RESEARCH ARTICLE

Individual and Community-level Determinants of Neonatal Mortality in Pakistan: indication from Pakistan Demographic and Health Survey (2017-18)

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Abstract

Objective: To evaluate individual and community-level factors influencing neonatal mortality in Pakistan.

Method: The retrospective, secondary-data, quantitative study was done from July 2021 to January 2022 after approval from the ethics review committee of the International Islamic University, Islamabad, Pakistan, and comprised data of live births from November 22, 2017, to April 30, 2018, which was the period covered by the Pakistan Demographic and Health Survey 2017-18. Significant community-level, maternal and proximate determinants of neonatal mortality were identified. Data was analysed using STATA 13.

Results: Among the 12,708 live births covered, the neonatal mortality rate within the first month of birth was 5337(42%), and 3939(31%) neonatal deaths occurred in the first week of life, while 3431(27%) deaths occurred on the first day. Distance to health facility (adjusted hazard ratio: 1.1; 95% confidence interval: 0.8-1.6), unimproved toilet facility (adjusted hazard ratio: 2.0; 95% confidence interval: 0.7-2.1), caesarean section deliveries (adjusted hazard ratio: 1.6; 95% confidence interval: 0.6-1.9) and child's birth size smaller than average (adjusted hazard ratio: 1.7; 95% confidence interval: 1.1-2.7) carried significantly higher risk of neonatal deaths. Compared to women aged 15-19 years, older women's child (adjusted hazard ratio: 0.6; 95% confidence interval: 0.2-1.6) and neonates having birth order 3 compared to birth order 1 (adjusted hazard ratio: 0.5; 95% confidence interval: 0.2-0.9) and female gender of child (adjusted hazard ratio: 0.3; 95% confidence interval: 0.2-0.9) were less likely to die.

Conclusions: There was a markedly high prevalence of neonatal mortality rate in Pakistan. Unimproved toilet facility, distance to health facility, caesarean mode of delivery and small size of the child at birth were found linked with increased risk of neonatal mortality.

Key Words: Neonatal mortality, Determinants, Low- and middle-income countries, Pakistan, Health policy.

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Introduction

The neonatal period comprises the first 4 weeks after birth, and is the most susceptible period of human life in terms of diseases. During the neonatal period, which lasts for the first 28 days of life, newborns have the greatest risk of dying[1]. Neonatal mortality is a major public health issue, with low- middle-income countries (LMICs) accounting for 60% of such deaths[2].

Improving neonatal outcomes is a crucial phenomenon for global sustainable development in the fields of maternal, neonatal and child health (MNCH). Despite a global decline in child mortality rates, many countries are missing the global target of eliminating preventable newborn deaths by 2030, and lowering neonatal mortality to as low as 12 per 1000 live births[3]. There were 5.3 million reported deaths of children aged <5 in 2018[4]. The <5 mortality rate in LMICs was 68 deaths per 1000 live births in 2018; nearly 14 times higher than the average of 5 deaths per 1000 live births in high-income countries (HICs)[4].

Despite the fact that Pakistan was falling short of the Millennium Development Goal-4 (MDG4) target, the Pakistan Demographic and Health Survey PDHS (2012-13) found that significant progress had been made in lowering all <5 mortality indicators except neonatal mortality[5]. Pakistan has the highest neonatal mortality rate (NMR) (61.8%) among 9 LMICs; Zimbabwe, Ghana, Bangladesh, Nepal, Afghanistan, Pakistan, Nigeria, Ethiopia and Tanzania[6].

After the MDGs expired in 2015, the United Nations General Assembly replaced them with Sustainable Development Goals (SDGs), which prioritised maternal, neonatal, child and adolescent health[7]. The SDGs' first three health targets were extensions of the MDGs. The most important goal is to bring NMR down to <12 deaths per 1000 live births, and less than 5 mortality to <25 deaths per 1000 live births[7,8]. Pakistan has consistently fallen short of attaining the global targets seeking

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reduction in maternal and newborn mortality. The government of Pakistan introduced the National Maternal, Neonatal and Child Health (MNCH) Programme in 2007[9], which focussed on two key areas: endorsing institutional deliveries and skilled birth attendance, and providing emergency gynaecology services and community midwives in rural areas. Lady health workers (LHWs) provided obstetric and newborn services as well as primary healthcare through home visits[9]. The targets, however, were not met[10]. Preterm births combined with complications are the primary causes of poor neonatal health outcomes in Pakistan[11]. The social and economic status of women and their autonomy level have significant effects on their children's health. In Pakistan, gender inequality still plays an important role in determining the health of women and children. Women in Pakistan have historically performed poorly in comparison to men according to the UN Human Development Index (HDI)[12]. The cause of newborn death and the factors that contribute to neonatal mortality must be determined for the development of effective strategies to lower the NMR[7].

Multiple factors influence newborns' death, including genetic differences, socio-economic differences, demographic trends, healthcare arrangement, cultural norms, and technologies[13]. Improved access to high-quality maternal and newborn health services delivered by skilled healthcare professionals, potable water supply, proper antenatal and postnatal nutrition for mothers and newborns, sanitisers, and skin-to-skin interaction have shown to prevent the neonatal mortality[13,14].

The current study was planned to evaluate individual and community-level factors influencing neonatal mortality in Pakistan.

Materials and Methods

This, secondary-data, analysis study was conducted from July 2021 to January 2022 after approval from the International Islamic University (IIU), Islamabad, Pakistan, and comprised data of live births from November 22, 2017, to April 30, 2018, which was the period covered by PDHS (2017-18)[15], which is a 5-year nationally representative cross-sectional household survey. The PDHS-2017-18 collected data through two-stage stratified sampling frame. Samples were first selected through probability proportional to size sampling, and then units were allocated with the help of systematic sampling frame.

The response variable in the current study was survival information of mortality time/status of a newborn within the first 28 days of life. The NMR was computed as the number of deaths per 1,000 live births in the first month of life. The study outcome was reported as a binary variable, with 'Dead' coded as 1 and 'Survived' coded as 0.

Community-level variables included type of residence (urban and rural), region (Punjab, Sindh, Khyber Pakhtunkhwa [KP], Balochistan, Islamabad Capital Territory [ICT], Gilgit-Baltistan (GB), Azad Jammu and Kashmir [AJK] and Federally-administerd tribal area [FATA]), wealth status (poor, middle and rich), distance to health facility (no problem and big problem), type of toilet facility (improved and unimproved), type of cooking fuels (non-solid and solid), source of drinking water (improved, unimproved) and use of internet (no and yes). Seven maternal factors included mother's age group (15-19, 20-34, 35-49 years), mother's occupation (not working, professional/clerical/service, agricultural, manual [skilled/unskilled]), education (not educated, primary or secondary education and higher education), smoking status (non-smokers and smokers), pregnancy desire (then, later and no more), number of tetanus injections before birth (received no injection, 1 TT and 2+ TT) and use of contraceptives (no and yes).

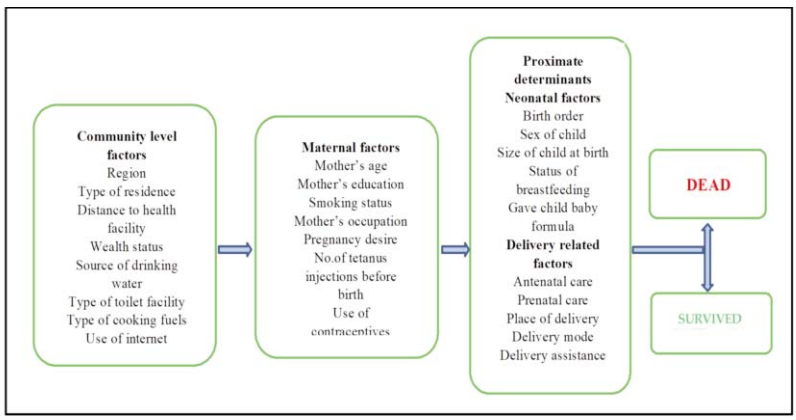

Figure: Conceptual framework for determinants of neonatal mortality in Pakistan

The approximate determinants were prenatal care (no care and some care), antenatal care (ANC) (no and yes), place of delivery (at home, government hospital, rural health centre small braces and private hospital), delivery mode (normal and caesarean section small braces), and delivery assistance (no assistance and some assistance).

Neonatal determinants were birth order (1st child, 2nd child, 3rd child, 4th child and above), gender of child (male and female), size of child at birth (below average, average, above average), status of breastfeeding (never breastfed, ever breastfed, not immediately) and consumption of baby formula (no and yes).

The conceptual model presented by Mosley et al. (1984)[16] was used with modifications subject to constraints and layout of the PDHS 2017-18 data (Figure).

Data was analysed using STATA 13. Descriptive statistics were expressed by frequencies and percentages. The association of neonatal, community and maternal factors with neonatal mortality was investigated using the Cox-proportional hazard model (1975)[17]. Using step-wise backward elimination process, a multivariate model was built that initially contained all the study variables. The exponential of the regression coefficients was used to estimate the 95% confidence interval (CI) and hazard ratio (HR). *p*-value <0.05 was considered statistically significant.

Results

Among the 12,708 live births covered, the neonatal mortality rate within the first month of birth was 42 %(n=5,337), and 31%(n=3,939) neonatal deaths occurred in the first week of life, while 27%(n=3,431) deaths occurred on the first day.

Majority of mothers belonged to Punjab, aged 20-34 years, were uneducated, belonged to poor families, were non-smokers, lived in rural areas, were housewives, used solid cooking fuels, did not use the internet, did not use any contraceptives, received no ANC service, and delivered in private hospitals (Table 1).

Table-1: Community-level, maternal and proximate characteristics identified by the Pakistan Demographic and Health Survey (PDHS) 2017-18.

Variables	Variable Attributes	Counts (%)
Community level factors		
Type of residence	Urban	5,609(44.1)
Wealth status	Rural	7,099(55.8)
	Poor	5,812(45.7)
	Middle	2,510(19.7)
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Rich	4,386(34.5)	
Type of toilet facility	Improved facility	10,408(81.9)
	Unimproved facility	2,300(18.1)
Distance to health facility	No problem	6,230(49.0)
	Big problem	6,466(50.9)
Maternal factors		
Mother's age	15-19	389(3.0)
	20-34	9,685(76.2)
	35-49	2,634(20.7)
No.of tetanus injection before birth	Received no injection	2,901(35.4)
	1 TT	3,729(45.5)
	2+ TT	1,561(19.0)
Use of contraception	Not using	8,314(65.4)
	Currently using	4,394(34.5)
Proximate factors		
Birth order	1st child	3,024(23.8)
	2nd child	2,727(21.4)
	3rd child	2,203(17.3)
	4th child and above	4,754(37.4)
Gender of child	Male	6,507(51.2)
	Female	6,201(48.8)
Size of child at birth	Average	9,414(74.1)
	Smaller than average	2,277(17.9)
	Larger than average	1,011(7.9)
Prenatal care	No care	5,259(42.8)
	Some care	7,028(57.1)
Antenatal care	No	6,942(54.7)
	Yes	5,737(45.2)
Delivery assistance	No assistance	48(0.3)
	Some assistance	12,657(99.6)
Place of delivery	At home	4,433(34.9)
	Government hospitals	3,381(26.6)
	Rural health Centre	154(1.2)
	Private hospitals	4,711(37.1)
Delivery mode	Normal	10,396(81.8)
	Caesarean section	2,299(18.0)

HRs and adjusted HRs (AHRs) for NMR in relation to the study variables were worked out and compared (Table 2).

Distance to health facility (AHR: 1.1; 95% CI: 0.8-1.6), unimproved toilet facility (AHR: 2.0; 95% CI: 0.7-2.1), CS deliveries (AHR: 1.6; 95% CI: 0.6-1.9) and child's birth size smaller than average (HR: 1.7; 95% CI: 1.1-2.7) carried significantly higher risk of neonatal deaths (p<0.05). Compared to women aged 15-19 years, older women's child (AHR: 0.6; 95% CI: 0.2-1.6), neonates having birth order 3 compared to birth order 1 (AHR: 0.5; 95% CI: 0.2-

Table-2: Adjusted and unadjusted Cox regression model for factors associated with neonatal mortality as identified by the Pakistan Demographic and Health Survey (PDHS) 2017-18.

Sr	Variable name		Unadjusted HR			Adjusted HR		
		Attributes	HR	P-value	95% CI	AHR	P-value	C-L
Community level factors		**Region**						
1		Punjab	-	-	-	-	-	-
		Sindh	0.9	0.7	0.6-1.3	0.6	0.2	0.2-1.3
		KP	0.9	0.5	0.6-1.2	0.6	0.5	0.2-2.0
		Baluchistan	0.7	0.006	0.4-1.0	0.2	0.05	0.0-1.0
		GB	1.0	0.03	0.6-1.8	1.5	0.4	0.4-5.4
		ICT	0.1	0.01	0.5-2.4	0.3	0.1	0.0-1.4
		AJK	0.8	0.6	0.5-1.3	0.9	0.8	0.2-3.7
		FATA	0.7	0.2	0.4-1.2	1.2	0.8	0.2-6.4
2	Type of place of residenc	Rural	-	-	-	-	-	-
		Urban	0.9	0.019	0.7-1.1	0.6	0.3	0.2-1.5
3	Distance to health facility	No problem	-	-	-	-	-	-
		Big problem	1.0	0.035	0.8-1.3	1.1	0.027*	0.8-1.6
4	Wealth status	Poor	-	-	-	-	-	-
		Middle	1.2	0.1	0.9-1.6	1.6	0.2	0.6-4.2
		Rich	1.0	0.7	0.8-1.3	0.5	0.3	0.1-1.8
5	Source of drinking water	Improved	-	-	-	-	-	-
		Unimproved	1.2	0.1	0.9-1.6	0.8	0.7	0.3-2.2
6	Type of toilet facility	Improved facility	-	-	-	-	-	-
		Unimproved facility	1.2	0.046	0.9-1.6	2.0	0.003*	0.7-2.0
7	Type of cooking fuels	Non-solid fuel	-	-	-	-	-	-
		Solid fuel	0.8	0.022	0.6-1.0	0.6	0.3	0.2-1.6
8	Use of internet	No	-	-	-	-	-	-
		Yes	0.8	0.5	0.6-1.2	1.5	0.3	0.5-4.2
Maternal characteristics								
9	Mother's age	15-19	-	-	-	-	-	-
		20-34	0.7	0.2	0.3-1.2	0.3	0.046*	0.1-1.0
		35-45	0.7	0.004	0.4-1.5	0.6	0.031*	0.2-1.6
10	Mother's education	No education	-	-	-	-	-	-
		Primary & secondary	1.2	0.2	0.8-1.7	1.7	0.3	0.4-6.5
		Higher education	0.9	0.032	0.7-1.1	0.9	0.9	0.4-2.2
11	Smoking status	Non-smokers	-	-	-	-	-	-
		Smokers	1.1	0.0	0.6-2.0	0.9	0.9	0.3-2.6
12	Mother's occupation	Not working	-	-	-	-	-	-
		Professional/sales/ clerical/services	1.2	0.5	0.6-2.2	0.9	0.9	0.2-3.6
		Agricultural	0.7	0.048	0.4-1.2	1.2	0.7	0.3-4.7
		Manual worker (skilled/unskilled)	0.9	0.8	0.5-1.5	3.0	0.2	0.4-9.5
13	Pregnancy desire	Then	-	-	-	-	-	-
		Later	1.3	0.030	0.8-2.1	2.2	0.1	0.7-6.4
		No more	1.6	0.07	0.9-2.9	1.1	0.8	0.3-4.6
14	No.of tetanus injections before birth	Received no injection	-	-	-	-	-	-
		1 TT	1.0	0.7	0.7-1.4	0.6	0.2	0.3-1.2
		2+TT	0.9	0.01	0.6-1.4	0.9	0.8	0.3-2.4
16	Use contraceptives	Not using	-	-	-	-	-	-
		Currently using	1.1	0.2	0.8-1.4	1.7	0.08	0.9-3.1
Delivery related factors								
16	Place of delivery	At home	-	-	-	-	-	-
		Government hospital	0.8	0.04	0.8-1.6	1.3	0.021*	0.8-2.1
		Rural health care	1.8	0.8	0.2-2.7	4.5	0.003*	0.4-3.0
		Private hospitals	1.0	0.028	0.7-1.3	1.1	0.6	0.7-1.7
17	Delivery mode	Normal	-	-	-	-		

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-		Caesarean section	1.0	0.047	0.8-1.4	1.9	0.049*	0.6-1.4
18	Antenatal care	No	-	-	-	-	-	-
		Yes	0.2	0.049	0.0-0.9	5.5	0.08	1.2-4.0
19	Prenatal care	No care	-	-	-	-	-	-
		Some care	0.7	0.1	0.5-1.0	1.2	0.3	0.7-1.8
20	Delivery assistance	No assistance	-	-	-	-	-	-
		Some assistance	0.8	0.9	0.1-6.3	2.2	0.6	0.0-9.0
Neonatal characteristics								
21	Birth order	1st child	-	-	-	-	-	-
		2nd child	1.0	0.9	0.7-1.3	0.7	0.2	0.4-1.2
		3rd child	0.8	0.04	0.5-1.1	0.5	0.028*	0.2-0.9
		4th child & above	0.9	0.001	0.6-1.2	0.6	0.032*	0.3-1.1
22		Gender of child	Male	-	-	-	-	--
		Female	1.2	0.01	0.9-1.5	0.3	0.039*	0.9-1.9
23	Size of child at birth	Average	-	-	-	-	-	-
		Smaller than average	1.4	0.006	1.1-1.9	1.7	0.010*	1.1-2.7
		Larger than average	0.6	0.08	0.4-1.0	0.8	0.6	0.4-1.7
24	Status of breastfeeding	Ever breastfed	-	-	-	-	-	-
		Never breastfed	1.5	0.05	0.8-2.8	2.8	0.2	0.4-19.8
		Not immediately	1.0	0.02	0.7-1.1	0.7	0.5	0.3-1.8
25	Gave child baby formula	No	-	-	-	-	-	-
		Yes	1.4	0.1	0.8-2.3	1.0	0.8	0.3-3.1

HR: Hazard ratio, AHR: Adjusted hazard ratio, CI: Confidence interval, KP: Khyber Pakhtunkhwa, ICT: Islamabad Capital Territory, GB: Gilgit Baltistan, AJK: Azad Jammu and Kashmir, FATA: Federally-administerd tribal area.

Table-3: Multivariate Cox regression model for factors associated with neonatal mortality as identified by the Pakistan Demographic and Health Survey (PDHS) 2017-18.

S No	Variable name	Attributes	Adjusted HR	P-value	C-L
Community level factors					
1	Distance to health facility	No problem	-	-	-
		Big problem	1.1	0.027*	0.8-1.6
2	Type of toilet facility	Improved facility	-	-	-
		Unimproved facility	2.0	0.003*	0.7-2.1
Maternal characteristics					
3	Mothers age	15-19	-	-	-
		20-34	0.3	0.046*	0.1-1.0
		35-45	0.6	0.031*	0.2-1.6
Delivery related factors					
4	Place of delivery	At home	-	-	-
		Government hospital	1.3	0.021*	0.8-2.1
		Rural health care	4.5	0.003*	0.4-3.0
		Private hospitals	1.1	0.6	0.7-1.7
5	Delivery mode	Normal	-	-	-
		Caesarean section	1.6	0.049*	0.6-1.9
Neonatal characteristics					
6	Birth order	1st child	-	-	-
		2nd child	0.7	0.2	0.4-1.2
		3rd child	0.5	0.028*	0.2-0.9
		4th child & above	0.6	0.032*	0.3-1.1
7	Gender of child	Male	-	-	-
		Female	0.3	0.039*	0.2-0.9
8	Size of child at birth	Average	-	-	-
		Smaller than average	1.7	0.010*	1.1-2.7
		Larger than average	0.8	0.6	0.4-1.7

HR: Hazard ratio

0.9) and girls compared to boys (AHR: 0.3; 95% CI: 0.2-0.9) were less likely to die (Table 3).

Discussion

Compared to community characteristics, maternal and neonatal characteristics explained a higher proportion of neonatal death variations in the current study. Mother's age, unimproved toilet facility, distance to health facility, birth order, gender of child, size of child at birth and mode of delivery had a significant effect on neonatal death.

The availability of unimproved toilet systems was significantly related to neonatal mortality. Improved sanitation lowers the risk of death in newborns by exposing them to less contamination, making them more susceptible to illnesses, infections and eventual death[18].

Women aged >19 years were less likely than women aged

<19 to experience neonatal mortality in their child. The finding is supported by other studies[18,19-22].

Children having birth order 3 had a lower risk of neonatal death than the first-borns. It has been reported earlier as well[16] and the likely reason could be the young age and inexperience of the mother at the time and duration of the first pregnancy and childbirth[12].

Boys were more likely than girls to die within the first month of birth, which has been widely reported in literature[7,13,17,21,23-25]. Inherited biological differences between the genders were found to play a big role in the development of the risk of male infant mortality[22].

Children who were smaller than average in size had a greater risk of death during the neonatal period than children who were of average size. The findings are in line with previous research[12,19,26]. A detailed analysis of PDHS 2017-18 by the National Institute of Population Studies (NIPS) revealed a clear link between small birth size and neonatal mortality. However, over half of the newborns were not weighed at the time of birth, and birth size is an essential proxy for birthweight[14]. Besides, in contrast to the current findings, studies[17,26] have reported that neonates of above-average size had higher risk of death.

In the current study, those delivered through CS were more likely to die than those through the normal mode. This could be due to autoimmune prematurity or life-threatening pregnancy-related issues that necessitate an emergency CS[27]. However, a cross-sectional, ecological study reported that CS delivery rates were inversely connected to newborn deaths[28].

The current study has several limitations. Because of the study's cross-sectional design, causality was not explored. The dates of birth and death were calculated using retrospective data derived from mothers' self-reporting, which could lead to recall and misclassification bias. Also, the mothers' description of the size of their babies was speculative. Finally, the data did not include information on the health condition and nutritional status of the neonates and their mothers. Besides, the cause of death was not covered.

Despite the limitations, however, the study based on a nationally representative survey, the findings may lead to informed policy priorities.

Conclusion

Distance to health facility, unimproved toilet facility, CS deliveries and child's birth size smaller than average carried significantly higher risk of neonatal deaths. Besides, compared to women aged 15-19 years, older women's child, neonates having birth order 3 compared to birth order 1, and girls compared to boys were less likely to die.

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References

1. Boscarino G, Conti MG, Gasparini C, Onestà E, Faccioli F, Dito L, et al. Neonatal hyperglycemia related to parenteral nutrition affects long-term neurodevelopment in preterm newborn: A prospective cohort study. Nutrients.2021; 13:1930. doi: 10.3390/nu13061930.
2. Nove A, Friberg IK, de Bernis L, McConville F, Moran AC, Najjemba M, et al. Potential impact of midwives in preventing and reducing maternal and neonatal mortality and stillbirths: a Lives Saved Tool modelling study. Lancet Global Health.2021; 9:e24-e32.
3. Paulson KR, Kamath AM, Alam T, Bienhoff K, Abady GG, Abbas J, et al. Global, regional, and national progress towards Sustainable Development Goal 3.2 for neonatal and child health: all-cause and cause-specific mortality findings from the Global Burden of Disease Study 2019. Lancet. 2021; 398:870-905.
4. Mabey D, Okomo U, Greenwood B. Priorities in reducing child mortality: Azithromycin and other interventions. PLoS Med. 2020; 17:e1003364. doi: 10.1371/journal.pmed.1003364.
5. National Institute of population studies (NIPS) Pakistan and ICF International. Pakistan Demographic and Health Survey (2012–13). Islamabad, Pakistan, and Cleverton, Maryland, USA: NIPS and ICF International. [Online] [Cited 2022 September 10]. Available from: URL: https://dhsprogram.com/data/dataset/Pakistan_Standard-DHS_2012.cfm?flag=0.
6. Ahmed M, Won Y. Cross-national systematic review of neonatal mortality and postnatal newborn care: Special focus on Pakistan. Int J Environ Res Public Health. 2017; 14:1442.doi: 10.3390/ijerph14121442.
7. Bhutta ZA. Community–based primary health care: a core strategy for achieving sustainable development goals for health. J Glob Health. 2017; 7:010101.doi: 10.7189/jogh.07.010101.
8. Tekelab T, Chojenta C, Smith R, Loxton D. The impact of antenatal care on neonatal mortality in sub-Saharan Africa: A systematic review and meta-analysis. PloS One. 2019; 14:e0222566. doi: 10.1371/journal.pone.0222566.
9. Sarfraz M, Hamid S. Exploring managers' perspectives on MNCH program in Pakistan: a qualitative study. PloS One. 2016; 11:e0146665. doi: 10.1371/journal.pone.0146665.
10. Aziz A, Saleem S, Nolen TL, Pradhan NA, McClure EM, Jessani S, et al. Why are the Pakistani maternal, fetal and newborn outcomes so poor compared to other low and middle-income countries? Reprod Health. 2020; 17:1-12. doi: 10.1186/s12978-020-01023-5.
11. Shahid R, Sabir SA, Bilal S, Sheikh AR, Nasim S, Qureshi M. Pattern and maternal determinants of neonatal morbidity in tertiary care hospitals of Rawalpindi medical university, Pakistan. Rawal Med J. 2022; 47:101.
12. Patel KK, Rai R, Rai AK. Determinants of infant mortality in Pakistan: evidence from Pakistan Demographic and Health Survey 2017–18. J Public Health. 2021; 29:693-701.
13. Nisar YB, Dibley MJ. Determinants of neonatal mortality in Pakistan: secondary analysis of Pakistan Demographic and Health Survey 2006–07. BMC Public Health.2014; 14:663. doi: 10.1186/1471-2458-14-663.
14. Imbo AE, Mbuthia EK, Ngotho DN. Determinants of Neonatal Mortality in Kenya: Evidence from the Kenya Demographic and

Health Survey 2014. Int J MCH AIDS. 2021; 10:287.
15. National Institute of population studies (NIPS) Pakistan and ICF International. Pakistan Demographic and Health Survey (2017–18). Islamabad, Pakistan, and Cleverton, Maryland, USA: NIPS and ICF International. [Online] [Cited 2022 September 1]. Available from: URL: https://dhsprogram.com/data/dataset/Pakistan_Standard-DHS_2017.cfm?flag=1
16. Mosley WH, Chen L. An analytic framework for the study of child survival in developing countries. Popul Develop Rev.1984; 10:25-45. doi: 10.1016/j.socscimed.2014.09.046.
17. Cox DR. A note on data-splitting for the evaluation of significance levels. Biometrika. 1975; 62:441-4. DOI:10.1093/BIOMET/62.2.441
18. Islam MA, Biswas B. Socio-economic factors associated with increased neonatal mortality: A mixed-method study of Bangladesh and 20 other developing countries based on demographic and health survey data. Clin Epidemiol Global Health. 2021; 11:100801. doi: 10.1016/j.cegh.2021.100801.
19 .KC A, JHA AK, Shrestha MP, Zhou H, Gurung A, Thapa J. et al. Trends for neonatal deaths in Nepal (2001–2016) to project progress towards the SDG target in 2030, and risk factor analyses to focus action. Matern Child Health J. 2020; 24: 5-14. doi: 10.1007/s10995-019-02826-0.
20 .Kibria GMA, 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. Global Health. 2018; 14:47. doi: 10.1186/s12992-018-0363-8.
21. Huda TM, Tahsina T, Arifeen SE, Dibley MJ. The importance of intersect oral factors in promoting equity-oriented universal health coverage: a multilevel analysis of social determinants affecting neonatal infant and under-five mortality in Bangladesh. Global Health Action.2016; 9:29741. doi: 10.3402/gha.v9.29741.
22. Drevenstedt GL, Crimmins EM, Vasunilashorn S, Finch CE. The rise and fall of excess male infant mortality. Proceed Nat Acad Sci. 105: 5016-21.
23. Tesema GA, Worku MG. Individual-and community-level determinants of neonatal mortality in the emerging regions of Ethiopia: a multilevel mixed-effect analysis. BMC Pregnancy Childbirth. 2021; 21:1-11. doi: 10.1186/s12884-020-03506-6.
24. Shibre G, Idriss-Wheeler D, Yaya S. Inequalities and trends in Neonatal Mortality Rate (NMR) in Ethiopia: Evidence from the Ethiopia Demographic and Health Surveys, 2000–2016. PloS One. 2020; 15:e0234483. doi: 10.1371/journal.pone.0234483.
25. Hong R, Ahn PY, Wieringa F, Rathavy T, Gauthier L, Hong R, et al, The unfinished health agenda: Neonatal mortality in Cambodia. 2017; 12:e0173763. doi: 10.1371/journal.pone.0173763.
26. Devine S, Taylor G. Every child alive: the urgent need to end newborn deaths. Unicef. 2018; 22:1-44.
27. Mukhopadhyay P, Chaudhuri RN, Paul B. Hospital-based perinatal outcomes and complications in teenage pregnancy in India. J Health Popul Nutr.2010; 28:494-500. doi: 10.3329/jhpn.v28i5.6158.
28. Molina G, Weiser TG, Lipsitz SR, Esquivel MM, Uribe-Leitz T, Azad T, et al. Relationship between cesarean delivery rate and maternal and neonatal mortality. JAMA. 2015; 314:2263-70. doi: 10.1001/jama.2015.15553.