOR = 1.9; 95% CI (1.1, 3.30)], primi parity (AOR=2.8; 95%CI(1.2-6.5)), duration of labor (13-24 hours) [AOR=1.9; 95% CI[(1.1-9.3)]]], Birth weight [(<1500g (AOR=3.2 95%CI (2.7-27)) , (1500 and 2500 g [AOR = 1.5; 95% CI(((1.1-8.6)))] were positively associated with neonatal sepsis. Whereas being delivered at health center [AOR=0.45; 95% CI ((0.24-0.82)) p=0.012] was negatively associated with neonatal sepsis.

Conclusion and Recommendation: This study revealed that the burden of neonatal sepsis is still high. Being male sex, duration of labor between 13-24 hours, low birth weight, and place of delivery (health center) were identified risk factors significantly associated with neonatal sepsis. Therefore, follow-up of mothers during delivery with intent to shorten duration of labor, provision of health care services including measurement of maternal body

mass index (BMI), assessing maternal comorbid conditions, and advice on maternal prenatal nutrition is paramount.

Table of Contents

Contents

ACKNOWLEDGMENT.....	IV
ABSTRACT.....	V
LIST OF TABLES.....	IX
LIST OF FIGURES	X
ABBREVIATION AND ACRONYMS	XI
1. INTRODUCTION.....	1
1.1 Background.....	1
1.2. Statement of the problem.....	2
1.3. Significance of the study.....	3
1.4. The objective of the Study	3
1.4.1. General Objective	3
1.4.2. Specific objectives	3
1.5. Operational definitions and terms.....	3
2. LITERATURE REVIEW	5
2.1 The magnitude of Neonatal Sepsis	5
2.2. Factors associated with neonatal sepsis	7
2.2.1 Neonatal factors	7
2.2.2 Maternal medical and obstetric characteristics	8
2.2.3 Maternal socio-demographic characteristics.....	10
2.2.4 Neonatal procedures.....	10
Conceptual Framework.....	11
3. METHODS AND MATERIALS.....	12
3.1. Study area and period.....	12
3.2. Study design.....	12
3.3. Study Population.....	12

3.4. Eligibility Criteria	12
3.5. Sample size determination	13
3.6. Sampling technique and process	14
3.7. Data collection method	15
3.8. Variables of the study	15
3.9. Data collection tools, procedure and quality management	15
3.10. Data processing and Analysis	16
3.11. Ethical consideration.....	16
4. RESULTS	17
4.1. Neonatal characteristics	17
4.2. Mothers Socio-Demographic Characteristics	17
4.3. Mothers Medical and Obstetric Conditions	18
4.4. Medical Procedures Related to Neonatal Health Care Services	19
4.5. The proportion and clinical characteristics of neonates.....	20
4.6. Factors Associated with Neonatal Sepsis.....	22
5. DISCUSSION.....	25
6. CONCLUSION, LIMITATION AND RECOMMENDATION.	27
6.1 Conclusion	27
6.2 Limitations	27
6.3 Recommendation	27
7. REFERENCES	28
Annex.....	33
Annex I: Information sheet.....	33
Annex II: Consent form	33
Annex III: Questionnaire	34

LIST OF TABLES

Table 1: the sample size calculated using STATCALC by taking strongly associated factors taken from study from primary hospitals of central Gonder zone(28).....	13
Table 2: Clinical characteristics of neonates Admitted to Neonatal Intensive Care Units (NICUs) of Tibebe Ghion Specialized Hospitals, Northwest Ethiopia, 2022.....	17
Table 3: Socio-Demographic Characteristics of Mothers of Neonates Admitted to NICU in Tibebe Ghion Specialized Hospitals, Northwest Ethiopia, 2022.....	18
Table 4: Medical and Obstetrical Characteristics of Mothers with Neonates Admitted to NICU in Tibebe Ghion Specialized Hospitals, Northwest, Ethiopia, 2022.....	18
Table 5: Medical Procedures are Done for Neonates Who Were Admitted to NICU in Tibebe Ghion Specialized Hospital, Northwest Ethiopia, 2022.....	20
Table 6: Clinical Characteristics of Neonates who were admitted to Tibebe Ghion Specialized Hospitals, Northwest Ethiopia, 2022.....	20
Table 7: Bivariable and Multivariable Analysis of Factors Associated with Neonatal Sepsis among Neonates Admitted at Tibebe Ghion Specialized Hospitals, BahirDar, Northwest Ethiopia, 2022.....	22

LIST OF FIGURES

Figure 1: Conceptual framework of Neonatal sepsis and associated factors at neonatal ward of Tibebe Gion Specialized Hospital, North West Ethiopia, 2022 GC.....	11
Figure 2: Schematic representation of sampling procedure of the study.....	15
Figure 3: The proportion of neonatal sepsis among neonates admitted in TGSN North west Ethiopia, 2022GC.....	21

ABBREVIATION AND ACRONYMS

ANC.....	Antenatal care
APGAR.....	Appearance, Pulse, Grimace, Activity, Respiration
EDHS.....	Ethiopian Demographic and Health Survey
EONS.....	Early-onset neonatal sepsis
KMC.....	Kangaroo mother care
LONS.....	Late-onset neonatal sepsis
NICU.....	Neonatal Intensive Care Unit
NMR.....	Neonatal Mortality Rate
PROM.....	Premature rupture of membrane
RDS.....	Respiratory distress syndrome
SIRS.....	Systemic inflammatory response syndrome
SPSS.....	Statistical package for social sciences
TGSH.....	Tibebe Gion Specialized hospital
WHO.....	World Health Organization

1. INTRODUCTION

1.1 Background

Although lacks an exact definition, neonatal sepsis is systemic inflammatory response syndrome (SIRS) in the presence of an infectious process either suspected or proven to occur within 28 days of life (1, 2). SIRS is characterized by two or more of the following one of which is abnormal temperature or abnormal leukocyte count: hypothermia or fever (core temperature(T_0) < 36 degree Celsius($^{\circ}C$) or $> 38.5^{\circ}C$), tachycardia > 2 standard deviation (SD) above the mean for age, tachypnea > 60 and abnormally low or high leukocyte(White blood cells (WBC) count: $< 4,000 \times 10^9$ cells/L OR $> 20,000 \times 10^9$ cells/L) (1, 3) although standard text book do not recommend to use WBC as a criterion in neonates(4). Additionally other clinical and laboratory criteria used to diagnose sepsis include delayed capillary refill > 3 seconds, hypotension $> 2SD$ below the mean for age, hypoxemia ($PaO_2 < 70$ mmHg on room air), oliguria < 0.5 ml/kg/hour, lactic acidosis (serum lactate > 2 mmol/L or $PH < 7.25$), altered mental status, Immature to total neutrophil ratio (I/T) greater than 0.2, C reactive protein > 15 mg/L OR procalcitonin ≥ 2 mg/ml (5).

Based on the time of onset neonatal sepsis is divided into early-onset neonatal sepsis (EONS) if symptoms start before 7 days of life and late-onset neonatal sepsis (LONS) if symptoms start afterward. Others use 72 hours (hrs.) as cut-off, but most epidemiological studies use 7days (5-8)

World Health Assembly resolution (WHA) makes several recommendations including prevention, diagnosis, and treatment of sepsis in national health systems, training all health professionals on infection prevention and patient safety, promoting research, and others(9). In Ethiopia, various efforts have been made to reduce neonatal morbidity and mortality but remain high (9). Improving maternal health and nutrition, maternal immunization, clean delivery, intrapartum antibiotic prophylaxis, intravenous central line management, clean umbilical cord cutting, early detection and treatment of infectious disease, closed medication system, improvements in perinatal care services, and producing trained health professionals, like skilled birth attendants and neonatal nurses are implementing approaches to prevent neonatal sepsis (10).

1.2. Statement of the problem

The epidemiology of sepsis is better known in adults than in children, yet neonatal and child mortality due to sepsis is a major problem (11). The overall incidence of neonatal sepsis in developed countries ranges from 1 to 5 cases per 1,000 live births (4). The pooled prevalence of neonatal sepsis in sub-Saharan Africa is 29.92% (12) which is similar to the prevalence in East Africa (29.65%) (13). In Ethiopia, the pooled prevalence of neonatal sepsis is higher (45%), particularly in the Amhara region (64.4%) (14).

Neonatal sepsis is a major public health problem responsible for 1.6 times the global number of childhood deaths as malaria, and over four times the number of childhood deaths caused by the human immune deficiency virus (HIV) (15). There are an estimated 2.9 million deaths worldwide from sepsis every year (44% of them in children under 5 years of age) and one-quarter of these are due to neonatal sepsis(11). A study done on the economic burden of neonatal sepsis in sub-Saharan Africa (SSA) estimate that 5.29–8.73 million DALYs are lost annually in SSA due to neonatal sepsis(15). Among all major causes of neonatal deaths, sepsis accounts for 7% Globally (16) and 25% of all neonatal deaths in sub-Saharan Africa and southern Asia(14). According to the Ethiopian Demographic health survey (EDHS) 2016 report, the neonatal mortality rate (NMR) was 29/1000 live births, greatly attributed to neonatal sepsis(17, 18). A study was done at Felege Hiwot Referral Hospital, Amhara region, Ethiopia five years back showing that neonatal death due to sepsis was 14% (7).

It is recommended that in resource-limited settings with a high neonatal mortality rate, such as Ethiopia, a combination of risk factors and clinical signs should guide intrapartum and neonatal management to reduce neonatal mortality (19). Chorioamnionitis, maternal intrapartum fever, prematurity, repeated vaginal examination, meconium-stained amniotic fluid, dietary intake of contaminated foods, cervical cerclage, place of birth, low birth weight, complicated or instrument-assisted delivery low appearance pulse grimace activity respiration (APGAR) scores prolonged rupture of membranes and inadequate intrapartum antibiotic prophylaxis increase risk of EONS (7, 10).

The risk factors for LONS are invasive procedures such as resuscitation in the delivery room, intubation, mechanical ventilation, central venous catheters, surgical procedures, and staying in the neonatal intensive care unit for a prolonged period (20). LONS is caused by infectious agents in the neonatal intensive care unit (NICU), the nursery, or in the

community (including family, direct contact with hospital personnel, the mother, or other family members). Furthermore, the use of broad-spectrum antibiotics is a risk factor for fungal neonatal sepsis(9).

Regular neonatal auditing is vital as disease patterns and significant contributors to neonatal sepsis vary from region to region and institution to institution. The significant contributors of neonatal sepsis are variable in different regions and institutions even in the same country requiring continuous research to be done. The purpose of this study is, therefore, to assess the prevalence and associated risk factors of neonatal sepsis in Tibebe gion specialized hospital, Bahir Dar, Ethiopia.

1.3. Significance of the study

This study decreases neonatal sepsis in the hospital by preparing preventive strategies to significantly associated risk factors which are identified. It also enables health professionals to advice child bearing women on determined significant risk factors of neonatal sepsis. Additionally, it saves costs and resources both for caregivers as well as the institution. Furthermore, it will serve to supplement information for further research studies on the same topic.

1.4. The objective of the Study

1.4.1. General Objective

The main objective of this study was to assess neonatal sepsis and its associated factors among neonates admitted to the NICU ward of TGSH in BahirDar city, North West Ethiopia, 2022 GC.

1.4.2. Specific objectives

- ✓ To determine the proportion of neonatal sepsis among neonates admitted at the NICU ward of TGSH in BahirDar city, North West Ethiopia, 2022 GC.
- ✓ To identify factors associated with neonatal sepsis among neonates admitted at NICU ward of TGSH in BahirDar city, North West Ethiopia, 2022 GC.

1.5. Operational definitions and terms

Neonate: a term used until the age of 28 days of postnatal life.

Neonatal sepsis: in this study neonatal sepsis is when a neonate with suspected or proven infection documented by the physician in the unit on the neonatal chart with two or more of the following occurring before 48 hours of admission.

- A temperature of 37.5 °C or higher or 35°C or lower.
- Respiratory rate of 60 or more breaths per minute/ hypoxemia PSO 2 <90% on room air(presence of one or both counted as one criteria).
- Tachycardic for age(for preterms >180 and for term neonates >160 beats/minute)/ delayed capillary refill >3 sec.(one or both counted as one criteria).
- Decreased mentation/Oliguria, urine output <0.5 mL/kg/hr(one or both counted as one criteria).

NB: The above criteria is from Nelson 21st Edition (Standard text book).

EONS: sepsis occurring \leq 7 days of postnatal life.

LONS: sepsis occurring $>$ 7 days of postnatal life.

Birth weight: the weight of a neonate measured within 24 hours of postnatal life.

Gestational age: number of weeks that a newborn stayed in the uterus calculated from the last normal menstrual period/Ballard score(normal is 37-42 weeks).

Preterm: if gestational age is $<$ 37 weeks.

Prolonged rupture of membrane (PROM): rupture of amniotic membrane for \geq 18 hours before giving birth.

2. LITERATURE REVIEW

2.1 The magnitude of Neonatal Sepsis

A systematic review and meta-analysis done recently (from databases for the period January 1979–May 2019) on the global incidence and mortality of neonatal sepsis, included studies on the population-level neonatal sepsis incidence that used a clinical sepsis definition, such as the 2005 consensus definition and performed a random-effects meta-analysis on neonatal sepsis incidence and mortality stratified according to sepsis onset, birth weight, prematurity, study setting, WHO region and World Bank income level and we found in 26 studies a pooled neonatal sepsis incidence of 2824 sepsis cases per 100,000 live births and a mortality of 17.6% (21).

The prevalence of neonatal sepsis in Africa is increasing. A cross-sectional descriptive study was conducted on the prevalence of neonatal sepsis and its predisposing factors among neonates admitted to Ahmadu Bello University Teaching Hospital (ABUTH), a tertiary hospital in northwest Nigeria from May 2017 to May 2018 on a total sample size of 409 cases found that the prevalence of neonatal sepsis was 37.6% (20).

When we come to Ethiopia the prevalence of neonatal sepsis is even higher. A Systematic Review and Meta-Analysis on the prevalence of Neonatal Sepsis was conducted in Ethiopia from January 27 to June 3, 2019. Eighteen studies with a sample size of 10,495 study subjects were included with a reported range of neonatal sepsis from 17% to 78%. The pooled prevalence of neonatal sepsis was 45%. Early-onset neonatal sepsis (age \leq 7days) was found to have a prevalence of 75.4%, the highest neonatal sepsis in the Amhara region at 64.4%, and the lowest in Southern Nations, Nationality, and People at 28%. In this review, the prevalence of neonatal sepsis in Ethiopia was found to be high, especially in terms of early-onset neonatal sepsis. As a result of the findings, it is important to consider the early and optimal points for interventions to better manage the prevalence and outcomes of neonatal sepsis. Further research is needed to investigate the neonatal sepsis status in different regions and associated factors for neonatal sepsis not yet studied(14).

In Shashemene town, an institution-based cross-sectional study with a retrospective document review method was conducted on Prevalence of Neonatal Sepsis and Associated Factors among Neonates in Neonatal Intensive Care Unit(NICUs) of two governmental hospitals (Shashemene referral hospital and Melkaoda general hospital, the only hospitals in the area which give NICU

service) from February 5, 2017, to February 30, 2017. The total sample size was 244 and neonates were included in the sample when the medical diagnosis of “neonatal sepsis” is stated by the physician on the neonatal medical chart and excluded a chart with missed information. The overall prevalence of neonatal sepsis in this study was 77.9%. From this 65% and 35% of neonates developed early-onset neonatal sepsis and late-onset neonatal sepsis, respectively (22).

A hospital-based prospective cross-sectional study was conducted on the epidemiology of neonatal sepsis and associated factors at the Neonatal Intensive Care Unit of Arsi University Teaching and Referral Hospital, South East Ethiopia from April 2016 to May 2017. The study included neonates with the clinical diagnosis of sepsis based on the following two risk factors and/or clinical features of bacterial infections. Risk factors include low birth weight (<2500 grams) or prematurity (<37 weeks of gestation age), febrile illness in the mother within 2 weeks before delivery, foul-smelling discharge and/or meconium-stained amniotic liquid, Suspected chorioamnionitis, prolonged rupture of membranes >18 hours, prolonged labor (sum of 1st and 2nd stage of labor > 24 hrs.), and Perinatal asphyxia (Apgar score <4 at 1 minute). Clinical features of sepsis include poor reflexes, lethargy, respiratory distress, bradycardia, apnea, fever, convulsions, abdominal distension, and bleeding. A total of 901 neonates were admitted to the NICU of which 303 neonates were admitted with a diagnosis of clinical sepsis making the prevalence of neonatal sepsis to be 34%. (23).

Another institutional-based cross-sectional study was conducted on the prevalence of neonatal sepsis and associated factors amongst neonates admitted to NICU from February 1 to 15, 2019 at Arba Minch General hospital, Arba Minch, southern Ethiopia, 2019. To select samples the total number of neonates who have been admitted to the NICU during the study period has been taken from the registration book in the unit. After that, the charts have been reviewed for the presence of complete data within them which gives us 480 charts with complete data. Charts matching the number of the sample size required (244 charts) have been then selected by a computer-generated random sampling method. In this study neonatal sepsis is asserted when a medical diagnosis of the neonate has been stated as neonatal sepsis in his/her medical record chart by the physician who has examined the infant at that time and found the magnitude of neonatal sepsis to be 78.3%.(24).

Another hospital-based cross-sectional study was conducted in 275 newborns from April 22 to June 29, 2018, on Neonatal sepsis and associated factors among newborns at hospitals of Walaita Sodo town (Sodo Christian hospital and Wolaita Sodo University Teaching Referral Hospital). All neonates who were admitted to the intensive care unit were included in this study, whereas neonates who were early discharged before data collection was completed but the only card was available, had incomplete patient chart information, and died on arrival (neonates expired without taking any investigation and treatment on arrival) were excluded from this study. The prevalence of neonatal sepsis in this study was 33.8%, of which 26.9% of the neonates had early onset of neonatal sepsis (0-7days) and 6.9 of the neonates had late onset of neonatal sepsis (25).

Another institutional-based cross-sectional study was conducted on the prevalence and associated risk factors of neonatal sepsis among neonates admitted to NICUs in five district primary hospitals (Dembiya, Chilga, Wogera, Delhi, and East Belesa) in the central Gondar zone, Amhara regional state, Ethiopia from March to April 2019. A total of 352 subjects (mother-neonate pairs) were selected. The admission diagnosis of neonates was taken from the diagnosis of the physician in the unit.

The data collectors cross-verify the diagnosis of neonatal sepsis with reviewed neonate's medical record to ascertain the final clinical diagnosis of neonatal sepsis before they collect the data. The WHO IMNCI criteria were applied to assess babies for clinical sepsis. A retrospective review of the history was taken to find out if the neonate had the symptoms suggestive of neonatal sepsis since birth. A conclusion of clinical neonatal sepsis was ascertained if the baby had any one of the symptoms of sepsis listed in the IMNCI criteria and admitted in NICUS. The overall proportion of neonatal sepsis was 64.8% (26).

2.2. Factors associated with neonatal sepsis

2.2.1 Neonatal factors

A systematic review and meta-analysis done recently (from databases for the period January 1979–May 2019) on global incidence and mortality of neonatal sepsis showed that being Preterm and having very low birth weight positively affected neonatal sepsis(21). Similarly, a study done in India on risk factors of neonatal sepsis from inception up to March 2018 found that birth weight and gestational age at delivery were the most frequently reported factors and male sex emerged as a risk factor for neonatal sepsis(19). These findings were in contrast to a study in Sub-Saharan Africa conducted from inception to June 2020 which

showed low birth weight was a statistically insignificant risk factor(27). According to this study; male sex, low Apgar score, not breastfeeding within one hour of birth, and being preterm were independent predictors(27).

Another unmatched retrospective case-control study conducted on Factors Associated with Neonatal Sepsis among 900 neonates born from January to December 2017 at the Trauma and Specialist Hospital, Winneba, Ghana, and found that being younger age (<7 days), low APGAR score (<7 at first and fifth minutes) increase the risk of neonatal sepsis (28).

Another cross-sectional study was conducted on the prevalence of neonatal sepsis and its predisposing factors among neonates admitted to ABUTH, a tertiary Hospital in North West Nigeria from May 2017 to May 2018. Based on this study neonatal characteristics include neonatal age, sex, birth weight, maturity, and APGAR score. Neonates 0–7 days of age were less likely to develop neonatal sepsis than older neonates. Babies born with an Apgar score of <6 within the 1st min were more likely to develop neonatal sepsis than those whose Apgar score was higher(20).

According to studies done at Arsi University, Arbaminch general hospital, Shashemene town government hospitals, and Debre Markos referral hospital risk factors including; low APGAR(<6), prematurity, and low birth weight are positively associated with neonatal sepsis(29) whereas gestational age >37weeks and birth weight >2500 were protective factors(10). But according to the study in Wolaita Sodo APGAR score and whether neonates cried immediately at birth are not associated with neonatal sepsis while other factors have a positive association(25).

2.2.2 Maternal medical and obstetric characteristics

In India, a systematic review and meta-analysis on risk factors of neonatal sepsis was done from inception up to March 2018 and found that being outborn neonates is a risk factor for neonatal sepsis (19).

According to the study in Nigeria characteristics of mothers of the neonates studied included maternal age, parity, occupation, education status, mode of delivery, antenatal care (ANC) attendance, urinary tract infection during pregnancy, prolonged rupture of membrane (PROM), and foul-smelling liquor. Maternal risk factors for neonatal sepsis found in this study were PROM and UTI during the index pregnancy. Birth weight, mother's age, sex,

gestational age, parity, ANC, prolonged labor, mother's occupation, mother's level of education, and foul-smelling liquor were not found to be predictors of neonatal sepsis in this study(20).

According to a study in Wolaita Sodo place of delivery, urinary tract infection/sexually transmitted infection of the mother, premature rupture of membrane (PROM), neonate crying at birth, and Apgar scores were not associated with neonatal sepsis(25).

According to the study in Shashemene town, maternal risk factors for neonatal sepsis among neonates admitted included the history of maternal UTI, history of antenatal care, history of maternal fever, history of foul-smelling liquor, history of chorioamnionitis, meconium-stained amniotic fluid, history of premature rupture of membrane, duration of PROM, parity, mode of delivery, place of delivery, and duration of labor. This study revealed that the age of neonates(<7 days), history of meconium aspiration, birth asphyxia, low birth weight, and gestational age less than 37 weeks show significant association with neonatal sepsis(22).

According to the study in Walaita Sodo town maternal age, multiple digital vaginal examination, exclusive and immediate breastfeeding within an hour, put on kangaroo mother care (KMC) within 1 hour, and neonatal age was statistically significantly associated with neonatal sepsis. So, Strengthening the provision of health information on exclusive and immediate breastfeeding and KMC on postnatal and antenatal care services as well as decreasing multiple per digital vaginal examination as not indicated should better be promoted(25).

According to a study in public hospitals of Mekelle City possible risk factors were; history of maternal urinary tract infection or sexually transmitted infection, prolonged rupture of membrane, Place of delivery; health center delivery, intrapartum fever, APGAR score <7 at 5th minute, and not crying immediately at birth and were positively associated(30).

According to a study at the University of Gondar Hospital, risk factors of neonatal sepsis were cesarean section, and mode of delivery has a positive association (9).

According to the study in five district primary hospitals (Dembiya, Chilga, Wogera, Delgi, and East Belesa) in the central Gondar zone; being male neonate, history of urinary tract infections during the index pregnancy, frequency of per-vaginal examination greater than three during labor and delivery, neonatal resuscitation at birth, place of delivery at the health center, lack of training of health workers on neonatal resuscitation and infection prevention

practices, late age of neonate at the onset of illness and maternal age of 30–34 years were significantly associated with neonatal sepsis(26).

2.2.3 Maternal socio-demographic characteristics

An institution-based cross-sectional study with a retrospective document review method was conducted on Prevalence of Neonatal Sepsis and Associated Factors among Neonates in Neonatal Intensive Care Unit(NICUs) of two governmental hospitals (Shashemene referral hospital and Melkaoda general hospital, the only hospitals in the area which give NICU service) in Shashemene town from February 5, 2017, to February 30, 2017. Sociodemographic characteristics of neonates and mothers according to this study include address, maternal age(22).

According to the study in Wolaita Sodo town, maternal sociodemographic characteristics include maternal age, marital status, religion, educational status, income level, occupation, family size. This study showed that maternal age (20-34years) and multiple per digital vaginal examination (>4) were significantly associated with neonatal sepsis whereas the place of delivery, urinary tract infection/sexually transmitted infection of the mother, and premature rupture of membrane (PROM) were not had an association(25).

2.2.4 Neonatal procedures

According to the study in Shashemene town government hospitals, neonatal procedures includes Mechanical ventilation, Oxygen via nasal catheter, and Oxygen via mask. The neonates who used oxygen via mask were at risk to develop neonatal sepsis compared to neonates who did not use it at birth (22).

Conceptual Framework

Figure 1 below shows the conceptual framework of factors associated with neonatal sepsis which is adopted from different works of literatures (20, 22, 23, 25, 26, 31)

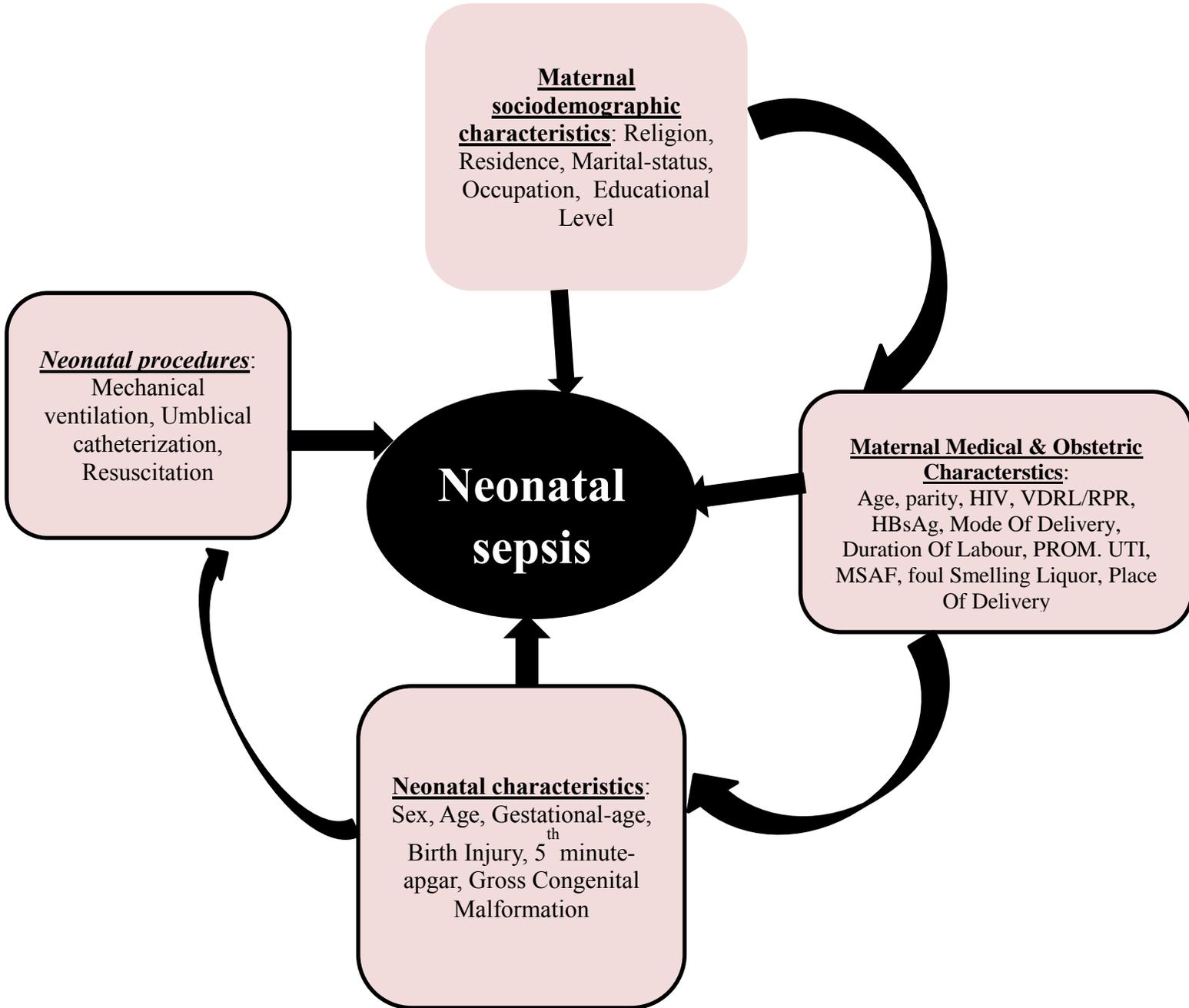


Figure 1: Conceptual framework of Neonatal sepsis and associated factors at neonatal ward of Tibebe Gion Specialized Hospital, North West Ethiopia, 2022 GC.

3. METHODS AND MATERIALS

3.1. Study area and period

The study was conducted at the neonatal ward of TGSH in Bahir Dar city, North West Ethiopia from February 1 to May 30, 2022, G.C. Bahir Dar city is the capital city of the Amhara region and is found 560 km to the northwest of Addis Ababa. TGSH is a teaching university hospital serving as a training center for undergraduate and postgraduate medical and other health students and has 5 major departments; pediatrics, internal medicine, surgery, Gynecology & Obstetrics, Dermatology, Orthopedic and Radiology, and 2 minor departments Ophthalmology and ENT. The pediatric department has 11seniors of whom 1 is a pediatric cardiologist & 65 nurses distributed within 9 wards; critical ward, stable ward, malnutrition ward, pediatric surgical ward, OPD(outpatient), ETAT(emergency triage and treatment), PICU(pediatric ICU) and NICU(neonatal ICU). The neonatal ward has 55 beds (12preterm, 12term, 23 maternal, and 8KMC) staffed with 2senior and 24 nurses.

3.2. Study design

An institution-based cross-sectional study design was conducted.

3.3. Study Population

Source population

All neonates admitted to the neonatal ward at TGSH in BahirDar city, North West Ethiopia.

Target population

All neonates admitted to the neonatal ward at TGSH during the survey time.

3.4. Eligibility Criteria

Inclusion criteria

All neonates admitted to the neonatal ward whose mothers are available for interview during the study period.

Exclusion criteria

Babies whose mothers are not available for interview to complement the data despite the neonates fulfilling the inclusion criteria were excluded because of data incompleteness and inconsistencies.

-Referred neonates from other institutions with a difficulty tracing evidence of sepsis.

3.5. Sample size determination

The required sample size was calculated by using a single population proportion formula for prevalence and STAT CALC for associated factors. Using the single population proportion formula:

$$n = z^2 p(1-P) / d^2$$

Where; n - The minimal required sample size

Z – Standard normal variation value at a confidence interval of 95% (so z value is 1.96)

P - Proportion of neonate with neonatal sepsis (P= 0.697) taken from the previous study conducted at Gonder university hospital.

d -desired precision, take 0.04

N-total population

Then $n = z^2 p(1-P) / d^2 \rightarrow n = (1.96)^2 * 0.697 (1-0.697) \div (0.04)^2 = 324.5 \approx 325$, by adding 10 % non-response rate, the final sample size was 357.

Table 1: the sample size calculated using STATCALC by taking strongly associated factors taken from study from primary hospitals of central Gonder zone(26).

Factor	Assumptions			% exposed	Adjusted odds ratio(AOR)	Sample size
	Ratio	Power	Confidence interval(CI)			
Gestational age	1:1	80%	95%	16	0.98	178
Birth weight	1:1	80%	95%	15.1	0.76	94
Parity	1:1	80%	95%	14.5	1.11	160

NB: The largest sample size is obtained from the first objective so that the final sample size was 357.

3.6. Sampling technique and process

The average number of neonates admitted to the neonatal ward at TGSB per month was 180 obtained from the previous admission registration book giving the total study participants within four-month duration to be 720. The calculated sample size is 357. The first participant was chosen by lottery method from the first day admissions of January, 2022 and the K value was $720/357= 2$ was used to recruit next participants. A systematic random sampling technique was used to select the participant mother neonate pairs based on the order they were registered on admission registration book from which every 3rd interval was selected for interview; and the data was taken at 48 hours of admission. For referred neonates, phone communication was made from referring facility health professionals to trace full information. If difficulty to trace, it was replaced with the next participant. Maternal chart was used as well.

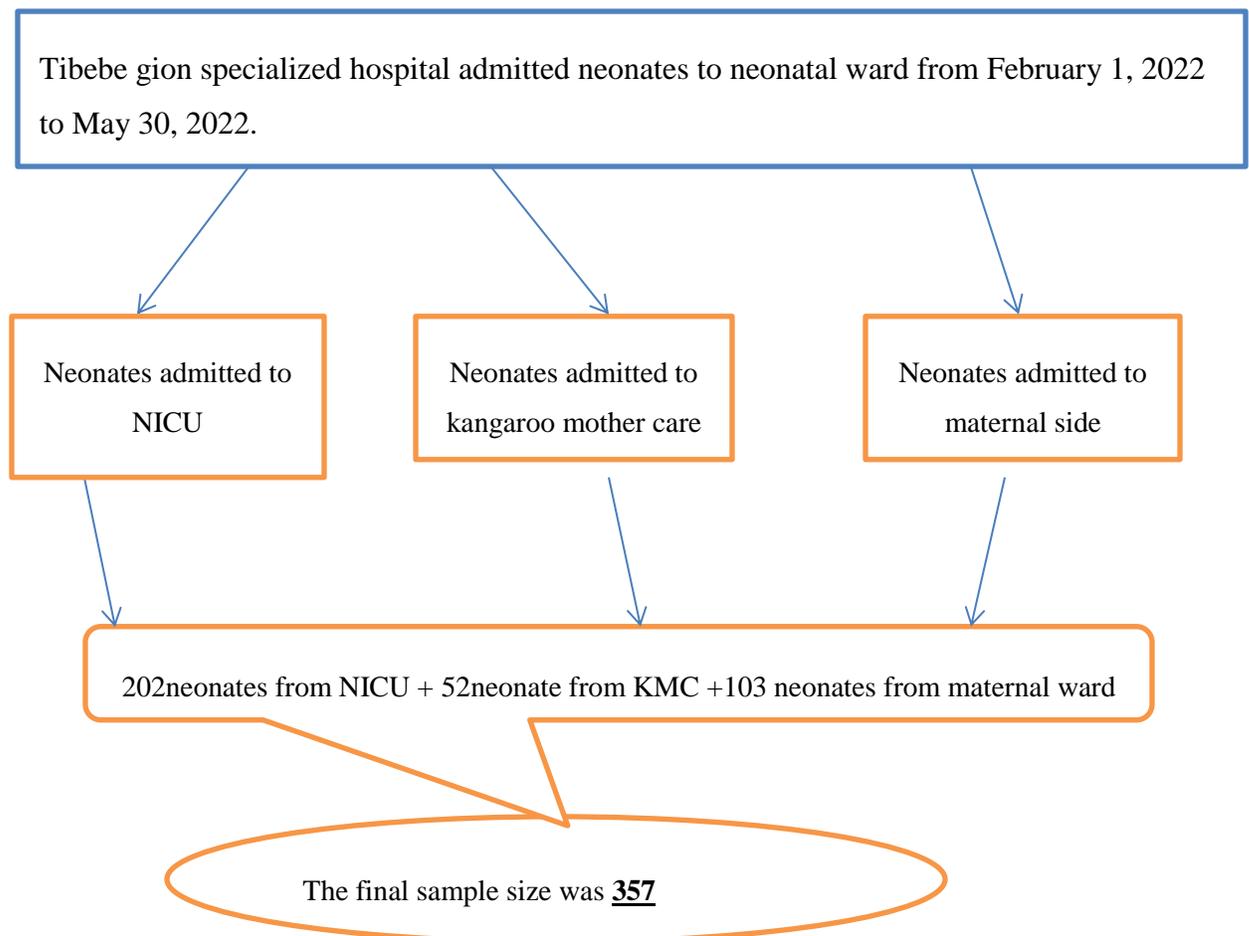


Figure 2: Schematic representation of sampling procedure of the study.

3.7. Data collection method

The interviewer-administered structured questionnaire and checklist were used to collect the data.

3.8. Variables of the study

- i. Dependent variable
 - ✓ Neonatal sepsis(yes/no)
- ii. Independent variables
 - ✓ **Clinical characteristics of neonates**
(Sex, age, gestational age, birth injury, 5tminute-APGAR, gross congenital malformation)
 - ✓ **Medical procedures that were done for neonates**
(Urinary catheterization, umbilical catheterization, resuscitation, mechanical ventilation)
 - ✓ **Maternal sociodemographic characteristics**
(religion, residence(urban/rural),marital status, occupation, monthly income, educational level)
 - ✓ **Medical and obstetric characteristics of mothers**
(Age, parity, HIV, VDRL/RPR, HBsAg, mode of delivery, duration of labor, PROM. UTI, MSAF, foul-smelling liquor, place of delivery)

3.9. Data collection tools, procedure and quality management

The structured questionnaire and check list was used to collect the data. The questionnaire was initially prepared in English language and translated into Amharic (local language) and again it was retranslated back to the English language to check for any inconsistencies or distortions in the meaning of words and concepts. Four pediatric residents were data collectors. They were trained by the principal investigator to have a clear and common understanding of the data collection tool. The diagnosis of sepsis was made by the physician in the unit and was cross-checked by the trained data collectors

based on neonatal sepsis criteria's (see operational definition).One trained R3 resident had regular supervision of data collectors on daily basis and principal investigator had weekly onsite supervision. To check the completeness of the data collection tool, 5 % of the sample was pre-tested. After assuring completeness, data was collected, cleaned manually, and entered into Epi data version 4.6 then transported to SPSS version 25 for analysis.

3.10. Data processing and Analysis

The collected data using questionnaire was coded and entered into Epi data version 4.6 then transferred to SPSS 25 for analysis. Summary statistics such as frequencies and proportions were computed. Data were cleaned by running frequencies of all the variables to check for the missing value. Descriptive & regression analysis was carried out. Crude and adjusted odds ratio with 95% CI was calculated to determine the strength of association between the dependent and independent variables. A binary logistic regression model was used to recruit analysis.

3.11. Ethical consideration

Before conducting the study, permission and approval letter from TGSH hospital management and the research review committee of Bahir Dar University College of medicine and health science was received. The participants of the study were informed of the purpose of the research and verbal consent was taken. They were told that they could discontinue the interview whenever they wanted. During the data collection procedure, patient privacy and confidentiality were kept to the maximum.

4. RESULTS

4.1. Neonatal characteristics

In this study, a total of 357 mother-neonates pairs were included making the response rate 100%. The mean age of neonates was 1.2 days with SD ± 0.49 days. More than half of 188 (52.7%) of them were female neonates while the rest were males. Nearly three-fourths of (258, 72.3%) neonates were born at hospitals. Two-thirds (236, 66.9%) of neonates were term and the remaining one-third (121, 33.9%) were preterm. Among the neonates, 138(38.6%) of them were Low birth weight (**Table**).

Table 2: Clinical characteristics of neonates Admitted to Neonatal Intensive Care Units (NICUs) of Tibebe Ghion Specialized Hospitals, Northwest Ethiopia, 2022

Variables		Frequency	Percent
Age	0–7 days	200	56
	8–28 days	157	44
Sex	Male	169	47.3
	Female	188	52.7
place of delivery	Home	20	5.6
	Health center	79	22.1
	Hospital	258	72.3
Gestational age	< 37 weeks	121	33.9
	≥ 37 weeks	236	66.9
Birth weight	<1500 g	56	15.1
	1500–2499 g	84	23.5
	2500 –3499 g	217	60.8
			0.6

4.2. Mothers Socio-Demographic Characteristics

In this study out of the study participants, two third (232, 65%) were from rural areas. One-third of neonate mothers (115, 33.9%) were in the age range of 25 to 29 years. Near to half (168, 47.1%) of the neonates' mothers, educational level were unable to read and write.

Table 3: Socio-Demographic Characteristics of Mothers of Neonates Admitted to NICU in Tibebe Ghion Specialized Hospitals, Northwest Ethiopia, 2022

Variables		Frequency	Percent
Residence	Urban	125	35
	Rural	232	65
Maternal age	20–24 years	82	23
	25–29 years	118	33.9
	30–34 years	111	31.1
	≥ 35 years	46	12.9
Marital status	Married	355	95.3
	Unmarried	2	0.6
Maternal educational level	Unable to read and write	168	47.1
	Able to read and write	57	16
	Primary education	48	13.4
	Secondary education and above	84	23.5
Occupation	Housewife	302	84.6
	Government employee	53	14.8
	NGO (private)	2	0.6
Religion	Orthodox	286	80.1
	Muslim	63	17.6
	Protestant	8	2.2

4.3. Mothers Medical and Obstetric Conditions

In this study, more than half of the mothers 219 (61.3%) of the neonates' mothers were multiparous women. The majority of the mothers 326 (91.3%) had at least one ANC follow-up during pregnancy and 7 (2%) of them were positive for HIV AIDS. About 19 (5.3%) of them had a duration of PROM >18 and above and nearly three-fourths of 260 (72.8%) of neonates were delivered by spontaneous vaginal delivery. (**Table 4**).

Table 4: Medical and Obstetrical Characteristics of Mothers with Neonates Admitted to NICU in Tibebe Ghion Specialized Hospitals, Northwest, Ethiopia, 2022

Variables		Frequency	Percent
Parity	Primi	138	38.7
	Multi	219	61.3
Antenatal care	Yes	326	91.3
	No	31	8.7
HIV test result	Positive	7	2
	Negative	350	98
VDRL/RPR status	Reactive	8	2.2
	Non-reactive	349	97.8
Mode of delivery	Vaginal delivery	260	72.8
	Cesarean section	87	24.4
	Instrumental	10	2.8
Duration of labor	< 6 hours	67	38.8
	6 –12 hours	177	49.6
	13–24 hours	101	28.3
	> 24 hours	12	3.4
Frequency of PV exam during labor	<4 times	339	95
	≥4 times	18	5
History of foul smelling liquor	Yes	6	1.7
	No	351	98.3
Duration of PROM (in hours)	<18	338	94.7
	18 and above	19	5.3
History of high grade fever during Pregnancy	Yes	17	4.8
	No	340	95.2
History of maternal UTI	Yes	23	6.4
	No	334	93.6

4.4. Medical Procedures Related to Neonatal Health Care Services

Around 66 (18.5%) of the neonates were on mechanical ventilation. About 2 (0.6%) of

neonates had the application of umbilical catheterization for resuscitation and 89 (24.9%) were on oxygen therapy through an intranasal oxygen catheter.

Table 5: Medical Procedures are Done for Neonates Who Were Admitted to NICU in Tibebe Ghion Specialized Hospital, Northwest Ethiopia, 2022

Medical Procedures are Done for Neonates Who Were Admitted to NICU in Tibebe Ghion Specialized Hospital, Northwest Ethiopia, 2022

Variables		Frequency	Percent
Mechanical ventilation	Yes	66	18.5
	No	291	81.5
Use of oxygen via a nasal catheter	Yes	89	24.9
	No	268	75.1
Application of umbilical Catheterization	Yes	2	0.6
	No	358	99.4

4.5. The proportion and clinical characteristics of neonates

More than half of the neonates 200(56%) were admitted within one week of age and the overall proportion of Neonatal sepsis was 35.6% (95% CI (30.7, 40.5)). Gross congenital malformation like neural tube defect, cleft palate, and hydrocephalus was also found in 62 (17.4%) of neonates. About 152 (42.6%) of the neonates were depressed reflex during delivery and 67(19.8%) of the neonates were not crying at the time of birth.

Table 6: Clinical Characteristics of Neonates who were admitted to Tibebe Ghion Specialized Hospitals, Northwest Ethiopia, 2022

Variables		Frequency	Percent
5 minute APGAR Score	0-6	9	2.5
	7-10	338	94.7
	Unknown	10	2.8
Neonatal Reflex	Intact	205	57.4
	Depressed	152	42.6
Birth injury	Yes	25	7
	No	332	93

presence of Meconium stained amniotic fluid	Yes	15	4.2
	No	342	95.8
Birth asphyxia	Yes	56	16.6
	No	282	83.4
Gross congenital malformation	Yes	62	17.4
	No	295	82.6
Cry at birth	Yes	271	80.2
	No	67	19.8
Application of umbilical catheterization	Yes	2	0.6
	NO	355	99.4

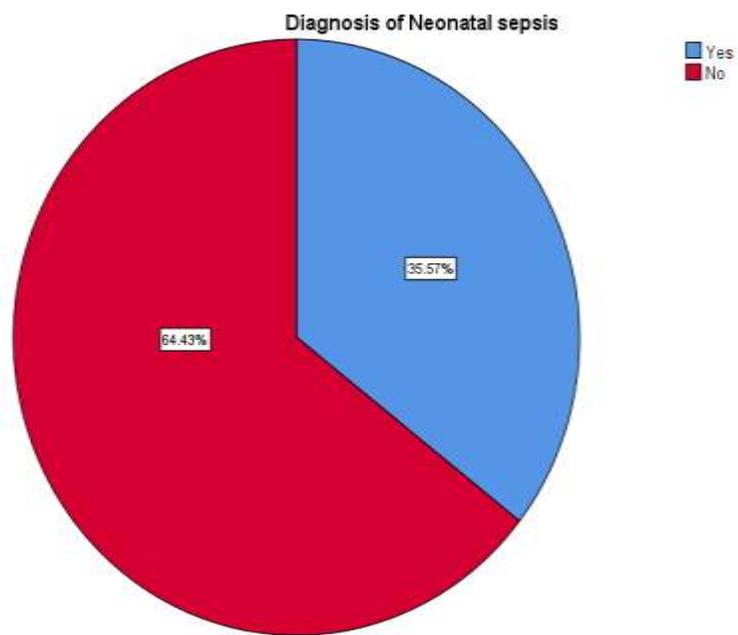


Figure 3: The proportion of neonatal sepsis among neonates admitted in TGSN North west Ethiopia, 2022GC

4.6. Factors Associated with Neonatal Sepsis

On Bivariable logistic regression analysis sex of the newborn, Residency, gestational age, neonatal Reflex, presence of gross neonatal congenital malformation, Use of mechanical ventilation, use of intranasal oxygen, Residence, maternal age, parity, ANC follow-up, HIV status, mode of delivery, place of birth, duration of labour, duration of PROM, place of delivery, history of foul smelling liquor, Presence of MSAF, history of maternal fever and umbilical catheterization are candidate for multivariable variable logistic regression analysis (p-value < 0.25).

On Multivariable logistic regression analysis, sex of neonates, parity, place of delivery, birth weight and duration of labour were factors significantly associated with neonatal sepsis at multivariable logistic regression analysis with p value less than 0.05.

Accordingly, the sex of neonates showed a significant association with the risk of the onset of neonatal sepsis. The odds of having neonatal sepsis were two times higher among male neonates as compared to female neonates [AOR = 1.9; 95% CI (1.1, 3.30)].

This study showed that neonates of mothers who are primi were more than two and half times higher odds of developing neonatal sepsis than neonates of mothers who were multi parity (AOR=2.8; 95%CI(1.2-6.5 p=0.011)).

Similarly, those neonates of mothers with duration of labour 13-24 hours were nearly two times higher odds of developing neonatal sepsis compared to mothers of neonates with duration of labour <6 hours [AOR = 1.9; 95% CI((1.1-9.3))p=0.040]]. Neonates who delivered with <1500g birth weight were more than 2 times higher odds of developing neonatal sepsis than neonates born with >2500 g (AOR=3.2 95%CI (2.7-27 p=0.001). similarly the the odds of neonatal sepsis were more than 1.5 times higher among neonates whose birth weight is between 1500 and 2500 g compared to those birth weight greater than 2500 g [AOR = 1.5; 95% CI((1.1-8.6) p=0.021].

Finally, Place of delivery also has a significant effect on neonatal sepsis. Neonates delivered in the health center were neonatal sepsis decreased by 55% among neonates compared to those delivered at the hospital [AOR=0.45; 95% CI ((0.24-0.82)) p=0.012] (Table 7).

Table 7: Bivariable and Multivariable Analysis of Factors Associated with Neonatal Sepsis among Neonates Admitted at Tibebe Ghion Specialized Hospitals, BahirDar, Northwest Ethiopia, 2022

Variables		Neonatal Sepsis		COR	AOR	P-value	
		Yes	No	(95%CI)	(95%CI)		
Sex of Newborn	Male	48	121	1.8(1.1-2.8)	1.9(1.1-3.30)	0.010	
	Female	79	109	1	1		
Gestational Age	<37 week	53	68	0.58(0.37-0.92)	1.4(0.36-6.0)	0.577	
	>37 week	74	162	1	1		
Birth Weight	<1500	25	31	0.49(0.27-0.9)	3.2.(2.7-27)	0.001	
	1500-2499	40	44	0.44(0.26-0.74)	1.5 (1.1-8.6)		0.021
	2500-3999	62	155	1	1		
Presence of *GCM	Yes	17	45	1.5(0.85-2.8)	1.1(0.38-3.4)	0.803	
	No	110	185	1	1		
Use of MV	Yes	37	29	0.35(0.20-0.60)	1.7(0.67-4.3)	0.257	
	No	29	201	1	1		
Use of intranasal oxygen	Yes	60	29	0.16(0.09-0.27)	0.8(0.29-2.7)	0.836	
	No	67	201	1	1		
Residence	Rural	96	136		0.71(0.30-1.6)	0.436	
	Urban	31	94	1	1		
Maternal Age	20-24	26	56	1.5(0.71-3.2)	2.2(4.5-11)	0.316	
	25-29	49	69	0.99(0.49-1.9)	1(0.26-4.0)		0.952
	30-34	33	78	1.6(0.81-3.3)	1.7(0.46-6.8)		
	≥35	19	27	1	1		
Parity	Primi	43	95	1.3(0.87-2.1)	2.8(1.2-6.5)	0.011	
	Multi	84	135	1	1		
ANC	Yes	110	216	1	1	0.003	
	No	17	14	0.41(0.19-0.88)	0.28(0.11-0.6)		
HIV status	Positive	5	7	0.21(0.04-1.1)	0.17(0.03-0.9)	0.045	
	Negative	122	228	1	1		
Mode of delivery	Spontaneo	84	176	1	1	0.004	
	CS	35	52	0.7(0.43-1.1)	0.28(0.12-6)		

	Instrument	8	2	0.11(0.02-0.57)	0.23(0.01-5.7)	0.436
Duration of labour	<6hr	26	41	1	1	
	6-12hr	68	109	1(0.57-1.8)	0.49(0.20-1.2)	0.134
	13-24hr	23	78	2.1(1.0-4.2)	1.9 (1.1-9.3)	0.040
	≥24hr	10	2	0.12(0.02-0.62)	0.63(0.02-15)	0.779
Duration of PROM	<18	116	222	1	1	
	≥18	11	8	0.38(0.14-0.97)	0.4(0.06-2.7)	0.366
Hx of foul smelling	Yes	4	2	0.27(0.04-1.4)	0.5(0.03-1.3)	0.078
	No	123	228	1	1	
Place of delivery	Hospital	86	172	1	1	
	Health Center	36	43	0.59(0.38-0.89)	0.45(0.24-0.82)	0.012
	Home	5	15	1.5(0.52-4.6)	0.3(0.06-2.1)	0.272
Precence of MSAF	Yes	9	6	0.35(0.12-1.0)	0.90(0.05-15)	0.947
	No	118	224	1	1	
History of Maternal Fever	Yes	10	7	0.36(0.13-0.99)	0.2(0.04-1.3)	0.103
	No	117	223	1	1	

*GCM = Gross congenital malformation

5. DISCUSSION

Neonatal sepsis is currently a major global public health problem which contributes substantially to neonatal morbidity and mortality (32). In this study, the magnitude of neonatal sepsis was 35.6% (30.7, 40.5).

The finding of the current study is in line with a study conducted in Nigeria and Arsi university teaching and referral hospital which is 34% in both cases (23, 33). The possible reason for having similar results might be due to similarities of study population and the settings in which the studies were conducted. However, the finding of this study is lower than previous findings on the prevalence of neonatal sepsis in Eastern Ethiopia is (45.8%)(34), Shashemene (77.9%)(22), Gondar (64.8%)(26). This may be explained by the difference in the clinical definition of neonatal sepsis which they used more liberal approach using Integrated Management of Childhood illness(IMCI) criteria while this study used the updated relatively restrictive neonatal sepsis criteria (4, 19). Furthermore, this may be due the difference in economic status of the study population and better access to health facilities.

In this study, neonates with male sex showed a significant association with the risk of the onset of neonatal sepsis. The odds of having neonatal sepsis were two times higher among male neonates as compared to female neonates. This finding is in agreement with the studies conducted previously in Australia (35)) and Central Gondar (26). Male sex is believed to be associated with a higher risk of neurological, pulmonary, cardiovascular, and infectious morbidities as well as overall mortality when compared to female infants of similar preterm gestation(26). However, the aetiology of sex-specific differences in disease remains relatively undetermined and is likely multifactorial, with genetic, immunological, and hormonal influences playing key roles(35).

This study also identified significant associations between maternal parity and neonatal sepsis. The odds of developing neonatal sepsis among neonates who were primi parity were more than two and half times higher odds of developing neonatal sepsis than neonates of mothers who were multi parity. This finding was in agreement with studies from Ghana(36, 37), and Tanzania(32). This is due Poor hygiene practices is more common in first time

mothers of young age and those with low socioeconomic status; predispose them to urinary tract infection leading to preterm and low birth weight newborns(38).

Furthermore, in this study neonatal birth weight was found to be a significant factor for neonatal sepsis. Neonates who born with <1500g were 3.2 times more likely to develop neonatal sepsis compared with neonates born with normal birth weight. Similarly neonates born with 1500g to 2499g were 1.5 times more likely to develop neonatal sepsis than neonates born with normal birth weight. This finding is consistent with studies done in Afghanistan (39) Ethiopia (40), and Shashemene, Ethiopia (22). This may be due to low birth weight newborns are mostly premature, have immature immune system, unable to feed, easily lose their heat, low store of glucose and more likely risk to develop hypoglycemia all of which increase neonatal sepsis(4).

The place of birth was found to be statistically significant association with neonatal sepsis. Neonates delivered at the health center were 55% times less likely to develop sepsis as compared to neonates delivered at hospitals. This finding is in contrast to finding from studies in Nigeria where neonates delivered at health center developed sepsis more likely compared to those delivered at hospital(33). This might be due to the reason that neonates who were delivered at the health center were more likely to be screened based on a risk approach referring complicated pregnancies.

Duration of labor was also significantly associated with neonatal sepsis. Neonates from mothers with duration of labor between 13-24 hours were 1.9 times more likely to develop neonatal sepsis as compared to those neonates mothers with duration of labor <6hours. There is no previous study which supports the current finding.

6. CONCLUSION, LIMITATION AND RECOMMENDATION.

6.1 Conclusion

The study revealed the burden of neonatal sepsis is still high. Being male sex, duration of labor between 13-24 hours, low birth weight and place of delivery (health center) were identified risk factors significantly associated for neonatal sepsis.

6.2 Limitations

Clinical criteria has limited diagnostic accuracy compared to culture test or other microbiology tests as the neonatal sepsis was diagnosed based on clinical signs. Neonates were followed only for 48hours of admission which misses neonates developing sepsis later as nosocomial infection reducing actual proportion of neonatal sepsis.

6.3 Recommendation

. Therefore, follow-up of mothers during delivery with intent to shorten duration of labor, provision of health care services including measurement of maternal BMI, assessing and care of maternal comorbid conditions, and advice on maternal nutrition is paramount. In this regard the recommendation mainly goes to Gynecology and Obstetrics department that labor and delivery should be followed with partograph by trained health professionals to avoid unnecessary prolongation of labor. It is also important to screen and care maternal comorbid illness and advice maternal nutrition during ANC follow up to decrease low birth weight delivery.

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Annex

Annex I: Information sheet

Title of the research project: Neonatal sepsis and associated factors among newborns admitted to neonatal ward of TGSB in Bahir Dar city, North West Ethiopia in 2022G.C

Name of the principal investigator: Dr.Bogale Adera

Name of the Organization: Bahirdar University, College of Medicine and Health science, school of medicine department of pediatrics and child health.

Introduction: Neonatal sepsis results in a significant number of neonatal death and needs identification and prevention of associated factors.

Objective: The main aim of this study is to assess neonatal sepsis and associated factors of admitted neonates at neonatal ward in TGSB,Bahir Dar city,North West Ethiopia during the study period.

Benefits and risk: Being involved in this study has no harm other than taking 10-15minutes.The study may help to develop treatment and prevention guidelines basically for neonatal sepsis.

Participation and withdrawal: You have the full right whether to participate or not and can withdraw at any time or ask to jump specific questions if you want to do so.

Confidentiality: All personal identifiers and information will not be taken hence your responses will be kept confidential. Data will be accessed by the principal investigator, advisors, and research assistant only and finally will be analyzed anonymously.

Person to contact: If you have any questions you can contact;

Dr.Bogale Adera

Mobile: 0928476487

Email:bogale.adera29@gmail.com

Annex II: Consent form

My name is_____ from Bahir Dar University's department of pediatrics and child health. I am going to collect the data to assess the proportion of neonatal sepsis and

associated factors among neonates admitted to the neonatal ward at TGSB from January 1, 2022, to May 30, 2022. The data will be used to prepare prevention and treatment guidelines for neonatal sepsis. For this, I am going to ask some questions that you will waste no more than 15 minutes and see medical records of your baby. Your willingness is appreciable and you have full right to withdraw or discontinue the response. Your name will not be mentioned and your information, as well as the information from the baby's medical chart, will be kept confidential.

Are you willing to take part, please?

Yes _____ No _____

If yes, let's continue.

Respondent code (MRN): _____ Ward _____ Date of interview _____.

Interviewer's name _____ signature _____.

Supervisor's name _____ signature _____.

Annex III: Questionnaire

Part I: Neonatal characteristics

Serial number	Questions	Answers
1	Sex of newborn	1.Male 2.Female
2	Gestational age(in weeks)	
3	Age of the neonate(In hours if < 72hours and in days if >72hrs)	
4	Birth weight in grams	
6	Neonatal reflexes	1.Intact 2.Depressed

7	Gross congenital malformation	1. Yes(mention.....) 2.No
8	Birth injury	1. Yes 2.No
9	5 th minute APGAR	

Part II: Medical procedures done to neonates who will be admitted to NICU

Serial number	Questions	Answers
11	Mechanical ventilation	1. Yes 2.No
12	Oxygen via a nasal catheter	1. Yes 2.No
13	Oxygen via face mask	1. Yes 2.No
14	Umbilical catheterization	1. Yes 2.No

Part III: Mothers socio-demographic Characteristics

Serial number	Questions	Answers
16	Residence	1.Urban 2.Rural
17	Marital status	1. Married 2. Unmarried 3. widowed

18	Maternal educational level	1. Unable to read and write 2. Able to read and write 3. Primary education 4. Secondary education Certificate and above
19	Occupation	1. Housewife 2. Government employee 3. NGO (private) 4. Others mention.....
20	Monthly income
21	Religion	1. Orthodox 2. Muslim 3. Protestant 4. Others mention....

Part IV: Medical and obstetrical characteristics of mothers of neonates admitted to NICU

Serial number	Questions	Answers
22	Maternal age	
23	Parity	1. Primipara 2. multipara
24	Antenatal care	1. Yes

		2.No
25	HIV test result	1. Positive 2. Negative 3. Unknown
26	VDRL/RPR status	1. Reactive 2. Non-reactive 3. Unknown
27	Mode of delivery	1.Vaginal delivery(Non instrumental) 2. Cesarean section 3. Instrumental
28	Duration of labor	
29	Duration of premature rupture of membrane(PROM)	
30	Frequency of PV exam during labor	
31	History of foul-smelling liquor	1. Yes 2.No
33	Place of delivery	1. Hospital 2. clinic 3. Health center 4. Home
34	Meconium stained amniotic fluid	1. Yes 2.No

35	History of maternal urinary tract infection (UTI) during pregnancy	1. Yes 2.No
36	Presence of maternal intrapartal fever	1.yes 2.no
38	Neonatal sepsis	1.yes 2.no