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Original Article

# Neonatal Sepsis and Associated Factors among Neonates Admitted to a Hospital Neonatal Intensive Care Unit in Hossana, Ethiopia 2022: A Cross-sectional study

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## Abstract

**Introduction:** Neonatal sepsis is a major cause of neonatal deaths worldwide. The prevalence is highest in low - and middle - income countries. Without a significant reduction in neonatal sepsis, it will be impossible to achieve the 2030 sustainable development goal 3. Therefore, this study aims to assess the prevalence and associated factors of neonatal sepsis among neonates.

**Methods:** A hospital-based cross-sectional study was conducted with 361 participants from March 1 to May 30, 2022. A pre-tested questionnaire and check list were used to collect the data. Binary logistic regression analyses were employed to identify the factors associated with neonatal sepsis. $P < 0.05$ with a 95% CI was considered statistically significant.

**Results:** The overall prevalence of neonatal sepsis among neonates was 46.5%. Primipara [AOR = 1.7; 95% CI: 1.1, 2.9], history of premature rupture of foetal membranes [AOR = 4.0; 95% CI: 2.3, 5.8], chorioamnionitis [AOR = 3.4; 95% CI: 1.5, 7.6], neonatal age 8 – 28 days old [AOR = 6.5; 95% CI: 2.9, 14.6] and birth asphyxia [AOR = 1.8; 95% CI: 1.1, 3.0] were significantly associated with neonatal sepsis.

**Conclusion:** Neonatal sepsis is still prevalent in the study setting. Therefore, the Zonal Health Department and other concerned bodies should design appropriate intervention measures to eliminate risk factors for this condition.

## Introduction

Neonatal sepsis (NNS) is a clinical syndrome characterised by signs and symptoms of infection with or without accompanying bacteraemia in the first month of life.[1] Early onset sepsis (EOS) is sepsis in neonates that occurs at or before three days of life and late onset sepsis (LOS) is defined as sepsis occurring on or after three days up to 28 days of life.[2] NNS is a major contributor to neonatal mortality worldwide, with an estimated 1.3 million annual cases.[3] The prevalence is highest in low and middle-income countries and is the third leading cause of neonatal deaths.[1,4-6] In Sub-Saharan Africa NNS contributes to 17% of neonatal deaths as compared to 6% in developed countries.[1] In Ethiopia, the prevalence of NNS is 45%,[7] accounting for 18.5% of all neonatal deaths, preceded by birth asphyxia (31.5%) and preterm birth (21.8%).[8] NNS is responsible for 8% of deaths of children under five years of age.[9] Furthermore, NNS places economic burdens on the continents and countries involved.[10]

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Several studies have identified factors associated with NNS in different countries. However, the factors are not the same across different cultures and socioeconomic statuses. Rural resident, single mothers, low maternal educational level, primipara, urinary tract infections, intrapartum fever, pre-existing medical disease and anemia are documented maternal factors associated with NNS. Premature rupture of fetal membranes, chorioamnionitis, frequent vaginal examination, foul-smelling vaginal discharge and prolonged labor, are obstetric factors associated with NNS whereas neonates age 0 – 7 days, male sex, preterm birth, birth asphyxia, low birth weight, meconium stained amniotic fluid and congenital anomalies are all neonatal related factors.[11–26]

The Maternal and Child Health Directorate of Ethiopia developed a National Strategy for Newborns and Child Survival in Ethiopia (2015–2020) in 2015. The program uses strategies include equity and accessibility; community engagement, empowerment; integration, partnership, efficient use of resources, innovation and use of technology, evidence-based decision making; and the provision of quality maternal, newborn and child health services and others to reach the long-term goal of eliminating all preventable childhood deaths by 2035.[27] Despite this, a high number of neonatal deaths due to NNS have been reported in Ethiopia.

Findings from different studies indicated that the prevalence and factors were inconsistent and varied across different regions. Therefore, this study aims to assess the prevalence and associated factors of NNS in Ethiopia.

## Methods

A hospital-based cross-sectional study was conducted from 01 Mar 2022 to 30 May 2022 at NICU of Wachemo University Nigist Eleni Mohamed Memorial Comprehensive Specialized Hospital (NEMMCSH) in Hossana town, Southern Ethiopia. The study was initiated after getting approved by Institutional Review and Ethics Committee and the concerned Hospital authorities. The study population consisted of all neonates admitted to NICU in NEMMCSH in the study period. The single population proportion formula was used to determine the sample size with the following assumptions: the proportion of NNS cases was taken from a study conducted in Wolayita Public Hospitals (33.8%),[14] with a 95% confidence interval (CI), margin of error of 5 and a 5% non-response rate. As a result, the final sample size was 361 neonates. These 361 study participants were obtained using a consecutive sampling technique. A structured pre-tested questionnaire was used which had been derived from other related studies.[12–14,17–19,23] Midwifery students collected the data. The questionnaire was pre-tested on 5% of the sample size in the Durame Hospital, and necessary modifications were made as required. Written and informed consent was obtained from each respondent. The neonate presenting with any of the systemic manifestations of danger signs (not feeding well, convulsions, drowsiness or unconsciousness, movement only when stimulated or no movement at all), fast breathing (60 breaths per min), grunting, severe chest in-drawing, raised temperature $> 38°C$, hypothermia $< 35.5°C$, central cyanosis, severe jaundice, severe abdominal distension, or localizing signs of infection were diagnosed as neonatal sepsis. Epi-Data version 3.1 software was used for data entry, and SPSS version 24.0 was used for data analysis. Descriptive statistics, frequencies, and proportions were used to summarize the results. We used binary logistic regression analyses to determine the factors associated with neonatal sepsis. Initially, all independent variables were examined using bivariate logistic regression analysis. Then, variables that had a p value of $\leq 0.25$ in the bivariate logistic regression analysis were transferred to multivariable logistic regression. The degree of association between the independent and dependent variables was determined using the odds ratio. The statistical significance was affirmed at a P value of $< 0.05$ with a 95% CI. A Hosmer–Lemeshow goodness-of-fit test was used to ensure that the needed assumptions for multivariable logistic regressions were met.

## Results

A total of 361 charts of neonates admitted to the NICU were reviewed. The sociodemographic and obstetrics characteristics have been charted in Tables 1 and 2. The associated factors in NNS have been depicted in Table 3.

**Table 1:** Sociodemographic and obstetrics characteristics of the study population

| Variables | Categories | Frequency (N = 361) | Percent (%) |
|---|---|---|---|
| Maternal age | < 20 years | 32 | 8.9 |
| | 20 - 24 years | 105 | 29.1 |
| | 25 – 34 years | 206 | 57.1 |
| | ≥ 35 years | 18 | 5.0 |
| Residence | Urban | 142 | 39.3 |
| | Rural | 219 | 60.7 |

| | | | |
|---|---|---|---|
| Marital status | Single | 12 | 3.4 |
| | Married | 349 | 96.7 |
| Religion | Protestant | 236 | 65.4 |
| | Orthodox | 84 | 23.3 |
| | Muslim | 36 | 10.0 |
| | Catholic | 5 | 1.4 |
| Ethnicity | Hadiya | 279 | 77.3 |
| | Kambata | 47 | 13.0 |
| | Silte | 16 | 4.4 |
| | Other | 19 | 5.3 |
| Educational status | Unable to write and read | 27 | 7.5 |
| | Primary | 175 | 48.5 |
| | Secondary | 89 | 24.7 |
| | College and above | 70 | 19.4 |
| Occupation | Governmental employs | 59 | 16.3 |
| | Private employs | 92 | 25.5 |
| | Merchant | 63 | 17.5 |
| | House wife | 147 | 41.7 |

**Table 2:** Obstetrics and fetal characteristics in the study population

| Variable | Categories | Frequency | Percent (%) |
|---|---|---|---|
| Parity (N = 361) | Primipara | 158 | 43.8 |
| | Multipara | 203 | 56.2 |
| Antenatal care | Yes | 348 | 96.4 |
| | No | 13 | 3.6 |
| Frequency of ANC (N = 356) | ≤ 4 ANC visits | 163 | 46.8 |
| | ANC 4+ visits | 185 | 53.2 |
| Place of delivery | Hospital | 316 | 87.5 |
| | Health center | 40 | 11.1 |
| | Home | 5 | 1.4 |
| Duration of labor (N = 356) | < 6 hours | 60 | 16.9 |
| | 6 - 12 hours | 183 | 51.4 |
| | 12 – 24 hours | 113 | 31.7 |
| Frequency of PV exam during labor (N = 356) | ≤ 3 times | 135 | 37.9 |
| | > 3 times | 221 | 62.1 |
| History of premature rupture of fetal membranes (N = 356) | Yes | 143 | 40.2 |
| | No | 213 | 59.8 |
| History of maternal urinary tract infection | Yes | 26 | 7.2 |
| | No | 335 | 92.8 |
| Chorioamnionitis | Yes | 88 | 24.4 |
| | No | 273 | 75.6 |
| Meconium stained amniotic fluid (N = 356) | Yes | 131 | 36.8 |
| | No | 225 | 63.2 |

| | | | |
|---|---|---|---|
| Sex of neon ate | Male | 219 | 60.7 |
| | Female | 142 | 39.3 |
| Age of neonate | 0 - 7 days | 313 | 86.7 |
| | 8 - 28 days | 48 | 13.3 |
| Type of sepsis | Early onset | 127 | 75.6 |
| | Late onset | 41 | 24.4 |
| Birth weight (N = 356) | < 2.5 kg | 111 | 31.2 |
| | 2.5 - 4 kg | 229 | 64.3 |
| | > 4 kg | 16 | 4.5 |
| Gestational age | < 37 weeks | 106 | 29.4 |
| | 37 - 42 weeks | 244 | 67.6 |
| | > 42 weeks | 11 | 3.0 |
| Birth asphyxia (N = 356) | No | 227 | 63.8 |
| | Yes | 129 | 36.2 |

**Table 3:** Associated factors of neonatal sepsis

| Character | Category | Neonatal sepsis | | OR at 95% CI | |
|---|---|---|---|---|---|
| | | No | Yes | Crude OR | Adjusted OR |
| Age of neonate | 0 - 7 days | 182 | 131 | reference | Reference |
| | 8 - 28 days | 11 | 37 | 4.7 (2.3, 9.5) | 6.5 (2.9, 14.6)** |
| Parity | Primipara | 75 | 83 | 1.5 (1.0, 2.3) | 1.7 (1.0, 2.9)* |
| | Multipara | 118 | 85 | Reference | Reference |
| History of premature rupture of fetal membranes | No | 148 | 67 | Reference | Reference |
| | Yes | 45 | 101 | 4.5 (3.1, 7.8) | 4.0 (2.7, 7.5)** |
| Chorioamnionitis | No | 175 | 116 | Reference | Reference |
| | Yes | 16 | 49 | 4.5 (2.5, 8.4) | 3.4 (1.5, 7.6)** |
| Maternal UTI | No | 187 | 148 | Reference | Reference |
| | Yes | 6 | 20 | 4.2 (1.6,10.8) | 0.8 (0.2,2.8) |
| Birth asphyxia | No | 130 | 96 | Reference | Reference |
| | Yes | 61 | 69 | 1.5 (1.0, 2.4)* | 1.8 (1.1, 3.0)* |
| Birth weight | Low birth (< 2.5kg) | 67 | 44 | 0.7 (0.4, 1.1) | 1.3 (0.8,2.3) |
| | Normal birth weight (2.5 - 4 kg) | 116 | 113 | Reference | Reference |
| | Macrosomic (> 4 kg) | 8 | 8 | 1.0 (0.4, 2.8) | 2.2(0.7,7.2) |
| Duration of labor | < 6 hours | 36 | 25 | Reference | Reference |
| | 6 - 12 hours | 104 | 81 | 1.1 (0.6,2.0) | 0.8 (0.4,1.8) |
| | 12 - 24 hours | 53 | 62 | 1.6 (0.9,3.2) | 1.2 (0.6,2.5) |

## Discussion

NNS was found to be prevalent in this study as it affected 46.5% (95% CI: 41.4–51.7%) of neonates. Similar results were found for studies conducted in Ruvuma, Tanzania (49.8%), and eastern Ethiopia (45.8%).[26,28] However, the incidence was greater than that obtained from studies in southern Ethiopia (33.8%),[14] northwest Ethiopia (11.7%), [29] south East Ethiopia (34%),[25] Kenya (28.6%)[12] and Ghana (17%).[15] The increased prevalence in this study may be related to sociocultural variations across research sites and the method used to diagnose NNS. Furthermore, this discrepancy is a sign of the failure of national initiatives to improve neonatal care services.

On the other hand, the prevalence of NNS in this study was found to be lower than that of studies conducted in Yergalem (53.3%),[11] Central Gondar Zone (64.8%),[22] Arba Minch (78.3%),[24] Woldia and Dessie (64.8%)[30] and Bangladesh (69.3%).[23] Possible explanations for this variation include differences in quality of care from pregnancy to delivery and the postnatal period, as well as facility-specific disparities in professional expertise related to the prevention of NNS during labour and delivery. Furthermore, the frequency of NNS cases may be influenced by health-seeking habits, socioeconomic status and disparities between rural and urban locations within the research areas.

NNS was also found to be present more in neonates aged eight to 28 days old. This was consistent with studies in Ethiopia,[14] Ghana[16] and Tanzania[26] that reported that neonates aged eight to 28 days old were more likely to develop NNS, whereas it was inconsistent with other studies in Ethiopia,[11,16] which reported that neonates aged 0 – 3 days old were significantly more likely to suffer from NNS. Gaps in sociocultural norms and maternal knowledge of infant care in the community may explain this difference.

The present study noted that premature rupture of fetal membranes was positively associated with NNS, in congruence with similar studies in Ethiopia, Kenya and Bangladesh.[12,21-23,28,30] A possible reason for this finding may be that bacteria colonizing the perineum and vaginal canal can move up the uterine canal into the amniotic sac. NNS was significantly associated with primiparous woman which is in accordance to another study from Ghana.[16] A probable explanation is that obstetric complications are more common in this group, such as prolonged and obstructed labor, which may subsequently increase the chances of NNS. Another reason may be that newborns can acquire infection during birth by picking up pathogens that are present in the women's reproductive tract.

Neonates who experienced birth asphyxia were at greater risk of NNS compared to their counterparts, which is in line with what has been found in Ethiopia, Kenya, Ghana and Bangladesh.[12,15,24,28] The possible cause might be that most neonates with birth asphyxia remain in NICU for a longer period, increasing their chance of contracting hospital-acquired infections. Furthermore, birth asphyxia facilitates systemic infections by inhibiting leukocyte activity because it requires energy for cytoskeletal microfilament contractions.

A higher risk of NNS is also linked to chorioamnionitis. This is in line with research from Congo[13] and Ethiopia.[21,23] The chorioamnionitis-related inflammatory problems and resulting neonatal immunological dysfunction, which makes newborns more susceptible to infection after birth, could serve as a viable explanation. Another argument could be that NNS could be acquired by the vertical transmission of microorganisms through the placenta.

The prevalence of NNS is quite alarming in Ethiopia. Hence, the Zonal Health Department and other concerned bodies should design appropriate intervention measures to eliminate these primary risk factors for this condition. Healthcare providers should furnish appropriate prophylaxis for women with PROM and chorioamnionitis, as well as work on early identification and other measures to prevent birth asphyxia. Researchers interested in exploring this topic should also take microbiological evidence into account.

The present study does have its limitations. First, the study's sample may not be representative of the larger community because it was carried out in a single hospital. Second, in our investigation, we classified NNS based on clinical data only. This could have led to an overestimation or underestimation of the incidence of NNS.

## Conclusion

NNS is quite prevalent in Ethiopia. Neonatal age eight to 28 days, primiparity, chorioamnionitis, premature rupture of foetal membranes and birth asphyxia have all been identified as risk factors for NNS.

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