Research Article

Burden and Outcomes of Respiratory Diseases in Hospitalized Neonates at a Tertiary Care Hospital in Lahore: A Cross-Sectional Study

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Abstract

Background: Respiratory diseases constitute a significant contributor to health issues in neonates, leading to admissions to neonatal intensive care units (NICU), and many of these neonates never recover, resulting in high neonatal mortality rates with respiratory diseases.

Objective: To assess the burden of respiratory diseases in hospitalized neonates and determine their outcomes, including discharges and deaths, among those admitted to neonatal intensive care units in a tertiary care hospital in Lahore.

Methods: An observational analytical cross-sectional study was conducted on 187 neonates admitted to a neonatology department of the tertiary care hospital in Lahore. Demographical data was collected by using a structured questionnaire. The analyses were conducted using R software. The chi-square test was employed to ascertain the associations between significant factors of respiratory diseases in neonates.

Results: Among the respiratory conditions requiring admission, pneumonia (n=92, 49.1%) stood out as the most frequently diagnosed respiratory disease in neonates, followed by respiratory distress syndrome (RDS) (n=53, 28.3%), transient tachypnea of the newborn (TTN) (n=18, 9.62%), and meconium aspiration syndrome (MAS) (n=24, 12.8%). In terms of mortality among these respiratory conditions, pneumonia had the highest frequency (40.5%), followed by RDS (39.2%), MAS (20.2%), in neonates.

Conclusion: Respiratory disorders proved to be a prevalent reason for neonatal admissions to the NICU, showcasing a significant association with neonatal mortality, especially in pneumonia, respiratory distress syndrome, and meconium aspiration syndrome.

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Introduction

Respiratory diseases significantly contribute to morbidity and mortality among neonates, necessitating frequent admission to the neonatal intensive care unit (NICU).[1] The mortality rate is 2-4 times higher in neonates with respiratory disorders than in neonates unaffected by such diseases.[2] Respiratory distress is a prevalent condition that afflicts approximately 50-90% of neonates delivered worldwide at 26, 28, and 30 weeks of gestation, and among all full-term deliveries, this rate is 2.2% to 7.6%.[3] Frequent NICU admissions occur among late preterm neonates (29%) and term neonates (15%),

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contributing significantly to respiratory morbidity.[3]

Neonatal respiratory diseases contribute to the global disease burden and challenge healthcare in low-income countries (LIC), low-middle-income countries (LMIC) and high-income countries (HIC). In the LICs and the LMICs, neonatal respiratory distress's primary causes include preterm delivery, low Apgar scores at the first and fifth minute, meconium aspiration syndrome, pneumonia, maternal gestational diabetes, premature rupture of membranes (PROM) leading to chorioamnionitis and septicemia, caesarean delivery and transient tachypnea of the newborn (TTN).[4-7] However, in HICs, intrapartum hypoxia, meconium aspiration syndrome and pneumonia, maternal medical diseases such as gestational diabetes mellitus, hypertension, and asthma lead to neonatal respiratory distress.[8] Furthermore, respiratory distress morbidity appears higher in countries with limited resources compared to high-income settings.[9]

A variety of pathological conditions contribute to respiratory diseases including pneumonia (22.5%), respiratory distress syndrome (RDS) (20.8%), meconium aspiration syndrome (MAS) (16.7%), sepsis (12.5%), transient tachypnea of the newborn (TTN) (11.7%), birth asphyxia (BA) (7.5%), congenital heart disease (CHD) (4.3%), and other factors. The most significant cause of neonatal respiratory diseases remains premature birth, particularly among neonates born earlier than 34 weeks gestation, leading to respiratory distress syndrome. Understanding the frequency of different causes of neonatal respiratory diseases among NICU admissions facilitates planning the management specific to the geographical location. Consequently, health professionals can devise health policies and hospital protocols using the data on the common causes and outcomes.[10,11]

The Sustainable Development Goals (SGD) by the United Nations General Assembly and the various policies, initiatives and programmes developed by the healthcare sectors to prevent and manage neonatal respiratory disease burden are employed.[12,13] However, despite all these measures and efforts, respiratory diseases remain the primary cause of morbidity and mortality among neonates in Pakistan.[14] Unfortunately, there is a gap in the knowledge about the burden and outcomes of respiratory diseases in neonates, particularly in the LICs and LMICs. Therefore, the current study aims to assess the disease burden and the neonatal outcomes of respiratory diseases among neonates admitted to the neonatal intensive care unit at a tertiary care hospital in Lahore, Pakistan.

Methods

The current study was an observational analytical cross-sectional study conducted on neonates admitted to the NICU of the Avicenna Hospital, Lahore. The study period was from 1 January 2022 to 31 December 2022. Geographically, Lahore is the capital city of Punjab Province, situated at 31◦32′59′′ latitude and 74◦20′37′′ longitude and is the second-most populous city in Pakistan and Avicenna Hospital is located at the southern urban-rural border of the city, a tertiary care hospital affiliated with the Avicenna Medical College, Lahore, Pakistan.

The study participants' geographical locations were identified and marked on Google Maps. Subsequently, a dot map was generated utilising the QGIS software version 3.2. The study protocol adhered to the guidelines outlined in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

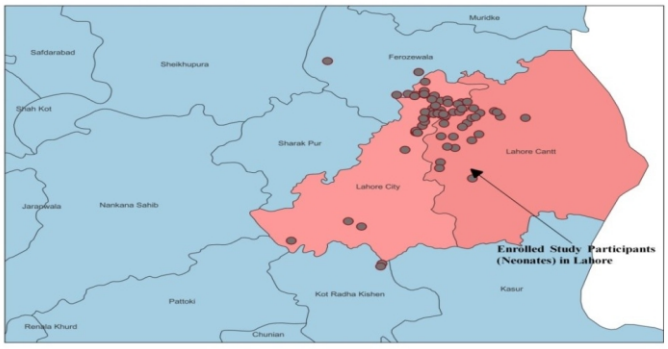

Figure 1: *Study map area of enrolled study participant's location in Lahore District*

Our research team calculated the sample size by using winPepi software with a 95% confidence level, 5% margin of error and an expected percentage of 14.1% of TTN, the least among all respiratory diseases in neonates. The calculated sample size was 187 cases, and we used a consecutive sampling technique. The inclusion criteria were neonates with respiratory disease (RDS, MAS, TTN and pneumonia), patients within the age range of birth to 28 days, irrespective of gender, neonates with a gestational age of 28 weeks (on dating scan) and weight of more than 1000 gm.

The cases of syndromic neonates and those with congenital anomalies were excluded from the study. The re-

search was carried out following the principles outlined in the Declaration of Helsinki and received approval from the Institutional Review Board (IRB) for Biomedical Research at Avicenna Medical College & Hospital, Lahore (Letter No. IRB-43/8/23/AVC). A total of one hundred and eighty-seven patients who met the inclusion criteria were enrolled in the study. The parents or guardians of neonates provided written informed consent.

A structured questionnaire was used to collect data, including demographic information such as name, age, sex, and date of admission. When admission to the NICU, the chest examination was done, and the findings were recorded. As a work-up of respiratory diseases, the following tests were conducted: oxygen saturation via pulse oximetry, chest X-ray, arterial blood gases, complete blood picture (CBC), and blood culture.

The data sets were inputted into the EpiData software (version 3.1, accessible at http://www.epidata.dk/) and subjected to error and inconsistency validation through random comparisons between the digital and hard copy records. Subsequently, the data was exported to Microsoft Excel for further processing. The 'epiR and epiDisplay' packages from the R software (version 4.2.1, R Foundation for Statistical Computing, Vienna, Austria) were used for all statistical analyses. Variables with a categorical nature were measured in terms of frequencies and percentages. The Chi-square test was utilized to ascertain the association of the significant contributing factors of respiratory diseases in neonates.

Results

The neonates ranged in age from 1 to 28 days, with a mean of 15.01±7.99 days. The gestational age of the subjects varied between 28 weeks and 40 weeks, with a mean of 37.4±1.9 weeks. One hundred and thirty-five (72.19%) neonates were preterm, while 52 (27.8%) were full-term neonates. One hundred and twenty-four neonates (66.3%) were male, while sixty-three (33.7%) were female, resulting in a male-to-female ratio of 2:1. Neonates which were 126 (67.37%) born via cesarean section as shown in Table 1.

Among the respiratory conditions necessitating admission, pneumonia was the most frequent. It was recorded in 92 (49.1%) neonates, followed by respiratory distress syndrome (n=53, 28.3%), transient tachypnea of the newborn (n=18, 9.62%) and meconium aspiration syndrome (n=24, 12.8%) as shown in figure 2.

Table 1: *Characteristics of Study Participants (n=187)*

Characteristics	Frequency (%)
Age (days)	15.01±7.99
Gender	
Male	124 (66.3%)
Female	63 (33.7%)
Gestational Age (weeks)	
28-36 weeks	135 (72.19%)
37-40 weeks	52 (27.8%)
Mode of Delivery	
Vaginal Birth	31 (16.57%)
Cesarean Section	126 (67.37%)

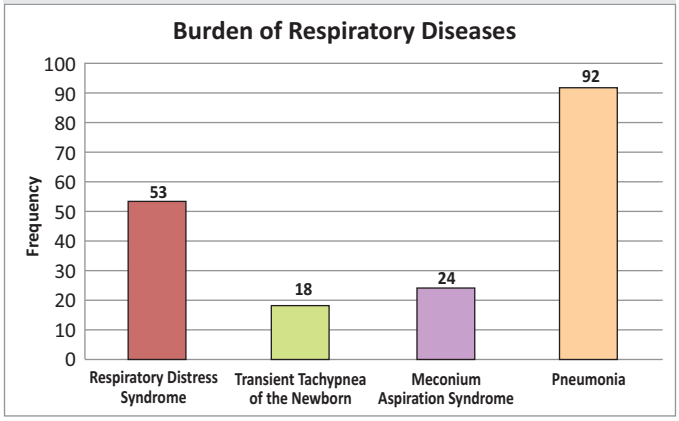

Figure 2. *Burden of Respiratory Diseases (n=187)*

Distribution of respiratory diseases in terms of outcome (Death & Discharge)

There were a total of 187 participants selected for the present study. Among these, 108 were discharged on recovery, and 79 neonates died. The flow chart presents the number of cases of respiratory distress in terms of outcome i.e. discharge and death (Figure 3).

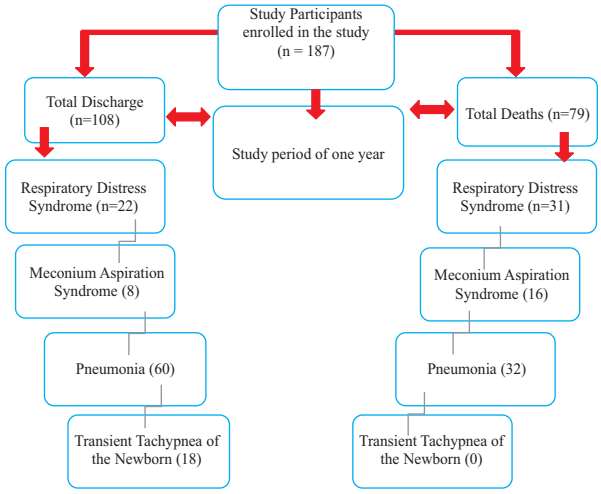

Figure 3. *Flow chart showing Outcome of Neonates Admitted to NICU*

A Significant association was observed among the causes of respiratory diseases in neonates. A gestational period of 28-36 weeks significantly correlated with respiratory distress. The mode of delivery, specifically Cesarean Section (p=0.03), showed a significant association with neonatal respiratory distress. Further details are in Table 2.

Table 2: *Association of causes of respiratory Diseases in neonates in terms of the outcomes (Death and Discharge)*

Variables		Total Cases	Outcome		P Value
			Death	Discharge	
Gender	Male	124	49	75	0.6
	Female	63	27	36	
Gestational Period	28-36 weeks	135	71	64	0.01**
	37-40 weeks	52	15	37	
Mode of Delivery	Cesarean Section	126	61	65	0.02**
	Vaginal Birth	31	18	43	
Causes of Respiratory Distress	Pneumonia	92	32	60	0.01**
	Respiratory Distress Syndrom	53	31	22	
	Transient Tachypnea of the Newborn	24	16	8	
	Meconium Aspiration Syndrome	24	16	8	

Chi-Square was applied. P value <0.05 was considered significant. ** highly significant results. Fisher exact test applied on causes of respiratory distress due to having one cell value less than 5.

Discussion

Respiratory diseases are a significant contributor to morbidity and mortality rates and are a prevalent ailment that necessitates admission to neonatal intensive care units (NICUs) for neonates worldwide.[15-17] Pakistan is an LMIC with limited resources and a significant neonatal disease burden; therefore, this study assessed the burden and outcomes of respiratory diseases among neonates admitted to a tertiary care hospital in Lahore.

The present study observed a greater incidence of respiratory diseases in males (66.3%) than in females (33.7%). This finding is consistent with earlier research that reports that the growth and development of the lungs commences during the prenatal phase, and the maturation of the lungs is comparatively more advanced in the female fetus.[17-19] The present study revealed a higher risk of acquiring respiratory diseases among neonates delivered via cesarean section than those delivered vaginally. The earlier studies supported our findings and reported that respiratory illnesses are more common in neonates born via caesarean section. Newborns delivered through caesarean section exhibit a higher quantity of residual lung fluid and a reduced residual capacity, resulting in a decreased secretion of surfactant into the alveolar space. Conversely, during vaginal delivery, the infant's chest compression facilitates the elimination of some fetal lung fluid, and the adrenergic stimulation associated with the process of vaginal labour promotes the release of surfactant into the airways.[17,20,21]

The current study revealed a higher prevalence of respiratory diseases among neonates delivered at a gestational age of 28-36 weeks in contrast to those born at term pregnancy between 37-40 weeks. The results of our study align with studies conducted in Rawalpindi and Peshawar, which reported poor neonatal outcomes among low-birth-weight neonates.[22,23] Various research indicates that fetal lungs mature biochemically with increasing gestation, and premature birth results in inadequate lung maturation in fetuses.[24,25] According to a study conducted by De Luca et al., neonates born even at 34 weeks gestation face a significantly higher risk of respiratory morbidity in low-resource settings, which is ten times higher compared to infants born at full term.[26]

The present study has identified the prevailing etiologies of respiratory distress in neonates, namely pneumonia, respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), and meconium aspiration syndrome (MAS). Our results are consistent with previous studies[27-30] and align with findings from a survey carried out in Karachi.[31] The present study is the first of its kind in our setup. It has revealed that respiratory diseases frequently cause neonatal admission to NICU and are associated with neonatal mortality, particularly in respiratory distress syndrome, meconium aspiration syndrome and pneumonia. The rise in neonatal morbidity and mortality rates in LICs and LMICs is attributed to a scarcity of resources and can be reduced with appropriate and immediate intervention.[31] These findings emphasize the urgency of implementing routine prenatal and antenatal screening for early detection of maternal conditions leading to neonatal respiratory disorders,

as well as immediate neonatal evaluation at birth in high-risk cases, along with parental counselling and preventive strategies, to decrease the alarmingly higher neonatal mortality rate in this part of the world.

However, there are certain limitations in the present study. Our study had a relatively limited sample size compared to other research efforts, limiting our findings' generalizability. Furthermore, we did not assess the long-term neonatal outcomes in cases discharged from the NICU. As a result, we recommend conducting a comprehensive future study with more extensive sample size and prolonged follow-up period to comprehensively assess the health challenges and survival rates of infants experiencing respiratory diseases. Another limitation of the present study was that we didn't consider various management options and their impact on the neonatal outcome. This consideration could have facilitated the identification of more suitable treatments for respiratory disorders in newborns in future medical practice.

Conclusion

The study highlighted that respiratory diseases were one of the cause of neonatal admission to the Neonatal Intensive Care Unit (NICU) and were associated with neonatal mortality, particularly respiratory distress syndrome, pneumonia, transient tachypnea of the newborn, and meconium aspiration syndrome.

Ethical Approval: Approval from the Institutional Review Board (IRB) for Biomedical Research at Avicenna Medical College & Hospital, Lahore (Letter No. IRB-43/8/23/AVC).

Conflict of Interest: The authors declare no conflict of interest.

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Authors' Contribution

MZ: Conception & design, acquisition of data, analysis & interpretation

GW: Conception & design, analysis & interpretation of data, drafting of article, critical revision for important intellectual content, final approval

SK: Acquisition of data, data analysis

AZ: Acquisition of data, interpretation of data

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