Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i3.4957

NEONATAL MORBIDITY AND MORTALITY PATTERN IN A TERTIARY CARE NEONATAL ICU OF A TEACHING HOSPITAL

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Abstract:

Background: Pakistan is ranked third among the countries having the highest annual rate of neonatal deaths. Three main factors worldwide that contribute to neonatal mortality (NNM) in low-income nations are prematurity, birth asphyxia, and sepsis.

Objective: To identify the causes and patterns of newborn death in a tertiary care neonatal intensive care unit.

Methodology: This retrospective analysis was carried out at the multiple centers including Jinnah Teaching Hospital Peshawar and The Children's Hospital and University of Child Health Sciences (UCHS) in the duration from Jan, 2023 to June, 2023. The research included all neonates admitted alive to the neonatal intensive care unit, along with a definitive diagnosis and supporting symptoms. Data was gathered using a pre-made proformas. A minimum of one diagnosis was assigned to each neonate based on the modified Wigglesworth classification.

Results: Out of 1765 admitted sick neonates, 67.5% were male and 32.5% female. Morbidity pattern showed share of prematurity 33.6%, sepsis 30.08%, birth asphyxia 12.12%, meconium aspiration syndrome (MAS) 5.55%, congenital malformations 3.9%, Transient tachypnea of newborn (TTN) 5.21%, neonatal jaundice (NNJ) 2.94%, Intrauterine growth restriction (IUGR) 2.66%, Infant of diabetic mother (IDM) 1.5%, seizure disorder (1.5%) and bleeding diathesis 0.79%. Mortality was 19.54% (345 cases). Early neonatal mortality was 86.6%. Case fatality for prematurity was 28.78%, Birth asphyxia 21.49%, congenital malformations 26%, sepsis 16.94%, MAS 14.28%, and seizure disorder 22.22%.

Conclusion: The study found that the primary causes of newborn death were prematurity, low birth weight, neonatal infection, and birth asphyxia. Healthcare managers should design and execute

interventions at the community level to prevent low birth weight, premature delivery, and birth asphyxia. There will undoubtedly be fewer infant fatalities if neonatal care is improved at all levels.

Keywords: Neonatal mortality, Prematurity, Birth asphyxia, Sepsis, Tertiary care neonatal ICU

Introduction:

A newborn's first 28 days of life are referred to as the neonatal phase, which is further separated into three categories: very early (birth to fewer than 24 hours), early (birth to less than seven days), and late (7 days to less than 28 days(Alebel et al., 2020; Behrman and Vaughan III, 1983). The neonatal stage of life is the most susceptible to illnesses, most of which may be avoided. (Hadgu et al., 2020) Additionally, a newborn's chance of dying is 500 times higher on their first day of being alive than it is at their first month of age (UNICEF., 2008). An estimated 130 million babies are born annually; 4 million pass away during the first 28 days of their lives(Lawn et al., 2005). In neonatal time, 75% of fatalities occur within the first seven days of life, compared to 50% within the first 24 hours (Lawn et al., 2005). Thus, reducing first-week newborn mortality through appropriate interventions and techniques can aid in achieving Millennium Development Goal 4 (MDG4).

Ten nations, mainly in Asia, account for two-thirds of all newborn fatalities worldwide(Seyal et al., 2011). Pakistan ranks third among the nations with the highest yearly number of newborn fatalities (298,00) and is seventh in terms of population in the world.(Shabbir et al., 2021) With an infant mortality rate of 49/1000 live births, Pakistan accounts for 7% of all neonatal fatalities worldwide. (Muzzamil et al., 2022).Prematurity, birth asphyxia, and sepsis are major global contributors to neonatal mortality (NNM) in low-income countries. In contrast, prematurity and deformities are the leading causes of mortality in developed nations(Lawn et al., 2005). A critical component of neonatal mortality is birth weight. Several WHO research have demonstrated an indirect relationship between newborn mortality and birth weight less than 2.5 kg, with this weight contributing to around 15% of all neonatal deaths. Prematurity and its implications are the leading cause of low birth weight, which contributes to newborn death in high-income nations by 6% and in low-income countries by 30%(Blanc and Wardlaw, 2005). Prematurity, birth asphyxia, and sepsis are all avoidable in underdeveloped nations(Jehan et al., 2009). A sensitive measure of the accessibility, use, and efficacy of mother and child health care in the community is the pattern of illness and newborn death. (Ugwu, 2012) **.** Since obtaining community-based data is challenging in our current setting, the burden of this issue is evaluated using hospital-based data. Over the past ten years, we have not been able to dramatically lower infant mortality in Pakistan. The prognosis of sick newborns is based on the level of internal disease and the level of medical attention they get. Both of these things may contribute to the high NNM in our nation.

Thus, this study was conducted to determine the disease pattern and causes of neonatal mortality in a teaching hospital's tertiary care neonatal ICU.

Method:

This hospital-based retrospective investigation using a descriptive case series was carried out Jinnah Teaching Hospital Peshawar and The Children's Hospital and University of Child Health Sciences (UCHS) in the duration from Jan, 2023 to June, 2023. Newborns referred to us from other public and private hospitals are admitted to our facility. Most unwell newborns needing tertiary treatment are referred here from nearby areas. The hospital's ethical committee gave its permission to conduct this retrospective research. No consent was required due to the retrospective nature of the study.

A pre-made proforma was used to gather data on the patient's place of birth, sex, weight, age at admission, gestational age, and delivery method. At the time of admission to the ICU, newborn data was gathered, and it was concluded at discharge or death. When the infant arrived at the neonatal ICU, an official (an FCPS trainee) evaluated him first, followed by a pediatrician or neonatologist. The phrase "neonatal period" refers to the period from birth to 28 days for term babies and 44 weeks of gestation for preterm babies. The modified Wigglesworth classification identified a single cause of admission or death.

All newborns brought living to the neonatal ICU, together with a conclusive diagnosis and symptoms, were included in the study. The research did not have any newborns that were brought in dead to the neonatal ICU. Those patients whose medical records were missing critical information were also not included. Based on Wigglesworth categorization and WHO standards, the diagnosis was primarily clinical. Diagnostic assistance from radiology and the laboratory was provided and used to verify the diagnosis. Even if the infant experienced complications from the initial disease or had more than one illness, the primary ailment was always considered the definitive diagnosis. Premature delivery, low birth weight (LBW), meager birth weight (VLBW), meager birth weight (ELBW), and congenital deformity were all defined according to WHO guidelines. Based on clinical, radiological, and previous history, meconium aspiration syndrome was determined. Using the APGAR score, birth asphyxia syndrome was clinically diagnosed. Clinical and biochemical indicators such as complete blood count (CBC), erythrocyte sedimentation rates (ESR), C-reactive protein (CRP), and cultures as a whole were used to evaluate sepsis. According to hospital regulations, all newborns delivered via LSCS or instrumental delivery spend their first few hours in the neonatal unit. After passing urine or meconium and enduring oral feeding, the child is given to the mother. The study employed SPSS version 21 for data collection and analysis. The study determined the frequency and percentages of several morbidity and mortality factors.

Results:

There were 2660 total admissions to the neonatal ICU during the study period. Of them, 895 were retained for observation only, and 1765 were sick newborns.

Table I: Demographics and Neonatal Morbidity Parameters

Variable		Frequency N=1765	Percentage,%
Place of birth			
1	Indoor	773	43.8
2	Outdoor	992	56.2
Gender			
	Male	1192	67.5
	Female	573	32.5
Mode of delivery			
	LSCS	1027	58.18
	SVD	738	41.82
WEIGHT (all patients' data included)			
	Up to 999 gms	49	2.77
	1-1.499kg	225	12.74
	1.5-1.999kg	261	14.78
	2-2.499kg	429	24.3
	2.5-4kg	771	43.6
	>4kg	30	1.6
Total patients	----------	1765	100
Low birth weight	Less than 2.5kg	964	54.61
Primary disease			
	Birth asphyxia	214	12.12
	Prematurity	594	33.6
	Sepsis	531	30.08
	MAS	98	5.55
	Malformations	69	3.9
	TTN	92	5.21
	NNJ	52	2.94
	IMAGE	47	2.66

	IDM	27	1.5
	Seizure disorder	27	1.5
	Bleeding diathesis	14	0.79

Of these 1765 neonates, 573 (32.5%) were female, and 1192 (67.5%) were male. Of the hospital deliveries, 773 (43.8%) were admitted due to inborn conditions, and 992 (56.2%) were referred from other hospitals. When it comes to birth methods, 738 (41.82%) had vaginal (SVD), while 1027 (58.18%) had lower segment cesarean sections (LSCS). 54.61% of neonates had a birth weight of less than 2.5kg. (Table 1).

Table 2: Neonatal mortality pattern

Variable		Number of death	Percentage
	Total	345	19.54
Place of birth			
	Indoor	131	37.97
	Outdoor	214	62.03
Gender			
	Male	221	64.05
	Female	124	35.95
Admission age			
	Less than 24 hour	246	71.30
	More than 24 hour	99	28.7
Age at death time			
	Less than seven days	299	86.66
	Greater than seven days	46	13.34
Weight			
	Up to 999gm	21	6.08
	1-1.499kg	81	23.4
	1.5-1.999kg	61	17.68
	2-2.499kg	62	17.97
	2.5-4kg	110	31.8
	Greater than 4kg	10	2.8
Primary disease			
	Prematurity	171	50.1
	Sepsis	90	26.08
	Birth asphyxia	46	13.33
	MAS	14	4.05
	Malformation	18	5.21
	Seizure disorder	6	1.73

345 of the 1765 ill newborns who were admitted died and could not be saved, yielding a 19.54% death rate. Of these fatalities, 124 (35.95%) were female and 221 (64.50%) were male. Two hundred forty-six people, or 71.3%, were admitted while younger than 24 hours. 171 (28.78%) of the 594 preterm newborns died. Out of the 531 infants with sepsis, 90 (16.94%) of them passed away. There were 214 admissions and 46 (21.49%) deaths due to birth asphyxia. Of the 98 neonates with meconium aspiration syndrome, 14 (or 14.28%) died. Six (22.22%) of the 27 newborns with neonatal seizure condition died. Comparably, there were 69 deformities and 18 deaths (26%).

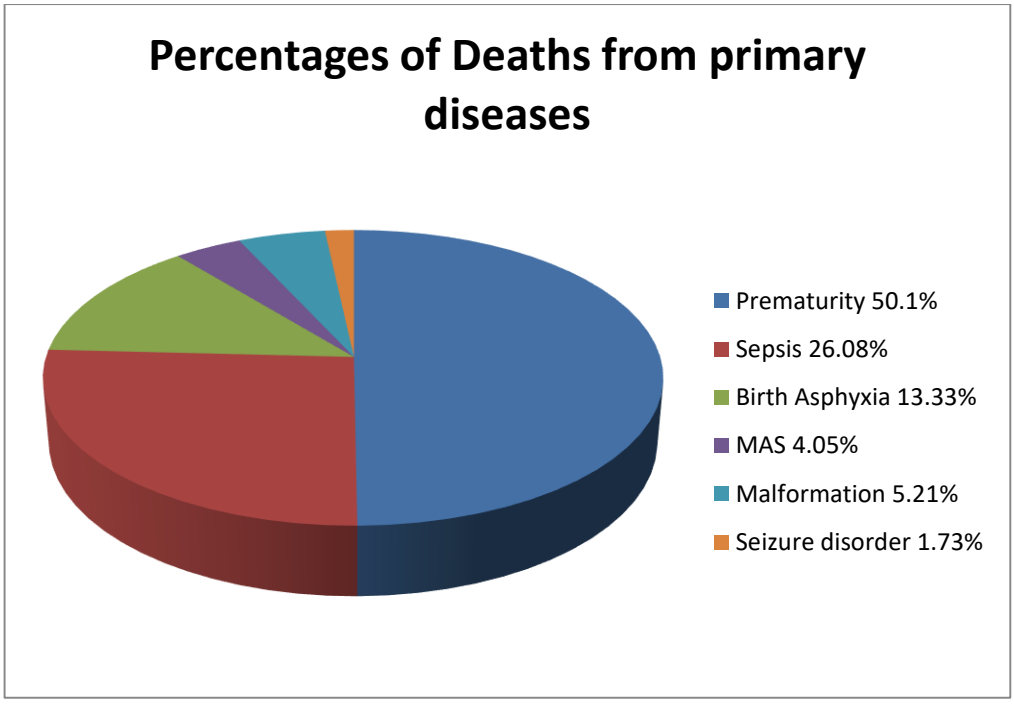

Figure 1: Distribution of primary causes leading to mortality:

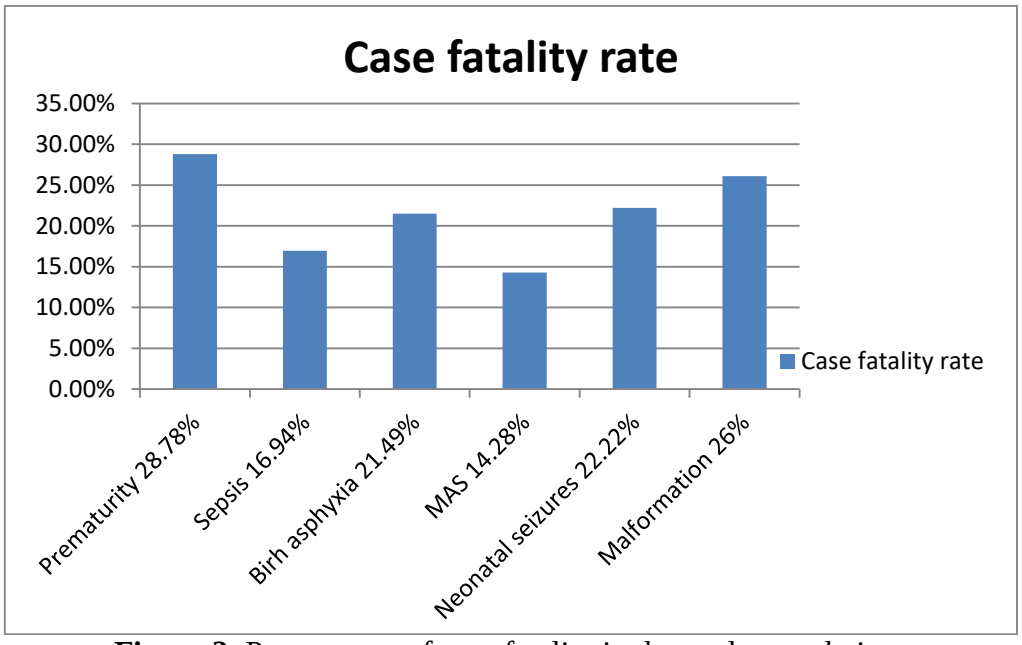

Figure 2: Percentages of case fatality in the study population**:**

Discussion:

Our research's primary findings align with other studies conducted locally and globally. Comparable numbers of ill newborns were admitted during the study period in Rawalpindi(Zulfqar and Naeemullah, 2009) (1631), Lahore (Seyal et al., 2011) (1391), and Karachi(Manzar et al., 2012)(1463). According to our data, the bulk was admitted within the first 24 hours of life. It agrees with data from Rawalpindi(Zulfqar and Naeemullah, 2009) (60.1%) and Lahore (Seyal et al., 2011)(67.9%). It indicates that most newborn issues occur in the early postnatal phase.

The analysis revealed a majority of neonates were male. Once again, it is in line with the local literature published by Tallat et al. (59.55 percent male vs 40.5% female)(Seyal et al., 2011), Ali Akbar et al. (68.73% male versus 31.27% female) (Ali Akbar et al., 2012), and international research from Nigeria (54.3% male versus 45.7% female) (Ugwu, 2012) and India (60 % male versus 40 %)(Kumor et al., 2012)**.** There might be societal, cultural, and biological reasons behind it.

More than half of the sample included in this study came from outlying hospitals to provide newborn care. In local statistics, 80.8% were inborn hospital deliveries (Seyal et al., 2011), completely contrasting our study. One possible explanation may be that there isn't another newborn critical care unit nearby. Thus, we are the only one offering it. The primary delivery method in our investigation was LSCS. A more obvious and understandable reason is that complex obstetric situations are sent to our tertiary care hospital.

Nearly half of all admissions to hospitals, both preterm and full term, were LBW (54.61%), according to morbidity statistics. It is similar to Parkash et al.(Parkash and Das, 2005) (55.4%), Tallat et al(Seyal et al., 2011) (49.3%), and Fazalur Rahim et al.(Rahim et al., 2007) (41.2%). Interestingly, even though they are developing nations as well, it is low in Ethiopia(Gebremariam, 2005) (11.02%), Bangladesh(Islam, 2000)(13.25%), and India(Kumor et al., 2012) (39%). The most common reason for admission in our newborn ICU (33.6%) is prematurity. It agrees with findings published by Parkash et al.(Parkash and Das, 2005) (31%), Manikk et al. **(Kumor et al., 2012)** (38.6%), Nahar et al.(Nahar et al., 2007) have found an even greater percentage from Bangladesh (60.7%). Rawalpindi (Zulfqar and Naeemullah, 2009) has recorded a lower proportion (20.41%). This variance may arise from variations in the type and quantity of samples used in various research.

Among the reasons for hospitalization, sepsis ranked second (30.8%). Studies that were accessible locally showed that the percentage of admissions due to sepsis was 37.82% in Rawalpindi(Zulfqar and Naeemullah, 2009), 30.64% in Karachi(Parkash and Das, 2005), 26.3% in Peshawar(Rahim et al., 2007). Birth asphyxia is a reflection of a community's health care system's performance as well as its socioeconomic, educational, and standards for prenatal and neonatal care. The percentage of birth asphyxia that contributed to morbidity was around 12.12%. In comparison to previous research, it is lower. Manzar and associates 15%(Manzar et al., 2012) and global research studies Islam and associates 18.7%(Islam, 2000), Ugwu (Ugwu, 2012)(Nigeria 18.3%). The fact that LSCS delivered the majority of hospitalized patients might contribute to the low incidence in our analysis.

MAS, TTN, congenital malformations, IUGR, and NNJ contributed 5.55%, 5.21%, 3.9%, 2.66%, and 2.94% to morbidity, respectively. NNJ has been reported to be extremely high in various locations, such as Peshawar(Parkash and Das, 2005) 19.95%). This discrepancy may result from regional customs, awareness, and evolving illness patterns.

In our study, the mortality rate is 19.54%. It is recounted differently in literature from various locations, Parkash et al. (Parkash and Das, 2005) 25.85%, Rubina et al. (Zulfqar and Naeemullah, 2009) 23.48%, From Bangladesh, Nigeria, and India, it is 20.6%(Islam, 2000), 20.3%(Ugwu, 2012), and 13.6%(Kumor et al., 2012), respectively, from bordering nations. Given that the care given to newborns is also a factor in their survival, this variance may result from the type of sample used and the amenities offered in the neonatal unit.

Preterm delivery is responsible for 35-70% of newborn fatalities, which has a significant influence on neonatal mortality(Parkash and Das, 2005). In our study, the case fatality rate for preterm is 28%, which is lower than the reported rates of 38.7% from Rawalpindi (Zulfqar and Naeemullah, 2009), 46.9% from India (Kumor et al., 2012), and 28.8% from Nigeria (Ugwu, 2012). Once more, these differences may result from contemporary amenities, such as ventilation and surfactant usage, in these newborn units.

In comparison 43.8% reported by Rubina et al.Zulfiqar and Naeemullah, 2009) and 36% by Parkash et al.(Parkash and Das, 2005), our case fatality rate for birth asphyxia is low (21%). It is nearly identical to emerging nations. But Nepal's lowest percentage (4%) is recorded (Shah et al., 2005). The standards of perinatal care are the cause of these discrepancies. Our MAS case fatality rate of 14% is similar to local statistics, which is 17.3(Zulfqar and Naeemullah, 2009) and 19.17%(Parkash and Das,

2005). It highlights standards for perinatal care that are established in the community and shows that labor progress has to be observed by professionals. The sepsis mortality rate in our research is 17%, which is comparable to the 12.5% reported from Rawalpindi (Zulfqar and Naeemullah, 2009) and the 14.9% from Nigeria(Ugwu, 2012), In comparison to 34.4% from India, it is low(Kumor et al., 2012)**.** The absence of antiseptic measures during delivery and in newborn facilities is linked to neonatal sepsis. Variations in antiseptic procedures and practices throughout time and space may have led to this discrepancy.

In contrast to previous research, the case fatality rate for congenital abnormalities is relatively low. This stark difference can be attributed to the availability of newborn medicine, pediatric surgery, urology, and neurosurgical services in our setting.

The frequency of LBW is high in developing nations, and it significantly affects the mortality of newborns and children under five. Its etiology is complex. Our study's 65% case fatality rate for LBW is consistent but slightly more with that of India(Kumor et al., 2012), where it is 59.2%. This disparity can result from the disorders linked to low birth weight (LBW) and the newborn services that are offered in neonatal intensive care units (NICU). In our study, the case fatality rate for NNJ is less than 1%, whereas, in Rawalpindi, it is 10.27%(Zulfiqar**.** The public's understanding of the illness, local customs, and differences in newborn conditions at admission might all contribute to this low incidence frequency.

When it comes to the impact of birthplace on mortality, 62% of the neonates who passed away were born outside of our hospital. While it differs from previous local studies 5, it aligns with research from Nigeria(Omoigberal et al., 2010)**,** where 20.3% of inborn and 64.2% of outborn deaths occurred. Out-of-hospital births were treated at clinics without newborn services before being sent to the NICU in critical condition. These cases increase newborn morbidity and mortality. To effectively reduce infant mortality, it's crucial to consider the age at death. Our study found an early infant mortality rate of 56% , equivalent to 84.8% in Lahore(Seyal et al., 2011)

The study's scope was confined to research conducted within a hospital setting, limiting the generalizability of findings to broader population statistics. Additionally, the inability to access sufficient diagnostic resources hindered the identification of potential inborn metabolic defects, thereby constraining the comprehensiveness of the study's outcomes.

Conclusion:

In our area, the death rate for newborns is relatively high, particularly for early neonates. Asphyxia at delivery, sepsis, low birth weight, and premature birth are the leading reasons for this mortality in our research. With proper prenatal, perinatal, and neonatal care, all of these etiologies can be partially avoided. It is necessary to raise awareness and equip prenatal and newborn clinics with modern tools and apparatus. At the Tehsil/District level, level I and II newborn care facilities have to be built. Community services should also be emphasized for early diagnosis and referral to avoid difficulties.

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