ORIGINAL ARTICLE

Pattern of Etiologies of Early Neonatal Mortality in Tertiary Care Hospital, Peshawar

Lal Muhammad, Hina Parvaiz*, Afzal Khan, Bakhat Beland, Inyat Ullah

ABSTRACT

Objective: To identify the pattern of etiologies responsible for the early neonatal mortality in neonates admitted in the neonatal intensive care unit.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: This study was conducted in Neonatal Intensive Care, Lady Reading Hospital, Medical Teaching Institute Peshawar, Pakistan from September 2023 to January 2024.

Methods: Data was collected for both groups according to sample size and parents were interviewed through Semi semi-structured questionnaire at the time of expiry. Through SPPS 27, data analysis was performed for quantitative and qualitative variables. *Chi-square* test was performed and then Binary logistic regression was performed taking outcome as the dependent variable.

Results: The estimated neonatal mortality for our study was 25.5%. The mean age at the time of admission was 2.69 days±1.75. Overall females were 19.2% and male neonates were 80.8%. Neonatal mortality was significantly associated with the age of the mother, mode of delivery, sepsis, preceding birth interval in months, antenatal clinic visits in pregnancy, mother's education, father's education, and wealth index. The age of the mother had a significant relation with neonatal mortality age <16 years caused 9.9 times higher mortality when compared with the reference category. Considering the antenatal visits during pregnancy, no antenatal visit is 4.5 times more associated with mortality. Similarly, maternal illiteracy had a significant impact on mortality with an odds ratio of 3.6. The short preceding birth interval was significantly associated with neonatal mortality with an odds ratio of 2.8 on multivariate analysis.

Conclusion: The findings of this research depict an association between early neonatal mortality and various factors including the mother's age, preceding birth interval, antenatal clinic visits during pregnancy, mother's and father's education, and wealth index of the family.

Keywords: *Child, Developing Countries, Infant Mortality, Mothers, Neonates, Public Health.*

How to cite this: *Muhammad L, Parvaiz H, Khan A, Beland B, Ullah I. Pattern of Etiologies of Early Neonatal Mortality in Tertiary Care Hospital, Peshawar. Life and Science. 2024; 5(4): 563-570. doi: http://doi.org/10.37185/LnS.1.1.699*

Introduction

Neonatal death is a core public health issue worldwide. Over the past decade, the course of the early neonatal mortality has been slower than that of late neonatal mortality and infant mortality.[1] The United Nation's Sustainable Development (SDGs) Goal 3 by World Health Organization aims to reduce maternal, childhood, and particularly neonatal mortality with new targets for 2030.[2,3]

There is over 65% of neonatal deaths occur in the world but mainly in ten countries including Pakistan. In Africa and South Asia, 2.6 million live born die within the first month of life.[3] Worldwide the overall post-natal mortality is nearly 73%.[4]

Pakistan continues to grapple with persistent hurdles in diminishing neonatal mortality rates, compounded by societal norms in many regions of Pakistan that discourage seeking medical care, leaving numerous women unable to access healthcare for themselves and their infants.[5]

The neonatal mortality rate is 42 per thousand live

Department of Pediatric
Leady Reading Hospital (LRH) Peshawar, Pakistan
Correspondence:
Dr. Hina Parvaiz
Assistant Professor, Paediatric
Leady Reading Hospital (LRH) Peshawar, Pakistan
E-mail: hnprvz@gmail.com
Received: April 23, 2024; Revised: Jul 16, 2024
Accepted: Aug 20, 2024

births in Pakistan. With an estimated 300,000 neonates dying annually, Pakistan is at a higher ranking in global neonatal deaths.[6] A number of studies show that approximately 3-fourths of neonatal deaths occur for the duration of the early neonatal life, this excessive proportion of deaths in this era indicates that the first week of postnatal life is crucial for neonatal survival. Reduction of these preventable deaths in this era is essential to meet the targets of SDGs.[7]

Risk factors that account for early neonatal mortality can be maternal age and parity, neonatal causes like birth weight, prematurity and gender, socioeconomic status, parental education, and economic status of the parents.[7,8] The main factors causing early neonatal deaths are prematurity and intrapartum-related activities, consisting of birth asphyxia, whereas infections are responsible for late neonatal and infant mortality. Consequently, early neonatal survival is intently related to care at delivery, while post neonatal survival relies upon as a substitute on excellent care practices at home together with feeding and hygiene and care in search of for sickness.[9]

The current study will help in the care and management of newborn in the first week of life. This paper will open a window for further research activities and will help to cover the identified research gap.

Objective of the study

To identify the pattern of etiologies responsible for the early neonatal mortality in neonates admitted to neonatal intensive care.

Methods

The comparative cross-sectional study was conducted at Neonatal Intensive Care unit, Lady Reading Hospital Peshawar, Pakistan from 1st September 2023 to 31th March,2024 after taking approval from the Ethical Review Board on dated: 31st August 2023 vide letter no: 900/LRH/MTI. By using open Epi software, with 95% confidence interval, 4.2% anticipated population[6] and 3% absolute precision, the calculated sample size was 172. About 86 cases were taken having outcome as mortality in control group and data of 86 alive babies was collected as controls. Data was collected using convenient sampling. The subjects fulfilling the following criteria will be included in the study. All neonates presented to the nursery unit Lady Reading Hospital Medical Teaching Institute in the first week of life. The subjects with the following mentioned conditions will be excluded from the study. Still birth and Death occurred after 7 days of postnatal life. In this comparative cross-sectional study, the data was collected for neonates admitted to Neonatal Intensive Care between September 2023 and January 2024. Data was collected after any neonate expired, regarding the age of the neonate at the time of death, length, and weight of the neonate, gender, residency, age of mother, gestation, place of delivery, mode of delivery, single or multiple gestation, birth asphyxia, perinatal asphyxia, neonatal sepsis, number of antenatal visits during pregnancy, preceding birth interval in months, number of alive children, number of Tetanus Toxoid injections during pregnancy, mothers' education, fathers' education, wealth index. Postgraduate residents were trained and instructed regarding the collection of data. For the control group similar data was collected from alive neonates, those getting treated in hospital after admission and discharged. Expired neonates were allocated to group A and alive neonates as group B.

Results were subjected to appropriate statistical analysis using SPSS version 27. Binary logistic regression was performed taking independent categorical variables with *P*-value as significant and taking outcome as the dependent variable. Among the dependent variables, those neonates that were alive after treatment and discharged were coded as "0" and the neonates that expired were coded as "1". Both univariate and multivariate binary logistic regression was performed and results were performed and results were analyzed.

Results

About 2098 neonates were admitted in the nursery from September 2023 to January 2024, and out of them, 535 expired. The estimated neonatal mortality for our study was 25.5%. Neonates were allocated to two groups that is, Group A and Group B. Expired neonates were taken into group A, and alive neonates were taken in Group B for comparison according to the calculated sample size. The mean age at the time of admission was 2.69 days±1.75. Overall females were 19.2% and male neonates were

80.8%. The descriptive statistics were performed for the categorical variables and are shown in table-1.

Data was analyzed in SPSS version 27; *Chi-square* test was applied to determine the association of different variables with neonatal mortality and the *P*-value was calculated. A *P*-value less than 0.05 was taken as significant. Table-2 shows results of bivariate analysis based on *Chi-square* test.

Neonatal mortality was significantly associated with age of the mother. (*P*-value<0.05), sepsis (*P*-value<0.05), preceding birth interval in months (*P*-value<0.05), antenatal clinic visits in pregnancy (*P*-value<0.05), number of tetanus toxoid injections during pregnancy (*P*-value<0.05), mother's education (*P*-value<0.05), father's education (*P*-value<0.05), and wealth index (*P*-value<0.05). The *P*-value was not significant relevant to the length of the neonate, APGAR scores at 5 and 10 minutes after

Table-1: Descriptive Statistics

Variable		**Frequency**	**% age**	Variable		**Frequency**	**% age**
Neonatal Risk Factors							
Baby Length	45-55cm	150	87.2%	Baby wt	Normal	138	80.20%
	40-44cm	13	7.60%		Low Birth Weight	26	15.10%
	35-39cm	9	5.20%		Very Low Birth wt	6	3.50%
Apgar Score at 5min	<5	33	19.20%	Sepsis	Yes	137	79.70%
	>5	139	80.80%		No	35	20.30%
Apgar Score at 10 Min	<8	14	8.10%	Perinatal Asphyxia	Yes	33	19.20%
	>8	158	91.90%		No	139	80.80%
Other Factors							
Residency	Urban	33	19.20%	Place of Birth	Home	32	18.60%
	Rural	139	80.80%		Health Facility	140	81.40%
Mother's Age	<16 Years	10	5.80%	Mode of Delivery	Normal vaginal delivery	154	89.50%
	>16 Years	162	94.20%		C-Section	18	10.50%
Duration of Pregnancy	Term	153	89%	Type of Birth	Single	161	93.60%
	Preterm	19	11%		Twins	7	4.10%
Preceding Birth Interval	<24m	78	45.30%		Triplets	1	0.60%
	>24m	94	54.70%		Quadruplet	3	1.70%
ANC Visits	No Visit	19	11%	Tetanus toxoid Injections	No Inj.	79	45.90%
	One Visit	54	31.40%		1 Inj.	66	38.40%
	Two Visits	70	40.70%		2 Inj.	1	0.60%
	Three Visits	29	16.90%		3 Inj.	26	15.10%
No. of Alive Children	None	66	38.40%	Fathers' Education	No Education	47	27.30%
	1	51	29.70%		Primary	70	40.70%
	2	21	12.20%		Secondary	41	23.80%
	3	13	7.60%		Higher	14	8.10%
	>3	21	12.20%		Low	107	62.20%
Mothers' Education	No Education	100	58.10%	Wealth Index	low	107	62.2%
	Primary	54	31.40%		Middle	58	33.70%
	Secondary	18	10.50%		High	7	4.10%

Table-2: Tabulation of *Chi-square* test Result

Variable	Category	Control Group	Mortality Group	X^2	df	*P*- value
		% age	% age			
Baby Length	45-55cm	83.70%	90.70%	1.9	2	0.38
	40-44cm	9.30%	5.80%			
	35-39cm	7%	3.50%			
Baby weight	normal	75.60%	84.90%	5.6	3	0.13
	Low birth wt	19.80%	10.50%			
	very low birth wt	4.70%	2.30%			
	very very low birth wt	0%	2.30%			
Residency	Urban	19.80%	18.60%	0.037	1	1*
	Rural	80.20%	81.40%			
Mother's age	>16 yrs	1.20%	10.50%	6.79	1	0.018*
	<16 yrs	98.80%	89.50%			
Pregnancy duration	Term	86%	91.90%	1.47	1	0.33*
	Preterm	14%	8.10%			
Place of birth	Health Facility	81.40%	81.40%	0.00	1	1*
	Home	18.60%	18.60%			
Mode of delivery	C-Section	5.80%	15.10%	3.97	1	0.08*
	Normal Vaginal Delivery	94.20%	84.90%			
Type of birth	Singleton	95.30%	91.90%	4.1	3	0.24
	Twins	4.70%	3.50%			
	Triplets	0%	1.20%			
	Quadruplets	0%	3.50%			
Apgar score at 5 min	<5	18.60%	19.80%	0.037	1	1*
	>5	81.40%	80.20%			
Apgar score at 10 min	<8	8.10%	8.10%	0.00	1	1*
	>8	91.90%	91.90%			
Perinatal Asphyxia	yes	18.60%	19.80%	0.037	1	1*
	no	81.40%	80.20%			
Sepsis	yes	87.20%	72.10%	6.0	1	0.02*
	no	12.80%	27.90%			
Antenatal Visits	no visit	8.10%	14%	7.8	3	0.049
	1 visit	27.90%	34.90%			
	2 visits	39.50%	41.90%			
	3 visits	24.40%	9.30%			
Preceding birth interval	<24m	31.40%	59.30%	13.5	1	<0.001*
	>24m	68.80%	40.70%			
No. of Alive Children	none	33.70%	43%	6.5	4	0.16
	1	38.40%	20.90%			
	2	11.60%	12.80%			
	3	5.80%	9.30%			
	>3	10.50%	14%			

No. of TT Injections	No Injections	41.90%	50%	7.9	3	0.047
	1 Injection	47.70%	29.10%			
	2 Injections	0%	1.20%			
	3 Injections	10.50%	19.70%			
Mothers' Education	No Education	46.50%	69.70%	9.6	2	0.008
	Primary Education	39.50%	23.30%			
	Secondary Education	14%	7%			
Fathers' Education	No Education	17.40%	37.20%	10.4	3	0.015
	Primary Education	43%	38.40%			
	Secondary Education	31.40%	16.30%			
	Higher Education	8.10%	8.10%			
Wealth Index	Low Income	70.90%	53.50%	6.65	2	0.036
	Middle Income	24.40%	43%			
	High Income	4.70%	3.50%			

**Fisher's Exact Test*

birth, number of alive children, and birth weight.

Binary logistic regression was performed by taking categorical variables with *P*-value as significant and taking outcome as the dependent variable. Among the dependent variable, those neonates that were alive after treatment and discharged were coded as "0" and the neonates that expired were coded as "1". Both univariate and multivariate binary logistic regression was performed and results were analyzed. Table-3 shows results of logistic regression analysis.

Modal 1 (Univariate analysis in Table-3) shows that the age of the mother had a significant relation with neonatal mortality, age <16 years caused 9.9 times higher mortality when compared with the reference category. (95% C.I. of 1.23-80.2). Considering the antenatal visits during pregnancy, no antenatal visit caused significant mortality,4.5 (95% C.I. 1.3-15), and one Antenatal visit 3.2 (95% C.I. 1.2-8.7). The short preceding birth interval of fewer than two years was significantly associated with neonatal mortality with an odds ratio of 3.1 (95% C.I. 1.7-5.9). Similarly, maternal illiteracy had a significant impact on mortality with an odds ratio of 3.6 (95% C.I. 1.04-8.46). Modal 2 (Multivariate analysis in Table-3) showed a significant association for preceding birth interval among all, with Adjusted O.R. 2.88 (95% C.I. 1.37-6).

Discussion

Assessing neonatal mortality provides a dependable measure of neonatal care within a community.[10] Our study aimed to pinpoint significant community and individual-level factors influencing neonatal mortality with the goal of highlighting policy implications.

Our results were similar to the study of Islam MA et al. where they say that maternal education, wealth index, and ANC utilization had a substantial effect on neonatal death in developing countries.[11] Currently, the World Health Organization recommends a minimum of eight antenatal care visits for an uncomplicated pregnancy in order to improve the survival rate of newborns.[12] In another study done by Wodesdy et al. neonates born from mothers with no ANC follow-up had 4.7 times a greater odds ratio of neonatal mortality. In their study, prematurity, early onset neonatal sepsis, perinatal asphyxia low birth weight, and C-section delivery were the major causes of neonatal mortality.[13]

In another study done by Alamirew WG et al., the neonatal mortality rate in multiple births was found to be 8.53 times higher compared to single births, also, birth order was taken as yet another significant factor causing neonatal morbidity and mortality. Additionally, the average neonatal mortality rates during antenatal visits were reduced by 0.48 and 0.72 times, respectively, compared to those without any antenatal visits during pregnancy.[14]

A study done in Ethiopia by Girma D et al. showed that birth interval less than 18 months and twin pregnancy was established as significant predictors for neonatal mortality. Moreover, similar to our

Table-3: Tabulation of Binary Logistic Regression Results

Variable	Univariate		Multivariate	
	***P*-value**	**O.R. (95% C.I.)**	***P*-value**	**O.R. (95%C.I.)**
Age of mother				
<16 Yrs	0.03	9.935 (1.23-80.23)	0.09	7.5 (0.7-79.8)
>16 Yrs	Reference	Reference	Reference	Reference
Mode of Delivery				
C-Section	0.05	0.347(0.118-1)	0.04	0.27 (0.07-0.97)
Normal Vaginal Delivery	Reference	Reference		
Sepsis				
Yes	0.016	0.379 (0.172-0.834)	0.31	0.58 (0.2-1.6)
No	Reference	Reference	Reference	Reference
Antenatal Visits				
No Visit	0.017	4.5 (1.3-15.5)	0.89	0.8 (0.059-11.8)
1 Visit	0.017	3.28 (1.23-8.7)	0.31	2.2 (0.45-11.6)
2 Visits	0.033	2.78 (1.08-7.11)	0.04	3.6 (1-12.9)
3 Visits	Reference	Reference	Reference	Reference
Preceding Birth Interval In Months				
<24	<0.001	3.18 (1.7-5.95)	0.005	2.88 (1.37-6)
>24	Reference	Reference	Reference	Reference
No. of TT Injections				
No Injection	0.33	0. 6 (0.25-1.58)	0.26	0.33 (0.047-2.29)
1 Injection	0.2	0.3 (0.125-0.83)	0.12	0.167 (0.017-1.6)
3 Injections	Reference	Reference	Reference	Reference
Mothers' Education				
No Education	0.042	3 (1.04-8.6)	0.05	3.68 (0.96-14)
Primary Education	0.777	1.17(0.4-3.6)	0.53	1.57(0.37-6.6)
Secondary Education	Reference	Reference	Reference	Reference
Fathers' Education				
No Education	0.221	2.13 (0.63-7.2)	0.18	3.02 (0.59-15.4)
Primary Education	0.845	0.89 (0.28-2.8)	0.80	1.2 (0.25-5.95)
Secondary Education	0.296	0.52 (0.151-1.77)	0.33	0.4 (0.08-2.2)
Higher Education	Reference	Reference	Reference	Reference
Wealth Index				
Low Income	0.994	1.0 (0.21-4.7)	0.97	0.97 (0.14-6.8)
Middle Income	0.292	2.349 (0.48-11.5)	0.36	2.47 (0.35-17.45)
High income	Reference	Reference	Reference	Reference

study they also demonstrated that the absence of antenatal care has been the primary predictor for neonatal mortality.[15]

Significant progress in lowering neonatal mortality can be achieved through simple yet effective interventions implemented across different stages of care, beginning before pregnancy and extending through the postnatal phase for both mothers and infants. Ensuring newborns receive sufficient healthcare is paramount. Strategies that prioritize antenatal care, education, nutrition, and maternal well-being are vital for tackling challenges associated with neonatal mortality.[16]

Conclusion

The findings of this research indicated a strong association between Neonatal mortality and various factors including the mother's age, mode of delivery, sepsis, preceding birth interval, antenatal clinic visits during pregnancy, number of tetanus toxoid injections received, mother's education, father's education, and wealth index.

Acknowledgment: None.

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

Grand Support and Financial Disclosure: None.

REFERENCES

1. Perera K, Weerasekera M, Weerasinghe UD. Risk factors for early neonatal sepsis in the term baby. Sri Lanka Journal of Child Health, 2018; 47: 44-9. doi: 10.4038/sljch.v47i1.8429
2. Patel AB, Simmons EM, Rao SR, Moore J, Nolen TL, Goldenberg RL, et al. Evaluating the effect of care around labor and delivery practices on early neonatal mortality in the Global Network's Maternal and Newborn Health Registry. Reproductive Health journal. 2020; 17: 156. doi: 10.1186/s12978-020-01010-w
3. Akuze J, Blencowe H, Waiswa P, Baschieri A, Gordeev VS, Kwesiga D, et al. Randomised comparison of two household survey modules for measuring stillbirths and neonatal deaths in five countries: TheEvery Newborn-INDEPTH study. The Lancet Global Health. 2020; 8: e555-66. doi: 10.1016/S2214-109X(20)30044-9.
4. Lehtonen L, Gimeno A, Parra-Llorca A, Vento M. Early neonatal death: A challenge worldwide. Seminars in Fetal and Neonatal Medicine. 2017; 22: 153-160. doi: 10.1016/j.siny.2017.02.006
5. Khan A, Kinney MV, Hazir T, Hafeez A, Wall SN, Ali N, et al. Pakistan Newborn Change and Future Analysis Group. Newborn survival in Pakistan: a decade of change and future implications. Health Policy and Planning journal. 2012; 27: iii72-87. doi: 10.1093/heapol/czs047
6. Nisar YB, Dibley MJ. Determinants of neonatal mortality in Pakistan: secondary analysis of Pakistan Demographic and Health Survey 2006–07. BMC public health. 2014; 14: 1-2. doi: 10.1186/1471-2458-14-663
7. Kibria GM, Burrowes V, Choudhury A, Sharmeen A, Ghosh S, Mahmud A, et al. Determinants of early neonatal mortality in Afghanistan: an analysis of the Demographic and Health Survey 2015. Globalization and health. 2018; 14: 1-2. doi: 10.1186/s12992-018-0363-8
8. Creanga AA, Woo M, Estifanos AS, Feleke H, Woldesenbet D, Kebede E, et al. Qualitative assessment of patient-provider communication and provider reporting on misclassification of stillbirths and early neonatal deaths in Ethiopia. Minerva obstetrics and gynecology. 2020; 72: 138-48. doi: 10.23736/S0026-4784.20.04549-9
9. Lohela TJ, Nesbitt RC, Pekkanen J, Gabrysch S. Comparing socioeconomic inequalities between early neonatal mortality and facility delivery: Cross-sectional data from 72 low-and middle-income countries. Scientific Reports journal. 2019; 9: 9786. doi: 10.1038/s41598-019-45148-5
10. Oza S, Lawn JE, Hogan DR, Mathers C, Cousens SN. Neonatal cause-of-death estimates for the early and late neonatal periods for 194 countries: 2000–2013. Bulletin of the World Health Organization. 2015; 93: 19-28. doi: 10.2471/BLT.14.139790
11. Gudayu TW. Epidemiology of neonatal mortality: a spatial and multilevel analysis of the 2019 mini-Ethiopian demographic and health survey data. BMC Pediatrics journal. 2023; 23: 26. doi: 10.1186/s12887-023-03838-0
12. Islam MA, Butt ZA, Sathi NJ. Prevalence of Neonatal Mortality and its Associated Factors: A Meta-analysis of Demographic and Health Survey Data from 21 Developing Countries. Dr. Sulaiman Al Habib Medical Journal. 2022; 4: 145-52. doi: 10.1007/s44229-022-00013-y
13. Woday Tadesse A, Mekuria Negussie Y, Aychiluhm SB. Neonatal mortality and its associated factors among neonates admitted at public hospitals, pastoral region, Ethiopia: A health facility based study. PLOS One. 2021; 16: e0242481. doi: 10.1371/journal.pone.0242481
14. Alamirew WG, Belay DB, Zeru MA, Derebe MA, Adegeh SC. Prevalence and associated factors of neonatal mortality in Ethiopia. Scientific Reports journal. 2022; 12: 12124. doi: 10.1038/s41598-022-16461-3
15. Girma D, Dejene H, Adugna L. Predictors of Neonatal Mortality in Ethiopia: A Comprehensive Review of Follow-Up Studies. International Journal of Pediatrics. 2022; 2022: 1491912. doi: 10.1155/2022/1491912
16. Hug L, Alexander M, You D, Alkema L. UN Inter-agency Group for Child Mortality Estimation. National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario-based projections to 2030: A systematic analysis. Lancet Global Health. 2019; 7: e710-20. doi: 10.1016/S2214-109X(19)30163-9

Authors Contribution

LM: Idea conception, study designing, manuscript writing and proofreading
HP: Data collection, data analysis, results and interpretation, manuscript writing and proofreading
AK: Study designing, data analysis, results and interpretation
BB: Study designing, manuscript writing and proofreading
IU: Study designing, data collection

.....