

Original Research Article

Pattern of neonatal admissions and Care Outcomes in Special Care Newborn Unit of Cox's Bazar District hospital, Bangladesh

ABSTRACT

Background: Neonatal morbidity and mortality contribute significantly to under-five morbidity and mortality. A substantial reduction in neonatal mortality is therefore necessary to achieve the Sustainable Development Goals targets.

Aims: Assessed the pattern of neonatal admission and care outcome

Place and Duration of Study; Special Care Newborn Unit of Cox's Bazar District hospital, Bangladesh conducted in September 2022

Methodology: Hospital-based retrospective study . Data extracted from the admission register and the records of 3982 newborns admitted between August 2021 and July 2022. Bivariate analysis using the Chi-square test, was performed to determine factors associated with neonatal mortality and p value was set at significant level of 5%.

Results: 3982 neonates were admitted, 2426 (61%) were male and 1556 (39%) were female with 1071 (27%) from the hospital and 2911(73%) from outside the hospital. Birth asphyxia was the commonest morbidity, 49% followed by Low Birth Weight/prematurity (18%) and neonatal sepsis 17%. 3,225 (81.4%) of the neonates admitted survived while 538 (13.5%) died and 203(5.1%) were discharged against medical advice. There was significant association between birth weight, morbidity pattern and mortality ($p < 0.05$) with most death associated with prematurity/LBW. There was significant association between neonatal mortality and the place of delivery, death among outborn was 16% compared with 7% among inborn ($p < 0.05$) but no significant association between neonatal mortality and gender.

Conclusion: There was a high burden for neonatal care at the hospital and majority of causes of neonatal morbidity and mortality were preventable. There is need for holistic approach to pregnancy, delivery and newborn care to reduce neonatal morbidity and mortality in the district.

Keywords: Special Care Newborn Unit , Pattern, neonatal , admission, outcome .

1. INTRODUCTION

Globally, 2.4 million children die after birth each year and 36% of these children are from the developing countries [1]. Neonatal mortality contributes to the overall under-five death rates, accounting for 40% of the under-five mortality rate worldwide[1]. Bangladesh reported reduction in infant mortality from 52 per 1000

live birth in 2007 to 38 per 1000 live birth in 2017, however the decline in neonatal mortality is relatively slow from 37 to 30 per 1,000 live births in the same period[2]. Neonatal deaths account for an increasing share of the deaths of children under age five, rising from about 40% in the early 1990s to 61% currently.[2] The commonest causes of neonatal deaths in Bangladesh were birth asphyxia 25%, prematurity 33%, sepsis 9%, congenital abnormality 10% and others 13% [2].

Considering this high burden, the Government of Bangladesh (GoB) has emphasized newborn health and committed to achieving the Sustainable Development Goals (SDG) target by reducing newborn mortality to 12 per thousand live births or below by 2030 [3]. In response to the Global Every Newborn Action Plan (GENAP), the GoB also developed the Bangladesh Every Newborn Action Plan (BENAP) with specific strategies for averting newborn mortality and morbidity [3,4]. The plan included strengthening facility based newborn care services through establishing Special Care Newborn Unit (SCANU) in the district hospitals and Newborn Stabilization Unit (NSU) in the Upazila Health Complexes (UHCs) [5,6]. **In addition, the government has identified newborn signal functions that are categorized by health facilities to assist in appropriately planning and adequately monitoring of the progress and performance of health facilities in providing newborn care [3].**

Bangladesh has a well-structured health system with three tiers of primary health care – Upazila Health Complexes (UHC) at the sub-district level, Union Health and Family Welfare Centres (UHFWC) at the Union (collection of few villages) level, and Community Clinics (CC) at the village level. These are backed by the District Hospitals providing secondary level care and the tertiary hospitals of various kind in large urban centers. (Figure 1) [7,8].

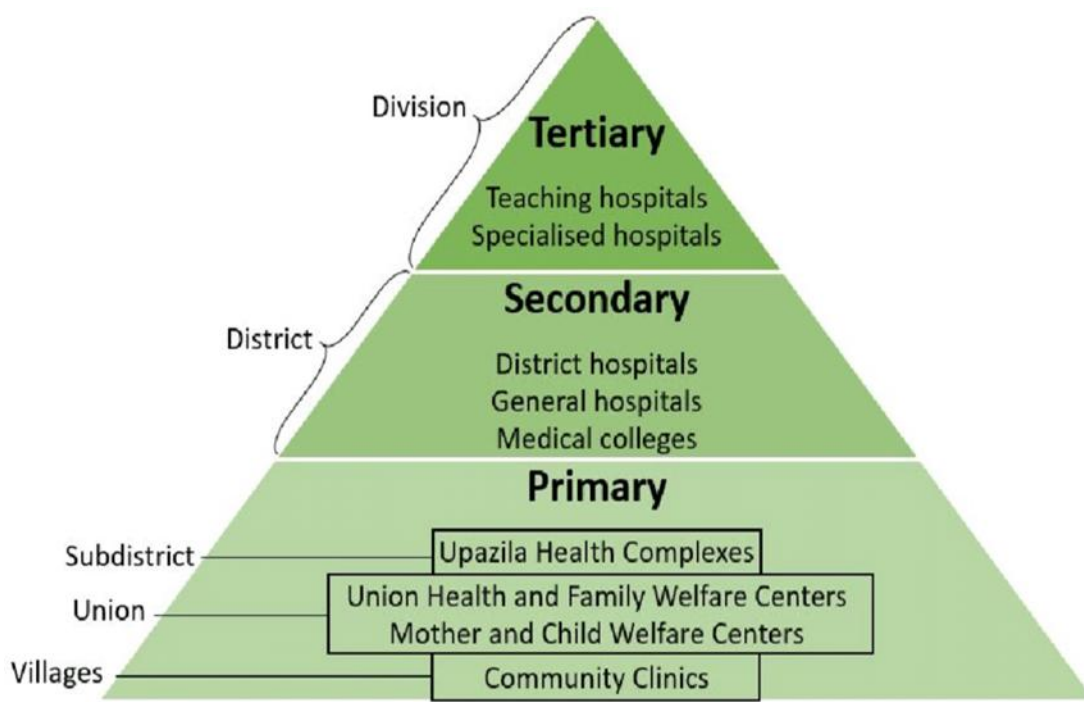


Figure 1: Health care system in Bangladesh.

This study assessed the pattern of **neonatal** admission and care outcome at Cox's Bazar District Hospital Special Care Newborn Unit (SCANU). The findings of this study will be used for evidence based newborn health programming for better newborn outcome in the district.

2. MATERIAL AND METHODS

2.1 DESIGN .

This was hospital-based retrospective survey which involved review of neonatal admission register and the records of 3982 newborns admitted between August 2021 and July 2022.

2.1 STUDY POPULATION AND SETTING. .

This study was done at Special Care Newborn Unit of Cox's Bazar District hospital, Bangladesh. It is a 65-bed unit and the only referral facility in Cox's Bazar district for the host communities and the Rohingya refugees (Forcibly Displaced Myanmar Nationals) (FDMN) and supported by UNICEF. The facility has trained manpower and necessary equipment to provide all essential and emergency cares for sick newborns including Kangaroo Mother care unit.

The study was conducted in September 2022

2.3 DATA COLLECTION AND STATISTICAL ANALYSIS

The data were extracted using a form designed to capture relevant information from the unit's admission register and case notes of the neonates. This data collected included recorded of admission such as date of admission, age, weight of the child, status at birth, gestational age, mode and place of delivery, diagnosis on admission, treatments given and outcomes. The extracted data were entered into a Microsoft Excel spreadsheet and analysed using SPSS version 21. Univariate analysis was done by generating frequencies and proportions and variables presented in graph and tables. Bivariate analysis using the Chi-square test, was performed to determine factors associated with neonatal mortality and p value was set at significant level of 5%.

3. RESULTS AND DISCUSSION

3.1.1 Characteristics of neonates on admission

Table 1 shows that among the 3,982 neonates admitted into the SCANU, 2426 (61%) were male and 1556 (39%) were female with 1071 (27%) from the Cox's Bazar district hospital and 2911(73%) from outside the hospital. The breakdown of the outborn admission shows that 1194(41%) were from home, 485(17%) from other government health facilities and 1232(42%) from private and Non-Governmental Organization health facilities in the host communities and refugee camps respectively. The mean length of stay was 4.64 ± 1.3 days and mean bed occupancy rate of $78 \pm 12.5\%$

Table 1: Basic characteristics of Neonates admitted (Aug 2021- July 2022)

Variables	Number(n=3982)
Gender	
Male	2426(61%)
Female	1556(39%)
Source of Admission	
Inborn	1071(27%)
Out born	
Home	1194(41%)
Government health facilities	485(17%)
Private and NGO health facilities	1232(42%)
Length of Stay (Days)(mean)	4.64 ± 1.3
Bed Occupancy Rate (%) (mean)	$78.8\% \pm 12.5\%$

3.1.2 Pattern of neonatal morbidity and mortality at admission

Figure 2 shows the distribution of the neonatal morbidity on admission with 1953 (49%) of the total 3982 admissions being Birth Asphyxia, 679(17%) was neonatal sepsis, 390(10%) was Low birth weight (>1.5-2.5kg) and 299 (8%) was very low birth weight (<1.5kg).

Figure 2: Pattern of neonatal admission at the SCANU (Aug 2021-July 2022) (n=3982)

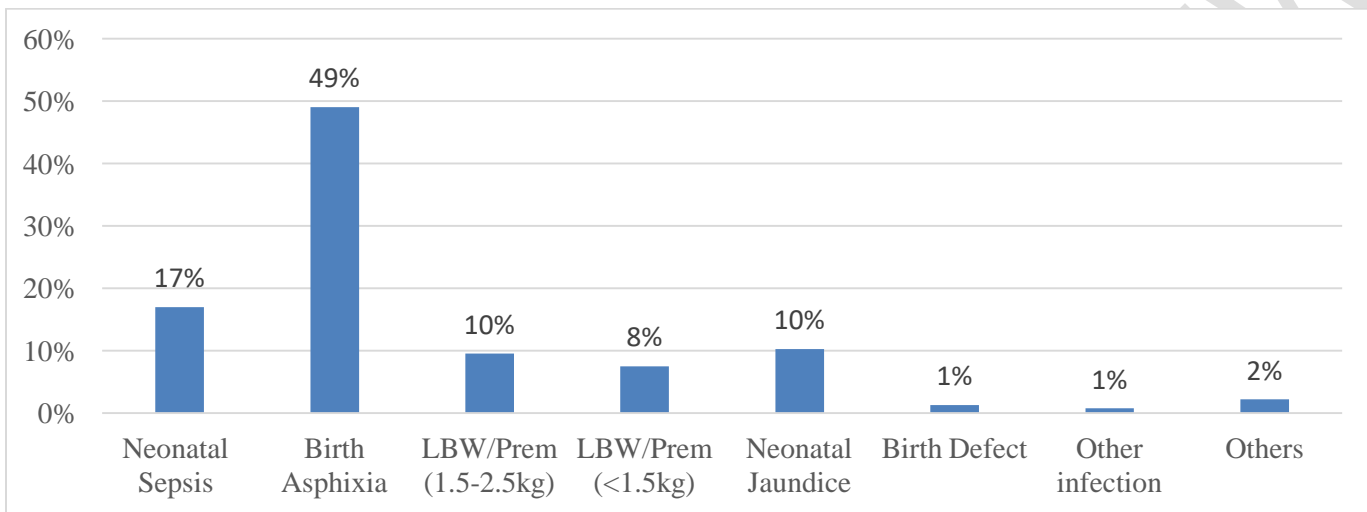


Figure 3 shows that 3,225 (81.4%) of the neonates admitted survived while 538 (13.5%) died and 203(5.1%) were discharged against medical advice.

Figure 3: Outcome of newborn admission(n=3982)

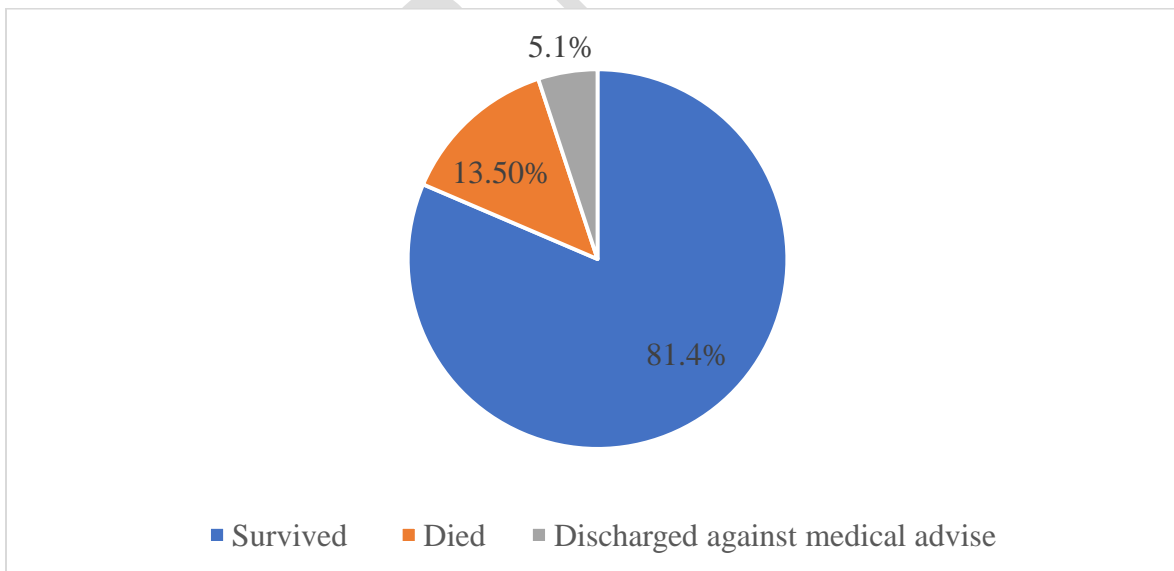


Figure 4 shows the causes of death among the neonates admitted into the unit. The commonest cause of death was due to Birth Asphyxia with 312(58%) of the total 538 deaths, while 113(21%) was due to Low birth weight(<1.5kg) and 59(11%) due to neonatal sepsis

**Figure 4: Causes of Death at the SCANU(Aug2021-July 2022)
n=538**

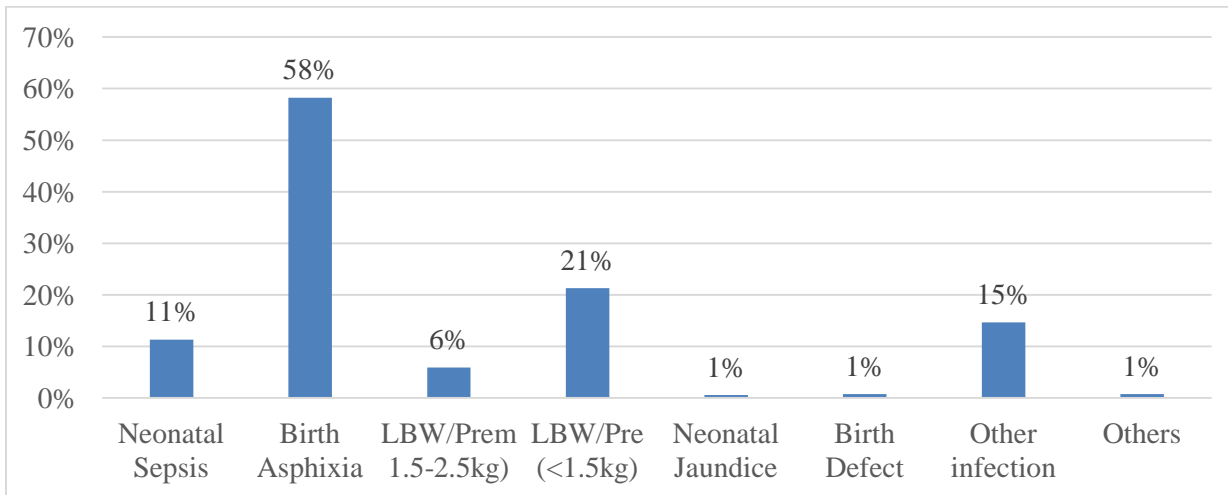


Table 2 shows the case fatality rate of the common cause of neonatal mortality with Low birth having highest case fatality of 22%, [LBW(<1.5kg ,case fatality of 38%: LBW(1.5-2.5kg, case fatality of 8.2%] followed birth Asphyxia,16% and Sepsis 8.7%.

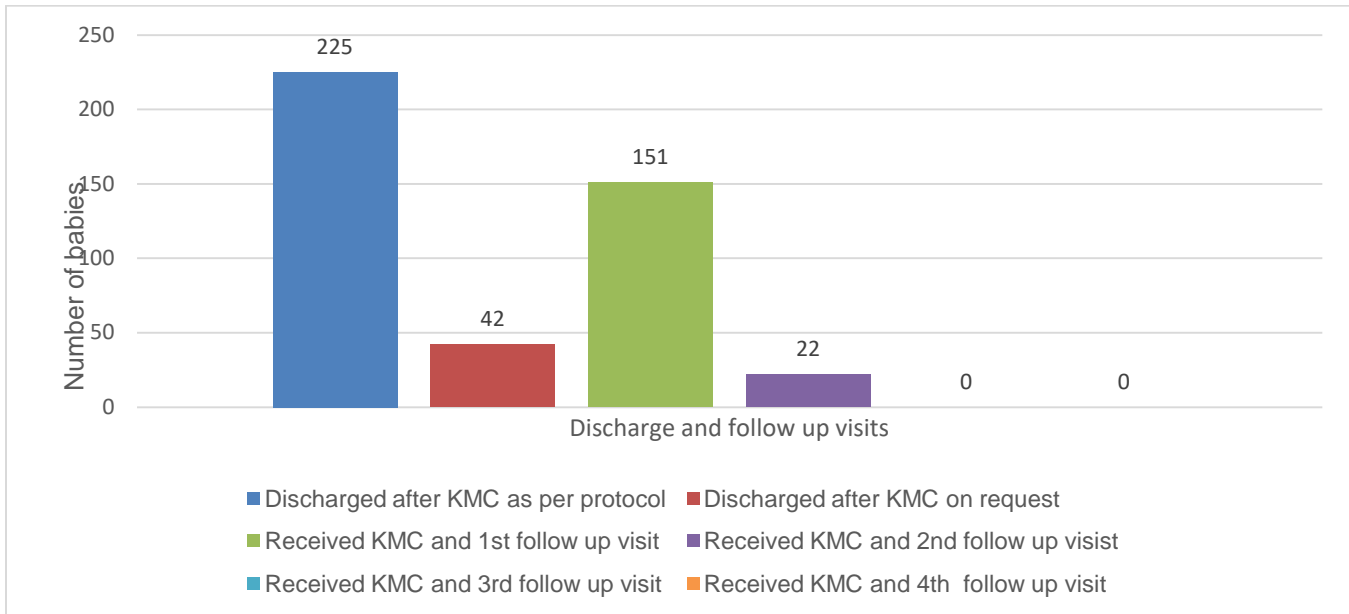
Table 2:Case fatality rates of the common causes of neonatal morbidity and mortality

Clinical indications for admission	Survived	Died	Case fatality rate(%)
Birth Asphyxia	1641	312	16%
LBW(<1.5kg)	186	113	38%
LBW(1.5-2.5kg)	358	32	8.2%
Sepsis	620	59	8.7%
Others	661	22	3.3%

3.1.3 Kangaroo Mother Care follow up visit

Figure 5 shows the follow up visits by low birth weight/premature babies who were managed using Kangaroo mother in the KMC section of the SCANU. It shows that 225 babies were managed and discharged using the national protocol while 42 other babies absconded and didn't fulfil the discharge criteria. Among the 225 neonates discharged and expected to return for the four follow up visit, 151(67%) came for the 1st visit and 22(10%) came from the 2nd visit and none of them came for the remaining 3rd and 4th visit.

Figure 5: KMC discharge and follow up visits



3.1.4 Factors associated with neonatal outcome

Table 3 shows the review of the records of each newborn who died from the SCANU. Among the 538 neonates that died between August 2021- July 2022, 394(73%) were normal vaginal delivery and 275(51%) were from primipara mothers. A total of 246(46%) of them died between 1st and 3rd day on admission while 102(19%) of them died within 24 hours of admission.

Table 3: Some characteristics of Neonatal death (August 2021-July 2022)

	Number(%) n=538
Mode of delivery	
Normal vaginal delivery (NVD)	394(73)
Caesarean session (CS)	144(27)
Parity	
Primipara	275 (51)
Multipara	241(45)
Grandmultipara	22(4)
Duration of stay(days)	
<1	102 (19)
1 to 3	246(46)
4 to 7	119 (22)
>7	71(13)

Factors associated with neonatal death

Table 4 shows that a significant association exists between birth weight of the neonates and neonatal mortality ($p < 0.05$). Newborns who weighed less than 1.5kg died most while there was better survival with increasing weight beyond 1.5kg with 38% of death among newborn less than 1.5 kgs and 8% among neonate 1.5-2.5kg.

Likewise, a significant association exist between clinical indications for admission and neonate's mortality ($p < 0.05$) with most deaths associated with prematurity LBW (21%) followed by Birth Asphyxia (16%) and Sepsis (9%) and 3.3% from other causes. The analysis shows there was significant association between neonatal mortality and the place of delivery. Neonatal mortality among outborn (home and other health facility) was 16% [13% among those delivered at home and 18% among those delivered in other health facilities including private or NGO health facilities] compared with 7% among those delivered at the Cox Bazar district hospital (inborn). There was no significant association between neonatal death and gender even though the mortality among the male neonates was 14% compared to 12.6% among female neonates ($p > 0.05$).

Table 4: Association between some variables and neonatal care outcomes (August 2021- July 2022)

Variables	Died	Survived	Total	Chi square(p value)
Birth weight				
<1.5kg	113	186	299	
1.5-2.5kg	32	358	390	167.26(0.000)*
>2.5kg	393	2900	3293	
Pattern of disease				
Birth Asphyxia	312	1641	1953	115.7 (0.000)*
LBW/prematurity	145	544	689	
Sepsis	59	620	679	
Others (Neonatal Jaundice, congenital abnormalities, birth trauma/injury etc)	22	639	661	
Place of delivery				
Inborn(home and other health facilities)	462	2450	2912	51.53(0.000)*
Cox Bazar District hospital	76	995	1071	
Gender				
Male	342	2084	2426	1.8275(0.176)
Female	196	1360	1556	

3.2. Discussion

The study highlighted the pattern of neonatal admission and care outcome among neonates admitted in the Special Care Newborn Unit. There was higher number of male neonates compared to female admitted. This is similar to findings from other studies which indicated that male neonates are more vulnerable during the neonatal period [9-14]. Many reasons have been attributed to this which included the biological vulnerability of

males to infections [15,16] or discrimination against female offspring due to cultural and social factors which contribute to male babies getting more attention by parents than females [11,12].

A study by Becklake and Kauffmann reported that the lungs of female neonates are at lower risk than those of male neonates for developing both transient tachypnoea of the newborn and respiratory distress syndrome.

They are also more responsive to hormone accelerators of surfactant production, presumably because of their more mature lung phospholipid profiles [15]. Also, a study by Libert et al., established a genetic influence in neonatal infection, revealing that in response to various immune challenges, females show better survival than males and the X-chromosome linked diseases are predominant in males than females [16]. However, a study in Karachi reported more female neonates on admission than male [17].

Causes of admission

Birth asphyxia was the commonest neonatal morbidity followed by low birthweight/prematurity and sepsis in the study. This is similar to findings from other studies in Pakistan, Nigeria, India and Tanzania which reported birth asphyxia as the most common cause of hospital admissions though the proportion attributable to it varies from each study [18-22]. Our study found 49% of admission due to birth asphyxia compared to 24%, 32%, 31%, 16% and 27% respectively in other studies in Pakistan, Nigeria, India and Tanzania [18-22]. However, in most of the studies on neonatal admission in NICU (neonatal intensive care unit), the commonest morbidity was prematurity/low birth weight [10, 13, 23-25], while sepsis was also reported as the commonest morbidity in few other studies [26-28]. This variation in causes of admission from studies to studies is likely a reflection of the health systems in terms of the quality of maternal and newborn care services at the lower-level health systems that affect the patient management and cases that are finally referred; the referral systems and other socio-economic factors.

Mortality rate and causes of mortality

In the study, the mortality rate among the neonates admitted was 13.5%, this is similar to 13.6% mortality rate reported in a study in India [29], but lower than finding from studies in India, Pakistan, Bangladesh, Ghana, and Ethiopia which reported mortality rates of 17.14%, 17.15%, 14.9%, 16% and 20.5% respectively [13, 26, 30, 31, 32]. The rate is however more than was reported in studies in Sri Lanka, previous study in Bangladesh, Northern Nigeria and Pakistan which reported neonatal mortality rate of 8%, 9.43%, 4.32%, and 8%

respectively [9,10,33,34]. Mortality rate of any neonatal intensive care unit depends on many factors other than the clinical conditions of the baby on admission such as the infrastructure, manpower and quality of care at the facilities. This could be responsible for the variations in the mortality rate reported in the studies.

Birth Asphyxia was the commonest cause of death, 58% of deaths, followed by low birth weight/prematurity and other infections. This is similar to findings in Pakistan, India, which also reported birth asphyxia as the major cause of mortality and contributed 46% and 30% of the total mortality respectively [35,36]. Most studies however reported prematurity/low birth weight as the commonest cause of death and accounted for between 35%–70% of neonatal deaths among admitted neonates [25,26,37-39]. A previous study in Bangladesh however reported neonatal infection as the predominant cause of death (29%) among the admitted neonates[40].

Time of death

In the study, majority of the deaths (46%) occurred between 1 and 3 days of admission and 19% occurred within first 24 hours of admission. This is unlike most studies in Nigeria and Pakistan that reported that between 88.5%, 46%, and 52% of death occurred within the first 24 hours respectively[14, 25, 35]]. The first 24 hours are regarded as the most dangerous of a child's life that carry the highest risk of death[41]. A study in Nigeria reported neonatal mortality was significantly higher in the first 24 hours of admission among neonates with low birth weight/prematurity [25]. This may be the reason for the difference in the time of death on admission in our study where the commonest cause of admission is birth asphyxia unlike the other studies where prematurity/LBW was the commonest cause of admission [10, 13,23-25].

Association factors and neonatal outcome.

There was significant association between the clinical indications and neonatal mortality with more death associated with prematurity/LBW (21%), Birth Asphyxia (16%) and Sepsis (9%). This is similar to other studies which reported significant association between pattern of diseases and neonatal mortality where most deaths were associated with prematurity LBW (27.4%), Respiratory distress (20.6%) and Birth asphyxia (17.3%) [25,42,43]. However other studies found birth asphyxia as a predictor of neonatal mortalities [44,45].

There was significant association between birth weight and neonatal mortality. This shows that the newborns who weighed less than 1.5kg died most, while there was better survival with increasing weight. This is similar to findings from other studies in Nigeria, Ghana, Kenya, Indonesia and Pakistan which observed that birth weight of the neonates are associated with the care outcomes and confirmed birth weight is a significant predictor of neonatal outcome [25, 42, 43, 46,47]. Survival and discharge rates increase as the birth weight increases. There was no significant association between gender and neonatal care outcome even though more death were recorded among the male than female neonates. This is similar to a finding in Nigeria, Mauritania and Pakistan which also reported no significant association between gender and neonatal outcome even though the mortality was higher among the male neonates [33,45,47].

The study found significant association between neonatal care outcome and the place of delivery, newborn deaths among those delivered outside the hospital, out born (home and other health facility) was 16% compared with 7% for the hospital (inborn). This is similar to finding from other studies in Pakistan and India that found significant association between out born neonates and mortality [47,48]. However, a study in Kenya found no significant association between newborn delivered out born (home and in order health facilities) compared to the inborn even though the out born newborn had increased tendency of dying [43].

Kangaroo Mother Care follow up visits

In the study among the 225 LBW/premature babies managed and discharged in the KMC unit and expected to return for the four follow up visits based on the treatment protocol, only 151(67%) came for the 1st visit and 22(10%) came from the 2nd visit and none of them came for the remaining 3rd and 4th visits. This is similar to finding in a previous study in Bangladesh where only 39% of the newborn discharge from KMC had at least one post follow up visit [49]. However other studies have reported better follow up visits [50,51]. Another study in Bangladesh reported 64% of newborn completed up to 3rd follow up visit while a study in Malawi reported that 88% of mothers and babies followed up at health facilities within 30 days, though the rate varied by sites[50,51]. Distance was cited as main reasons for not completing follow-up visit and completion of follow-up visits was higher at facilities closer to home (lower level)[51]. A study in Ghana reported low dropout rate of less than 20% compared to what was expected over the four weeks of follow up and use of phone calls to follow up and remind mothers following discharge from hospital was reported as the strategy used to

improve on the visits [52]. The low follow up visit in our study could have been attributed to distance, the study site is the only district referral newborn care facility which receive patients from other parts of the district some of which are very far. However, better follow up mechanism has to be considered to reduce the follow up dropout rate.

Limitation of the study

The study was a retrospective hospital-based study and relied on the available data from the SCANU so the finding cannot be used to generalize the pattern of newborn admission and mortality in the district. The analysis done in the study was limited to the information available in the hospital record and patients case notes. **Despite this, our study is the first to be conducted in the SCANU and our findings provided relevant and useful information that can be used to improve newborn care services in the hospital and also in the whole district.** Further studies are required to document the maternal risk factors and health system factors associated with newborn morbidity and mortality in the health facility.

4. Conclusion: The study highlighted relatively high number of neonatal cases that are managed at this hospital and **majority of causes of neonatal morbidity and mortality were preventable.** Holistic approach to pregnancy, delivery and newborn care at all levels of the health system is essential to reduce neonatal morbidity and mortality in the district. All efforts should be made by the government and partners to ensure effective and quality maternal and newborn care services with strong community health system and the implementation of key newborn interventions including the newly defined newborn signal functions in Bangladesh to reduce newborn deaths within the continuum of care at all levels of the health system in the district.

COMPETING INTERESTS

Authors declared no competing interests.

Disclaimer: The views expressed in the study are that of the authors and not of their affiliated institutions.

ETHICAL APPROVAL

The approval to use the data was granted by the hospital management and all personal identifiers were not included in the data collected to ensure confidentiality.

REFERENCES

1. World Health Organization. (2022). Neonatal Mortality. World Health Organization, Geneva <https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-mortality-report-2021> .
2. National Institute of Population Research and Training (NIPORT), and ICF. (2020). Bangladesh Demographic and Health Survey 2017-18. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT and ICF. <https://dhsprogram.com/publications/publication-FR344-DHS-Final-Reports.cfm>
3. Government of the People's Republic of Bangladesh Ministry of Health and Family Welfare(2022) NEWBORN SIGNAL FUNCTIONS IN BANGLADESH. http://rdm.icddr.org/wp-content/uploads/2022/07/Newborn-signal-function_Final-Report_17072022.pdf
4. UNICEF and WHO EVERY NEWBORN ACTION PLAN(2015) Country Progress Tracking Report <https://www.healthynewbornnetwork.org/hnn-content/uploads/160525-ENAP-country-progress-tracking-report-2015-v2.pdf>
5. Kabir Ehtesham (2021) National Newborn Health Standard Operating Procedure, Bangladesh: 2021-2030.https://www.researchgate.net/publication/360449118_National_Newborn_Health_Standard_Operating_Procedure_Bangladesh_2021-2030
6. Bangladesh MOH&FW(2019).Standard operating procedure(SOP) for Newborn Care services at primary and secondary level hospitals. http://qis.gov.bd/wp-content/uploads/2019/04/2019_02_07_1549511227_973canu.pdf
7. Anwar Islam, Tuhin Biswas(2014) Health system in Bangladesh: Challenges and opportunities. American Journal of Health Research; 2(6): 366-374 (<http://www.sciencepublishinggroup.com/j/ajhr>) doi: 10.11648/j.ajhr.20140206.18
8. World Health Organization (2015). Bangladesh Health System Review Health Systems in Transition, Vol. 5 No. 3 https://apps.who.int/iris/bitstream/handle/10665/208214/9789290617051_eng.pdf?sequence=1&isAllowed=y
9. Narayan R(2012) . A study of the pattern of admissions and outcome in a neonatal intensive care unit at high altitude. Sri Lank J Child Health ;41 (2): 79-81.
10. Monika Mazumder, Md Naznin Sultana, Akter Banu, Ayasha Sultana, Md. Eunos Ali(2019). The Pattern of Neonatal Admission and Outcome in Special Care Newborn Unit of A Medical College Hospital in Northern Bangladesh. Int J Med Res Prof. Sept; 5(5):214-17. DOI:10.21276/ijmrp.2019.5.5.047
11. Roy RN, Nandy S, Shrivastava P, Chakraborty A, Dasgupta M, Kundu TK(2008). Mortality pattern of hospitalized children in a tertiary care hospital of kolkata. Indian J Community Med. Jul;33(3):187-9. doi: 10.4103/0970-0218.42062. PMID: 19876482; PMCID: PMC2763676.

12. Doctor, H.V, Bairagi, R, Findley, S.E, Helleringer, S. and Dahiru, T(2011). Northern Nigeria Maternal, Newborn And Child Health Programme: Selected Analyses from Population-Based Baseline Survey. *The open demography journal* ; 4:11-21
13. Narayan R, Singh S(2017) A study of pattern of admission and outcome in a neonatal intensive care unit at Rural Haryana, India . *International Journal of Pediatric Research* October 2017/ Vol 4/ Issue 10
14. Toma BO, Ige OO, Abok I (2013). Pattern of neonatal admissions and outcome in a tertiary institution in north central Nigeria. *J Med Trop*; 15: 121.
15. Becklake MR, Kauffmann F(1999) Gender differences in airway behaviour over the human life span. *Thorax* ; 54: 1119–1138.
16. Libert C, Dejager L, Pinheiro I(2010). The X chromosome in immune functions: when a chromosome makes the difference. *Nat Rev Immunol.*; 10: 594-604
17. Aijaz, N, Huda, N. and Kauzar, S (2012). Disease Burden of NICU at a Tertiary Care Hospital, Karachi. *Journal of the Dow University of Health Sciences Karachi* ; (6)1: 32-35.
18. Naeem Akram Butt, Ammerulah Malik, Muhammad Yaqub Kazi(2010). Pattern of Neonatal Admissions in a Tertiary Care Hospital, P J M H S: Oct-Dec; 4(4): 436.
19. Sadia Yasmeen, Khawaja Ahmad Irfan Waheed, Rafia Gu(2017)I. Spectrum Of Neonatal Admissions And Their Outcome In A Tertiary Care Hospital, Pak Armed Forces Med J ; 67 (6): 1044-49
20. Osuorah D.; Ekwochi U.; Ndu I.; Nwokoye I.; Ezenwosu O.; Amadi O(2014). Pattern of Morbidity and Mortality of Newborns Admitted into the Sick and Special Care Baby Unit of Enugu State University Teaching Hospital, Enugu State. *Nigerian Journal of Clinical Practice*, 17 (3), 346. Available From: [https:// doi.org/10.4103/1119-3077.130238](https://doi.org/10.4103/1119-3077.130238) PMID: 24714015
21. Ravikumar S.; Harikrishnan E.; Elayaraja K(2018).; K, A. S. K. Morbidity and Mortality Profile of Neonates in a Tertiary Care Centre in Tamil Nadu: A Study from South India. *International Journal of Contemporary Pediatrics*, 5 (2), 377–382.
22. Mmbaga B. T.; Lie R. T.; Olomi R.; Mahande M. J.; Kvale G.; Daltveit A. K(2012). Cause-Specific Neonatal Mortality in a Neonatal Care Unit in Northern Tanzania: A Registry Based Cohort Study. *BMC Pediatrics*, 12 (1), 116. Available From: <https://doi.org/10.1186/1471-2431-12-116>
23. Baghel B, Sahu A, Vishwanadham K(2016). Pattern and Admission and Outcome of Neonates in NICU of Tribal Region Bastar, India. *Int J Med Res Prof* ; 2(6):147-50.
24. Parkash J, Das N(2005). Pattern of admissions to neonatal unit. *J Coll Physicians Surg Pak*. 2005 Jun;15(6):341-4.
25. Ike Elizabeth U, Modupe O, Oyetunde(2015). Pattern of Diseases and Care Outcomes of Neonates Admitted in Special Care Baby Unit of University College Hospital, Ibadan, Nigeria from 2007 To 2011, *IOSR J Nursing Health Science*;4(3): 62-71
26. Hussain S(2014). Neonatal Morbidity and Mortality Pattern in a Tertiary Care Neonatal Unit of a Teaching Hospital. *Ann Pak Inst Med Sci.*;10(1):7-11.

27. Sridhar PV, Thammanna PS, Sandeep M(2015) . Morbidity Pattern and Hospital Outcome of Neonates Admitted in a Tertiary Care Teaching Hospital, Mandya. *Int J Sci Stud* 2015;3(6):126-129
28. Seid SS, Ibro SA, Ahmed AA, Olani Akuma A, Reta EY, Haso TK(2019). Causes and factors associated with neonatal mortality in Neonatal Intensive Care Unit (NICU) of Jimma University Medical Center, Jimma, South West Ethiopia. *Pediatr Health Med Ther.* ;10:39-48
29. Kumar MK, Th akur SN, Singh BB(2012). Study of morbidity and the mortality patterns in NICU at tertiary care teaching hospital in Rohtas district, Bihar, India. *JCDR* ;6:282-5.
30. Shahidulla M, Hassan Z, Jahan I(2017) Perinatal Characteristics and Outcome of Neonates at NICU of a Tertiary Level Hospital in Bangladesh. *BANGLADESH J CHILD HEALTH* ; VOL 41 (1) : 34-39
31. Walana W, Acquash EKS, Abdul MA, NaafuB, Aruk E, Vicar KE(2016) Pattern, causes and treatment outcomes of neonatal admission in the Tamale Teaching Hospital. *Clinics Mother Child Health* ; 13 (4). DOI: 10. 4172/2090- 7214. 1000252
32. Mohamed Omar Osman , Abdikani Mawlid Nur, Tahir Yousuf Nour, Mahamed Hussien Hashi, Abdilahi Abdiselam Osman(2020). Prevalence and Causes of Neonatal Mortality Among Neonates Admitted in Neonatal Intensive Care Unit at Sultan Hassan Yabare Referral Hospital, East Ethiopia. *Science Journal of Clinical Medicine*; 9(1): 11-17 <http://www.sciencepublishinggroup.com/j/sjcm> doi: 10.11648/j.sjcm.20200901.13
33. Onwuanaku, C.A., Okolo, S.N., Ige, K.O., Okpe, S.E. and Toma, B.O. (2011) The Effects of Birth Weight and Gender on Neonatal Mortality in North Central Nigeria. *BMC Research Notes*, 4, 562. <http://dx.doi.org/10.1186/1756-0500-4-562>
34. Manzar N, Manzar B, Yaqoob A, Ahmed M, Kumar J(2012). The study of etiological and demographic characteristics of neonatal mortality and morbidity – A consecutive case series study from Pakistan. *BMC Pediatr*;12:131
35. Muhammad Sallem,Raghib Iqbal, Shahzad Bokhari(2014). Pattern of Neonatal Admissions and its outcome in a tertiary care hospital of Southern Punjab (a 5 years study) *P J M H S VOL. 8 NO.4 OCT – DEC*
36. Saini N, Chhabra S, Chhabra S, Garg L, Garg N(2016). Pattern of neonatal morbidity and mortality: A prospective study in a District Hospital in Urban India. *J Clin Neonatol* ;5:183-8.
37. Agarwal R, Agarwal K, Acharya U, Christina P, Sreenivas V, Seetaraman S(2007). Impact of simple interventions on neonatal mortality in a low-resource teaching hospital in India. *J Perinatol* ;27:44-9.
38. Ali SR, Ahmed S, Lohana H(2013). Disease patterns and outcomes of neonatal admissions at a secondary care hospital in Pakistan. *Sultan Qaboos Univ Med J* ;13:424-8
39. G Tajkia, SK Amin, ME Rahman, M Setu, K Roy, S Haldar(2019) Pattern of Admission and Outcome in a Neonatal Intensive Care Unit (NICU) of a Tertiary Care Hospital in Dhaka, Bangladesh. *AKMMC J*; 10(2) : 150-158
40. Hoque, M., Alam, S., & Ahmed, A. (2014). Pattern of Neonatal Admissions and Outcome in an Intensive Care Unit (ICU) of a Tertiary Care Paediatric Hospital in Bangladesh – A One-Year

Analysis. *Journal of Bangladesh College of Physicians and Surgeons*, 31(3), 134–139.

<https://doi.org/10.3329/jbcps.v31i3.20979>

41. Save the Children (2013). Surviving the first day. State of the worlds mothers. www.savethechildren.org.uk/sites/.../State_of_World_Mothers_2013 Retrieved 20/12/2013
42. Alhassan Abdul-Mumin , Sheila Agyeiwaa Owusu, Abdulai Abubakari (2020). Factors Associated with Treatment Outcome of Preterm Babies at Discharge from the Neonatal Intensive Care Unit (NICU) of the Tamale Teaching Hospital, Ghana. *Hindawi International Journal of Pediatrics* , Article ID 5696427, <https://doi.org/10.1155/2020/5696427>
43. Felicitas Okwako, Winstone Nyahiko, Eren Oyungu (2017). Short term Survival of Premature Infants admitted into the Newborn Unit at Moi Teaching and Referral Hospital Kenya. *East African Medical Journal* Vol: 94 No 10. October
44. Bayana E, Gela D, Gebreyohannis T(2020). Disease Outcome and Associated Factors among Neonates Admitted to Neonatal Intensive Care Unit at Jimma University Medical Center, Jimma, Southwest Ethiopia. *Iranian Journal of Neonatology*. Sep: 11(3). DOI: 10.22038/ijn.2020.44317.1733
45. . Koum D, Essomba N, Odile N, Ngwe I, Ndanga M, Ndombo PK(2015). Factors associated with early neonatal morbidity and mortality in an urban district hospital. *Int J Latest Res Sci Technol*. 2015; 5(3):9-43
46. Titaley, C.R, Dibley, M.J, Agho, K, Roberts, C. L. and Hall, J(2008). Determinants of neonatal mortality in Indonesia. *BMC Public Health* ; 8:232.
47. Javaria Rasheed, Tooba Aleem, Nabila Wakeel, Muhammad Khalid, Fauzia Zafar(2018) Pattern, causes and outcome of neonatal admissions in a Teaching Hospital, Multan, Pakistan *Rawal Medical Journal*: Vol. 43. No. 2, April.-June. 2018
48. Siva Saranappa SB, Madhu GN, Singh R. A(2014) .Study of disease pattern and outcome of newborns admitted to NICU in a tertiary care hospital. *J Evolut Med Dent Sci*. 2014; 3(5):1113-9.
49. Anna Williams, Sabbir Ahmed, Marufa Khan, Sanjida Alam, Joseph Johnson(2018). Introducing Kangaroo Mother Care in Public-Sector Health Facilities in Bangladesh Project Brief MaMoni HSS Project MCHIP USAID SEPT https://pdf.usaid.gov/pdf_docs/PA00TF9F.pdf
50. Md Mozammel Haque , Farzana Hoque Parna, Mirza Farzana Holy, Nazma Parvin Shammy(2020). Implementation and Outcome of Intermittent KMC - Experience at a Secondary Level Hospital in Bangladesh *archiv euromedical* vol.10 num.3 <http://dx.doi.org/10.35630/2199-885X/2020/10/3.16>
51. Queen Dube , Tanya Guenther , Bina Valsangkar , Gedesi Banda(2019) Save the children Kangaroo Mother Care Follow Up Study: Early outcomes among newborns discharged from facility based KMC in Malawi https://resourcecentre.savethechildren.net/pdf/kmc_follow_up_ipa_2019.pdf/
52. Nguah, S.B., Wobil, P.N., Obeng, R. *et al*(2011). Perception and practice of Kangaroo Mother Care after discharge from hospital in Kumasi, Ghana: A longitudinal study. *BMC Pregnancy Childbirth* 11, 99. <https://doi.org/10.1186/1471-2393-11-99>

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