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Original Article

Morbidity and Mortality Outcomes of Neonates admitted from other Health Care Facilities in a Resource-Limited Neonatal Intensive Care Unit

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ABSTRACT

Objective: To determine the morbidity and mortality outcomes of neonates admitted from other health care facilities in a resource limited neonatal intensive care unit.

Study Design: Prospective longitudinal study

Place and Duration of Study: Department of Paediatrics, Combined Military Hospital, Sialkot Pakistan, from Oct 2022 to Mar 2023.

Methodology: A total of 160 newborns were included. Their chronological and postmenstrual age, weight and gender were recorded. After investigations, they were followed for final diagnosis and outcome.

Results: The mean age of these neonates on admission was 3.11±4.92 days with majority of the neonates (70%) less than 24 hours old. Most were males (63.1)%. With a mean weight of 2.35±0.65 kg.

Low birth weight (LBW), which was seen in 25.63% of cases, respiratory distress syndrome (RDS) with prematurity, seen in 20.63 % neonates, and hypoxic ischemic encephalopathy (HIE), seen in 17.5% neonates, were the major factors associated with morbidity. Whereas mortality was associated predominantly with meconium aspiration syndrome (MAS), seen in 26.27% cases, intrauterine growth retardation (IUGR), seen in 25% and neonatal sepsis, seen in 20% of cases.

The majority of admitted cases experienced a successful discharge (86.25%), with an overall mortality rate of 13.75%.

Conclusion: Morbidity was predominantly due to low birth weight, respiratory distress syndrome with prematurity and hypoxic ischemic encephalopathy. Higher mortality was seen in cases of meconium aspiration syndrome, intrauterine growth retardation and sepsis.

Keywords: Low Birth Weight, Morbidity, Neonatal Intensive Care Unit (NICU), Neonatal Mortality, Neonate.

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INTRODUCTION

Ninety-eight percent of the 2.7 million newborn deaths that occurred in 2019 were concentrated in low- and middle-income nations.[1,2] Addressing socio-economic determinants of health and enhancing the continuum of care throughout pregnancy, delivery, and the postnatal period are necessary for further decreases in newborn death in high-burden nations.[3] Nearly four newborns are stillborn and five neonates die every minute around the world. About 4 out of every 10 stillbirths and neonatal fatalities occur in low- and middle-income countries (LMICs), with 42% happening in underdeveloped nations.[4]

In many parts of the world, newborns receive medical attention from vastly varied settings. In high-income and certain middle-income nations, neonatal intensive care units (NICUs) provide cutting-edge medical technologies including mechanical ventilation and incubators to premature infants.[5] The opposite is true of specialized newborn care units (SNCUs), which instead provide low-tech treatments like oxygen and phototherapy in addition to supportive care like feeding help and a dedicated nursing staff. This level of care is not provided for unwell and/or premature infants in the majority of the world's low-income countries.4 SNCUs in resource-constrained, mainly stable contexts are described, along with the outcomes their patients have experienced.[6,7]

Most hospitals in Pakistan that admit newborns do not provide basic Level I care, which includes routine monitoring, feeding support, and care for minor health issues, hence these infants must be transferred to higher-level facilities, with the appropriate facilities and equipment.[7,8] Although neonatal intensive care units (NICUs) help reduce preterm mortality, they are uncommon and expensive for healthcare systems in underdeveloped nations.[9,10]

The aim of our study was to determine the morbidity and mortality outcomes of neonates

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admitted from other health care facilities in a resource limited neonatal intensive care unit.

METHODOLOGY

This prospective longitudinal study was carried out at the neonatal unit of Combined Military Hospital in Sialkot, Pakistan from October 2022 to March 2023. The study received approval from the hospital's Ethical Review Committee (ERC/08/2021).

Inclusion Criteria: All out-born neonates of either gender who completed their treatment in our hospital and whose data was completely retrievable were included in the study.

Exclusion Criteria: Neonates discharged against medical advice, and those referred to other hospitals for further interventions or due to surgical reasons were excluded.

A sample size of 160 neonates was calculated using the WHO online calculator, based on a neonatal mortality rate of 18.6%.[10] Non-probability convenience sampling was used for data collection, and informed consent was sought form parents/guardians of the neonates.

At the time of admission to the hospital, a comprehensive dataset was collected, encompassing the patient's chronological and post menstrual age, gender, weight in kilograms were noted. Subsequently results of all investigations and progress of the case was recorded. Finally, the outcome, discharge diagnosis or mortality and duration of admission was recorded.

While documenting morbidity, prematurity was defined as the birth of neonates before reaching 37 weeks of gestation. Low birth weight (LBW) was identified when the birth weight was less than 2.5kg and more than 1.5kg.

The diagnosis of sepsis involved the isolation of the causative microorganism from the blood whenever possible. Congenital heart disease was determined based on clinical examination findings, complemented by chest X-rays and ECG. Subsequently, neonates were referred to a tertiary care hospital for confirmation through echocardiography as well as further management. Hypoxic ischemic encephalopathy was diagnosed when a history of delayed crying or inadequate respiratory effort after birth was evident, along with abnormal neurological examination, fits and a normal cerebrospinal fluid (CSF) and metabolic profile. Neonatal jaundice (NNJ) was diagnosed by measuring serum bilirubin levels, with levels exceeding 5 mg/dL considered indicative of NNJ. The diagnosis of pneumonia, meconium aspiration syndrome, and transient tachypnoea of the newborn relied on clinical, hematological, and radiological assessments.

Data were analyzed with Statistical Package for Social Sciences (SPSS) version 23. Qualitative variables, such as age categories, gender, weight categories, gestational age, diagnosis and outcome were presented using frequencies and percentages. Quantitative variable (Length of hospitalization) was presented using mean ± standard deviation. Chi-square test was applied to check the major factors associated with mortality in neonates, taking a p-value<0.05 as significant.

RESULTS

A total of 173 out-born neonates were received, out of which 13 were either referred onward for management or discharged against medical advice. The majority of the neonates (70%) were admitted to the NICU within the first day of their lives, while 22.5% were admitted between 2 to 10 days of age, and 7.5% were admitted after 10 days. In terms of gender, the neonates were fairly balanced, with 63.1% being male and 36.9% being female. The mean weight of these neonates was 2.35±0.65 kg. More than half (52.5%) of the neonates had a birth weight of 2.5 kg or less, while 47.5% had a birth weight greater than 2.5 kg. Regarding gestational age, 55% of the neonates were born prematurely, while the remaining 45% were born at term. The mean duration of hospitalization was 1.75±1.42 days as shown in Table-I.

Table-I: Descriptive Features of Neonates Admitted to the Neonatal Intensive Care Unit (n=160)

Variables	Characteristics	n (%)
Age	≤ 1 day	112(70%)
	2-10 days	36 (22.5%)
	> 10 days	12(7.5%)
Gender	Male	101(63.1%)
	Female	59(36.9%)
Weight (Kg)	Mean±SD	2.35±0.65
	≤ 2.5 kg	84(52.5%)
	> 2.5 kg	76(47.5%)
Gestational age	≤ 37 weeks	88(55.0%)
	> 37 weeks	72(45.0%)
Length of hospitalization in a secondary care facility (days)	Mean±SD	1.75±1.42

Table-II shows the morbidity profile of neonates admitted from other health care facilities. Among various morbidities, low birth weight was most

prevalent (25.63%) of all cases. Respiratory distress syndrome with prematurity being second most prevalent constituted 20.63%, followed by hypoxic ischemic encephalopathy (17.5%), neonatal sepsis (9.37%) and meconium aspiration syndrome (9.37%).

Table-II: Morbidity Profile of Neonates Admitted from other Health care Facilities (n=160)

Morbidity	n (%)
Low birth weight	41(25.63%)
Respiratory distress syndrome + Preterm	33(20.63%)
Hypoxic ischemic encephalopathy	28(17.50%)
Neonatal sepsis	15(9.37%)
Meconium Aspiration syndrome	15(9.37%)
Jaundice	10(6.25%)
Congenital anomalies	6(3.75%)
Intrauterine growth retardation	4(2.50%)
others	8(5.00%)

Table-III shows the major factors associated with mortality. Among the various morbidities, meconium aspiration was associated with the poorest outcome (26.7%), while intrauterine growth retardation (25.0%) and neonatal sepsis (20.0%) were also associated with significantly poor outcome.

Table-III: Major Factors Associated with Mortality (n=160)

Morbidity	Total Cases	Survivals n(%)	Mortality n(%)	*p*-value
Meconium aspiration syndrome	15	11(73.3%)	4(26.7%)	0.043
Intrauterine growth retardation	4	3(75.0%)	1(25.0%)	0.030
Neonatal sepsis	15	12(80.0%)	3(20.0%)	0.010
Congenital anomalies	6	5(83.3%)	1(16.7%)	0.029
Low birth weight	41	36(87.8%)	5(12.2%)	0.001
Hypoxic ischemic encephalopathy	28	25(89.3%)	3(10.7%)	0.022
Jaundice	10	9(90.0%)	1(10.0%)	0.050
Respiratory distress syndrome + Preterm	33	31(93.9%)	2(6.1%)	0.035
Others	8	6(75.0%)	2(25.0%)	0.060
Total	160	138(86.3%)	22(13.7%)	-

In total, the data indicates that the majority of admitted cases experienced a successful discharge or survival (86.3%), while a smaller percentage did not survive hospitalization and had a mortality rate of 13.7%.

DISCUSSION

Though robust data on factors affecting need for referral, morbidity and mortality of neonates in well-resourced set ups is available, similar data is lacking with regards to resource limited set ups. Such data is helpful in planning health care programs in these countries.

In our study the mean age of the neonates was 3.11±4.92 days with the majority of the neonates presenting at less than 24 hours old (70%). This was slightly earlier than that documented by Also *et al*.[11] who documented and average age of 6.35 days. However, in terms of gender we documented a similar trend to Also *et al*., as the majority of cases were males (63.1%).

The mean weight of neonates was 2.35 kg with a standard deviation of 0.65kg. The percentage of neonates weighing less than or equal to 2.5kg (52.5%) is comparable with findings from study conducted by Rahman K *et al*., (49.7%) and Ali SR *et al*., (37.7%).[12,13]

We observed that in our study, prematurity was more common with 55% of the neonates being premature while the remaining 45% were born at term. In a study conducted by Tette *et al*.,[14] recorded almost similar results, i.e., 51.9% of the admitted neonates were premature.

In our study, the mean length of hospitalization in a secondary care facility was 1.75 days, with a standard deviation of 1.42 days. A similar study conducted in Nepal revealed a corresponding pattern, with the majority of admitted neonates staying in the hospital for a duration of 6 to 10 day.[15]

Morbidity profile of neonates showed low birth weight being the most prevalent (25.63%) cause for admission, followed by respiratory distress syndrome with prematurity (20.63%) and hypoxic ischemic encephalopathy (17.5%). Neonatal sepsis constituted 9.37%. This is comparable to a study done in Eritrea by Andegiorgish *et al*., which showed neonatal sepsis being the most frequent cause (35.5%) followed by low birth weight (30%), respiratory distress syndrome of prematurity (15.4%) and perinatal asphyxia (13%).[16]

The highest mortality was observed in cases presenting with meconium aspiration syndrome (26.27%), followed by intrauterine growth retardation (25%), sepsis (20%) and congenital anomalies (16.67%). This is in consistent with a study done in Pakistan by Aslam *et al.,* which found sepsis followed by meconium aspiration and congenital anomalies have highest risk of neonatal mortality.[17] A study done in Indonesia by Alisjahbana *et al*.[18] found intrauterine growth retardation being a predictor of poor neonatal outcomes, with a 61% fatality rate.[18] A comparable study done by Shirazi *et al*., found meconium aspiration syndrome (19%) and sepsis (16.8%) along

with respiratory distress as major causes of neonatal mortality.[19]

In this study, the overall mortality was 13.75% which is similar to the finding of studies by Khemani *et al.*, (12%) and Tanveer *et al.*, (14%).20,21 Similarly, an overall mortality rate of 8.1% was observed by Al-Momani *et al.*, in study conducted at NICU at Princess Rahma Pediatric Hospital, Jordan.[22]

growth retardation and sepsis.

Gaining insights into the reasons behind neonatal morbidity and mortality among NICU admissions is valuable for prioritizing healthcare services, reallocating resources, and enhancing the standard of care.

It is advisable to conduct additional research to confirm these findings and identify the factors that can predict enhanced survival rates.

LIMITATION OF STUDY

The limitations of this study include a small sample size of only 160 neonates, and that this is a single-centre. In order to generalize the study, the sample size has to be increased and it needs to be conducted in multiple low resource neonatal intensive care units.

CONCLUSION

Morbidity was predominantly due to low birth weight, respiratory distress syndrome with prematurity and hypoxic ischemic encephalopathy. Higher mortality was seen in cases of meconium aspiration syndrome, intrauterine.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

RA & MA: Data acquisition, data analysis, critical review, approval of the final version to be published.

FB & SBS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

HS & FT: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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