International Journal of Contemporary Pediatrics
Rahman MM et al. Int J Contemp Pediatr. 2026 Dec;13(12):2402-2408
https://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20264304

Original Research Article

Verbal autopsy on neonatal mortality in selected urban slum areas of Dhaka city

Mohammad Mozibur Rahman[1], Mohammad Ahad Adnan[1]*, Mohammad Ahsanul Haque[1], Abdur Rahman[2], Mahbub Ahmed[1], Mohammad Tazul Islam[1], Khatuna Jannat[3]

[1]Department of Pediatrics, Institute of Child and Mother Health (ICMH), Dhaka, Bangladesh
[2]Department of Epidemiology and Biostatistics, Institute of Child and Mother Health (ICMH), Dhaka, Bangladesh
[3]Department of Dentistry, Shathi Bithi Medicine & Dental Centre, Dhaka, Bangladesh

Received: 21 September 2026
Revised: 02 November 2026
Accepted: 16 November 2026

***Correspondence:**
Mohammad Ahad Adnan,
E-mail: ahadnann@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Verbal autopsy (VA) is an important tool for determining the probable causes of neonatal deaths, particularly in settings where many deaths occur outside the formal health system and remain undocumented. This study aimed to determine the causes of neonatal deaths in selected urban slum areas of Dhaka, Bangladesh.
Methods: This cross-sectional study was conducted at the Institute of Child and Mother Health (ICMH), Dhaka, between 1 September 2019 and 31 December 2020. Data were collected from three urban slum areas-Maniknagar, Kamlapur, and Santibagh. All neonatal deaths (0-28 days) occurring during the study period were included, whereas cases without caregiver consent were excluded. Data were obtained using a structured verbal autopsy questionnaire.
Results: A total of 53 neonatal deaths were analysed, including 35 (66.0%) males and 18 (34.0%) females. Most deaths occurred at home (37, 69.8%), followed by hospitals (10, 18.9%) and during transportation to a hospital (6, 11.3%). The leading causes of death were pneumonia (19, 35.8%), sepsis (11, 20.8%), birth asphyxia (10, 18.9%), low birth weight/prematurity (5, 9.4%), and falls (3, 5.7%). A bimodal pattern of mortality was observed, with most deaths occurring either within the first 24 hours of life or between 22 and 28 days after birth.
Conclusions: Most neonatal deaths occurred at home. Pneumonia, sepsis, and birth asphyxia were the leading causes of mortality. The observed bimodal distribution of deaths highlights the need for interventions targeting both the immediate postnatal period and the late neonatal period in vulnerable urban slum populations.

Keywords: Verbal autopsy, Neonatal mortality, Pneumonia, Sepsis

INTRODUCTION

Verbal autopsy (VA) is a structured method used to determine the probable cause of death by interviewing the primary caregiver or another close family member about the symptoms and circumstances preceding death.[1] It is particularly valuable in low- and middle-income countries (LMICs), where many deaths occur outside health facilities and are not medically certified.[2] VA therefore provides an important source of cause-specific mortality information for public health planning, particularly where civil registration and vital statistics systems are incomplete.[3,4] The WHO has developed standardized VA instruments to facilitate the systematic ascertainment and classification of probable causes of death in populations where medical certification is unavailable.[5]

The neonatal period, defined as the first 28 days of life, remains a particularly vulnerable stage of human development. Despite substantial improvements in child survival, neonatal deaths continue to account for a considerable proportion of under-five mortality worldwide. Prematurity, intrapartum-related complications, and neonatal infections remain major contributors to neonatal mortality, although their relative contributions vary across regions and populations.[6,7] Every Newborn Action Plan, developed by WHO and UNICEF, emphasizes strengthening essential newborn care, improving the quality of care around birth, and expanding access to effective interventions to prevent avoidable neonatal deaths.[8]

In Bangladesh, neonatal mortality remains an important public health concern, particularly among disadvantaged populations with limited access to timely and appropriate healthcare. Community-based surveillance studies have demonstrated that a substantial proportion of neonatal deaths occur outside health facilities or during transfer to a health facility, while birth asphyxia, infections, and prematurity are among the leading causes.[9] A study conducted in selected urban slum areas of Dhaka also identified birth asphyxia and sepsis as major causes of neonatal mortality, highlighting the need to strengthen maternal, newborn, and child health services in underserved urban communities.[10] Earlier community-based research in rural Bangladesh similarly identified sepsis, birth asphyxia, and complications associated with prematurity or low birth weight as important causes of neonatal death.[11]

The timing and location of neonatal deaths provide additional information for planning targeted interventions. Deaths occurring shortly after birth may reflect complications associated with delivery and the immediate transition to extrauterine life, whereas deaths later in the neonatal period may be associated with infections and other neonatal illnesses. Studies from Bangladesh and other South Asian settings have demonstrated variation in the distribution of causes of death according to age at death and place of occurrence. Such findings support the importance of community-based mortality surveillance and timely identification of the circumstances surrounding neonatal deaths.[9]

Although national and community-based studies have described neonatal mortality in Bangladesh, evidence specifically addressing the causes and timing of deaths in selected urban slum communities remains limited.[12] These populations may face distinctive barriers to accessing appropriate maternal and newborn healthcare, making locally generated evidence important for designing context-specific interventions.[10] Therefore, this study aimed to determine the probable causes of neonatal deaths using verbal autopsy in three selected urban slum areas of Dhaka city, Bangladesh. It also described the distribution of deaths by sex, place of death, and age at death and examined the association between place of death and the assigned cause of death.

METHODS

Study design and setting

This cross-sectional study was conducted at the ICMH, Dhaka, Bangladesh, from 1 September 2019 to 31 December 2020. Data were collected from three purposively selected urban slum areas of Dhaka city: Maniknagar, Kamlapur, and Santibagh.

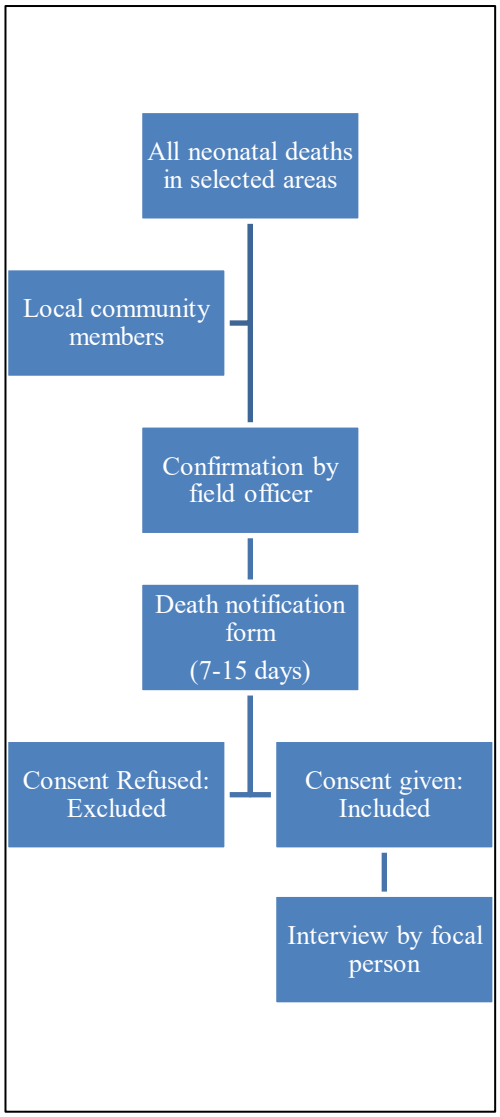


Figure 1: Flowchart of the study.

Study participants

All consecutive neonatal deaths (aged 0-28 days) that occurred in the selected study areas during the study period were screened for eligibility. Consecutive eligible cases were enrolled to minimize selection bias. Neonates whose caregivers declined to provide written informed consent were excluded.

Verbal autopsy procedure

Neonatal deaths were identified through community-based surveillance. After notification of a death, caregivers were approached within 15 days and invited to participate in the study. Following written informed consent, trained field officers conducted face-to-face VA interviews using a structured questionnaire.

The questionnaire was adapted from the WHO VA instrument and the Bangladesh Maternal and Neonatal Death Review (MNDR) infant death audit form. It was translated into Bengali, pretested in the study areas, and refined before data collection.

Field officers underwent structured training through multiple sessions conducted at the ICMH before commencing data collection. The entire data collection process was supervised by the Principal Author to ensure adherence to the study protocol and maintain data quality. The overall study procedure is illustrated in Figure 1.

Determination of cause of death

The probable underlying cause of each neonatal death was determined by the principal author based on the information obtained from the VA interviews and available supporting clinical records, where applicable. Causes of death were assigned according to the International Classification of Diseases, Tenth Revision (ICD-10) and subsequently grouped into broader diagnostic categories for analysis.

Statistical analysis

Data were entered and analysed using IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA). Categorical variables are presented as frequencies and percentages. Associations between categorical variables were assessed using the chi-square test. A two-sided p value of <0.05 was considered statistically significant.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the Institute of Child and Mother Health (ICMH), Dhaka, Bangladesh (Reference No. ICMH/IRB-30JUNE2019/01). The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from the caregivers of all participants before enrolment.

RESULTS

A total of 53 neonatal deaths were included in the study. Of these, 35 (66.0%) were males and 18 (34.0%) were females, giving a male-to-female ratio of 1.9:1 (Figure 2).

Most neonatal deaths occurred at home (37, 69.8%), followed by hospitals (10, 18.9%) and during transportation to a hospital (6, 11.3%). The distribution of causes of death according to place of death is presented in Table 1. Pneumonia was the leading cause of death irrespective of place of death, and no statistically significant association was observed between place of death and cause of death (p=0.929).

Table 1: Causes of death by location.

Cause of death	Place of death			P value
	Home	Hospital	During transport	
Pneumonia	15	3	1	0.929
Sepsis	7	3	1	
Birth asphyxia	6	2	2	
LBW/PT	3	1	1	
Fall down	3	0	0	
Others	3	1	1	

Table 2: Underlying causes of neonatal death with ICD code.

Underlying CoD (description of ICD-10 code)	Underlying CoD (ICD-10 code)	Distribution of neonate	
		N	%
Extremely low birth weight	P07	2	3.8
Other preterm infants	P07.3	3	5.7
Birth injury to the scalp, unspecified	P12.9	1	1.9
Birth asphyxia, unspecified	P21.9	10	18.9
Congenital pneumonia	P23	13	24.5
Congenital pneumonia due to other organisms	P23.8	5	9.4
Congenital pneumonia, unspecified	P23.9	1	1.9
Bacterial sepsis	P36	8	15.1
Sepsis due to other and unspecified streptococci	P36.1	1	1.9
Bacterial sepsis, unspecified	P36.9	2	3.8

Continued.

Underlying CoD (description of ICD-10 code)	Underlying CoD	Distribution of neonate	
Congenital malformation of the heart, unspecified	Q24.9	1	1.9
Congenital malformation, unspecified	Q89.9	1	1.9
Other ill-defined and unspecified causes of mortality	R99	2	3.8
Fall while being carried or supported by other persons	W04	2	3.8
Unspecified fall	W19	1	1.9
Total		53	100

Table 3: Underlying Causes of neonatal death with comparison to BDHS 2017.

Underlying CoD category	Distribution of neonate		BDHS 2017
	N	%	%
Pneumonia	19	36	13
Sepsis	11	21	12
Birth asphyxia	10	19	24
low-birth/preterm	5	9	19
Fall down	3	6	-
Others	5	9	32
Total	53	100	100

Note: Pneumonia includes P23, P23.8, and P23.9; Sepsis includes P36, P36.1, and P36.9; Birth Asphyxia includes P21.9; Low birth/preterm includes P07 and P07.3; Falls include W04 and W19; Other CoD includes P12.9, Q24.9, Q89.9, and R99; other causes include (BDHS 2017): birth injury 7%, congenital malformation 7%, other causes 10% and undetermined 10%.

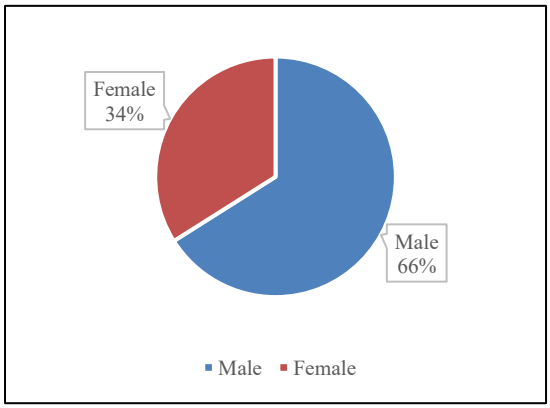


Figure 2: Gender distribution of dead neonates.

The distribution of underlying causes of death according to the ICD-10 classification is shown in Table 2. Congenital pneumonia was the most frequently assigned individual cause of death (13, 24.5%), followed by birth asphyxia, unspecified (10, 18.9%), bacterial sepsis of the newborn (8, 15.1%), congenital pneumonia due to other organisms (5, 9.4%), and other preterm infants (3, 5.7%).

When ICD-10 diagnoses were grouped into broader clinical categories, pneumonia was the leading cause of neonatal death (19, 35.8%), followed by sepsis (11, 20.8%), birth asphyxia (10, 18.9%), low birth weight/prematurity (5, 9.4%), falls (3, 5.7%), and other causes (5, 9.4%) (Table 3). Compared with the Bangladesh Demographic and Health Survey (BDHS) 2017, pneumonia and sepsis accounted for higher proportions of deaths in the present study, whereas birth asphyxia and low birth weight/prematurity accounted for relatively lower proportions.

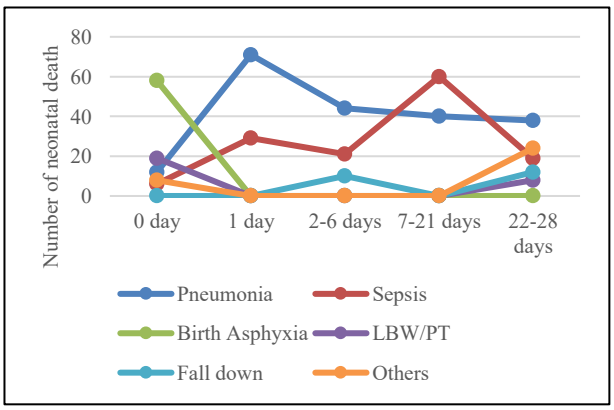


Figure 3: Underlying causes of neonatal death according to age distribution.

The distribution of deaths according to age at death demonstrated a bimodal pattern, with peaks within the first 24 hours after birth and during the late neonatal period (22-28 days) (Figure 3).

DISCUSSION

This study examined the probable causes and timing of neonatal deaths in three selected urban slum communities of Dhaka using verbal autopsy. Among the 53 deaths investigated, approximately two-thirds occurred in male

neonates, nearly 70% occurred at home, and pneumonia, sepsis, and birth asphyxia were the leading broad categories of causes of death. The distribution of deaths according to age at death demonstrated a bimodal pattern, with peaks within the first 24 hours after birth and during the late neonatal period (22-28 days). These findings provide locally relevant information about neonatal mortality in an underserved urban population.

Male neonates accounted for 66.0% of the deaths, with a male-to-female ratio of 1.9:1. Similar male predominance has been reported in previous neonatal mortality studies, including those conducted by Halim et al. in Bangladesh and Bazzano et al in Cambodia.[9,13] Biological differences in neonatal vulnerability may contribute to this pattern; however, the present study was not designed to establish sex-specific mortality risks. Furthermore, because the study included neonatal deaths without a corresponding denominator of live births by sex, the observed distribution should not be interpreted as evidence of a higher mortality rate among male neonates.

Nearly 70% of deaths occurred at home, while 18.9% occurred in hospitals and 11.3% during transportation to a hospital. This distribution highlights the importance of improving access to timely and appropriate newborn care in the selected communities. In a larger community-based surveillance study in Bangladesh, Halim et al reported that 51.3% of neonatal deaths occurred at home, while 5.5% occurred during transfer to a health facility.[9] Khatun et al., studying neonatal deaths in Dhaka slums, also identified important opportunities to improve the delivery and accessibility of maternal and newborn health services.[10] The higher proportion of home deaths in the present study may reflect differences in the selected populations, surveillance methods, and study periods. Nevertheless, the findings emphasize the need for effective community-based identification of neonatal illness, appropriate referral pathways, and timely access to quality facility-based care.

Pneumonia was the leading broad category of cause of death in the present study, accounting for 35.8% of deaths, followed by sepsis (20.8%), birth asphyxia (18.9%), and low birth weight/prematurity (9.4%). This distribution differs from the findings of Halim et al., who identified birth asphyxia as the leading cause of neonatal death in Bangladesh, followed by infections and prematurity.[9] Similarly, Khatun et al reported birth asphyxia and sepsis as the major causes of neonatal deaths in Dhaka slums.[10] In contrast, the present study identified pneumonia as the most frequent broad diagnostic category. Differences in population characteristics, the availability of clinical records, cause-of-death assignment, and the classification of respiratory infections may contribute to the observed variation.

The predominance of infectious causes is broadly consistent with findings from other South Asian verbal-autopsy studies. Khanal et al. reported infections and birth asphyxia as the leading causes of neonatal death in Nepal, while a later study from rural southern Nepal identified prematurity, intrapartum-related events, and severe infections as major contributors.[14,15] A verbal-autopsy study in Nepal by Wrammert et al also identified sepsis as the leading cause of neonatal death, followed by birth asphyxia and preterm birth.[16] These findings, together with the present results, reinforce the importance of infection prevention, early recognition of neonatal danger signs, and timely access to effective newborn care. However, differences in cause-of-death definitions and diagnostic approaches should be considered when comparing proportions across studies.

When the underlying causes were examined using ICD-10 codes, congenital pneumonia was the most frequently assigned individual diagnosis, followed by birth asphyxia, unspecified, and bacterial sepsis of the newborn.[17] Grouping these diagnoses into broader clinical categories allowed the study findings to be presented in a form that is more readily comparable with national and international mortality data. Nevertheless, comparisons require caution because some studies classify neonatal pneumonia within a broader infection category, whereas others report pneumonia and sepsis separately.[18] Standardized verbal-autopsy instruments and consistent cause-of-death classification are important for improving comparability across settings.[1]

Comparison with the Bangladesh Demographic and Health Survey (BDHS) 2017-18 showed that pneumonia and sepsis accounted for higher proportions of deaths in the present study, whereas birth asphyxia and low birth weight/prematurity accounted for lower proportions.[19] These differences should not be interpreted as evidence of a change in the national pattern of neonatal mortality. The present study included only 53 deaths from three purposively selected urban slum communities, whereas the BDHS provides broader population-level estimates using a different sampling and cause-of-death assessment framework. Global analyses have likewise demonstrated that the distribution of neonatal causes of death varies across countries and regions.[6] Consequently, the findings of this study are best interpreted as a description of the selected communities rather than as representative estimates for Dhaka or Bangladesh as a whole.

Another important finding was the bimodal distribution of deaths according to age at death, with peaks within the first 24 hours after birth and during days 22-28. The early peak is consistent with evidence from Bangladesh, where Halim et al reported that 46.1% of neonatal deaths occurred within the first 24 hours.[9] Studies from Nepal have also documented a substantial concentration of neonatal deaths on the first day of life.[16] The late neonatal peak observed in the present study differs from the predominantly early neonatal mortality pattern reported in some of these studies.[15] This difference may reflect the characteristics of the selected population, the small sample size, or variation in the timing and ascertainment

of deaths. Because the study was not designed to determine the factors responsible for this pattern, further research is required to establish whether it is reproducible in other urban slum populations.

The findings have practical implications for neonatal health services in underserved urban communities. The high proportion of deaths occurring at home supports strengthening community-based death notification and surveillance, caregiver education about newborn danger signs, timely referral, and access to appropriate facility-based care. The prominence of pneumonia and sepsis also highlights the importance of infection prevention, early assessment of sick neonates, and timely management. At the same time, the proportion of deaths occurring within the first 24 hours underscores the continued importance of quality intrapartum care, immediate newborn assessment, and effective resuscitation when indicated. These priorities are consistent with the objectives of Every Newborn Action Plan and established global strategies for reducing preventable neonatal deaths.[8]

In conclusion, neonatal deaths in the selected urban slum areas of Dhaka occurred predominantly at home, and pneumonia, sepsis, and birth asphyxia were the leading broad categories of causes of death. The observed bimodal distribution, with peaks during the first 24 hours and the late neonatal period, highlights the importance of addressing newborn care needs throughout the neonatal period. Strengthening community-based surveillance, improving access to timely and appropriate healthcare, and ensuring quality care around birth and during neonatal illness may help address preventable deaths in underserved urban communities. Larger multicentre studies using standardized cause-of-death assessment methods are needed to validate these findings and inform targeted interventions.

Limitations

This study has several limitations. First, the sample size was relatively small and restricted to three purposively selected urban slum areas, limiting the generalizability of the findings. Second, probable causes of death were assigned using verbal-autopsy interviews and available supporting clinical records rather than consistent laboratory or postmortem confirmation. Recall error and diagnostic misclassification therefore cannot be excluded. Third, the cause of death was determined by the Principal Author, which may introduce classification bias compared with independent assessment by multiple reviewers or automated algorithms. Finally, the study had no live-birth denominator for the selected communities; therefore, it cannot estimate neonatal mortality rates or determine sex-specific mortality risks. Despite these limitations, the study provides a detailed description of the probable causes, locations, and timing of neonatal deaths in a population for which locally relevant mortality data are important.

CONCLUSION

Neonatal deaths in Dhaka's urban slums occurred predominantly at home, driven primarily by pneumonia, sepsis, and birth asphyxia. The bimodal mortality peaks-within the first 24 hours and during the late neonatal period-underscore the need for continuous care throughout the first month of life. Addressing these preventable deaths requires strengthening community-based surveillance, streamlining referral pathways, and ensuring quality healthcare around birth and during illness. Finally, larger multicentre studies utilizing standardized cause-of-death tools are essential to validate these findings and guide targeted urban interventions.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. World Health Organization. Verbal autopsy standards: 2022 WHO verbal autopsy instrument. Geneva: World Health Organization; 2022. Available at: https://www.who.int/publications/m/item/2022-who-verbal-autopsy-instrument. Accessed on 17 May 2026.
2. de Savigny D, Riley I, Chandramohan D, Odhiambo F, Nichols E, Notzon S, et al. Integrating verbal autopsy into routine civil registration and vital statistics systems: The WHO, 2016 verbal autopsy instrument. PLOS Med. 2017;14(1):e1002211.
3. D'Ambruoso L, Boerma T, Byass P, Fottrell E, Kahn K, Tollman S, et al. Verbal autopsy in health policy and systems: a literature review. BMJ Glob Health. 2018;3(3):e000833.
4. Jha P. Counting the dead is counting for the living: a call for universal vital statistics. Lancet. 2014;383(9913):189-91.
5. World Health Organization. Verbal autopsy standards: ascertaining and attributing cause of death. Geneva: World Health Organization; 2007.
6. Perin J, Mulick A, Yeung D, Villavicencio F, Lopez G, Strong KL, et al. Global, regional, and national causes of under-5 mortality in 2000-19: an updated systematic analysis with implications for COVID-19. Lancet Glob Health. 2022;10(1):e41-51.
7. United Nations Inter-agency Group for Child Mortality Estimation (UN IGME). Levels & trends in child mortality: report 2023. New York: United Nations Children's Fund (UNICEF); 2024. Available at: https://childmortality.org/wp-content/uploads/2024/03/UNIGME-2023-Child-Mortality-Report.pdf. Accessed on 17 May 2026.
8. World Health Organization, UNICEF. Every newborn: an action plan to end preventable deaths. Geneva: World Health Organization; 2014. Available at:

https://www.who.int/publications/i/item/9789241507448. Accessed on 17 May 2026.
9. Halim A, Utz B, Delvaux T, Belton S, Rahman F, van den Broek N. When, where, and why are babies dying? Neonatal death surveillance in Bangladesh. PLoS One. 2016;11(8):e0159388.
10. Khatun F, Rasheed S, Moran AC, Khan AM, Rahman F, Mustafa RE, et al. Causes of neonatal and maternal deaths in Dhaka slums: Implications for service delivery. BMC Public Health. 2012;12:84.
11. Chowdhury HR, Thompson S, Ali M, Alam N, Yunus M, Streatfield PK. Causes of neonatal deaths in a rural subdistrict of Bangladesh. J Health Popul Nutr. 2010;28(4):375-82.
12. Billah M, Khan MA, Hasan MM, Islam MS, Rahman MM. Causes of under-five mortality using verbal autopsies in urban slum areas in Bangladesh: a cross-sectional analysis of surveillance data. J Glob Health Rep. 2024;8:e2024044.
13. Bazzano AN, Var C, Wilkosz D, Duggal R, Oberhelman RA. Neonatal deaths in Cambodia: findings from a community-based mortality review. BMC Res Notes. 2019;12:236.
14. Khanal S, GC VS, Dawson P, Houston R. Verbal autopsy to ascertain causes of neonatal deaths in a community setting: A study from Morang, Nepal. J Nepal Med Assoc. 2011;51(181):21-7.
15. Saya AR, Katz J, Khatry SK, Tielsch JM, LeClerq SC, Mullany LC. Causes of neonatal mortality using verbal autopsies in rural Southern Nepal, 2010-2017. PLOS Glob Public Health. 2022;2(9):e0001072.
16. Wrammert J, KC A, Nelin V, Clark R, Ewald U, Målqvist M. Causes and age of neonatal death and associations with maternal and newborn care characteristics in Nepal: a verbal autopsy study. BMC Pediatr. 2022;22(1):21.
17. World Health Organization. International statistical classification of diseases and related health problems: 10th revision (ICD-10). Geneva: World Health Organization; 2016. Available at: https://icd.who.int/browse10/2016/en. Accessed on 17 May 2026.
18. Leisher SH, Teoh Z, Reinebrant HE, Allanson E, Blencowe H, Erwich JJ, et al. Seeking better data on neonatal deaths: Review of neonatal cause-of-death classification systems. Paediatr Perinat Epidemiol. 2019;33(4):20-34.
19. National Institute of Population Research and Training (NIPORT), ICF. Bangladesh Demographic and Health Survey 2017-18. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT and ICF; 2020. Available at: https://microdata.worldbank.org/index.php/catalog/3825. Accessed on 17 May 2026.

Cite this article as: Rahman MM, Adnan MA, Haque MA, Rahman A, Ahmed M, Islam MT. Verbal autopsy on neonatal mortality in selected urban slum areas of Dhaka city. Int J Contemp Pediatr 2026;13:2402-8.