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FACTORS ASSOCIATED WITH NEONATAL ADMISSION TO NEONATAL INTENSIVE CARE UNIT AND THEIR OUTCOME AT LIAQUAT UNIVERSITY HOSPITAL, HYDERABAD

Irfan Ali Chandio[*1], Dr. Husan Bano Channar[2], Zaheer Abbas[3], Sonia Imdad[4], Janul Khatoon[5], Iqra[6]

*[*1]MSN Scholar Peoples Nursing School, Liaquat University of Medical and Health Sciences, Jamshoro*
[2]Assistant Professor Peoples Nursing School, Liaquat University of Medical and Health Sciences, Jamshoro
[3]MSN Scholar Peoples Nursing School, Liaquat University of Medical and Health Sciences, Jamshoro
[4]MSN Scholar Aga Khan University, School of Nursing and Midwifery, Karachi
[5]Nursing Instructor Liaquat College of Nursing Female, Jamshoro
[6]MSN Scholar Peoples Nursing School Liaquat University of Medical and Health Sciences, Jamshoro

[*1]irfanchandio40@gmail.com

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Corresponding Author: *Irfan Ali Chandio

Abstract

Background

The first 28 days of an infant's life are considered the neonatal phase. Neonatal admissions to the neonatal intensive care unit are crucial in healthcare settings, especially in developing countries like Pakistan, where every day approximately 675 babies under one month die from preventable complications. Each year, around 246300 newborn deaths were recorded. This study aims to identify factors associated with neonatal admissions to the NICU and their outcomes at Liaquat University Hospital, Hyderabad.

Methods

The prospective observational study was conducted among admitted neonates in the NICU of Liaquat University Hospital. The data were obtained through a purposive method from patient guardians and patient records using a pre-tested questionnaire. The data were entered and analyzed using SPSS version 26. Binary logistic regression was employed to predict the relationship between the dependent and independent variables of this study. The odds ratios (OR) and 95% CI were used to present these associations, and a P value < 0.05 was considered statistically significant.

Results

A total of 276 neonates were included in this study. Of the neonates, 64.5% were male, 74.3% were from rural areas, and 55.1% were delivered via caesarean section. The overall neonatal death rate was 41.9%. The major reasons for neonatal admission were respiratory distress syndrome, 34.1%, neonatal sepsis, 20.7% and pneumonia, 12.3%. RDS was the leading death-causing factor. The study found that factors such as preterm birth, low birth weight, being small for gestational age, insufficient antenatal care, and maternal health complications were significantly associated with poor clinical outcomes.

Conclusion

This study conclude that respiratory distress syndrome is the primary reason for admissions and deaths in the NICU. Understanding the reasons for admission to

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NICU and predictors for neonatal mortality is significant for planning health services, improving the quality of care and reducing neonatal mortality rate. The study recommends enhanced prenatal care, early identification of high-risk neonates, and improved neonatal care facilities to reduce mortality and improve outcomes.

INTRODUCTION

The first twenty-eight days after birth are known as the neonatal period, which is a critical time for newborns as they adapt to life outside the womb and encounter challenges in staying alive(1). According to World Health Organization (WHO), the death of a live-born infant within the first twenty-eight completed days of life, or four weeks postpartum is considered neonatal death. This death category can be further subdivided into early neonatal deaths (0-7) and late neonatal deaths (8-28) completed days after birth(2). It is important to note that majority of neonatal deaths approximately 36% of these fatalities transpiring during the first 24 hours following birth. This important period emphasizes newborns vulnerability and the urgent need for attentive medical care and assistance during their first moments in the world(3).

Each year, approximately 2.3 million newborns die within the first 20 days of life, according to the WHO, which translates to around 6,500 newborn deaths each day. The international neonatal death rate is estimated at 17 deaths per 1,000 live births, highest NMR rates are found in developing countries, like African countries, where the NMR at twenty-seven per thousand live births, in Asian developing countries at twenty-one per thousand live births(4). according to UNICEF reports in Pakistan, neonatal death rate is around 42 deaths per 1,000 live, besides some studies indicate 49.4 and 48 deaths per 1,000 live births, respectively. Thus, these figures exceed those of neighboring countries and indicate that Pakistan ranks third globally in terms of neonatal deaths, accounting for 7% of all such fatalities worldwide(5-7).

Therefore, the establishment and enhancement of Neonatal Intensive Care Units services are crucial for decreasing neonatal mortality rates becouse NICU provide vital medical treatment and care for newborns with acute or chronic illnesses(8).

Neonatal outcomes in the NICU can vary greatly depending on the various neonatal and maternal factors, reasons for admission, the severity of the illness, and the quality of care received(9). Maternal factors encompass a range of conditions and exposures experienced by the mother during pregnancy such as maternal age, number of previous births, inadequate maternal health, poor hygiene during delivery, negligence in initial crucial hours following birth, pre-existing medical issues like diabetes, bleeding disorders, infections, and the use of substances like smoking or alcohol during pregnancy, prolonged labor duration, inadequate prenatal care, cesarean delivery, can increase the likelihood of NICU admission for newborns(10, 11). Factors related to the fetus itself can also contribute to admission to NICU, such as being small for gestational age, prematurity, twin births, especially those involving low-birth-weight (LBW), often require NICU admission to address their unique physiological needs and challenges immediately after birth(12). However, the primary reasons for NICU admission and neonatal deaths were varies country to country the most common factors are prematurity, LBW, respiratory distress syndrome (RDS), birth asphyxia, infections such as sepsis and pneomonia, hypothermia, and pathological jaundice, however, prematurity remains the leading cause of neonatal admission in the NICU and RDS and sepsis were the leading death factor(13). Each of these factors greatly elevate the risk of adverse neonatal outcomes.

Neonatal Intensive Care Units are vital healthcare facilities designed to enhance the survival rates and overall health outcomes of newborns who seek intensive medical attention, the NICUs have high tech life support systems like incubators to keep babies warm, ventilators to help them breathe, and special monitoring devices to keep an eye on their vital signs all the time(14). The NICU team including neonatologists, supporting doctors, neonatal nurses, technicians, nutritionists and respiratory therapists, works together to make sure that each baby gets complete, well-coordinated care that is tailored to their unique needs because once admitted to the NICU, the newborn's the outcome is

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determined by their underlying illnesses, severity, and treatment care provided by the healthcare provider and also depends on intensive care environment(15).

Hence, neonatal period is crucial for reducing infant mortality and achieving Sustainable Development Goal (SDG) 3.2, which strives to ensure healthy lives and well-being for all. One of the main goals of SDG 3 is to decrease neonatal mortality to less than 12 deaths per 1,000 live births by 2030. To achieve this goal, it is essential to decrease neonatal admissions by identifying and mitigating risk factors encountered by newborns during pregnancy and after birth, and by ensuring proper care and effective management at all levels(16, 17).

Study Aim:

The aim of this research is to identify factors associated with neonatal admission and their clinical outcome in the NICU at the pediatric department, Liaquat University Hospital of Medical & Health Sciences, Hyderabad. The following general objectives have been addressed in the thesis.

Study Objectives:

1. To identify neonatal and maternal factors associated with neonatal admission in NICU, at LUH Hyderabad.

2. To determine causes of neonatal admission to NICU at Liaquat University Hospital (LUH), Hyderabad.

Research Question:

1. What factors are associated with neonatal admission to the neonatal intensive care unit and the clinical outcome?
2. What are the causes of neonatal admission and neonatal mortality in the NICU at Liaquat University Hospital (LUH), Hyderabad?

1.7 Rationale of the study:

Despite advancements in neonatal care, preventable measure and developing SDG goals to reduce newborn deaths and illness still numerous (preventable) factors continue to contribute high morbidity and mortality rates in neonates. Therefore this study aims to identify disease pattern, demographic, neonatal, and maternal factors associated with neonatal admissions to the NICU at Liaquat University Hospital, Hyderabad, and evaluate their clinical outcomes, thereby informing efforts to reduce neonatal deaths and improve survival rates in line with Sustainable Development Goal three.

METHEDOLOGY

Study Design and Setting

The prospective observational study was conducted in the NICU at Liaquat University Hospital, Hyderabad. This study design was chosen due to the researcher's available time and academic obligations. Additionally, this study design enables researchers to track neonates admitted to the NICU throughout their hospital stay and observe their outcomes in relation to various associated factors by the time of discharge.

Study Duration

The study was conducted over a six-month of period.

Study Population & Eligibility Criteria

The study population consisted of neonates, both male and female, aged up to 28 days.

- **Inclusion Criteria**: This study included all neonates, regardless of gender, born in this hospital or referred from other health centers and aged up to 28 days at admission.
- **Exclusion Criteria**: Neonates discharged against medical advice (DAMA), left against medical advice (LAMA), or without a mother or guardian present while data collection were excluded from the study.

Sample Size calculation:

The estimated sample size for this study was calculated using OpenEpi.info version 3 calculator, based on a previous NICU prevalence study reporting 20.5%(18). Resulting in a calculated sample size of 251 participants, with a 95% confidence interval and a 5% margin of error. To account for missing data, 10% was added, resulting in a final sample size of 276.

Sampling technique

A non-probability, purposive sampling technique was employed to collect samples from selected hospital.

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Data collection tool and Procedure

In this study, we used a pre-tested, structured questionnaire to collect data from guardians of patients and reviewed medical records of eligible neonates in the NICU. The data collection tool was adapted from a recently published study with permission from the author(19).

Data entry process and Analysis

The data was verified for completeness and entered into IBM's SPSS version 26 for analysis. Descriptive statistics for categorical variables were summarized in percentages and frequencies and presented in tables and charts. Quantitative variables were calculated for mean, standard deviation, and range. Logistic regression was performed. Crude odds ratios were analyzed with a 95% confidence interval, considering a p-value <0.05 was considered a statistically significant association.

Variables of study

A. The dependent variable of this study were neonatal outcome i.e. **discharge alive and neonatal expired.**

B. Independent variables of this study were neonatal and maternal factors.

Ethical considerations

Ethical approval was obtained from the Ethical Review Committee at LUMIHS in Jamshoro prior to conducting the research. Permission was also granted by the hospital's Medical Superintendent. Consent was acquired from the patient's mother or guardian.

RESULTS

A survey of 276 participants, presented in **Table 1**, showed a considerable majority (64.5%) of males compared to females (35.5%). Nearly half (49.6%) of neonates were admitted to the NICU within the first 24 hours. Most of the participants (74.3%) lived in rural areas, 55.1% delivered via caesarean section with 41.7% of neonates born at LUH Hospital. In terms of birth weights, 6.5% were extremely LBW (less than 1kg), 9.4% were very LBW (1 and 1.4 kg, the majority of 43.5% were found LBW (1.5 and 2.4 kg). Regarding gestational age, 47.8% were born before 37 weeks premature, while only 6.2% were twins admitted to NICU.

APGAR scores at one minute showed 10.1% scored less than 3 (abnormal), and at five minutes, 2.2% scored below 3. Regarding length of stay (LOS) in NICU, 38.4% stayed 1-7 days, 39.9% for 8-14 days, and 21.7% for more than fifteen days in the NICU.

Table 1: Frequency and Percentage distribution of Neonatal characteristics of study participants (n=276)

Variables Name	Categories	Frequency	Percentage %
Gender	Male	178	64.5
	Female	98	35.5
Neonatal age at the time of admission to NICU	First 24 hours	137	49.6
	2-7 days	102	37
	8-28 days	37	13.4
Residency	Urban	71	25.7
	Rural	205	74.3
Place of delivery	At LUH Hospital	115	41.7
	Other Government hospitals	99	35.9
	Private clinics/hospitals	53	19.2
	Home delivery	9	3.3
Delivery Type	Spontaneous vaginal delivery	124	44.9
	Caesarian Section	152	55.1
Neonatal birth weight in (kg)	< 1 Kg	18	6.5
	1 to 1.4 Kg	26	9.4
	1.5 to 2.4 Kg	120	43.5
	More than 2.5 Kg	112	40.6

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Gestation age at birth	Less than 37 weeks	132	47.8
	More than 37 weeks	144	52.2
Number of gestations	Single	259	93.8
	Twins	17	6.2
APGAR score 1st minute	<3 score (abnormal)	27	10.1
	4-6 score (moderately abnormal)	23	8.7
	>7 score (Normal)	19	7.2
APGAR score 5th minute	<3 score (abnormal)	7	2.2
	4-6 score (moderately abnormal)	66	23.9
	>7 score (Normal)	30	10.9
Length of stay in NICU	1-7 days	106	38.4
	8-14 days	110	39.9
	More than 15 days	60	21.7

Table 2 revealed that the majority of (83.7%) mothers were Muslims, (77.9%) were aged between 19 and 30 years. Most mothers (73.6%) were unemployed, with 87.3% being multigravida. In terms of antenatal care, 61.6% had 1 to 3 ANC visits, while 13.8% did not attend any ANC care during pregnancy. Regarding maternal illness this study found gestational diabetes and pregnancy-induced hypertension (8.7% each), 10.1% experiencing bleeding issues, regarding maternal allergy, 93.1% had no allergies. In terms of condition after delivery, 86.2% were in good condition, 12% critically ill, and 1.8% were maternal deaths.

Table 2: Frequency and Percentage distribution Maternal characteristics of study participants (n=276)

Variables Name	Categories	Frequency	Percentage %
Mothers Religion	Muslims	231	83.7
	Non-Muslims	45	16.3
Age of the neonatal mother	Less than 18 years	13	4.7
	19-30 years	205	77.9
	More than 30 years	48	17.4
Mother's Occupation	Unemployed	203	73.6
	Employed	73	26.4
Gravidity	Primigravida	35	12.7
	Multigravida	241	87.3
Number of ANC follow-Up	1-3 times	170	61.6
	More than 4 times	68	24.6
	None	38	13.8
Birth status	Term	140	50.7
	Preterm	130	47.1
	Post term	6	2.1
Gestational DM	Yes	24	8.7
	No	252	91.3
Pregnancy Induced hypertension	Yes	24	8.7
	No	252	91.3
Bleeding/Leakage problems	Yes	28	10.1
	No	248	89.9
History of Hepatitis and	Yes	16	6.15

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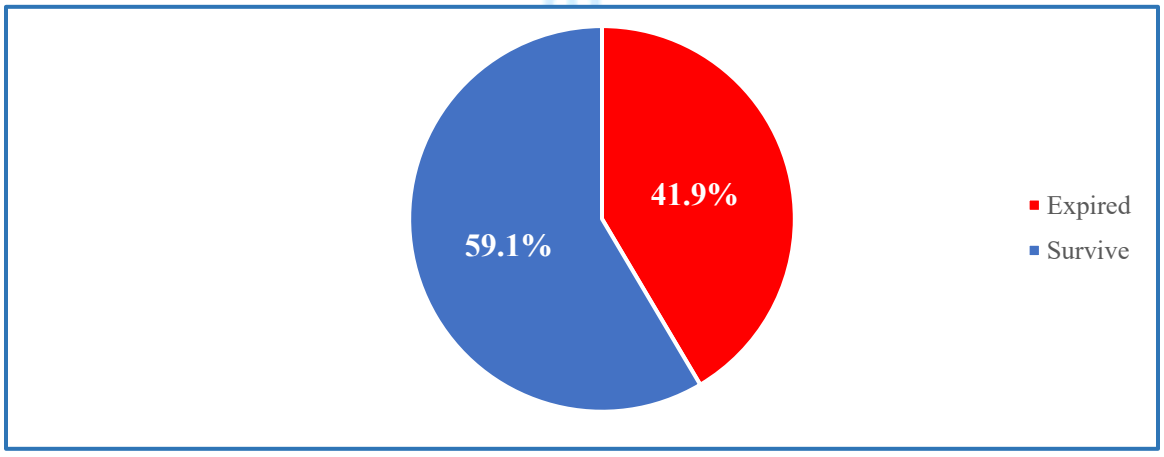
Asthma	No	260	93.85
Maternal allergy	No	257	93.1
	If Yes then what...?	19	6.9
	Allergy to food	6	2.2
	Allergy to medicine	8	2.9
	Allergy to fragrance	5	1.8
Maternal condition after delivery	Good	238	86.2
	Critical ill	33	12
	Maternal Death	5	1.8

Table No. 3 indicate results of continuous variables. The gestational age ranged between 27 and 42 weeks, with an average of 36.16 weeks (SD = 3.51), showing a slight predominance of preterm births. Regarding birth weights, which ranged from 0.8 kg to 4.4 kg, with an average of 2.2 kg (SD = 0.69), indicating that many newborns were of low birth weight (LBW), a known risk factor for admission to the NICU. The length of stay in the NICU ranged from a minimum of 2 days to a maximum of 54 days, with an average of 11.28 days (SD = 7.52). Maternal ages ranged from 17 to 40 years, with a mean of 26.8 years (SD = 5.39).

Table 3: The data includes the minimum, maximum, mean, and standard deviation of gestational age, birth weight of the neonates, duration of stay in the NICU, and maternal age.

Variable Name	Minimum	Maximum	Mean	Std. Deviation
Gestational age	27 weeks	42 weeks	36.16	3.519
Birth weight of the neonates	0.8 kg	4.4 kg	2.201	0.695
Duration of stay in the NICU	2 (days)	54 (days)	11.28	7.529
Maternal age	17 (age in years)	40 (age in years)	26.82	5.394

Pie Chart 1: Neonatal admission outcome



The above **pie chart** shows the results of the clinical outcome that indicates 41.9% (113) neonatal mortality rate at the NICU, LUH, out of the total sample size of 276.

The figure-2 displays the leading causes of neonatal admission and death among newborns in the neonatal ICU. Respiratory distress syndrome was the most frequent cause constitute 33.6% of deaths (38 infants). It was followed by neonatal sepsis at 18.6% (21) and pneumonia at 17.7% (20) while Transient

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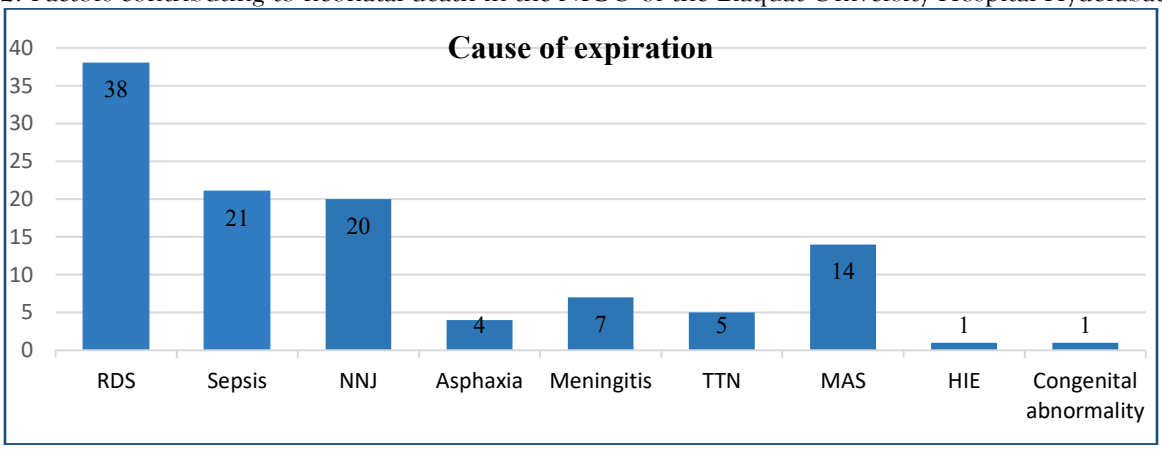
tachypnea of the newborn (TTN) accounted for 12.4% of fatalities. These results indicate that infections and respiratory issues are significant contributors to newborn mortality.

Figure 2: Factors contributing to neonatal death in the NICU of the Liaquat University Hospital Hyderabad



The binary logistic regression analysis were summarized in **Table 4** aimed to predict the relationship between neonatal factors and clinical outcomes. The odds ratio (OR) for birth weight was 1.636 (95% CI: 1.132-2.364; p = 0.009), indicating that neonates with normal birth weights have a higher probability of survival than those admitting with LBW in the NICU.

Gestational age predicts (OR of 4.521 95% CI: 1.466-13.947; p = 0.009), four times higher survival rates in full term babies than those preterm babies.

Regarding gestational size appropriate for gestational age AGA babies, (OR: 3.098 95% CI: 1.113-8.621,p value 0.030) had three times survival chances in NICU than that of those classified as small for gestational age (SGA). Gender differences noted an OR of 1.276 (p = 0.384), indicating a higher survival rate for females compared to males. Other factors with increased survival odds included place of delivery (OR = 1.205), number of births (OR = 1.202), feeding type (OR = 1.549), feeding duration (OR = 1.433), and birth status (OR = 1.333).

Table 4: Results of binary logistic regression model affecting neonatal factors associated with clinical outcome, at the NICU of LUH Hyderabad (n=276).

Variables	Response Category	Outcome (n)		Odds Ratio	95% C.I		p-value
		Survived	Expired		Lower	Upper	
Sex	Male	102	75	1			
	Female	60	38	1.276	.738	2.206	.384
Age on admission	Within 24 hours	72	65	1			
	2nd to 7th day	66	36	1.405	.990	1.994	.050
	>7 days	25	12	1.636	1.101	2.411	.049
Place of birth	Liaquat university hospital	61	54	1			
	Referral	102	61	1.205	.670	2.165	.534
Method of delivery	NVD	74	50	1			
	CS	89	63	1.002	.588	1.707	.995
Number of gestations	Twins	8	9	1			
	Single	155	104	1.202	.382	3.783	.753
Gestational Age	< 37 weeks	77	55	1			

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	>37 weeks	86	58	4.521	1.466	13.947	.009
Weight at admission in NICU	1 to 1.4 Kg	19	25	1			
	1.5 to 2.4 Kg	67	53	1.636	1.132	2.364	.009
	> 2.5 Kg	77	35				
Gestational size	SGA	61	59	1			
	AGA	102	54	3.098	1.113	8.621	.030
Birth status	Term	84	56	1			
	Preterm	75	55	.909	.560	1.477	.700
	Post term	4	2	1.333	.236	7.526	.745
Length of stay (days)	1-7 days	65	41	1			
	> seven days	98	72	1.029	.597	1.773	.918

Table 5 revealed the results of maternal factors influencing neonatal outcomes. The variables (occupation, maternal allergy, gestational terms, and living children) were found to have a statistically significant association with neonatal outcome. Thus, neonates born to mothers age between (19-30) years have 1.7 times higher survival rates than those born to mothers under 18 or above 30 years (OR 1.760, 95% CI: 0.450-6.886), those whose mothers had more than one antenatal care visit are 1.9 times more likely to survive than those had no ANC history (OR 1.940, 95% CI: 0.165-22.821). Neonates from mothers without allergies have sevenfold higher survival chances (OR 7.448, 95% CI: 0.957-664.719) and multigravidity is linked to 1.7 times higher odds of survival compared to primigravidity (OR 1.758, 95% CI: 0.613-5.038). In brief, the findings highlight the crucial role of maternal health in influencing neonatal survival rates.

Table 5: Binary regression analysis of maternal factors associated with clinical outcome of neonatal admission to the NICU of LUH Hyderabad (n=276)

Variable Name	Response Category	Outcome (n)		O.R	95% C.I		p-value
		Survived	Expired		Lower	Upper	
Maternal age	19-30y	66	51	1			
	<18y	9	4	1.760	.450	6.886	.417
	>30y	88	58	1.369	.790	2.372	.263
Residency	Urban	47	24	1			
	Rural	116	89	1.389	.768	2.509	.277
Occupation	Not working	113	90	1			
	Working women	50	23	1.815	.929	3.548	.040
Number of ANC follow-Up	None	16	22	1			
	1-3 times	28	40	1.940	.165	22.821	.598
	More than 4 times	69	101	1.735	.154	19.556	.656
Maternal Allergy	Allergy to food/medicine/Fragrance	14	5	1			
	None	149	108	7.448	.857	64.719	.050
Maternal condition	Critical ill	24	14	1			

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after delivery	Good	139	99	1.221	.602	2.478	.580
Maternal comorbidity	None	89	64	1			
	Gestational DM	8	16	1.468	.472	4.566	.507
	PIHTN	8	16	1.299	.406	4.155	.659
	PROM	12	16	1.277	.364	4.478	.703
	Other	15	15	.777	.275	2.196	.634
Gravida	Primigravida	23	12	1			
	Multigravida	140	101	1.758	.613	5.038	.294
Gestational terms	Preterm	56	76	1			
	Complete term	57	87	.420	.267	.661	.000
Living children	More than 6	20	3	1			
	4-5	38	22	.442	.092	2.136	.310
	1-3	105	88	1.807	1.263	2.585	.001

DISCUSSION

Discussion on study findings versus findings of the recent locally and internationally study:

Although there is a significant global dedication to decreasing neonatal mortality, however noteworthy challenges persist in developing nations, including Pakistan. Thus, this study was aimed to identify factors associated with neonatal admission to NICU and their clinical outcome at Liaquat University Hospital, Hyderabad. Therefore, we employed binary logistic regression model to analyze the data between dichotomous dependent variable with both categorical and continuous independent variables. The study found significant associations between various neonatal and maternal factors (Table 4&5).

This study found a male (64.5%) predominance among NICU admissions. This aligns with research from other developing nations, showing male predominance in NICU, including 58% in Sudan, 68% in Nigeria, 57.8% in India, 57.8% in South Africa, and 82.8% in Ethiopia(20-23). This was due to some people thinking that the difference in the number of males and females born, also, cultural and social factors may make parents pay more attention to baby boys than baby girls(24). Further, this study found that respiratory-related disorders were the primary reason for neonatal admissions to the NICU followed by infection-related disorders. These results align closely with the observations noted in the previous study conducted by Javed et al. from Quetta, Pakistan(5), which reported RDS at 43.6% and sepsis at 24.8%. Similar trends were observed in Iran (37%) and South Africa (36.6% for respiratory issues, 22.7% for sepsis). This observation may be attributed due to an absence of a lubricating

substance in the lungs, known as surfactant, which aids in the expansion of the lungs and stops the air sacs from collapsing therefore previous studied has shown that RDS commonly occurs in individuals whose lungs have not completely matured(25).

The normal birth weight neonates (OR: 1.636, p-value <0.050) have 1.6 times higher survival chances than those born with LBW. This aligns with findings from Sindh, Pakistan, where nearly one in four newborns is underweight. LBW is a significant public health concern, associated with increased risks of stunting and wasting. with children facing higher risks of moderate (OR = 1.5) and severe wasting (OR = 1.6) as well as being both stunted and wasted (OR = 2.0). These studies highlight the critical impact of birth weight on child health and NICU survival(26). Additionally, neonates admitted in the early neonatal period (0-7 days) had lower survival rates compared to those admitted during the late neonatal period (8-28 day) (OR: 1.4, 1.6, $p < 0.05$). due to first twenty-four hours are crucial as newborns experience significant cardiopulmonary changes transitioning from intrauterine to extrauterine circulation(27).

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Preterm neonates face more health issues than full-term infants. This study shows that full-term infants have four times higher survival chances (OR: 4.5, p-value 0.009) compared to those born before 37 weeks. Although these findings were aligns with(28), gestational age over 37 weeks reduces the risk of NICU admission and death (OR: 2.2) due to fewer life-threatening problems. Furthermore, babies with appropriate gestational size also show three times higher survival rates compared to those small or large for their gestational (OR: 3.01, p-value 0.030). The findings of our study align with those of prior research, indicating that the size of infants significantly impacts the neonatal outcome, these finding suggests a strong link between birth size and health outcomes in newborns(29).

Additionally, the logistic regression model demonstrated that mothers aged 19 to 30 years had 13% to 17% higher survival rates for their newborns compared to those under 18 or over 30 (OR 1.760 and 1.369, respectively; $p < 0.05$). This aligns with findings from MCH in Bisha, Saudi Arabia(30), which reported that mothers over thirty years were 7.17 times more likely to have their newborns admitted to the NICU compared to those mothers under thirty years. In terms of residency and occupational factors both significantly predict neonatal adverse outcomes, with odds ratios of 1.389 and 1.815, respectively. Rural residency can negatively impact newborn survival due to limited access to healthcare, poorer socioeconomic conditions, and adverse environmental factors. Additionally, long work hours, poverty, and hazardous jobs can worsen women's health during pregnancy. Findings from Bangladesh indicate that newborns from low-income areas are 1.2 times more likely to be admitted to the NICU than those from urban areas(31).

Mothers with gestational diabetes had a higher probability of their newborns needing NICU admission (OR 1.46, 95% CI 0.47-4.56) compared to mothers without such conditions. Similar findings were reported in previous studies(32-34), which reported that prepregnancy diabetes four times (OR 4.95, 95% CI 4.34, 5.64), preterm birth seven times (OR 7.45, 95% CI 6.58, 8.44) and vaginal bleeding are independent high-risk predictors for adverse neonatal outcome. Regarding ANC care, mothers who attended more than one antenatal care visits have higher neonatal survival rates compared to those who do not receive any. A similar finding was observed by(35, 36), which reported that mothers with at least one visit have more than twice the survival rate of those with insufficient care. This was due to early ANC visits allow for the detection and management of maternal health issues, reducing adverse outcomes for newborns. Furthermore, this study revealed that singletons had higher survival chances compared to twins (OR 1.23, 95% CI 0.382-3.783), Similar results were reported in a previous study(37), highlighting that twins face higher neonatal NICU admissions and mortality. This trend is attributed to multiple births' association with premature delivery and low birth weight, which lead to adverse outcomes.

Conclusion

The current study concludes that the primary reasons for NICU admission and death were respiratory distress syndrome, the neonatal mortality rate was found 41.9% which is significantly higher than in other regions of Pakistan and raises concerns about achieving SGD 3.2 by 2030. The study found that 64.5% of admitted neonates were male, 58.3% were referred from other hospitals, and the majority, 74.3%, were from rural areas. Key predictors of admissions and deaths included prematurity, low birth weight, age, weight at admission, gestational age, inadequate Apgar scoring, lack of antenatal care, advanced maternal age, occupation, multiple births, and delayed feeding initiation. Therefore, this study emphasized the need for improved prenatal care, early identification of high-risk neonates, and better neonatal care facilities to reduce mortality and enhance outcomes.

Study limitations and Recommendations

- This study was executed as a prospective observational analysis within a single Neonatal Intensive Care Unit. Consequently, the findings may not be generalizable to other settings or healthcare systems due to neonatal outcomes can vary significantly based on local healthcare quality, economic conditions, and the specific patient populations served.

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- This study did not include all variables such as community and environmental-related factors that might predict neonatal mortality. Additionally, it was noted that Apgar scores were not consistently documented in patient records.

These limitations suggest that while the study provides valuable insights specific to the observed NICU, caution should be exercised when extrapolating these findings to broader populations or different healthcare contexts. Future research could benefit from multi-center studies, longer observation periods, and more complete data collection protocols, and advanced statistical methods to account for data distribution issues.

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Authors Contributions

Conceptualization, writing the original draft: IAC
Data analysis and review: IAC & HBC.
Data collection: IAC, HBC & ZA
Reviewing & editing IAC, SA, JK and I.

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