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Original Article

Factors Leading to Morbidity and Mortality in Neonates Presenting to Pak Emirates Military Hospital, Rawalpindi

Sehar Aslam, Zeeshan Ahmed, Saeed Zaman, Eisha Mansoor*, Tariq Nadeem, Samina Tabussam

Pak Emirates Military Hospital/National University of Medical Sciences (NUMS), Rawalpindi Pakistan, *Army Medical College/ National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

***Objective*:** To determine the frequency and association of different risk factors for morbidity and mortality in neonates.
***Study Design*:** Case-control study.
***Place and Duration of Study*:** Department of Paediatrics, Pak-Emirates Military Hospital, Rawalpindi, Nov 2021 to Apr 2022.
***Methodology*:** A total of 332 patients (166 cases and 166 controls) admitted in the neonatal intensive care setting were included in our study. Patients who were stillborn or had incomplete records were excluded. All patients were followed up till discharge or death and were documented for various risk factors.
***Results*:** The mean age of our study population was 11.52 ± 6.45 days, with 176 (53.0%) males. Risk factors such as low birth weight (2.06 [95% CI 1.20-3.54]), multiple gestations (2.09 [95% CI 1.87-2.35]), premature delivery (1.61 [95% CI 1.01-2.57]), male gender (1.62 [95% CI 1.05-2.51]) and lack of antenatal care (1.61 [95% CI 1.01-2.57]) showed an association with mortality. Early-onset neonatal sepsis (1.78 [95% CI 0.98-3.22]), hypoxic ischaemic encephalopathy (3.01 [95% CI 1.55-5.82]), meconium aspiration syndrome (2.42 [95% CI 0.97-6.05]), congenital anomalies (4.15 [95% CI 0.87 – 19.85]) and inborn errors of metabolism (7.26 [95% CI 0.88-59.71]) were all associated with an increase in mortality.
***Conclusion*:** Increased risk for mortality in critically ill neonates is multifactorial and requires intervention at multiple levels to reduce mortality at all phases of gestation.

Keywords: Morbidity, Mortality, Neonates, Risk factors.

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INTRODUCTION

The United Nations Children's Fund (UNICEF) estimates that approximately one-half of all deaths occurring under the age of five years happen during the neonatal period.[1] The organization states that approximately 130 million newborns are added to the global population each year, with 2.4 million dying within the first month of life.[2,3] Pakistan ranks as the country with the third highest gross neonatal mortality, even though its mortality rate is comparably lower, by its large population size, with an estimated three hundred thousand deaths per year in the neonatal period.[4,5]

The Pakistan Demographic Health Survey (PDHS) noted that the neonatal mortality rate in the country in 1991 was 49 per 1000 live births, which increased to 47-55 per 1000 live births between 2009 to 2013 and stood at 42 per 1000 live births in 2018, these figures are well over the stated goal, with minimal visible improvement; Urgent attention needs to be given to address the situation if this goal is to be met on time.[6,7,8]

In order to meet the objectives set by SDG-3 for reductions in neonatal mortality, the health services of Pakistan need to take urgent measures to manage risk factors for mortality in the neonatal period. However, these risk factors need to be identified before specific measures can be planned or adopted. Studies conducted in the developed world have identified several key causes.[9,10] However, it is unclear whether these apply to our particular circumstances. Thus, we conducted this study intending to determine risk factors for mortality in our neonates, the identification of which will be the first step towards formulating and implementing a concrete plan towards addressing this problem and attaining the SDG-3 goals on time.

METHODOLOGY

This a case-control study was conducted between January 2021 to April 2022 at the Department of Paediatrics/Neonatal Intensive Care Unit (NICU), Pak-Emirates Military Hospital, Rawalpindi, after seeking approval from the Institutional Ethical Committee. The study population consisted of 332 neonates under treatment for any illness during the neonatal period in the NICU in our hospital. All the participants were

Correspondence: Dr Sehar Aslam, Department of Paediatrics, Pak Emirates Military Hospital Rawalpindi Pakistan
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included via consecutive non-probability sampling. The EPI tools calculator was used to calculate the sample size keeping an expected proportion in controls of 1.3%, an assumed odds ratio of 7.6, a confidence level at 95%, and a power of the test of 80%.[11]

Inclusion Criteria: Patients of either genders who died within the first 28 days of life were included as cases, while those who survived were included as controls.

Exclusion Criteria: Those patients who were still born or had incomplete records were excluded. Patients who aged over 28 days during the study were also excluded.

A total of 166 cases and a similar number of controls were enrolled during the study period. A detailed history was obtained from the guardians of the patients, and their medical records were analyzed. Data were collected regarding patient demographics, characteristics of pregnancy and delivery, and the course/illness of the patient leading up to discharge if the patient was a control or the terminal event if the patient was a case. Premature birth was defined as birth before the completion of 37 weeks of gestation, while any neonate with a weight less than 2500 gm at birth was considered to have a low birth weight.

Statistical Package for Social Sciences (SPSS) version 26.0 was used for the data analysis. Mean±SD were calculated for quantitative variables. In addition, qualitative variables were recorded in terms of frequency and percentage. The Chi-square test and the independent samples *t*-test were used to compare cases and controls, and the *p*-value of ≤0.05 was considered significant. Odds ratios were used to measure the associations between risk factors under study and neonatal mortality.

RESULTS

The patient, maternal and pregnancy characteristics are displayed in Table-I. We studied 332 patients, 166 cases and the same number of controls. The mean age of the study population was 11.52 ±6.45 days. The mean gestational age at birth was 35.06 ± 2.49 weeks, while 227 (68.4%) were born before the completion of 37 weeks of gestation. A total of 176 (53.0%) patients

Table-I: Characteristics of the Study Participants (n=332)

Variable	Cases	Controls	*p*-value
Age (Days)	11.50±6.26	11.52±6.65	0.959
Gestational Ageat Birth (Weeks)	34.73±2.49	35.39±2.47	0.015
Prematurity (<37 Weeks Gestation)	122(73.5%)	105(63.3%)	0.045
Gender			
Male	98(59.0%)	78(46.9%)	0.028
Female	68(41.0%)	88(53.1%)	
Birth Weight (g)	2969.20± 583.78	3133.96±548.08	0.008
Low Birth Weight (<2500g)	46(27.7%)	26(15.7%)	0.008
Maternal Ageat Birth (Years)	31.86±6.15	33.01±6.35	0.096
Maternal Education			
None	84(50.6%)	87(52.4%)	0.077
Primary	36(21.7%)	33(19.9%)	
Secondary	23(13.9%)	27(16.3%)	
Bachelors	20(12.0%)	9(5.4%)	
Masters	3(1.8%)	10(6.0%)	
Antenatal Care	113(68.1%)	125(75.3%)	0.144
Previous History of Abortions	31(18.7%)	43(25.9%)	0.114
Multiple Gestation	14(8.4%)	-	<0.001
Modeof Delivery			
Vaginal Delivery	109(65.7%)	126(75.9%)	0.040
Caesarean Section	57(34.3%)	40(24.1%)	
Rhesus Incompatibility	16(9.6%)	9(5.4%)	0.145
Complications During Delivery			
None	103(62.0%)	112(67.6%)	0.239
Birth Asphyxia	26(15.7%)	17(10.2%)	
Prolonged Labour	12(7.2%)	14(8.4%)	
Peri-Partum Haemorrhage	12(7.2%)	5(3.0%)	
Arrested Labour	6(3.7%)	11(6.6%)	
Foetal Distress	7(4.2%)	7(4.2%)	
Vaccination Status	72(43.4%)	85(51.2%)	0.153

were male. The mean birth weight was 3051.58 ± 571.35 g, with 72 (21.7%) being low birth-weight. A total of 238 (71.7%) patients had received some form of antenatal care. Rhesus incompatibility was seen in 25 (7.5%) cases. As far as complications during delivery, a total of 43 (13.0%) patients suffered from birth asphyxia, 26 (7.8%) had prolonged labour, 17(5.1%) suffered from peripartum haemorrhage, 17(5.1%) developed arrested labour and 14 94.2%) developed foetal distress during labour. Of the total number of neonates in our study, only 147(47.3%) were vaccinated appropriately for age.

A total of 101 (30.4%) neonates suffered from respiratory distress syndrome, 62 (18.7%) were premature and did not have any specific system complications and 55 (16.6%) had developed early-onset neonatal sepsis. A breakdown of reasons for admission was shown in Table-II.

Table-II: Reasonsfor Admission (n=332)

Variable	Cases	Controls	*p*-value
Reasonsfor Admission			
Respiratory Distress Syndrome	39(%)	62(%)	<0.001
Prematurity	20(%)	42(%)	
Early-Onset Neonatal Sepsis	34(%)	21(%)	
HypoxicIschaemic Encephalopathy	36(%)	14(%)	
Meconium Aspiration Syndrome	16(%)	7(%)	
CongenitalAnomaly	8(%)	2(%)	
In-Born Errors of Metabolism	7(%)	1(%)	
COVID-19 Infec tion	1(%)	7(%)	

Only low birth-weight neonates and multiple gestation pregnancies were at an increased risk of death (Table-III). At the same time, premature delivery, male gender, and lack of antenatal care also showed a positive association with death. Early-onset neonatal sepsis, hypoxic ischaemic encephalopathy, meconium aspiration syndrome, congenital anomalies and inborn errors of metabolism were all associated with increased mortality.

DISCUSSION

We found that the reasons for admission were multifactorial in our study. Identifying and understanding the role of these factors will help to target these in future, which will help to reduce neonatal mortality. However, gender had a weak albeit positive association with neonatal mortality in our study (OR: 1.62 [95% Cl 1.05-2.51]). This was in keeping with previous studies (OR: 0.59 [95% Cl 0.42-0.84]),[12] and (OR: 1.85; 95% CI: 1.06-3.26), who reported similar, non-significant rates.[13]

Low birth-weight and prematurity were found to have a positive relationship with the development of (OR: 2.06 [95% Cl 1.20-3.54] and OR: 1.61 [95% Cl 1.01-2.57]). Both are associated with a higher risk of neonatal mortality and many other problems, such as feeding difficulties and delayed milestones.[14] Orsido *et al*. reported significant odds ratios for bother low birth weight and premature delivery (OR: 3.41 [95% Cl 2.46-4.73] and OR: 3.60 [95% Cl 2.63-4.93], respectively).[15]

Table-III: Odds Ratio for Risk Factors (n=332)

Variable	Odds Ratio
Premature Delivery	1.61 [95% Cl1.01–2.57]
Gender	1.62[95% Cl1.05–2.51]
Low Birth-Weight	2.06[95% Cl1.20–3.54]
Low Maternal Literacy	0.93[95% Cl0.61–1.43]
Antenatal Care	1.61[95% Cl1.01–2.57]
Maternal History of Abortions	0.66[95% Cl0.39–1.11]
Multiple Gestation	2.09[95% Cl1.87–2.35]
Mode of Delivery	0.60[95% Cl0.38–0.98]
Rhesus Incompatibility	0.54[95% Cl0.23–1.25]
Non-Compliance with Vaccinations	0.73[95% Cl0.47–1.13]
Respiratory Distress Syndrome	0.52[95% Cl0.32–0.83]
Early Onset Neonatal Sepsis	1.78[95% Cl0.98–3.22]
Hypoxic Ischaemic Encephalopathy	3.01[95% Cl1.55–5.82]
Meconium Aspiration Syndrome	2.42[95% Cl0.97–6.05]
Congenital Anomalies	4.15[95% Cl0.87–19.85]
In-Born Errors of Metabolism	7.26[95% Cl0.88–59.71]
COVID-19 Infection	0.14[95% Cl0.02–1.13]

Receipt of antenatal care is integral to the well-being of a foetus,[16,17,18] and our study showed that neonates whose mothers did not receive any ante-natal care were a slightly increased risk of death (OR: 1.61 [95% Cl 1.01-2.57]). Tietzmann *et al*. noted a similar relationship between the number of antenatal visits and neonatal mortality, noting that mothers who had less than four antenatal visits had a higher incidence of neonatal mortality, (OR: 1.21 [95% Cl 1.05-1.40)].[19] It must be noted that while the odds were greater than one in this study, as in ours, it did not approach the threshold for significance. Furthermore, our study showed that neonates of mothers who had a previous miscarriage were not at an increased risk of death (OR: 0.66 [95% Cl 0.39-1.11]).

We found the presence of inborn errors of metabolism (OR: 7.26 [95% Cl 0.88-59.71]), congenital anomalies (OR: 4.15 [95% Cl 0.87-19.85], hypoxic ischaemic

encephalopathy (OR: 3.01 [95% Cl 1.55-5.82] and meconium aspiration syndrome (OR: 2.42 [95% Cl 0.97-6.05]) to be associated with a greatly increased risk of neonatal mortality, while early-onset neonatal sepsis also had a positive, albeit less significant, role (OR: 95% Cl 1.78 [95% Cl 0.98-3.22]. Inborn errors of metabolism are a common cause of mortality in populations with high rates of consanguineous marriage, as demonstrated by previous studies.[20,21]

Our study showed that the most important factors increasing neonatal mortality were usually related to the primary diagnosis that the neonate was admitted with, while demographic factors and other neonatal, maternal and pregnancy characteristics also played a role. Thus, these factors represent targets for which future interventions can be tailored to help mitigate their effects on neonatal mortality.

CONCLUSION

The neonatal period is one of the more vulnerable stages of human life and is associated with a comparatively high mortality rate in developing countries. Therefore, urgent interventions at all stages of pregnancy if goals pres-cribed by the world health bodies are to be attained. Poor antenatal care, malnutrition, home deliveries and consan-guineous marriages are responsible for most of the risk factors identified as highrisk for mortality in our study. Therefore, future research should target these problem areas and formulate plans to mitigate their effects to promote universal neonatal health.

Conflict of Interest: None.

Author's Contribution

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

SA: Conception, interpretation of data, drafting the manuscript, approval of the final version to be published.

ZA: Study design, data analysis, drafting the manuscript, cri-tical review, approval of the final version to be published.

SZ: Critical review, approval of the final version to be published.

EM: Data acquisition, interpretation of data, approval of the final version to be published.

TN: Study design, Drafting the manuscript, interpretation of data, approval of the final version to be published.

ST: Critical review, 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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