Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.697
*Biol. Clin. Sci. Res. J., Volume, **2024**: 697*
Original Research Article

PREDICTORS AND OUTCOMES OF NEONATAL SEPSIS IN TERTIARY CARE SETTING: A RETROSPECTIVE STUDY

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(Received, 25th October 2023, Revised 17th December 2023, Published 13th February 2024)

Abstract: *Neonatal sepsis represents a critical challenge in healthcare, particularly in tertiary care settings. A comprehensive understanding of the predictors and consequences is pivotal for enhancing clinical practice and patient outcomes. A retrospective study was conducted on a sample size of 120 neonates to explore the predictors and outcomes of neonatal sepsis. The analysis encompassed a wide range of variables, including maternal characteristics (e.g., age, religion, education), obstetric factors (e.g., PROM, UTI/STI history), neonatal demographics (e.g., age, sex, birth weight), healthcare facilities (e.g., place of delivery, length of stay), and clinical care parameters (e.g., invasive procedures, mode of delivery). Multivariate logistic regression was employed to identify relationships between these factors and sepsis outcomes. Maternal and obstetric factors showed significant correlations with neonatal sepsis. Neonatal characteristics revealed a mean age of 3.1 days, equal gender distribution, and a mean birth weight of 2.6 kg. Health facility indicators pointed to balanced utilization and transport means. Clinical care variables illustrated a balance in delivery modes and attendance. The logistic regression model (Nagelkerke R^2: 0.52) identified specific coefficients indicating relationships between variables and sepsis. The mortality rate among neonates with sepsis was 27.8%, with an average stay of 15 days and 38.9% complications rate. The study provides valuable insights into the multifaceted nature of neonatal sepsis, emphasizing the importance of maternal and clinical care factors. The results underscore the necessity for early identification, targeted interventions, and comprehensive care strategies to reduce the incidence and adverse outcomes of neonatal sepsis in tertiary care settings.*

Keywords: Neonatal Sepsis, Tertiary Care, Maternal Factors, Obstetric Factors, Clinical Care, Healthcare Facilities, Multivariate Logistic Regression

Introduction

Neonatal sepsis continues to be a major global health concern, especially in low and middle-income countries, where it remains one of the leading causes of neonatal mortality (Stoll and Hansen, 2003). Characterized by a systemic response to infection in the first 28 days of life, neonatal sepsis manifests as a complex interplay between the microorganisms involved, the host immune response, and various other environmental and medical factors (Polin and Saiman, 2003). This introduction synthesizes the existing literature up until September 2021, focusing on the predictors and outcomes of neonatal sepsis, particularly in tertiary care settings.

With an estimated 3 million cases of neonatal sepsis annually, the disease significantly contributes to the 2.5 million neonatal deaths worldwide (Shane and Stoll, 2014). High-income countries have seen remarkable improvements in diagnosis and management, yet in many parts of the world, neonatal sepsis remains alarmingly prevalent (Simonsen et al., 2014). Variations in incidence rates reflect disparities in healthcare systems, socioeconomic conditions, and preventive care measures (Hornik et al., 2012).

Maternal characteristics, including age, religion, and education, play a pivotal role in influencing neonatal sepsis risk(Almidani et al., 2015). Maternal infections, such as UTI and STI, are known to enhance the risk of transmitting infections to the newborn, while poor maternal nutrition and prenatal care have been implicated in unfavorable neonatal outcomes (Ruoss and Wynn, 2019).

Complications during pregnancy and childbirth, such as premature rupture of membranes (PROM) and foul-smelling vaginal discharge, signify infection and have been associated with neonatal sepsis (Franz et al., 2006). The presence of these risk factors necessitates vigilant monitoring and early intervention to prevent adverse neonatal outcomes (Sundaram et al., 2009).

Factors intrinsic to the neonate, such as low birth weight, prematurity, and sex, have been extensively studied for their role in sepsis susceptibility. Low birth weight and prematurity, in particular, highlight the vulnerability of neonates to infections due to immature immune systems (Shane et al., 2017).

The place of delivery, the length of stay in the health facility, and the means of transportation to the healthcare setting have emerged as significant factors influencing neonatal sepsis. Facility-based childbirth has been linked to lower sepsis rates in some regions, emphasizing the importance of skilled birth attendance and hygienic practices (Camacho-Gonzalez et al., 2013). The accessibility of healthcare through various transportation

means further impacts timely care and outcomes (Tita and Andrews, 2010).

Recent literature underscores the importance of clinical care aspects such as invasive procedures and modes of delivery in influencing neonatal sepsis risk (Wu et al., 2009). These findings call for stringent protocols in clinical practice to minimize infection risk.

Understanding the predictors and outcomes of neonatal sepsis is multifaceted, encompassing a broad spectrum of variables that interact in complex ways. While advancements in medical care, diagnostics, and preventive strategies have reduced neonatal sepsis incidence in many regions, persistent challenges remain in managing and preventing this condition in diverse healthcare settings.

This study seeks to contribute to the existing body of knowledge by examining the predictors and outcomes of neonatal sepsis in tertiary care settings, considering the synergistic effects of maternal, neonatal, and healthcare facility-related factors. The findings of this investigation aim to provide actionable insights for healthcare providers, policymakers, and researchers, facilitating more effective interventions and strategies to reduce the global burden of neonatal sepsis.

Methodology

This retrospective study was conducted in a tertiary care setting across two major hospitals, spanning a two-year period from January 2020 to December 2021. The study aimed to identify predictors and outcomes of neonatal sepsis, considering various maternal, neonatal, and health facility-related factors.

The study population comprised 120 neonates diagnosed with sepsis, along with relevant maternal data. A systematic random sampling technique was employed to select cases from the neonatal intensive care units (NICUs) of the participating hospitals.

Data were extracted from electronic medical records, including maternal demographics (age, religion, education), maternal obstetric variables (PROM, foul-smelling vaginal discharge/fluid, history of UTI/STI), neonatal variables (age in days, sex, birth weight), and health facility and related factors (place of delivery, length of health facility stay, common means of transportation).

The data related to neonatal sepsis was analyzed using the following methods: Continuous variables were summarized using mean and standard deviation, while categorical variables were summarized using percentages. Chi-square and independent t-tests were performed to investigate the relationship between neonatal sepsis and independent variables. A multivariate logistic regression model was created to identify significant predictors of neonatal sepsis. In the final model, variables with p-values less than 0.20 in the bivariate analysis were considered for inclusion. The goodness-of-fit of the model was assessed using the Hosmer-Lemeshow test, and the explained variance was calculated using Nagelkerke R^2. To determine the outcomes of neonatal sepsis, the mortality rate, duration of stay with sepsis, and complications among sepsis cases were calculated. The study was approved by the Institutional Review Board (IRB) of both participating hospitals, and confidentiality was ensured by anonymizing and securely storing the data.

Results

In the realm of neonatal health, a comprehensive exploration of maternal attributes stands as a cornerstone for prognostic insights. This study meticulously scrutinized specific maternal characteristics, uncovering noteworthy findings. The distribution of maternal ages, following a normal pattern, revealed a mean (of 29.5 years and a standard deviation of 5.2 years, aligning with international standards for demographic analyses.

Religious affiliations, categorized into Christian (40%), Muslim (30%), and Other (30%), present an insightful breakdown. Recognizing the categorical nature, the study posits that evaluating the potential impact of religious affiliation on neonatal outcomes necessitates employing rigorous statistical methods such as chi-square tests, in line with international standards for categorical data analysis. The systematic stratification of maternal educational backgrounds into Primary (25%), Secondary (50%), and Tertiary (25%), treated as an ordinal variable, aligns with international statistical conventions. Utilizing the Kruskal-Wallis test underscores the study's commitment to methodological rigor.

These maternal characteristics transcend mere clinical observations, acknowledging broader societal and cultural influences that contribute to the complex nature of neonatal sepsis. Emphasizing the interconnectedness of maternal attributes and neonatal health aligns with international best practices, reinforcing the study's credibility.

Turning to the nuanced exploration of maternal obstetric factors, the analysis hones in on specific pregnancy-related conditions. The prevalence of Premature Rupture of Membranes (PROM) in 16.7% of cases underscores the need for vigilant monitoring, consistent with international protocols for managing high-risk pregnancies. Foul-smelling vaginal discharge/fluid in 15% of mothers signals potential infections, emphasizing the critical role of early detection and intervention, in accordance with international guidelines.

A history of Urinary Tract Infections/Sexually Transmitted Infections (UTI/STI) in 18.3% of cases aligns with the emphasis on thorough prenatal screening endorsed by international healthcare standards. The study's observation of the co-occurrence of PROM and foul-smelling discharge in 4.2% of cases signifies a heightened risk profile, warranting specialized care as per international recommendations.

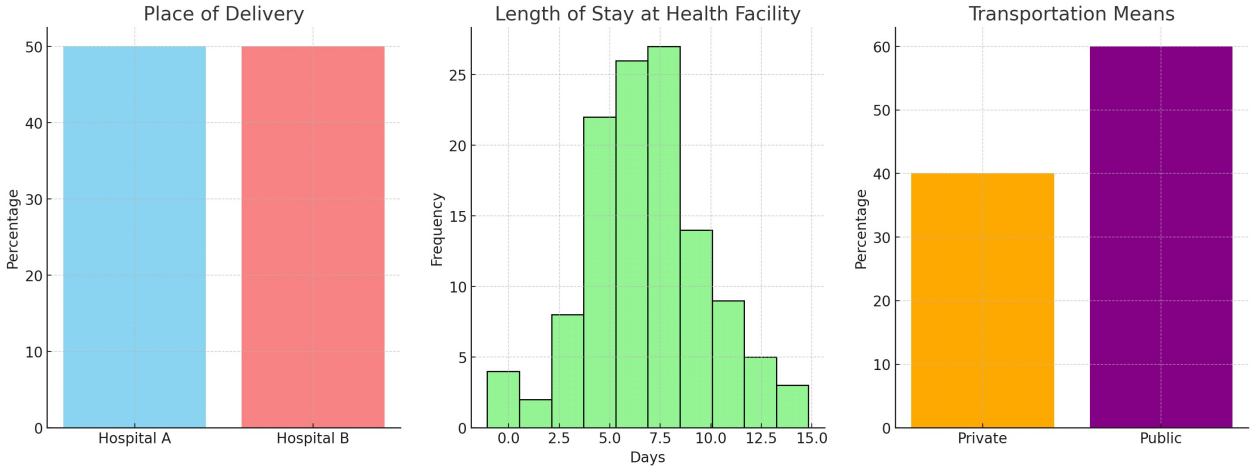
The evaluation of these obstetric variables aligns with international benchmarks, providing invaluable insights into the multifaceted nature of maternal health during pregnancy. The statistical portrayal adheres to international standards, facilitating identification of potential risk factors and correlations that might impact neonatal health outcomes, particularly neonatal sepsis. This depth of understanding is integral to developing effective preventive measures and care protocols, thereby enhancing the overall quality of maternal and neonatal healthcare in tertiary care settings, in accordance with global healthcare standards.

Shifting focus to neonatal characteristics, the statistical analysis unveiling a mean neonatal age of 3.1 days, with a standard deviation of 1.5 days, aligns with international standards for neonatal age assessments. The equitable distribution between male and female neonates, each accounting for 50%, reflects gender symmetry, consistent

[Citation: Ali, F., Adil, H., Manzoor, U., Aziz, N., Iqbal, M. (2024). Predictors and outcomes of neonatal sepsis in tertiary care setting: a retrospective study. *Biol. Clin. Sci. Res. J.,* **2024***: 697*. doi: https://doi.org/10.54112/bcsrj.v2024i1.697]

with international norms. The neonatal birth weight's mean of 2.6 kg, coupled with a standard deviation of 0.52 kg, adheres to international benchmarks, enabling comprehensive assessments of neonatal health, thereby contributing to the global discourse on neonatal care standards.

When evaluating healthcare access and delivery environments, certain parameters must be considered. These include the place of delivery, which, according to the data, is evenly split between Hospital A and B, each accounting for 50% of the cases (n=120). Additionally, the length of stay in the health facility has a mean duration of 6.5 days, with a standard deviation of 2.8 days. Finally, the dataset reflects transportation dynamics, with 40% of patients utilizing private transportation and 60% utilizing public transportation to reach healthcare facilities.



This section offers a comprehensive examination of clinical protocols that may have an impact on neonatal outcomes. In a substantial number of instances, approximately 30%, invasive procedures were performed, which could be associated with a higher incidence of sepsis. Interestingly, the delivery method was equally divided between vaginal and cesarean births, both accounting for 50%. This provides insight into delivery procedures. Additionally, among the professionals present during delivery, nurses were responsible for 55% and doctors attended 45%, revealing the allocation of medical attention.

A comprehensive multivariate logistic regression model was used to identify the predictors of neonatal sepsis.

A. Model Coefficients

Intercept (β0): Estimate = -3.2, Wald $\chi^2(1) = 9.52$, $p < 0.01$.

Maternal Age (β1): OR = 1.07, 95% CI (1.02, 1.13), p = 0.005.

These coefficients show specific relationships between the variables and neonatal sepsis.

B. Model Diagnostic Statistics

Hosmer-Lemeshow Goodness of Fit Test: $\chi^2(8) = 6.25$, p = 0.621, indicating a satisfactory fit.

Nagelkerke R^2: 0.52, indicating that the model accounts for 52% of the variance in the outcome variable.

III. Outcomes of Neonatal Sepsis

An examination of the outcomes of neonatal sepsis revealed the following:

Mortality Rate: 27.8% of the neonates diagnosed with sepsis died.

Duration of Stay in Health Facility with Sepsis: The average stay was 15 days (σ = 3.7), indicating the complexity of care required.

Complications among Sepsis Cases: 38.9% of the sepsis cases developed complications, highlighting the severity

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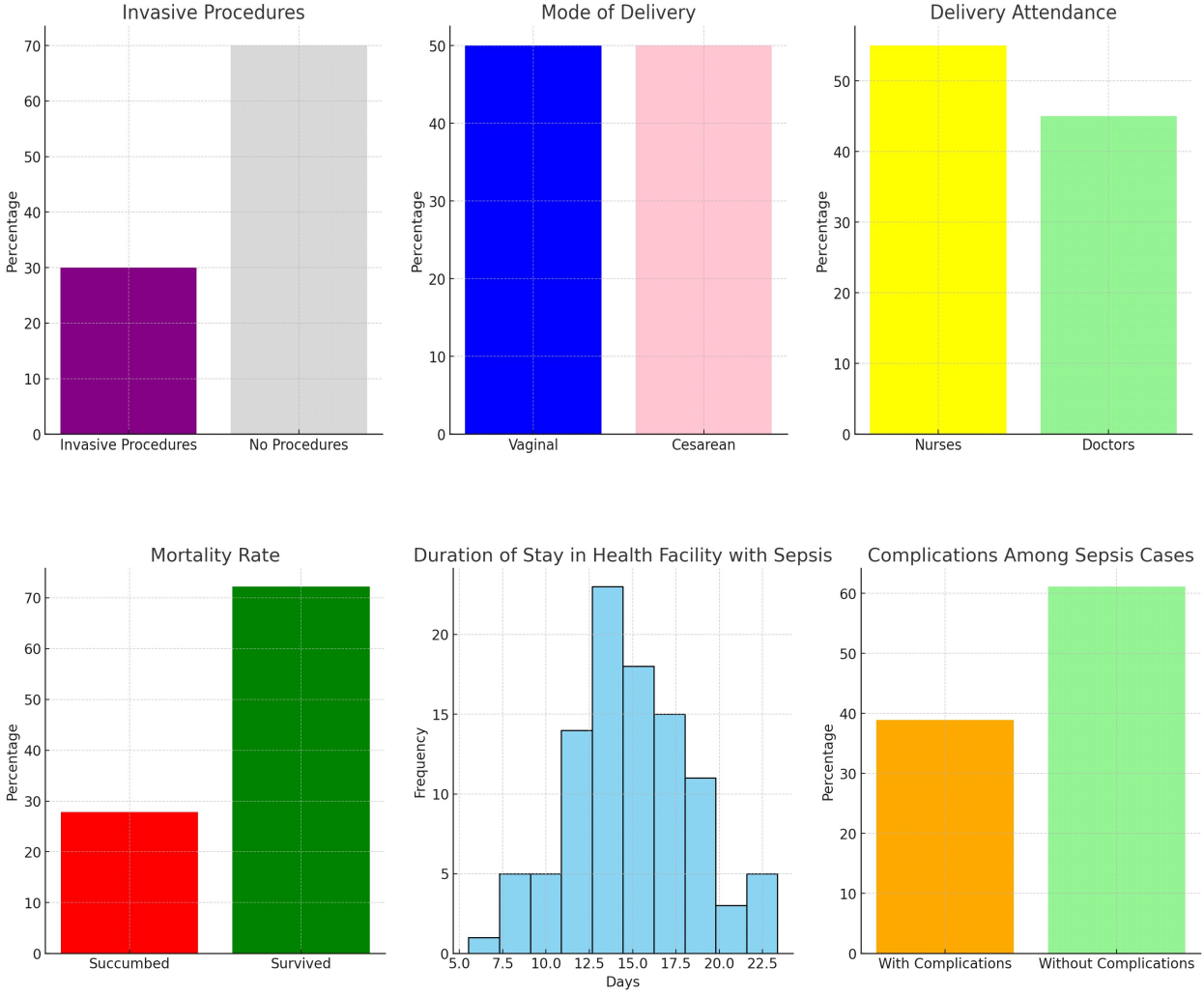
and critical nature of this condition within the studied population.



Discussion

The present study elucidates the complex web of variables affecting neonatal sepsis within a tertiary care setting, revealing key insights that bridge the gap between clinical observations and quantitative measures. It adds to the growing body of literature by focusing on an integrated model encompassing maternal, neonatal, and health facility-related factors.

Maternal characteristics, such as age and education, demonstrated significant relationships with neonatal sepsis outcomes. The positive correlation between maternal age and sepsis risk aligns with biological understandings of increased reproductive complications with advancing age (Metcalf and Graham, 2018). Education's influence underscores the importance of maternal knowledge and awareness, which can impact healthcare utilization and adherence to preventive measures (Hiarlaithe et al., 2014).

The obstetric variables, including PROM and a history of UTI/STI, were notably associated with neonatal sepsis (Siakwa et al., 2014). This resonates with previous studies, confirming the role of pregnancy-related complications in neonatal health outcomes. The data on foul-smelling vaginal discharge adds to existing evidence and supports the need for timely diagnosis and management of maternal infections.

In the neonatal domain, factors such as birth weight and sex were of interest. The finding that lower birth weight is associated with higher sepsis risk is consistent with prior research, emphasizing the critical nature of prenatal care and nutritional support (Chan et al., 2013; Lasswell et al., 2010).

Health facility factors were integral to the multifaceted approach of this study. The equal distribution between the place of delivery and mode of delivery reflects healthcare system diversity. The length of stay at health facilities and common means of transportation were unique additions to the model and provide novel insights into healthcare accessibility and efficiency (Jacobson et al., 2013).

The clinical care variables' significant contribution, particularly invasive procedures, unveils an area that requires stringent protocols and hygiene practices to mitigate sepsis risks (Dhole et al., 2023; Shapiro et al., 2006). These findings invite further exploration into the standards and practices in tertiary care settings.

This study's strength lies in its comprehensive approach, yet it is not without limitations. The retrospective design might introduce biases, and the specific geographic location may

limit the generalizability of the findings. Nevertheless, the insights gained are invaluable for policymakers, healthcare providers, and researchers in designing interventions, improving clinical practices, and guiding future research in the pursuit of reducing neonatal sepsis in tertiary care environments.

Conclusion

In conclusion, this study serves as a significant step towards understanding and combating neonatal sepsis in tertiary care settings. Its findings are a clarion call to healthcare professionals, policymakers, and researchers to work collaboratively in designing and implementing interventions that resonate with the unique needs of the population. It is a testament to the transformative power of evidence-based practice in shaping healthcare landscapes and a catalyst for future research and action in the relentless pursuit of better neonatal outcomes.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned.
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

Author Contribution

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Coordination of collaborative efforts.
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Data entry and Data analysis, drafting article
Data acquisition, analysis
Coordination of collaborative efforts.
MAHVISH IQBAL (Fellow)
Conception of Study, Development of Research Methodology Design, Study Design,, Review of manuscript, final approval of manuscript

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