

WOLKITE UNIVERSITY SCHOOL OF MEDICINE AND HEALTH SCIENCE

ASSESSMENT OF MAGNITUDE AND ASSOCIATED FACTORS OF NEONATAL SEPSIS AMONG NICU ADMISSIONS AT WUSH

A STUDENT RESEARCH PROJRCT TO BE SUBMITTED TO THE DEPARTMENT OF PUBLIC HEALTH, WKU, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF MEDICINE

August, 2023

WOLKITE, ETHIOPIA

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MEDICINE AND HEALTH SCIENCE

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Table of Contents

LIST OF TABLES 4

LIST OF FIGURES 5

ACKNOWLEDGEMENT 6

ABREVIATIONS AND ACRONYMS 7

ABSTRACT 9

1. INTRODUCTION 10

1.1. Background 10

1.2. Statement of the problem 10

1.3. Significance of the study 12

2.1 Epidemiology of Neonatal Sepsis 13

2.2. Factors associated with Neonatal Sepsis 14

2.2.1 Socio-demographic Characteristics 14

2.2.2. Maternal risk factors 14

2.2.3. Neonatal risk factors 15

2.2.4 Medical risk factors 15

2.2.5 .Environmental risk Factors 15

3. OBJECTIVE 17

3.1 General objective 17

3.2 Specific objective 17

4. METHOD AND MATERIAL 18

4.1 Study area and period 18

4.2 Study design and period 18

4.3 Population 18

4.3.1 Source population 18

4.3.2 Study population 18

4.4 Inclusion and Exclusion criteria 18

4.4.1 Inclusion criteria 18

4.4.2 Exclusion criteria 18
4.5 Sampling techniques and sample size 19
4.6 Sampling technique and procedure 19
4.7. Data collection procedure and Pretest 20
4.8. Study variables 20
4.8.1. Dependent variables 20
4.8.2. Independent Variables 20
4.9 Operational definition/standard definition 21
4.10 Data Quality Assurance 21
4.11 Data Processing and Analysis 21
4.12. Ethical Consideration 22
4.13. Dissemination of the result plan 22
5. Result 22
5.1 Socio demographic Characteristics 23
5.2 Diagnosis of Neonatal Sepsis 23
5.2 Maternal Risk Factors for Neonatal Sepsis 24
5.3 Distribution of Neonatal factors for neonatal sepsis 25
5.4 Treatment out come 27
5.5 Factors Associated with Neonatal Sepsis 27
6. Discussion 29
7. Strength and Limitation 31
7.1 Strength 31
7.2 Limitation 31
8. Conclusion and Recommendation 31
Bibliography 33

LIST OF TABLES

Table 1 Socio demographic characteristics of neonates and mothers admitted to NICU of WUSH Wolkite, Ethiopia 2023 23
Table 2 Distribution of neon atal risk factors for Neonatal Sepsis in NICU of WUSH, Wolkite Ethiopia, 2023 26
Table 3 Bivariate and multivariable analysis of factors associated with neonatal sepsis among neonates admitted to the NICU of WUSH , Wolkite Ethiopia, 2023..... 28

LIST OF FIGURES

Figure 1 Distribution of diagnosis of neonatal sepsis among neonates admitted to NICU of WUSH Wolkite, Ethiopia 2023 24
Figure 2 Distribution of diagnosis of Early and Late onset neonatal sepsis among neonates admitted to NICU of WUSH Wolkite, Ethiopia 2023 24

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ABREVIATIONS AND ACRONYMS

APGAR -Activity, Pulse, Grimace, Appearance, Respiration
ABD –assisted breech delivery
CD –cesarean delivery

CI- Confidence Interval

CONS - Coagulase-Negative Staphylococcus Group

CRP-C reactive protein

DIC- Disseminated intravascular coagulation

EDHS - Ethiopia Demographic and Health Survey

EONS - Early onset neonatal sepsis

ESR-Erythrocyte sedimentation rate

GBS - Group B Streptococcal

LMIC- low and middle income countries

LONS - Late onset neonatal sepsis

LBW- low birth weight

MDG - Millennium development goal

MSAF - Meconium stained amniotic fluid

NMR - Neonatal mortality rate

NICU - Neonatal intensive care unit
NHB-neonatal hyperbliribinemea

NBW- Normal birth weight

NNS - Neonatal sepsis

PNA- Perinatal Asphyxia

PROM - Prolonged rupture of membrane

PSBI - Possible severe bacterial infection

RDS- Respiratory distress syndrome

SDG - Sustainable Development Goals

SIRS-systemic inflammatory response syndrome

SPSS - Statistical Package for Social science
SVD –spontaneous vaginal delivery

TLC- Total leukocyte count

UN –United Nation

UTI - Urinary tract infection

WHO - World health organization

WKU- Wolkite University

WUSH –wolkite university specialized hospital

ABSTRACT

Background: Neonatal sepsis is a serious medical condition that can affect newborns, particularly in developing countries. It is caused by an infection in the blood and can lead to significant morbidity and mortality. Several factors can increase the risk of neonatal sepsis, including socio-demographic, maternal, neonatal, and medical factors. The clinical signs and symptoms of neonatal sepsis are often nonspecific, making diagnosis difficult and time-consuming. As a result, healthcare providers must rely on a combination of risk factor assessment and diagnostic tests to accurately diagnose and treat neonatal sepsis

Objective: - To assess prevalence and associated factors of neonatal sepsis among neonates admitted to NICU of WUSH from June 28 2022- June 28, 2023

Methodology: A retrospective documentary review study will be conducted at an institution to evaluate prevalence and associated factors of neonatal sepsis among neonates admitted to the NICU of WUSH between June 28 2022- June 28, 2023. The sample size will be determined using a single population proportion formula, and study subjects will be selected using a systematic random sampling method. Data collection tools will be adopted and will be used, and the data will be checked for completeness and clarity before being analyzed using the statistical package for social sciences (SPSS) version 25. Descriptive statistics and binary logistic regression will be employed, and the degree of association will be calculated using odds ratios with 95% CI. A p-value of less than 0.05 will be considered significant for associations between dependent and independent variables

Result: The overall prevalence of NNS was 58.1% with MR of 6% from total admission (616) of neonates in the past one year, Being male neonate (AOR=5.5; 95% CI (1.8-16.5)), having history of PROM during the index pregnancy (AOR =6.3; 95% CI (2-19.9)), prolonged duration of labor (AOR=0.06; 95% CI (0.01-0.49)), lower APGAR score at birth (AOR=0.02; 95% CI (0.06-0.61)), more than three days of hospital stay (AOR=0.028; 95% CI (0.007-0.11)).

Conclusion: The present study had identified many factors from those neonatal sex, mode of delivery, duration of labour, history of maternal PROM, neonatal comorbidities ,APGAR score, and duration of hospital stay, place of delivery were identified as having strong association for NNS, So measures that reduce preventable causes of above factor need to be taken as to reduce the occurrence of sepsis.

Keywords: neonate, neonatal sepsis, associated factors

1. INTRODUCTION

1.1. Background

Neonatal sepsis is defined as a SIRS that occurs in the presence of or as a result of suspected or proven infection in a neonate due to bacteria, viruses, fungi, or rickettsia which can encompass septicemia, meningitis, pneumonia, arthritis, and osteomyelitis (2) (3). The normal fetus is sterile until shortly before birth due to the protective barriers of the placenta and amniotic sac. However, at birth, the newborn loses this protection and is exposed to the microbial world (4). Neonatal sepsis can be divided into early neonatal sepsis or late onset sepsis depending on the age of onset.

EONS is mainly due to organisms acquired before and during delivery and is most commonly caused by GBS and E.coli. LONS is due to organisms acquired after delivery from the environment and can be caused by CONS, S.aureus, Pseudomonas species, anaerobes, and Candida species (5). It is helpful to differentiate between early and late-onset infections according to per partum pathogenesis because they have different sources of infection, onset of disease occurrence, mode of transmission, management, and risk factors (6)

The clinical presentation of NNS can be non-specific and may include symptoms such as fever, respiratory distress, lethargy, impaired or refusal of feeding, jaundice, absent Moro reflex, hypothermia, convulsion, bleeding disorder, and bulging fontanel (7). Blood culture is the definitive diagnostic tool for NNS, but it can be time-consuming and may result in false positive or false negative results (8). NNS can also be diagnosed based on a combination of clinical appearance and positive septic screening parameters such as TLC < 5000/mm, band to total polymorph nuclear cells ratio of >0.2, CRP >1mg/dl, and micro Erythrocyte ESR > 10 mm-first hour (9).The management of NNS involves empirical antimicrobial therapy and supportive care. Treatment should be started immediately after obtaining samples for culture rather than waiting for the culture results (10).

1.2. Statement of the problem

Neonatal sepsis is a major cause of morbidity and mortality among neonates globally, particularly during the neonatal period. In 2015, nearly 1 million of the 5.9 million child deaths occurred on the first day of life, and close to 2 million occurred in the first week of life. The main causes of neonatal deaths were preterm birth complications (35%), intrapartum-related complications (24%), and sepsis (15%) globally (11).

The incidence of neonatal bacterial sepsis varies from 6 to 9 cases per 1,000 live births in developed countries, with significant differences over time and geographic location (12). In the last two decades, there has been remarkable progress in reducing maternal and child deaths, but neonatal health remains an unfinished agenda. The proportion of deaths among children under five that occur in the neonatal period is increasing worldwide. Despite the fact that many neonatal deaths are preventable, they are concentrated in the world's poorest countries. In fact, 85% of all neonatal deaths occur in LMICs, even though they are home to only 62% of the world's newborns. Furthermore, it is also associated with increased medical costs, prolonged hospital stay and potentially poor long-term neurodevelopment outcomes. Surviving infants, approximately one-fourth of neonates, have significant neurological squeal as a consequence of CNS involvement, septic shock or hypoxemia secondary to severe parenchymal lung disease (13) (14)

In Africa, 17% of neonatal deaths in sub-Saharan Africa are attributed to neonatal sepsis, compared to only 6% in high-income countries (15). Despite Ethiopia's success in achieving MDG three years early, the reduction in neonatal mortality was comparatively low. At the end of the MDG era, the international community agreed on a new framework, the SDGs, to reduce under-five mortality to at least as low as 25 per 1,000 live births by 2030 (16). According to the 2016 EDHS report, the NMR was 29/1,000 live births, which has not shown significant reduction from the 2011 EDHS report of 33.7/1,000 live births (17).

Despite improvements in the diagnosis and management of NNS in recent years, it remains a leading cause of admission and death in neonatal units, especially in developing countries. Many factors contribute to the high mortality due to delays in identifying and treating newborns with infection. These include under-recognition of illness, delay in seeking care at the household level, delay in initiating treatment, and lack of access to appropriately trained health workers and high-quality services to manage sepsis (18). Many neonatal deaths occur in the community without the newborn ever having contact with appropriate health services (19) (20).

Strategies that can prevent and treat neonates with sepsis are essential to accelerate progress on newborn survival. However, in many developing country settings, identification and treatment of newborns with infection is unsatisfactory. Epidemiological data from developing countries shows differences in incidence, risk factors, pattern and antimicrobial sensitivities of pathogens and mortality from Developed countries (21), (22). Identification of risk factors and early initiation of therapy can improve neonatal mortality and morbidity. Even though there are few studies exploring prevalence and associated factors of NNS in Ethiopia, there has not been a single study in the study area.

Based on the limited data available, NNS has been found to be common and has been associated with poor neonatal outcomes. Therefore, this study will be conducted to explore the prevalence and associated factors of NNS at NICU of WUSH

1.3. Significance of the study

The results of this study can be useful for responsible bodies in planning necessary training programs for health professionals to improve their knowledge about the problem. It can also help to raise awareness in the community, as health professionals can use the results to provide health education to mothers about different risk factors during ANC follow-up.

The study can also serve as a baseline for future prospective research, as it assesses past events. The results can provide insight to healthcare providers in identifying common risk factors of neonatal sepsis, which can help overcome the challenge of early diagnosis and management of sepsis and finally in reducing neonatal mortality.

The reduction of neonatal mortality is the key MDG so this study will be significant to achieve it by assessing prevalence and associated risk factor with related neonatal mortality.

Therefore, this study will conduct to explore the prevalence and associated factors of NNS and neonatal outcome. And also the results will have significance for administrators to solve the problem. Finally the data will be used for other studies for who want to assess other working area and regions as well. Furthermore, the findings can also be used for researchers on further study.

2 .LITERATURE REVIEW

2.1 Epidemiology of Neonatal Sepsis

The global burden of NNS is estimated to be 2,202 per 100,000 live births. NNS prevalence and mortality also varied substantially across regions of the world, with the highest burden in sub-Saharan Africa, Oceania, South Asia, East Asia, and Southeast Asia. In Africa, sepsis constitutes 28% of all neonatal deaths (23) (24) (25).

The overall incidence of neonatal sepsis ranges from 1 to 5 cases per 1000 live births. Estimated incidence rates vary based on the case definition and population studied. In a systematic review and meta-analysis of population-based studies from around the world, the estimated pooled incidence of neonatal sepsis was 22 per 1000 live births, with an associated mortality rate of 11 to 19 percent. This translates to a global incidence of three million cases of neonatal sepsis per year. (25)

Globally; neonatal sepsis and other severe infections were responsible for an estimated 430,000 neonatal deaths in 2013, accounting for approximately 15 percent of all neonatal deaths. According to a report from the Global Health Observatory in 2015, approximately 4.5 million children under the age of five died, with 75% of these deaths occurring within the first year of life. The highest rates were reported in Africa, where there were 55 deaths per 1000 live births. This rate is more than five times higher than that of Europe, where there were only 10 deaths per 1000 live births. In developing countries, the neonatal mortality rate from all causes is about 34 per 1000 live births, with most of these deaths occurring within the first week of life and particularly on the first day.

Neonatal sepsis is more prevalent in developing countries than in developed ones. In Japan, a study found that the incidence of neonatal sepsis was 0.74%, with 0.13% being EONS (26). In Egypt, the prevalence was found to be 40.7%, with a mortality rate of 51% for EONS and 42.9% for LONS (27). A study in Sudan reported a prevalence of 17.5% and a mortality rate of 14.5% (28). In Ethiopia, a study conducted at hospitals of wolaita sodo town, southern Ethiopia in 2019, from April 21 to June 29, among 275 neonate admitted to NICU, the overall prevalence was 33.8% and among them 26.9% of the neonates had EONS and 6.9% of the neonates had LONS. (28)

EONS is mainly caused by ascending infection in the mother with chorioamnionitis, perinatal infection via direct contact in the birth canal, and haematogenous spread. The main microorganisms implicated in causing EONS include GBS, Escherichia coli (E. coli), CONS, Haemophilus influenzae, and Listeria monocytogenes. LONS is usually

acquired in the hospital after delivery and can be associated with having a catheter in a blood vessel for a long time or staying in the hospital for an extended period (23) (24)

2.2. Factors associated with Neonatal Sepsis

2.2.1 Socio-demographic Characteristics

Factors such as the age of the mother, the sex and age of the newborn can contribute to the risk of neonatal sepsis. For example, male newborns are more likely to be affected than females. Preterm newborns (born before 37 weeks) have a higher incidence of infection, 3 to 10 times higher, than full-term newborns (born between 37 and 42 weeks). (31)

A study from Iraq found that out of 50 septic newborns, 32 (64%) were male and 18 (36%) were female, resulting in a female to male ratio of 1:1.8. (32) The criteria for defining neonatal sepsis differ for term and preterm newborns due to differences in their developmental stage and immune response. Therefore, a specific agreement on the definition is necessary for both groups to improve understanding of observational studies, training for practitioners, and implementation of clinical trials in newborns (33)

According to study done at hospitals of Wolaita Sodo Town, Southern Ethiopia, in which 275 of neonates were involved from April 22 to June 29, 2018 where more than half (61.5%) of the neonates were male and 183 (66.5%) were in the age group 0–7 days (early neonatal period) and the rest 92 (33.5%) were from 8 to 28 days (late neonatal period). (34)

2.2.2. Maternal risk factors

Neonatal infections can be acquired from the mother through various routes, including prenatal transmission during pregnancy, with or without recognizable signs and symptoms of bacteremia, through the placenta to the fetus (35). Infections can also occur immediately before or during delivery by ascending transmission of microorganisms to the fetus. Several studies conducted in different countries have identified several maternal risk factors for neonatal sepsis, including foul-smelling amniotic fluid, MSAF, parity, history of UTI/STI, maternal age, chorioamnionitis, genital tract colonization with GBS, and PROM (36) (37) (38). For example, according to study done at primary hospital in central Gondar, 2019 ,neonate born to mothers who had UTI during the index pregnancy had 6 times higher odds of developing sepsis as compared to those neonate born from mothers who didn’t have UTI. Likewise increased odds of neonatal sepsis was noted

among mothers who had >3 PV examinations during labor compared to mothers who had <3 PV examination. (39)

2.2.3. Neonatal risk factors

Several neonatal risk factors have been identified that play a significant role in the occurrence of neonatal sepsis. These include male sex, preterm delivery, gestational age, birth asphyxia, LBW (<2.5kg), APGAR score less than seven in the first minute and PROM. These factors have been shown to have significant roles in both early and late onset neonatal sepsis, as they do in resource-rich countries (35) (37) (38). Studies conducted in different areas have revealed that EONS is more frequent than LONS. For example, a study conducted in Woldiya and Desse comprehensive specialized hospital 2021 revealed that preterm delivery is one of the significant risk factors for neonatal sepsis, which is 4.4 times. It is explained that preterm neonates tend to have poor host defenses and are more likely to suffer neonatal sepsis. Preterm infants may experience limited enteral feedings and/or exposure to breast milk, which collectively increase the risk for infection more likely as compared to post-term delivery (40)

2.2.4 Medical risk factors

After birth, neonates can acquire infections from their surroundings, including nosocomial infections in the delivery room or postnatal room. The main pathways for infection are the respiratory and gastrointestinal tracts, as well as the place of delivery. Bishoftu hospital found that a significant number of neonates, 95%, were born in a health center and developed sepsis. This rate was 4.2 times higher than that of neonates born at home (41). These findings highlight the importance of infection control measures in healthcare facilities to prevent neonatal sepsis. EONS is often associated with maternal conditions, while LONS is typically related to medical and surgical risk factors. These risk factors can include invasive and non-invasive procedures, such as neonatal resuscitation, the use of vascular catheters, endotracheal tubes, or feeding tubes, which may be necessary for neonates who already have an underlying illness (42). Evidence has shown that the risk of acquiring sepsis is 6.2 times higher in neonates born via instrumental delivery compared to those born via spontaneous vaginal delivery (43). Similarly According to research conducted at primary hospital at central Gondar, 2019, showed that, those neonates who were resuscitated at birth had 6 times higher odds of developing sepsis compared to those neonates who were not resuscitated (39).

2.2.5 .Environmental risk Factors

Neonatal sepsis rates are often higher in low-income countries where access to healthcare facilities and resources are limited. Cultural beliefs and practices related to prenatal care, childbirth, and healthcare utilization can also impact neonatal sepsis rates. Environmental

factors such as place of delivery can also increase the risk of neonatal sepsis. According to research done at primary hospitals in central Gondar zone, North West Ethiopia in 2019, from March - April 2019 Place of delivery has a significant effect on NNS. Neonates delivered in the health center were three times more likely to develop sepsis compared to those delivered at the hospital. And also, neonates who get care by health workers who had no training on NICU/IPPs were 2 times more likely to develop sepsis as compared to neonates who get care by trained health professionals. (38)

3. OBJECTIVE

3.1 General objective

To assess the prevalence and associated risk factors of neonatal sepsis among neonates admitted to NICU of WUSH from June 28 2022- June 28, 2023.

3.2 Specific objective

- To identify the prevalence of neonatal sepsis among neonates admitted to NICU of WUSH from June 28 2022- June 28, 2023.
- To identify the associated factors of neonatal sepsis among neonates admitted to NICU of WUSH from June 28 2022- June 28, 2023.

4. METHOD AND MATERIAL

4.1 Study area and period

This study was conducted in WUSH, Wolkite, Ethiopia. The hospital was located in gubre sub-city Wolkite town which was zonal town of Guraghe Zone. Wolkite was about 158km from the capital Addis Ababa. It was almost halfway between Addis and Jimma. Geographically, it lay between $8^0 17'$ N latitude and $37^0 49'$E longitude with an elevation between 1910 and 1935 meters above sea level. It was surrounded by Kebena and Abeshghe woredas, and Cheha woreda. According to the statistics obtained from Wolkite's Town Municipality, the population was 70,796 out of which 35, 848 were males and 34,948 females. This hospital provided full health care service for population guraghe zone and its surrounding in Oromia region such as silk amba and keta wayu as their primary catchment areas. The total number of staff of the hospital was 406 including 6 general surgeon,5gynecologist- obstetrician, 6 internist, 45 general practitioners,10 health officers,5 anesthetists, 1dentist, 128 nurses,23 laboratory technologists, and 24 pharmacists. There were a total of 174 beds in the surgical, medical, gynecology-obstetrics, and pediatrics wards of the hospital.

The department of Pediatrics and child Health at WUSH had a total of 55 patient beds. NICU was among the case team units under the department which encompassed around 29 beds for both term and preterm infants.

4.2 Study design and period

A Hospital based Retrospective document review study was conducted at WUSH from June 28 2022- June 28, 2023.

4.3 Population

4.3.1 Source population

The source population for the study was all neonates who were admitted and treated in the neonatal intensive care unit of WUSH in the past 1 year from June 28 2022- June 28, 2023

4.3.2 Study population

All neonates admitted to the NICU of WUSH from June 28 2022- June 28, 2023.

4.4 Inclusion and Exclusion criteria

4.4.1 Inclusion criteria

- All neonates admitted at age equal to or less than 28 days to the NICU of WUSH during the study period.

4.4.2 Exclusion criteria

- Neonatal card with incomplete information. (The exclusion criteria will be if >5 of questions are not answered)

- Neonates who were admitted with the diagnosis of suspected sepsis but not proven upon discharge

4.5 Sampling techniques and sample size

- Sample size was determined by using single population proportion sample size calculation formula and the proportion will be taken from the previous literature in Ethiopia. According to study conducted at Wachemo University Comprehensive Specialized Teaching Hospital, NICU the prevalence rate of neonatal sepsis was 39.5% (1). The sample size will be determined by using single population proportion statistical formula
- P=39.5%
- Confidence level=95%
- Margin of error=5%

$n = \frac{(Z\alpha/2)^2 \mathrm{p}(1-\mathrm{p})}{(d)^2} n = \frac{(1.96)^2 0.395(1-0.395)}{(0.05)^2}$= 230

Since total population is less than 10,000, the correction formula will be used.

n=n/ [1+ (n/N)] =167

n= required sample size

p= Expected proportion of neonatal sepsis among neonates admitted in NICU with prevalence of 39.5%

d=marginal error between sample and population (0.05)

1-p = proportion of population that do not possess the character of interest.

Z α/2= critical value at 95% confidence interval

4.6 Sampling technique and procedure

In the study population, there were 616 Neonates who were admitted to WUSH NICU. The sampling technique used was the systematic random sampling. The sampling interval was determined by the formula N/n = 4 and after the calculation it became 1 in every 4 charts, so one every neonatal medical record was be taken from the HMIS log book by

the next card for those cards which contains incomplete information and then continues every 4th Value in similar pattern until the required numbers of samples were collected.

4.7. Data collection procedure and Pretest

The questionnaire contains four parts which includes: Socio-demographic characteristics; maternal information, neonatal information and contain medical factors for neonatal sepsis. Records of neonates for the last one year (from June 28 2022- June 28, 2023.) were reviewed. This involved going through the HMIS Log book records of neonates from June 28 2022- June 28, 2023. Risk factors were identified from medical files of patients. The medical charts were traced using the patient card numbers on the log book registry.

4.8. Study variables

4.8.1. Dependent variables

- Prevalence of neonatal sepsis

4.8.2. Independent Variables

Socio-demographic characteristics of mothers with their index neonates (age 0-28 days)

- Mother's age
- Mother's place of residency
- Neonate's age
- Neonate's sex

Maternal health related factors

- Parity
- Place of delivery
- Duration of labor
- Duration of rupture of membrane
- History of MSAF
- Chorioaminitis

Neonatal health related factors

- Gestational age
- APGAR score
- Birth Weight at birth
- Co morbid diagnosis
- WBC count

4.9 Operational definition/standard definition

Neonatal sepsis: neonates with proven or clinical diagnosis of sepsis.

Early onset neonatal sepsis: neonate with sepsis within less than or equal to 3 days

Late onset neonatal sepsis: neonate with sepsis within 4-28 days

Low Birth Weight: weight of the child <2.5kg

Preterm Birth: live birth before 37 weeks of gestation

Neonatal period: The time from 0-28 days of life

Prolonged rupture of membrane: Rupture of amniotic membrane >=18 hour

4.10 Data Quality Assurance

The quality of data was controlled starting from the time of questionnaires preparations. The collected data was manually checked for completeness, accuracy and clarity by the data collectors, then it was transferred to SPSS version 25 for analysis. Each chart was given a case number to avoid mixing and for confidentiality.

4.11 Data Processing and Analysis

After the data collection was completed used data editing, the data was entered SPSS version 25 system. The entered data was subjected to cleaning using simple frequency

and cross tabulation to ensure the validity of the data. Then, the analysis was made with IBM SPSS version Descriptive statistics and binary logistic regression was employed, and the degree of association was calculated using odds ratios with 95% confidence intervals. A p-value of less than 0.05 was considered significant for associations between dependent and independent variables. Binary and multivariate logistic regression was done to see the effect of each of the independent variables on the outcome variable by simultaneously suppressing the effect of extraneous variables. A descriptive statistic was performed to determine frequency, proportion and percentage. The data presentation will be presented by table, figures, chart, and bar graph.

4.12. Ethical Consideration

Ethical clearance was sought from Wolkite University, Department of Public Health ethical review Committee. After explaining about the purpose and the possible benefit of the study, permission to gather data was obtained from the department of pediatrics and child health, and head nurse of the NICU. The data was collected anonymously and Confidentiality of the information will be maintained

4.13. Dissemination of the result plan

The final result of this paper will be submitted to Wolkite University College of medicine and health science, department of public health. The finding of this study will be disseminated through presentation, publication. Hard and soft copies will be available in the library of WKU, for students as well as for other concerned bodies. Dissemination of the result will also be made to Department of Pediatrics and Child Health, NICU case team and to the department of Obstetrics and Gynecology

5. Result

5.1 Socio demographic Characteristics

A total of 167 neonates were involved in this study with a response rate of 100% from September 11, 2016 to February 7, 2018 in WUSH, 123(73.7%) of mothers were from outside Wolkite. Among the participants, three fourth of neonate's mother 132 (79%) were in the age <30 years. Among neonates who were enrolled in this study, more than half of them 88 (52.7%) were female. The highest proportion of neonates in the survey 127 (76%) were admitted at the age of less than 72 hours.

Variables		Frequency	Percent
Maternal Age	<30 yrs	132	79.0
	>=30 yrs	35	21.0
Neonatal Age	0-3 days	127	76.0
	>3 days	40	24.0
Neonatal Sex	male	79	47.3
	female	88	52.7
Place of Residence	wolkite	44	26.3
	others	123	73.7

Table 1 Socio demographic characteristics of neonates and mothers admitted to NICU of WUSH Wolkite, Ethiopia 2023

5.2 Diagnosis of Neonatal Sepsis

Among the total admission 616 of neonates in NICU of WUSH from June 28 2022- June 28, 2023, prevalence of neonatal sepsis was 58.1% and the remaining 41.9 were diagnosis other than sepsis.More than three fourth 70 (72.2%) of the neonates were diagnosed as EONS and around one fourth 27 (27.8%) of them were diagnosed as LONS,And there was leukocytosis(>20,000 cells/mm3) in more than two third of the neonates 68 (70.1%).

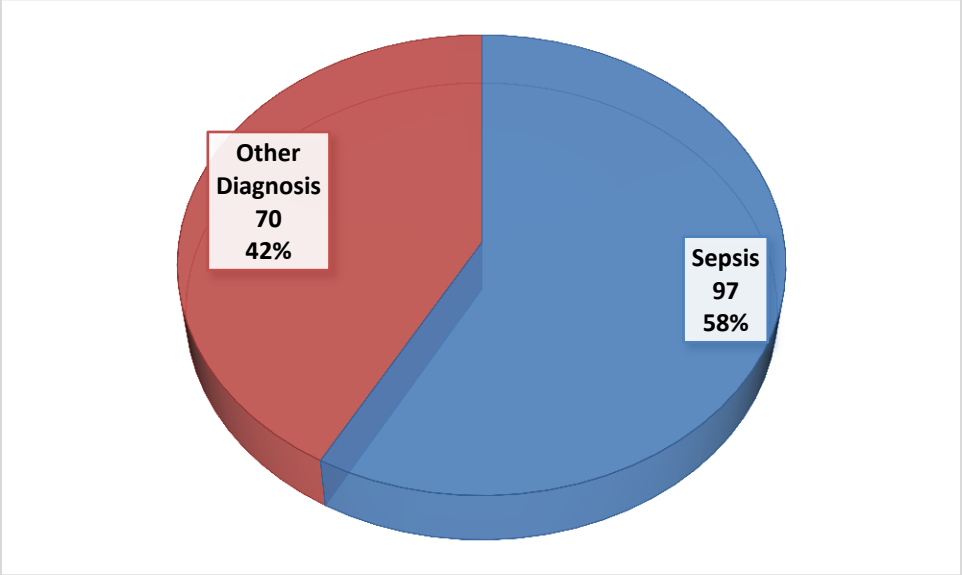


Figure 1 Distribution of diagnosis of neonatal sepsis among neonates admitted to NICU of WUSH Wolkite, Ethiopia 2023

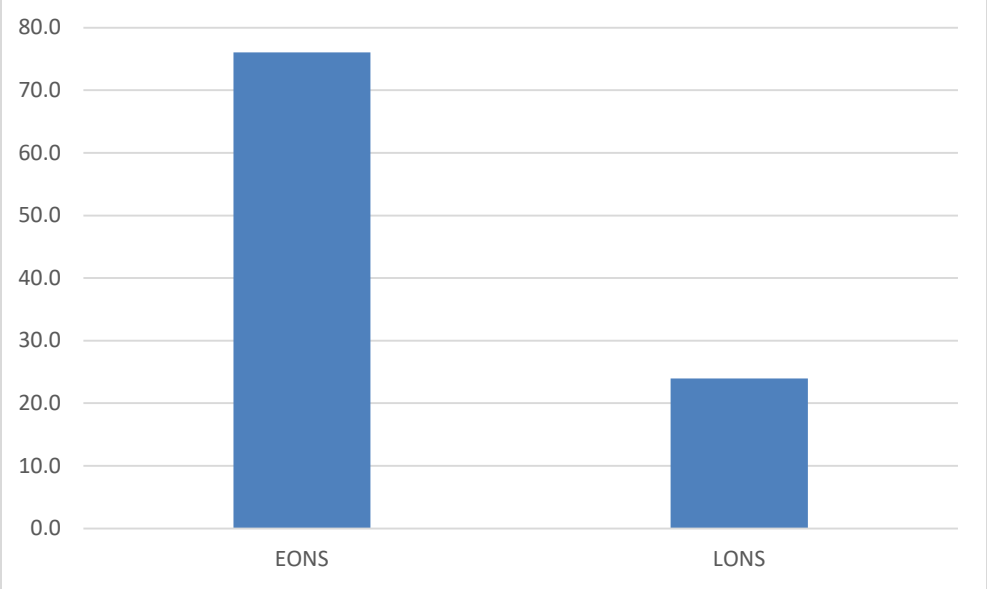


Figure 2 Distribution of diagnosis of Early and Late onset neonatal sepsis among neonates admitted to NICU of WUSH Wolkite, Ethiopia 2023

5.2 Maternal Risk Factors for Neonatal Sepsis

Among mothers of the neonates admitted more than half of the mothers ere multiparious (108, 64.7%) and more than half of the neonates 106 (63.5%) were delivered at hospital and around one third of the neonates were delivered at health center and six neonates (5.4%) were home deliveries. The majority of neonates were delivered By SVD (123, 73.7%) and cesarean section were the second most common mode of delivery accounting for 34 (20.4%) while 6% and 0.6 % of neonates were delivered by instrumental vaginal delivery and ABD respectively. Around 98

(58.7%) of neonates had maternal history of premature rupture of membrane and (27, 16.2%) had maternal history of prolonged duration of labour. From the record reviewed, around 16 (9.6%) had maternal history of chorioamniotis and more than quarters of them 55 (32.9%) had MSAF delivered at hospital and around one third of the neonates were delivered at health center and six neonates(5.4%) were home deliveries.

Variables		Frequency	Percent
Parity	Primiparous	59	35.3
	Multiparous	108	64.7
Place of delivery	Home	9	5.4
	Health Institution	158	94.6
Mode of delivery	SVD	123	73.7
	Operative delivery	44	26.3
Duration of labour	1-24hrs	140	83.8
	>24 hrs	27	16.2
History of maternal PROM	Yes	98	58.7
	No	69	41.3
History of chorioaminionitis	Yes	16	9.6
	No	151	90.4
Meconium stained amniotic fluid	Yes	55	32.9
	No	112	67.1

Table2 Distribution of Maternal risk factors neonatal sepsis among neonates admitted in NICU of WUSH, Wolkite Ethiopia, 2023

5.3 Distribution of Neonatal factors for neonatal sepsis

Among admitted neonates, 46.7 % (78) of neonates were preterm and more than half of them 53.3 % (89) were delivered at term. Regarding Birth weight nearly two third of neonates (119, 65.7%) had birth weight less than 2500 gram and the remaining 62(34.3%) of neonates had normal birth weight. forty-one percents of neonates APGAR score was less than seven at the first minute and only six percent of them had persistent low APGAR score. Preterm was the most common comorbid disorder at the time of admission occurring in nearly 25.7 % (43) of neonates followed by RDS (22.8%) and MAS(7.8%). Perinatal asphyxia occurred in 5.4% of children.

Variables		Frequency	Percent
Apgar score	<7	66	39.5
	> or=7	101	60.5
	Total	167	100.0
Birth weight at birth	<2500	60	35.9
	> or =2500	107	64.1
Duration of hospital stay	1-3days	49	29.3
	>3 days	118	70.7

Table 3a Distribution of neonatal risk factors for Neonatal Sepsis in NICU of WUSH, Wolkite Ethiopia, 2023

	As comorbidity		**As dx other than sepsis**		**Total**	
Admission diagnosis	**frequency**	**Percentage**	frequency	percentage	**frequency**	**Percentage**
Preterm	43	25.7%	35	21%	78	46.7%
PNA	9	5.4%	18	10.8%	27	16.2%
RDS	38	22.8%	20	12%	58	34.8%
MAS	13	7.8%	15	9%	28	16.8%
NHB	11	6.6%	21	12.6%	33	19.2%
Cong. Dis.	8	4.8%	6	3.6%	14	8.4%
Birth injury	9	5.4%	10	6%	19	11.4%
Others					19	11.4%

Table 2 Distribution of neonatal risk factors for Neonatal Sepsis in NICU of WUSH, Wolkite ----------Ethiopia, 2023

5.4 Treatment out come

Among the one 167 neonate who were recruited for the study 136 (81.4%) were successfully treated and discharged home and 14 (8.0%) of them died and 10 (5.9%)of them survived with complication and 7 (4.2%) were referred. The most common cause of death being neonatal sepsis 10 (4.1%), and the second being Preterm and RDS both of them accounting for 3 (1.8%).

5.5 Factors Associated with Neonatal Sepsis

All the variables which fulfilled the chi-square assumption were fitted into bivariable and multivariable logistic regression. Neonatal age, neonatal sex, place of delivery, mode of delivery, duration of labor, history of maternal PROM, history of chorioamnitis, RDS, APGAR score, duration of hospital stay and other diagnosis fulfilled the variable screening criteria (p-value < 0.25) and entered into multivariable logistic regression analysis. Consequently, neonatal sex, mode of delivery, duration of labor, history of maternal PROM, RDS, APGAR score, and duration of hospital stay were significantly associated with neonatal sepsis at multivariable with less than 0.05 p values.

Accordingly, the sex of neonates showed a significant association with the risk of the onset of neonatal sepsis. The odds of having neonatal sepsis among male neonates were 5.5 times higher as compared to female neonates [AOR = 5.5; 95% CI (1.8-16.5)]. This study showed that neonates born to mothers who had PROM during the index pregnancy had 6.3 times higher odds of developing sepsis as compared to those neonates born from mothers who did not have a PROM during the index pregnancy [AOR =6.3 CI[(2.00-19.9)]. Nevertheless, the odds of neonatal sepsis among neonate whose born from a mother with duration of labor of >24hr had 94% higher odds of developing sepsis than neonate born from a mother with duration of labor <24hr [AOR =0.06 CI [(0.01-0.49)]. Neonate born via operative delivery had 3.2 times higher odds of developing sepsis as compared to those via SVD [AOR =3.2 CI [(1.0-9.9)].

The odds of having neonatal sepsis in those neonate whose APGAR score was <7 where 80% higher than in those neonate whose APGAR score was >7 [AOR = 0.20; 95% CI [(0.06-0.61)]].

The odds of having neonatal sepsis in neonate who born at health institution was 11 times higher those neonate who born at home [AOR = 11; 95% CI [(1.17-104)]]

Finally the odds of having neonatal sepsis in neonates who stayed for more than 3 days had 97% higher than in neonate who stayed for <3 days. That could be due to multiple interventions the neonates undergo, risk of acquiring nosocomial infection, which increases risk of sepsis specially LONS [AOR = 0.03; 95% CI [(0.009-0.13)]].

Variables		Sepsis diagnosis N %		COR (95%CI)	P-value	AOR (95%CI)	p-value
		Yes	No				
Neonatal sex	male	38 22.8%	41 21.6%	2.1(1.1-4.1)	0.014	5.5(1.8-16.5)	0.001
	female	59 35.3%	29 17.4%	1	1		1
Place of delivery	home	7 4.2%	2 1.2%	1	1		1
	health institution	90 53.9%	68 40.7%	0.37 (0.07-1.8)	0.234	11(1.17-104)	0.038
Mode of delivery	SVD	75 44.9%	48 28.7%	1	1		1
	operative delivery	22 13.2%	22 13.2%	0.64(0.32-1.2)	0.207	3.2(1-9.9)	0.047
History of maternal PROM	yes	49 29.3%	49 29.3%	2.2 (1.1-4.3)	0.012	6.3(2-19.9)	0.0
	No	48 28.7%	21 12.6%	1	1		1
Duration of labor	<24hrs	72 43.1%	68 40.7%	1	1		1
	>=24hrs	25 15%	2 1.2%	11(2.6-51)	0.001	0.06(0.01-0.49)	0.001
RDS as comorbidity	yes	31 18.6%	7 44.2%	0 (0-0)	0.001	0.47(0.02-10)	0.0
	No	66 39.5%	63 37.7%	1	1		1
APGAR score	<7	42 25.1%	24 14.4%	0.68 (0.36-1.2)	0.0241	0.02(0.06-0.61)	0.005
	>=7	55 32.9%	46 27.5%	1	1		1
Duration of hospital stay	<3days >=3 days	9 5.4% 88 52.7%	40 24% 30 18%	1 0.07(0.03-0.17)	0.0	0.028(0.007-0.115)	0.0

Table 3 Bivariate and multivariable analysis of factors associated with neonatal sepsis among neonates admitted to the NICU of WUSH , Wolkite Ethiopia, 2023

6. Discussion

Neonatal sepsis contributes substantially to neonatal morbidity and mortality and is a major global public health challenge. In this study, the magnitude and associated risk factors neonatal sepsis among neonates admitted to the NICU of WUSH were investigated over the past one year. Accordingly, the overall prevalence of neonatal sepsis was 58.1% with mortality rate of 6% from total admission of neonates. More than three fourth 70 (76%) of the neonates were diagnosed as EONS and around one fourth 27 (27%) of them were diagnosed as LONS.

This finding is more likely in line with a study conducted in Gondar (67.9%). The possible reason for having comparable results might be due to similarities of study population studied in the same area but, it was higher than study conducted at Wachemo University Comprehensive Specialized Teaching Hospital, NICU which was neonatal sepsis prevalence of 39.5%, (44) and in hospitals of wolaita sodo town, southern Ethiopia, among 275 neonate admitted to NICU, the overall prevalence was 33.8% and among them 26.9% (among the total it become 79.5%)of the neonates had EONS and 6.9%(among the total it become 20.5%) of the neonates had LONS. (29). This difference might have been contributed by methodological differences, socio-demographic factors, and economic status of the study population.

This study showed that neonates born to mothers who had PROM during the index pregnancy had 6 times higher odds of developing sepsis as compared to the counterpart [AOR =6.3; 95% CI[(2-19.9)]. This result goes in line with the cross-sectional study conducted at Wachemo University Comprehensive Specialized Teaching Hospital, NICU, southern Ethiopia, 2022, among 205 neonates , where the odds of developing neonatal sepsis among neonates born from mothers with a history of PROM were 7.5 times more likely (44). This can be explained by the fact that early ROM increases the chance of microorganisms to ascend from the birth canal into the amniotic sac and fetal compromise as well as asphyxia, which may lead to sepsis.

The sex of neonates was significantly associated with neonatal sepsis. In our study The odds of having neonatal sepsis among male neonates were 5.5 times higher as compared to female neonates [AOR = 4.2; 95% CI (1.8-16.5)]. Based on cross-sectional study conducted in Amhara regional state, central Gondar zone public primary hospitals in Ethiopia ,2019, among total of 352 subjects, male was 3.7 times more likely to develop neonatal sepsis as compared to females (39). The reason could be being male is associated with a higher risk of neurological, pulmonary, cardiovascular, and infectious morbidities as well as overall mortality when

compared to female neonate of similar preterm gestation. Important differences in the immune response between male and female preterm neonates have also been noted. However, the etiology of sex-specific differences in disease remains relatively undetermined and is likely multifactorial, with genetic, immunological, and hormonal influences playing key roles.

Neonates with lower APGAR score (< 7) are at higher risk for NNS that could be due to presence of the cause of lower APGAR as a comorbidites or more need of resuscitations, which found to be a substantial risk factor for neonatal sepsis since many life-saving treatments, like suctioning and endotracheal intubations, can cause transient and persistent bacteremia, and resuscitation may be performed with contaminated equipment, introducing microorganisms into the lungs of the neonate's immune system, which is still developing.

Others also explain the reason by theory that a neonate who had a compromised APGAR score might have been exposed to infection causing microbes at birth or might have a decreased respiratory other body function at birth which pose a risk to infection later in life compared to those neonates functioning well at birth.

Place of delivery also has a significant effect on neonatal sepsis. Based on our study the odds of having neonatal sepsis in neonate who born at health institution was 11 times higher those neonate who born at home [AOR = 11; 95% CI [(1.17-104)]]. This goes in line with the study done at primary hospitals in central Gondar zone, north west Ethiopia 2019, in a total of 352 subjects showed that, neonates delivered in the health institution were three times more likely to develop sepsis compared to those delivered at the home [AOR=3.05; 95% CI (1.19, 7.79)] (39).

Even if Neonatal age, history of chorioamnionitis, and neonatal comorbidities,had association with neonatal sepsis they were not found to be predictors of neonatal sepsis in this study, this is against the findings of studies on risk factors of neonatal sepsis indifferent parts of the world.

7. Strength and Limitation

7.1 Strength

- As the study design was retrospective documentary review, it will be baseline for prospective study.
- The study may reflect associated factors of neonatal sepsis.

7.2 Limitation

- Since the study was done on admitted neonates, these findings may lack generalizability to the entire population in the catchment area.
- Additionally, this study selectively addressed certain factors of neonatal sepsis while various other factors are not addressed such as history of maternal colonization with GBS, some of investigation modalities like blood culture(which may over estimate the prevalence of sepsis)
- Since we did retrospective study we couldn't asses some of variables like number of PV examination, presence or absence of maternal UTI

8. Conclusion and Recommendation

The overall prevalence of neonatal sepsis was 58.1% with mortality rate of 6% from total admission of neonates which was high, where our study had identified many factors, such as neonatal sex, mode of delivery, duration of labor, history of maternal PROM, neonatal comorbidities, APGAR score, and duration of hospital stay as having strong association for neonatal sepsis, So measures that reduce preventable causes of above factor need to be taken as to reduce the occurrence of sepsis.

Based on our study we recommend the following interventions:

- Health worker training and infection prevention strategies must be strengthened and/or implemented.
- Focusing on the specific determinants and provides information about neonatal sepsis risk factors to help the community adopt behavioral changes.
- Provision of health care services as per standards, and monitoring and evaluation of obstetrical/neonatal care during labor and delivery are mandatory
- Early detection and prevention of infection should be strictly applied to pre term, low birth weight and poor APGAR scoring babies

Finally further study should be done to see other unexplored associated factors that were not included in this study.

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Annexes

Socio-demographic characteristics		
No.	Question	Response
1	Mother's age	1 <30 years 2 >30 years
2	Residence	1 wolkite town 2 others
3	Neonate's age	1 <3 days 2 >=3 days
4	Neonate's sex	1 Male 2 Female
PART II. Maternal health related factors		
5	Parity	1 <1 delivery 2 > 2 delivery
6	Place of delivery	1. Home 2. Health Institution
7	Mode of delivery	1 SVD 2 Operative(instrumental and CD)
8	Duration of labor	1 <24 hrs 2 >24hrs
9	History of maternal PROM	1 yes 2 no
10	History of Chorioamnionitis	1 yes 2 no
11	MSAF	1 yes 2 no
III: A checklist on neonatal health related factors		
12	diagnosis of sepsis	1 yes 2 no
13	Is there comorbiditys?	1=yes

		2=no
		If no for n^{o} 13 or yes for n^{o} 14
		1, RDS
		2, PNA
		3, Birth injury
		4, NHB
		5, congenital disorders
		6, MAS
		7, Preterm
		8, others
14	NICU diagnosis	
15	Gestational age	1 < 37 weeks
		2 > 37 weeks
16	APGAR score	1 <7
		2>=7
17	Birth Weight at birth	1 <2500
		2 > 2500

18	Duration of hospital stay	1 <3 days 2 >=3 days
19	WBC	1 < 20k cells/m3
		2 > 20k cells/m3
20	Outcome	1=died 2=survived

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