

**PROPORTION OF EARLY ONSET SEPSIS IN LOCAL NICU AND IDENTIFICATION OF MATERNAL RISK FACTORS**

**HABIB M\***

Department of Paediatrics Combined Military Hospital Peshawar, Pakistan

\*Corresponding author's email address: [mashalhabib76@gmail.com](mailto:mashalhabib76@gmail.com)

(Received, 10<sup>th</sup> June 2024, Revised 14<sup>th</sup> September 2024, Published 18<sup>th</sup> September 2024)

**Abstract:** Early onset neonatal sepsis (EOS) remains a significant cause of morbidity and mortality in neonatal intensive care units (NICUs). Identifying maternal risk factors associated with EOS is crucial for early diagnosis and prevention. **Objective:** To evaluate the prevalence of early onset sepsis in neonates admitted to the local neonatal intensive care unit (NICU) and identify maternal risk factors associated with neonatal sepsis. **Methods:** A comparative cross-sectional study was conducted at the Pediatrics Department, Combined Military Hospital Peshawar, from January 2021 to May 2022. One thousand neonates admitted to the NICU due to any indication were included. A consultant paediatrician or neonatologist diagnosed neonatal sepsis based on clinical signs and laboratory findings. Maternal factors such as age, premature rupture of membranes (PROM), maternal fever, and chorioamnionitis were analyzed for their association with early onset sepsis. Data were statistically analysed using SPSS, with  $p$ -value  $<0.001$  considered significant. **Results:** Out of 1000 neonates, 690 (69%) were male and 310 (31%) were female. The mean maternal age was  $33.38 \pm 4.53$  years. EOS was observed in 123 neonates (12.3%), while 877 (88.7%) neonates showed no signs of sepsis. PROM and chorioamnionitis were significantly associated with early-onset sepsis ( $p$ -value  $<0.001$ ). **Conclusion:** Early onset neonatal sepsis is a common condition in neonates admitted to the NICU. Neonates born to mothers with PROM or chorioamnionitis were at a significantly higher risk of developing EOS. These findings emphasise the importance of addressing maternal risk factors in reducing the incidence of neonatal sepsis.

**Keywords:** Maternal Risk Factors; Neonates; Sepsis

## Introduction

The multidisciplinary team is usually responsible for the well-being of neonates, who are fragile individuals prone to multiple hazards if not managed well. The neonatal intensive care unit usually has trained staff to manage high-risk babies with health-related problems (1). Lower- and middle-income countries like ours are behind in antenatal services, increasing the burden of tertiary care units for tertiary care (2). Various risk factors in the maternal or fetal profile make the neonates high risk and warrant admission to the neonatal intensive care unit (3). The maternal body environment has been perfectly designed per the fetus's well-being, but in a few cases, this may not hold valid, and maternal health parameters may pose a risk to the baby's health (4). Various factors in a mother's sociodemographic or health profile may lead to high mortality and morbidity indices in the newborn, ranging from mild self-limiting complications to potentially life-threatening conditions (5, 6). Clinicians have done studies to pick up the risk factors associated with various poor neonatal outcomes, including early onset sepsis. Sands et al. 2022 discussed multiple aspects of early-onset neonatal sepsis in low- and low-income countries. They summarised that various factors are linked to the aetiology and outcome of early-onset sepsis, and prevention is the best strategy by focusing on risk factors (7). Flannery et al., 2022, published a study regarding identifying term and preterm infants at the lowest risk of early-onset sepsis using delivery characteristics.8 They concluded that babies with low-risk delivery characteristics were also at low risk of having early-onset

sepsis. This highlights the role of early identification and management of risk factors to prevent this potentially lethal condition. A case-control study regarding data from Ethiopia in 2021 aimed to look for determinants of neonatal sepsis among neonates delivered in Southwest Ethiopia in 2018 (9). They concluded that a history of meconium-stained amniotic fluid, foul-smelling liquor, maternal sexually transmitted infection/urinary tract, vascular catheter and low birth weight were significantly associated with the presence of early onset sepsis among their study participants.

Neonatal sepsis, especially early onset, poses a lot of burden on the baby, parents and health care system. Staying in NICU is not only expensive but also associated with other health care problems. The use of antibiotics is also associated with increased morbidity in neonates. Crus, therefore, lies in picking the high-risk cases early and preventing this phenomenon. A recent local study at Bahawal Victoria Hospital, Pakistan, highlighted the treatment outcomes, antibiotic use and resistance patterns among patients managed with neonatal sepsis (10). Limited local data on risk factors, especially maternal ones, associated with early onset sepsis have been available. Therefore, we planned this study to look for early onset sepsis in the local neonatal intensive care unit and identify maternal risk factors associated with sepsis.

[Citation Habib, M. (2024). Proportion of early onset sepsis in local NICU and identification of maternal risk factors. *Biol. Clin. Sci. Res. J.*, 2024: 1127. doi: <https://doi.org/10.54112/bcsrj.v2024i1.1127>]



**Methodology**

This comparative cross-sectional study was conducted at the nursing intensive care unit of Combined Military Hospital Peshawar from January 2021 to May 2022. The sample size was calculated by the WHO Sample Size Calculator using the population prevalence proportion of early-onset sepsis in neonates as 1.8% (11). The non-probability Consecutive sampling technique was used to gather the sample.

All babies born at our hospital, required admission to the nursing intensive care unit for any reason and stayed there for at least 48 hours were included in the study.

The neonates with severe congenital malformations or metabolic disorders, those who could not survive for 48 hours after admission in the nursing intensive care unit, or those whose parents got discharged against advice before 48 hours of admission were excluded from the study. Those neonates with any immuno-compromised condition at birth were excluded as well.

After ethical approval from the ethical review board committee via IREB letter no 25071-N and written informed consent from the parents or guardians of the potential participants or their caregivers, neonates who were admitted to the nursing intensive care unit of CMH PSW fulfilling the inclusion mentioned above and exclusion criteria were included in the study. Neonatal sepsis was diagnosed by a consultant neonatologist or paediatrician based on international pediatric sepsis consensus conference criteria, incorporating clinical and laboratory findings, including blood cultures (12). Premature rupture of membranes was diagnosed by a consultant obstetrician during labour and documented in the file of the patient and conveyed to the neonatology team as well.<sup>13</sup>Chorioamnionitis was diagnosed by incorporating the following clinical and laboratory data like maternal fever, maternal tachycardia, fetal tachycardia, uterine tenderness, purulent or foul-smelling amniotic fluid or vaginal discharge, and maternal leukocytosis (14). The characteristics of neonates participating in the study and the outcome variables were described with the help of descriptive statistics. Pearson chi-square analysis was done to evaluate the association of various maternal risk factors with the presence of early-onset sepsis in our study participants. Statistics Package for Social Sciences version 24.0 (SPSS-24.0) was used for the analysis mentioned above. The p-values less than or equal to 0.05 were considered significant for ascertaining the association between variables.

**Results**

A total of 1000 neonates admitted to the nursing intensive care unit were included in the final analysis. Of them, 690 (69.0%) were male, while 410 (41%) were females. Table I summarises the general characteristics of the study participants. The mean age of the mothers of newborns included in the study was 33.38±4.53 years. Out of all the neonates in the study, 123 (12.3%) had early onset sepsis, while 887 (88.7%) neonates did not show any signs of sepsis.

Table II shows the results of the chi-square analysis. It was revealed that premature rupture of membranes (PROM) and chorioamnionitis in mothers of neonates were the factors statistically significantly associated with the presence of

early-onset sepsis in our target population (p-value<0.001). (Table 1)

**Table 1: Characteristics of mothers and neonates included in the study**

Study parameters	n (%)
<b>Maternal Age (years)</b>	
Mean ± SD	33.38±4.53 years
Range (min-max)	18-44 years
<b>Gender of neonates</b>	
Male	690 (69%)
Female	410 (41%)
<b>Neonatal sepsis</b>	
No	877 (87.7%)
Yes	123 (12.3%)
<b>Chorioamnionitis</b>	
No	905 (90.5%)
Yes	95 (9.5%)
<b>Mode of delivery</b>	
Normal vaginal	530 (53%)
Cesarean	290 (29%)
Instrumental	180 (18%)
<b>Premature rupture of membranes</b>	
No	853 (85.3%)
Yes	147 (14.7%)

**Table 2: Maternal risk factors associated with early onset sepsis in neonates included in the study**

Factors	No early onset sepsis	Early onset sepsis	p-value
<b>Maternal age</b>			
<35 years	723 (81.5%)	93 (75.6%)	0.076
>35years	154 (18.5%)	30 (24.4%)	
<b>Maternal fever</b>			
No	763 (86.1%)	110 (89.4%)	0.438
Yes	114 (13.9%)	13 (10.6%)	
<b>Premature rupture of membranes</b>			
No	772 (87.1%)	81 (65.8%)	<0.001
Yes	105 (12.9%)	42 (34.2%)	
<b>Chorioamnionitis</b>			
No	824 (92.9%)	81 (65.8%)	<0.001
Yes	53 (7.1%)	42(34.2%)	

**Discussion**

Around 1/4th of the study participants had evidence of early onset sepsis, and PROM and chorioamnionitis were strongly associated with this finding. Neonates admitted in intensive care units are otherwise with compromised healthcare parameters and at increased risk of various long and short-term complications. Infections remain the most typical cause of mortality and morbidity in individuals of all age groups in lower and middle-income countries. Neonates are no exception to it, and sepsis in this group of patients may have life-threatening consequences. Early detection of this potentially life-threatening condition is critical and could be possible by screening the high-risk cases. We designed this study to look for early onset sepsis in the local neonatal intensive care unit and identify maternal risk factors associated with sepsis.

[Citation Habib, M. (2024). Proportion of early onset sepsis in local NICU and identification of maternal risk factors. Biol. Clin. Sci. Res. J., 2024: 1127. doi: <https://doi.org/10.54112/bcsrj.v2024i1.1127>]

Alemu et al. 2019 conducted a case-control study in Ethiopia to look for determinants of neonatal sepsis among neonates in the northwest part of the county. They revealed that along with some foetal determinants, premature rupture of membranes was an important maternal determinant of neonatal sepsis in their study participants (15). The findings of our study were not significantly different from those of Alemu et al., and premature rupture of membranes along with chorioamnionitis were significant risk factors associated with early onset sepsis in our study participants. Stoll et al. 2020 published a profile of neonates with early onset sepsis from 2015 to 2017. They came up with the findings that pre-term and low birth weight infants were more prone to develop this condition, and in maternal factors, chorioamnionitis was significantly associated with neonatal sepsis (16). Our findings also supported their results as neonatal sepsis turned out to be a common condition found in neonates admitted to the nursing intensive care unit of our hospital. Neonates with their mothers having premature rupture of membranes or chorioamnionitis were more at risk of having this condition than others. Risk factors for the development of neonatal sepsis in a neonatal intensive care unit of a tertiary care hospital in Nepal were studied by Manadhar et al. in 2021. It was concluded that this condition is complex regarding predisposing and precipitating factors. Maternal, foetal and nosocomial factors play an essential role in different modes. We didn't study foetal or nosocomial factors, but PROM and chorioamnionitis were maternal factors associated with early-onset sepsis in our study. Adatara et al. (2019) published a study in Ghana regarding risk factors associated with neonatal sepsis at a tertiary care hospital. They came up with the findings that parity, mode of delivery, bleeding disorder and premature rupture of membranes were the maternal factors associated with neonatal sepsis. We only studied early-onset neonatal sepsis and found premature rupture of membranes and chorioamnionitis associated with it.

This data from one nursing intensive care unit could not be generalised. Maternal fever and premature membrane rupture were confounding factors with neonatal sepsis, which may create bias. Strict control of confounding factors and recruiting neonates from multiple NICUs, especially public-sector hospitals, may generate generalisable results.

## Conclusion

Early onset neonatal sepsis turned out to be a common condition found in neonates admitted to the nursing intensive care unit. Neonates with their mothers having premature rupture of membranes or chorioamnionitis were more at risk of having this condition than others.

## Declarations

### Data Availability statement

All data generated or analysed during the study are included in the manuscript.

### Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-13/22-TCHAAD)

### Consent for publication

Approved

### Funding

Not applicable

## Conflict of interest

The authors declared the absence of a conflict of interest.

## Author Contribution

### MASHAL HABIB (Trainee, Medical Officer)

Coordination of collaborative efforts.

Study Design, Review of Literature.

Conception of Study, Development of Research protocol and drafting

## References

1. Al-Wassia H, Saber M. Admission of term infants to the neonatal intensive care unit in a Saudi tertiary teaching hospital: cumulative incidence and risk factors. *Ann Saudi Med.* 2017;37(6):420-424. doi:10.5144/0256-4947.2017.420
2. Quddusi AI, Razzaq A, Hussain S, Hussain A. Pattern of neonatal admission at the Children's Hospital and the Institute of Child Health, Multan. *J Ayub Med Coll Abbottabad.* 2012;24(2):108-110
3. Chow S, Chow R, Popovic M, et al. A Selected Review of the Mortality Rates of Neonatal Intensive Care Units. *Front Public Health.* 2015;3:225. Published 2015 Oct 7. doi:10.3389/fpubh.2015.00225
4. Fisher AL, Sangkhae V, Presicce P, Chougnet CA, Jobe AH, Kallapur SG, et al. Fetal and amniotic fluid iron homeostasis in healthy and complicated murine, macaque, and human pregnancy. *JCI Insight.* 2020 Feb 27;5(4):e135321. doi: 10.1172/jci.insight.135321. PMID: 31990688; PMCID: PMC7101151.
5. Salman M, Rathore H, Arif S, Ali R, Khan AA, Nasir M. Frequency of Immediate Neonatal Complications (Hypoglycemia and Neonatal Jaundice) in Late Preterm and Term Neonates. *Cureus.* 2021 Jan 5;13(1):e12512. doi: 10.7759/cureus.12512. PMID: 33564518; PMCID: PMC7863071.
6. Khowaja WH, Leghari AL, Hussain AS, Ariff S, Khan IA. Frequency and Early Complications of Late Preterm Infants: A Descriptive Analysis from Two Secondary-care Hospitals of Karachi. *Cureus.* 2019 Sep 28;11(9):e5789. doi: 10.7759/cureus.5789. PMID: 31728236; PMCID: PMC6827863.
7. Sands K, Spiller OB, Thomson K, Portal EAR, Iregbu KC, Walsh TR. Early-Onset Neonatal Sepsis in Low- and Middle-Income Countries: Current Challenges and Future Opportunities. *Infect Drug Resist.* 2022;15(3):933-946. Published 2022 Mar 9. doi:10.2147/IDR.S294156
8. Flannery DD, Mukhopadhyay S, Morales KH, Dhudasia MB, Passarella M, Gerber JS et al. Delivery Characteristics and the Risk of Early-Onset Neonatal Sepsis. *Pediatrics.* 2022;149(2):e2021052900. doi:10.1542/peds.2021-052900
9. Dirirsa DE, Dibaba Degefa B, Gonfa AD. Determinants of neonatal sepsis among neonates delivered in Southwest Ethiopia 2018: A case-control study. *SAGE*

Open Med. 2021;9(1):20503121211027044. Published 2021 Jun 24. doi:10.1177/20503121211027044

10. Atif M, Zia R, Malik I, Ahmad N, Sarwar S. Treatment outcomes, antibiotic use and its resistance pattern among neonatal sepsis patients attending Bahawal Victoria Hospital, Pakistan. PLoS ONE. 2021;16(1):e0244866. <https://doi.org/10.1371/journal.pone.0244866>

11. Camargo JF, Caldas JPS, Marba STM. Early neonatal sepsis: prevalence, complications and outcomes in newborns with 35 weeks of gestational age or more. Rev Paul Pediatr. 2021;40(2):e2020388. Published 2021 Oct 4. doi:10.1590/1984-0462/2022/40/2020388

12. Rafi MA, Miah MMZ, Wadood MA, Hossain MG. Risk factors and aetiology of neonatal sepsis after hospital delivery: A case-control study in a tertiary care hospital of Rajshahi, Bangladesh. PLoS ONE. 2020;15(11):e0242275. <https://doi.org/10.1371/journal.pone.0242275>

13. Ghafoor S. Current and Emerging Strategies for Prediction and Diagnosis of Prelabour Rupture of the Membranes: A Narrative Review. Malays J Med Sci. 2021;28(3):5-17. doi:10.21315/mjms2021.28.3.2

14. Conde-Agudelo A, Romero R, Jung EJ, Garcia Sánchez ÁJ. Management of clinical chorioamnionitis: an evidence-based approach. Am J Obstet Gynecol. 2020;223(6):848-869. doi:10.1016/j.ajog.2020.09.044

15. Alemu M, Ayana M, Abiy H, Minuye B, Alebachew W, Endalamaw A. Determinants of neonatal sepsis among neonates in the northwest part of Ethiopia: a case-control study. Ital J Pediatr. 2019;45(1):150. Published 2019 Nov 28. doi:10.1186/s13052-019-0739-2

16. Stoll BJ, Puopolo KM, Hansen NI, Sanchez PJ, Bell EF, Carlo WA et al. Early-Onset Neonatal Sepsis 2015 to 2017, the Rise of Escherichia coli, and the Need for Novel Prevention. JAMA Pediatr. 2020;174(7):e200593. doi:10.1001/jamapediatrics.2020.0593

17. Manandhar S, Amatya P, Ansari I, Joshi N, Maharjan N, Dongol S et al. Risk factors for developing neonatal sepsis in a neonatal intensive care unit of a tertiary care hospital in Nepal. BMC Infect Dis. 2021;21(3):546-556. <https://doi.org/10.1186/s12879-021-06261-x>

18. Adatara P, Afaya A, Salia SM, Afaya RA, Konlan KD, Agyabeng-Fandoh E et al. Risk Factors Associated with Neonatal Sepsis: A Case Study at a Specialist Hospital in Ghana. ScientificWorldJournal. 2019;2019:9369051. Published 2019 Jan 1. doi:10.1155/2019/9369051



**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third-party material in this article are included in the article's Creative Commons licence unless indicated otherwise in a credit line to the material. Suppose material is not included in the article's Creative Commons licence, and your intended use is prohibited by statutory regulation or exceeds the permitted use. In that case, you must obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. © The Author(s) 2024