Original Research Article

The pattern of admission and outcome of neonates managed in the neonatal intensive care unit in a Sudanese hospital

Safaa A. M. Ahmed[1], Mohammed A. O. Ali[1]*, Esraa A. A. Mahgoub[2], Mohammed Nimir[3,4], Elfatih M. Malik[5]

[1]Faculty of Medicine, University of Khartoum, Sudan
[2]Department of Community Medicine, Alneelain University, Khartoum, Sudan
[3]Department of Pathology, University Hospitals Coventry and Warwickshire, Coventry, England
[4]Department of Computer Science, University of Warwick, Coventry, England
[5]Department of Community Medicine, Faculty of Medicine, University of Khartoum, Sudan

*Correspondence:
Dr. Mohammed A. O. Ali,
E-mail: Mohawad333@gmail.com

ABSTRACT

Background: This study aimed to assess the admission pattern and outcome of neonates managed in the neonatal intensive care unit (NICU) in a Sudanese hospital.
Methods: This hospital-based retrospective study was conducted in the NICU of Saad Abu Elella Teaching Hospital in Khartoum, Sudan. Data was collected from medical records of 207 neonates using an extraction form. Chi-square test and binary logistic regression were used in analysis.
Results: Most of the neonates were term, and 43% of them had a birth weight less than 2.5 kg. Moreover, the most common morbidities among them were sepsis, respiratory distress syndrome, neonatal jaundice and asphyxia, and the mortality rate was 15%. Additionally, the birth weight, gestational age, the need for resuscitations, direct breast feeding and being beside mother were found to be significantly associated with the studied outcome.
Conclusions: Majority of causes of neonatal morbidity and mortality in our study were preventable diseases. Therefore, interventions to improve services in the NICU are highly needed to improve the outcomes.

Keywords: Neonates, Neonatal intensive care unit, Sudan, Neonatal mortality, Neonatal morbidity

INTRODUCTION

Neonatal period encompasses the first 28 days of life.[1,2] It is an extremely dangerous period of the child's life due to the numerous diseases that they can contract, and the risk of dying in developing countries is highest during this time. Worldwide, of deaths in children in 2018, 85% occurred in the first five years of life, amounting to 5.3 million deaths, of which 2.5 million (47%) occurred in the first month of life.[3] Globally in 2018, in children under 15, the first month of life harboured the highest risk of dying, with the neonatal mortality rate (NMR) being at an average

of 18 deaths/1000 live births. In contrast, the likelihood of dying after the neonatal period and before 1 year of age was 11 deaths/1000 live births, between 1-5 years was 10 deaths/1,000 and between 5-15 was 7 deaths/1,000 live births.

Neonatal intensive care units (NICU) are specialise in treatment of acutely unwell neonates and the care for babies who need specialised care, like prematurely-born children.[4] The NICU has specialised healthcare staff and equipment, like incubators, so that specialised care can be delivered.

Internationally, the majority of all neonatal deaths (75%) occur during the first week of life, and about 1 million neonates die within the first 24 hours.[5] The most common causes of neonatal deaths in 2019 were infections, prematurity, birth defects and intrapartum-related complications (birth asphyxia or lack of breathing at birth).

Neonates are facing disparities in survival chances depending on where they were born. 33% of the world's neonatal mortality burden was from Africa. In this continent, about 75% of deaths happened in the 7 days of life, almost half of those occurred within the first day. The Sub-Saharan Africa region was noted to have the highest NMR in 2017 at 27 deaths/1000 live births.[6,7]

Globally, the major causes of neonatal deaths in the NICU include birth before 37 weeks gestation (28%), infections (26%), and asphyxia (23%).[8] A study conducted in Sudan showed that the majority of neonatal admissions were due to low birth weight (25.4%), followed by neonatal sepsis (24.8%).[9]

Over the last 20 years, significant progress has been made globally in reducing childhood mortality.[6] Worldwide, the NMR fell by 51% from 37 in 1990 to 18 deaths/1000 live births in 2017. Despite the big reduction in NMR, this change is not as significant in comparison to the decrease in mortality rate of children aged 1–5 years (63%).

Knowing causes of admission to the NICU and the causes of mortality along with the mortality rate can help to direct the efforts to reduce neonatal mortality and morbidity. The aim of this study was to assess the admission pattern and outcome of neonates managed in the NICU at Saad Abu Elella Teaching Hospital in Khartoum, Sudan, 2018.

METHODS

Study design and setting

This is a hospital-based retrospective study conducted in the NICU of Saad Abu Elella Teaching Hospital, which specializes in obstetrics and gynaecology in Khartoum State, Sudan. The NICU provides service for inborn babies with almost 30 beds, 20 incubators, and 10 phototherapy units. The admission rate is 3-5 neonates/day. The NICU has facilities including radiant warmer; mechanical ventilation; and laboratory tests (e.g. haematological, biochemical, and body fluid analyses), but lacks facilities for blood gas analyses and computed tomography (CT) scan. The service in NICU is provided through nurses, intern doctors, paediatric resident doctors, and paediatric specialists and consultants.

Study population

The study covered all the neonates who were admitted to the NICU in the period from 01 January 2018 to 31 October 2018 and who aged under 28 days. Neonates with incomplete data, admitted for observation, or who were discharged in <24 hours of admission were excluded. A total of 207 neonates fulfilled our selection criteria were involved in the study.

Data collection

Data was collected from medical records over a period of 2 months from September 2018 to November 2018 using an extraction form. The form consists of three sections; the first section is about the characteristics of neonates including the new-born's sex, age at admission, birth weight, the duration of stay in the NICU, obstetric history, and postnatal history. The second section is about patterns of admission to the NICU; which include admission diagnosis and complications occurred during admission. The third one is about the primary outcome of admission which is either discharge or death.

Statistical analysis

The data were entered, screened and analysed using statistical package for social sciences (SPSS) software version 23. Continuous data were presented as medians and interquartile ranges (IQR), while the categorical data presented as frequencies and percentages.

Tables and graphs were used to present the data. Chi-square test and binary logistic regression were used to determine the relationship between the dependent and independent variables. The significant level was set to be 0.05.

Ethical consideration

Ethical approval was obtained from the community medicine department at Faculty of Medicine, University of Khartoum. Also, it was approved by the research unit of Khartoum Ministry of Health and Saad Abu Elella Teaching Hospital administration.

RESULTS

Demographic and participant information

A total of 207 neonates were included in this study. Males represented 51.7% (n=105) of the admitted neonates. Overall, 129 (62.9%) were term born at gestation age of ≥37 weeks, and 139 (67.5%) of neonates admitted to NICU within less than 24 hours from birth. Additionally, 117 (56.8%) neonates had a birth weight of 2500 gram and above, 64 (31.1%) being low birth weight (1500-2499 gram), 21 (10.1%) with very low birth weights (1000-499 gram), and 1.9% (n=4) were having extremely low birth weight (<999 gram). Moreover, 69 (33.3%) of neonates were admitted to the NICU for a period of 4 to 7 days. The median for gestational age is 37 weeks with an IQR of 4 weeks, and the median for birth weight was 2600 gm with an IQR of 1100 gram. Further demographic characteristics are depicted in Table 1.

Table 1: Demographic characteristics of neonates in the study.

Variable	N (valid %)
Gender	
Female	98 (48.3)
Male	105 (51.7)
Age at admission (day)	
<1	139 (67.5)
1	42 (20.4)
>1	25 (12.1)
Gestational age (in weeks)	
<30	14 (6.8)
30-36	62 (30.2)
>37	129 (63)
Birth weight (in grams)	
Extreme low birth weight (≤999)	4 (1.9)
Very low birth weight (1000-1499)	21 (10.2)
Low birth weight (1500-2499)	64 (31.1)
2500 and above	117 (56.8)
Duration of stay in NICU (in days)	
>3	61 (29.5)
4-7	69 (33.3)
8-30	66 (31.9)
>30	11 (5.3)
Premature rupture of membrane (PROM)	
Yes	69 (33.5)
No	137 (66.5)
Mode of delivery	
Normal vaginal delivery	69 (34.2)
Assisted vaginal delivery	6 (3.0)
Elective caesarean section	21 (10.5)
Emergency caesarean section	106 (52.5)
Prolonged labour	
Yes	33 (16.2)
No	171 (83.8)
Multiple birth	
Yes	11 (5.3)
No	196 (94.7)
Resuscitation	
Yes	63 (30.7)
No	142 (69.3)
Direct breast feeding (DBF)	
Yes	148 (71.5)
No	59 (28.5)
Beside mother	
Yes	106 (51.2)
No	101 (48.8)

Validity is less than 100%.

Diagnosis and complications at admission

The most common diagnosis at admission was neonatal sepsis (28.6%), followed by respiratory distress syndrome (23.3%) and then neonatal jaundice which represents 13.6% (Figure 1).
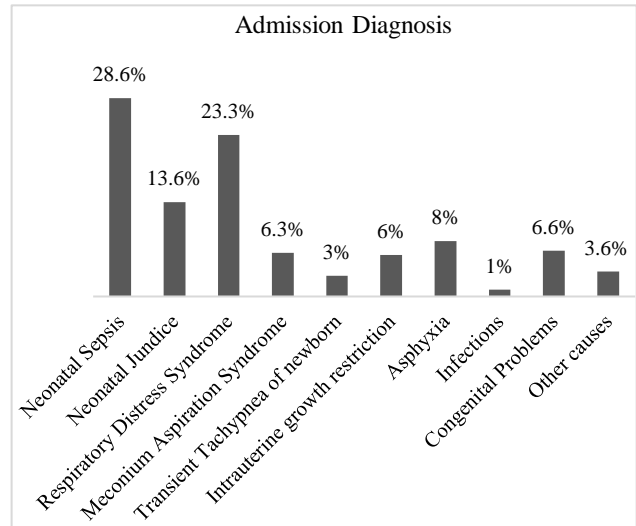

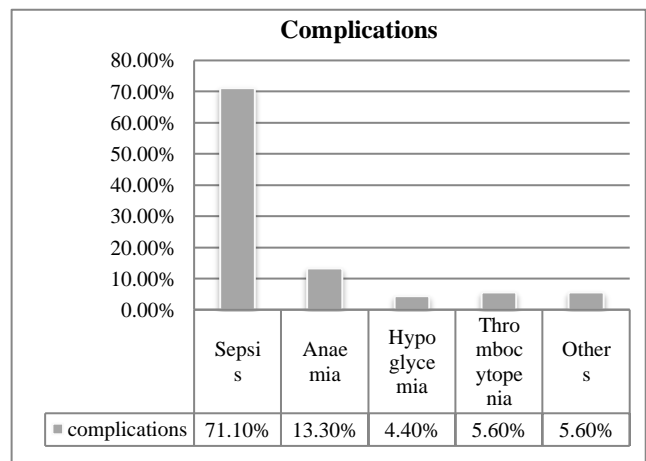**Figure 1: Diagnoses among neonates admitted to the NICU.**

Figure 2: Complications among neonates managed in the NICU.

Complications after admission were reported in 39.1% of neonates, with neonatal sepsis being the most frequent complication at 71.1% (Figure 2).

Outcomes and associations

The majority of the study participants (85%) were discharged healthy and 15% of them died. Chi-square test was used to assess the association between the outcome and demographic characteristics. Birth weight, gestational age, the need for resuscitations, direct breast feeding and being beside mother were found to be significantly associated with the outcome (discharge or death) (Table 2). Plotting the diagnosis at admission against the outcome, neonatal jaundice, asphyxia, and respiratory distress syndrome were found to be significantly associated with the outcome (Table 3).

Table 2: Association between demographic characteristics and final outcomes of neonates.

Variable	Final outcome		X^2	P value
	Discharge	Death		
Gender				
Female	83	15	0.0	1.0
Male	89	16		
Age at admission (days)				
<1	119	20		
1	36	5	0.546	0.761
>1	20	25		
Gestational age (in weeks)				
<30	5	9		
30-36	50	12	32	0.001*
>37	119	10		
Birth weight (in grams)				
Extreme low birth weight (<999)	1	3		
Very low birth weight (1000-1499)	12	9	27.8	0.001*
Low birth weight (1500-2499)	55	9		
Weight of 2500 and above	107	10		
Duration of stay in NICU (in days)				
>3	47	14		
4-7	60	9	7.4	0.06
8-30	61	5		
>30	8	3		
*Premature rupture of membranes (PROM)				
Yes	63	6	3.3	0.070
No	112	25		
Mode of delivery				
Normal vaginal delivery	64	5		
Assisted vaginal delivery	5	1	6.6	0.087
Elective cesarean section	19	2		
Emergency cesarean section	84	22		
Prolonged labor				
Yes	27	6	0.272	0.6
No	146	25		
Multiple birth				
Yes	10	1	0.316	0.57
No	166	30		
Resuscitation				
Yes	48	15	6.1	0.013*
No	127	15		
Direct breast feeding (DBF)				
Yes	140	8	37.3	0.001*
No	36	23		
Beside mother				
Yes	99	7	11.9	0.001*
No	77	24		

*Statistically significant association; validity is less than 100%

Table 3: Association between diagnosis at admission and final outcomes of neonates.

Variable	Final outcome		X^2	P value
	Discharge	Death		
Neonatal sepsis (NNS)				
Yes	76	10	1.3	0.255
No	100	21		

Continued.

Variable	Final outcome		X^2	P value
	Discharge	Death		
Neonatal jaundice (NNJ)				
Yes	40	1	6.31	0.012*
No	136	30		
Respiratory distress syndrome (RDS)				
Yes	50	20	15.2	0.001*
No	125	11		
Meconium aspiration syndrome				
Yes	17	2	0.33	0.57
No	159	29		
Transient tachypnea of newborn				
Yes	8	1	0.11	0.74
No	168	30		
Intra uterine growth retardation (IUGR)				
Yes	13	5	2.5	0.11
No	163	26		
Asphyxia				
Yes	17	7	4.3	0.04*
No	159	24		
Other infections £				
Yes	3	0	0.54	0.47
No	173	31		
Congenital malformations				
Yes	15	5	1.8	0.19
No	161	26		
Other reasons ⱡ				
Yes	11	0	2.0	0.153
No	165	31		

*Statistically significant association; £other infections: like UTI and pneumonia; ⱡother reasons: like polythycemia, bleeding tendency, and metabolic diseases; validity is less than 100%

Table 4: Binary logistic regression.

Variable	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I for exp (B)	
							Lower	Upper
Resuscitation	-0.531	0.559	0.901	1	0.343	0.588	0.197	1.760
Direct breast feeding	2.060	0.628	10.756	1	0.001*	7.842	2.290	26.853
Beside mother	-0.210	0.642	0.106	1	0.744	0.811	0.230	2.855
Neonatal jaundice	1.859	1.219	2.326	1	0.127	6.414	0.589	69.885
Respiratory distress syndrome	-1.043	0.538	3.762	1	0.052	0.352	0.123	1.011
Asphyxia	-1.689	0.763	4.904	1	0.027*	0.185	0.041	0.824
Gestational age	2.388	1.138	4.403	1	0.036*	10.887	1.171	101.253
Birth weight	0.297	0.657	0.204	1	0.651	1.345	0.371	4.873
Constant	-2.662	1.399	3.621	1	0.057	0.070		

*Statistically significant association

Logistic regression

In order to isolate the confounding factors, and to know which factor could predict the outcome, we analysed all the associated factors in Table 2 and 3 using a binary logistic regression model. This analysis showed that gestational age group of (30-36 week) (odds ratio [OR]=10.88; 95% CI: 1.171–101.253), having direct breast feeding (OR=7.84; 95% CI: 2.290–26.853), and diagnosis with asphyxia (OR=0.18; 95% CI: 0.041–0.824)

are the only factors that proved to be independently associated with the final outcomes of NICU management (Table 4).

DISCUSSION

This is a hospital based retrospective study aimed to demonstrate the pattern of admission and outcomes of neonates managed in the NICU at Saad Abu Elella Teaching Hospital. Around one third of the neonates in this

study were preterm and 43% of them had a birth weight less than 2.5 kg. Moreover, sepsis, respiratory distress syndrome, neonatal jaundice and asphyxia were the most common diagnoses among the admitted neonates. The mortality rate among them was 15% (n=31).

Sample characteristics

Males represent around 52% of the admitted neonates in our study, a result to some extent consistent with several studies conducted in developing countries which documented a male dominance among the neonates admitted to NICU in Pakistan, India, Iran and Ethiopia.[4,10-16] The male predominance may be attributed to complicated cultural and social factors that reflected in family's preference to male more than female babies, therefore, giving them more attention.[15] Additionally, it was proposed by Seboka et al that male neonates may be more vulnerable during the neonatal period, compared to female babies.[16] Additionally, 37% of neonates in our study were preterm. Higher percentages of preterm babies were revealed in studies conducted in Jorden and Ghana, where half of the neonates admitted to the NICU were preterm.[17,18] However, studies in south east Ethiopia and northwest Ethiopia reported percentages of preterm neonatal admission to be 27.9% and 34.8%, respectively.[15,19]

In our study, 43% of neonates had a birth weight less than 2500 gram, a result similar to that documented by Ali et al in Pakistan.[11] Lower proportions were documented in Nigeria, Ethiopia and South Sudan, where 35-37.7% of neonates weighed <2500 gram.[4,15,20,21] Conversely, higher number of suboptimal birth weight was reported in different studies. Two studies in Iran revealed percentages of 76.5% and 63% of neonates under study weighted less than 2.5 kg, likewise, in two studies in Pakistan they presented 53.8% and 64.4% of neonates and in India the proportions were 61%, 72% and 76% in three studies.[10,12,14,22-25]

Neonatal morbidity

The most common causes of admission in our study were neonatal sepsis, respiratory distress syndrome, neonatal jaundice and asphyxia, which is in agreement with studies in developing countries. The fact these diagnoses are the most common diseases affecting neonates in developing countries reflects the deficiency of appropriate interventions needed during pregnancy, during delivery, and after delivery.[26]

Despite being a preventable disease, neonatal sepsis continues to be a major health problem in developing countries. The World Health Organization reported its annual death rate to be 1 million neonates.[27] A meta-analysis showed a pooled prevalence of neonatal sepsis in developing countries to be 29.92%.[28] Likewise, our study revealed that neonatal sepsis is the most common diagnosis at admission affecting 28.6% of neonates. A

similar results were reported in studies in Kharian Cantonment, Pakistan, Mandya, India and south west Ethiopia.[12,13,19] However, lower percentages of neonatal sepsis were reported in Islamabad, Pakistan, Kano and Enugu state in Nigeria, Haryana, Bohal, Telangana and Andhra Pradesh and Maharashtra in India, Addis Ababa in Ethiopia and Tehran in Iran.[10,22-26,29-31] On the contrary, higher percentages compared to our result were pointed out by a number of studies, for example; studies conducted in different parts of Ethiopia reported that sepsis is the most common cause of admission to the NICU and it represented 40.5%, 67.9% and 78.4% of admission diagnosis in eastern Ethiopia, northwest Ethiopia and Adama respectively.[4,15,16] Moreover, a study in south Sudan, showed that sepsis is the leading cause of admission with a 63.7% morbidity rate, and another study in Benin city in Nigeria reported sepsis to be the causes of admission of 38.6% (n=??) of neonates in study.[20,21] The difference in the prevalence of sepsis even within the same country can be attributed to the difference in the characteristics of the studied population and the quality of health care provided by each institute. Therefore, health care workers should be trained to be able to diagnose, manage and refer the cases properly and timely, and to adopt the simple procedures that are known to reduce the risk of nosocomial infection including hand washing, isolation of infected neonates and early home discharge.[27,29]

The second cause of admission in our study was respiratory distress syndrome, which presented 23.3% of admission diagnoses, a result similar to that reported by Sridhar et al study in Mandya, India.[13] On the one Hand, studies in Jordan and Iran considered RDS as the most common cause of admission being the main diagnosis in around 66% and 91.2% of neonates, respectively.[14,17,22] On the other hand, Shirazi et al study conducted in Pakistan reported that it is responsible for 19.4% of morbidities.[10] In contrast, in Ethiopia and south Sudan respiratory distress in general was the cause of admission of only 8% of neonates.[16,20]

Our third cause of admission was neonatal jaundice, which represented 13.6% of admission diagnosis. Comparatively, Verma et al reported neonatal hyperbilirubinemia in 13% of the neonates.[23] In contrast, higher proportions were reported in India and lower percentages were reported in Pakistan, Ethiopia and Nigeria. Generally, it was estimated that 10% of newborn babies are expected to develop jaundice that need clinical treatment.[10,11,21,24,26,30-32] Bilirubin-induced mortality was among the top causes of death in the ten countries with the highest mortality rates globally.[32] In contrast to the other cause of morbidities, most of the neonatal jaundice is unpreventable. Therefore, the main aim of intervention is to prevent its complications.[32]

The fourth, and last, cause of admission was asphyxia representing 8% of the admitted neonates. Far lower percentages were reported in eastern Ethiopia and south

Sudan where birth asphyxia was seen in 2.1% and 4.7% of neonates, respectively.[4,20] In contrast, in Maharashtra, India it was the most common indication for NICU admission at (42.46%) also it represented around one third of the diagnosis in Nigeria.[24,29,30] These high percentage can be attributed to lack of proper antenatal care, home delivery, or poor maternal nutritional status.[11] Moreover, studies in Islamabad, Pakistan, Ethiopia, Sudan and different parts of India, reported a range of 19 to 10% of morbidities due to birth asphyxia.[9-13,23,25,26,31] The relatively low percentage in our study may indicate that mothers in our study had good antenatal service also the doctors and nurses are able to provide a proper resuscitation for neonates.

Neonatal mortality

Unfortunately, 31 of the neonates in our study died, giving a mortality rate of 15%. Likewise, Girma et al in south northwest Ethiopia, Ekwochi et al in Nigeria and Thomson et al in south Sudan all reported neonatal mortality rate of around 14%.[15,20,30] Alternatively, a higher rate was documented by Pal et al research in which 36.6% of the neonates in the study died.[25] Furthermore, around one fifth of new-borns died in studies in Ethiopia, Ghana, Benin, Nigeria, Iran and Islamabad, Pakistan.[10,18,21,22,26,33] Moreover, studies in northern Nigeria and Kharian cantonment, Pakistan the overall mortality rate was around 17%.[12,29] By way of contrast, some studies had a lower morality rate than the present study. In southwest Ethiopia, Iran as well as India the overall neonatal death rate was between 11-12%.[19,23,24,34] Even lower mortality rates (ranging from 4-9%) were reported in Ethiopia, Telangana and Andhra Pradesh and Mandya, India, Hyderabad, Pakistan, Tabriz, Iran, Jordan and Australia.[4,11,13,14,16,17,31] The difference in case fatality can be explained by numerous factors including; the difference and distribution of morbidities in each study population, the difference in the socioeconomic status of each country, the number and the distribution of the qualified health care providers and medical equipment in different facilities and the level and the quality of care provided by the health institutions especially the obstetrics and neonatal care facilities.[18,19,23,26] For instance, study in Ethiopia attributed the death due to the neonatal respiratory distress to the lack of treatment modalities likes administration of surfactant and mechanical ventilation.[16] It was also documented that the healthcare facilities that provide a high level of neonatal intensive care services had a lower mortality rate compared to other facilities with lower care.[18]

The most frequent diagnosis registered in dead neonates in our study was respiratory distress syndrome followed by neonatal sepsis, in consistent with the causes of mortality reported in a number of developing countries. In Ethiopia the major cause of death in neonates was sepsis followed by respiratory distress.[4,16,33] In India, the most common causes of mortality were prematurity associated with RDS, followed by sepsis and birth asphyxia.[13,23,25] In addition, in Iran, RDS was the most common cause of neonatal death with or without malformation or sepsis.[14,22] Moreover, in Nigeria and South Sudan, neonatal sepsis was the leading cause of mortality.[20,21] On the contrary, congenital anomalies were the main cause of neonatal death in Tabriz, Iran, Australia and Israel and prematurity was the main cause in Telangana and Andhra Pradesh India, Pakistan, Ethiopia, Iran and Wad-Madani, Sudan whereas asphyxia was the main cause in Nigeria and in Northern Ethiopia.[9,11,14,26,30,31,34-37]

Factors associated with neonatal outcome

In the present study, a significant association was found between the neonatal outcome and birth weight, gestational age, the need for resuscitation and direct breast feeding. Likewise, Seid et al and Ml et al showed an association between neonatal mortality and gestational ages, and birth weight.[19] Also, Sridhar et al reported an association between birth weight less than 1500 g and higher mortality rates.[13] Alternatively, we found no association between outcome and gender, age at admission, duration of admission, mode of delivery, prolonged labour and multiple birth. In the same way, studies in India, Ghana and Iran showed no significant difference in neonatal death between males and females.[14,18,24] However, studies in Ethiopia reported a significant association between mortality and length of hospital stay.[4,19]

For further understanding, logistic regression in our study showed that the predictors of outcome in the present study were gestational age group of (30-36 week) (OR=10.88), having direct breast feeding (OR=7.84), and diagnosis with asphyxia (OR=0.18). Similarly, Girma et al and Tekleab et al identified asphyxia as a predictors of mortality.[15,26] In addition, Seid et al documented that prematurity, asphyxia, low birth weight, RDS and congenital malformations were predictors of new-borns' death.[19]

Generalization of the study results is difficult as it involved only one hospital data and does not involve any community data. Also, the use of secondary data and the study focus on neonatal factors only can be considered as a limitation in this study. Having studied only these factors highlight the need for further studies to identify the maternal and institutional factors that can affect the neonatal health outcome.

Notwithstanding these limitations, our study demonstrated an important fact that most of the causes of neonatal morbidity and mortality were preventable diseases, hence, emphasizing the importance of adopting interventions that were proven to improve neonatal intensive care services.

CONCLUSION

Majority of causes of neonatal morbidity and mortality in our study were preventable diseases. Therefore, interventions to improve services in the NICU are highly needed to improve the outcomes.

REFERENCES

1. Roberts I. Nelson's textbook of pediatrics (20th edn.), by R. Kliegman, B. Stanton, J. St. Geme, N. Schor (eds). Pediatr Radiol. 2017;47(10):1364-5.
2. Lawn JE, Cousens S, Zupan J, Team LNSS. 4 million neonatal deaths: when? Where? Why? Lancet. 2005;365(9462):891-900.
3. Estimation UNIG for CM, Hug L, Sharrow D, Danzehn Y, Hereward M, Zhang Y. Levels & trends in child mortality : report 2019 : estimates developed by the. 2019; Available at: https://www.unicef.org/reports/levels-and-trends-child-mortality-report-2019. Accessed on: 24 January 2021.
4. Ml S, Oumer A, Mt I. Assessment of Reason for Admission and Factors Associated with their Treatment outcome of Neonates in Dil Chora Referral Hospital, Eastern, Ethiopia: Institutional Based Cross-Sectional Record Review . J Neona Stud. 2018;1(1):103.
5. World Health Organization. World health statistics 2020: monitoring health for the SDGs, sustainable development goals. Geneva: World Health Organization. 2020. Available at: https://apps.who.int/iris/handle/10665/332070. Accessed on: 24 January 2021.
6. Hug L, Alexander M, You D, Alkema L. National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario-based projections to 2030: a systematic analysis. LANGLO Lancet Glob Heal. 2019;7(6):710-20.
7. Elhassan EM, Hassanb AA, Mirghani OA, Adam I, Estimation UNIG for CM, Hug L, et al. The health of the people : what works : the African regional health report 2014. J Neonatal Stud 1 103 Abstr Keywords Neonatal Admiss. 2019;5(10):710-20.
8. Feng Y. Causes of death in neonatal intensive care units. Aust Med Student J. 2011;41-3.
9. Elhassan E, Hassanb A, Mirghani O, Adam I. Morbidity and Mortality Pattern of Neonates Admitted into Nursery Unit in Wad Medani Hospital, Sudan. Sudan J Med Sci. 2010;5(1):1-5.
10. Shirazi H, Riaz S, Mahmood RA. Morbidity and Mortality Pattern of Newly Born Babies in a Teaching Hospital. 2015;19(3):204-8.
11. Ali SR, Ahmed S, Lohana H. Disease patterns and outcomes of neonatal admissions at a secondary care hospital in Pakistan. Sultan Qaboos Univ Med J. 2013;13(3):418-21.
12. Hussain S. Neonatal Morbidity and Mortality Pattern in a Tertiary Care Neonatal Unit of a Teaching Hospital. Ann Pak Inst Med Sci. 2014;10(1):7-11.
13. Sridhar PV, Thammanna PS, Sandeep M. Morbidity Pattern and Hospital Outcome of Neonates Admitted in a Tertiary Care Teaching Hospital , Mandya. 2015;3(6):3-6.
14. Zeinalzadeh AH, Khodaei R, Heidarzadeh M, Mirnia K. Causes of neonatal mortality in the neonatal intensive care unit of taleghani hospital. Iran J Neonatol. 2017;8(3):58-61.
15. Girma A, Fentahun D, Mahlet A, Gizaw A, Tigabu Z. Medicine and Therapeutics. Pediatr Health. 2017;57-64.
16. Seboka J, Aberab AM, Rebituc AD. Pattern of Admission and Outcome of Neonate Admitted to Adama Hospital Medical College Neonatal Intensive Care Unit, Adama, Ethiopia. Int J Sci Basic Appl Res. 2018;42(1).
17. Quinn C, Sivasubramaniam P, Blevins M, Hajajra A, Taleb A, Khuri-Bulos N, et al. Risk factors for neonatal intensive care unit admission in Amman, Jordan. East Mediterr Heal J. 2016;22(3):163-74.
18. Sackey AH, Tagoe LG. Admissions and mortality over a 5-year period in a limited-resource neonatal unit in Ghana. Ghana Med J. 2019;53(2):117-25.
19. Seid SS, Ibro SA, Ahmed AA, Olani Akuma A, Reta EY, Haso TK, et al. 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. 2019;10:39-48.
20. Thomson J, Schaefer M, Caminoa B, Kahindi D, Hurtado N. Improved neonatal mortality at a district hospital in Aweil, South Sudan. J Trop Pediatr. 2017;63(3):189-95.
21. Omoigberale AI, Sadoh WE, Nwaneri DU. A 4 year review of neonatal outcome at the University of Benin Teaching Hospital, Benin City. Niger J Clin Pract. 2010;13(3):321-5.
22. Afrasiabi N, Mohagheghi P, Kalani M, Mohades G, Farahani Z. The effect of high risk pregnancy on duration of neonatal stay in neonatal intensive care unit. Iran J Pediatr. 2014;24(4):423-8.
23. Verma J, Anand S, Kapoor N, Gedam S, Patel U. Neonatal outcome in new-borns admitted in NICU of tertiary care hospital in central India : a 5-year study. 2018;5(4):1364-7.
24. Zurmure DHADS. Morbidity & Mortality Profile of Neonates Admitted in Neonatal Intensive Care Unit of District Hospital in Gadchiroli, Maharashtra: A Prospective Observational Study. Int J Sci Res. 2018;7(6):567-71.
25. Pal A, Batra S, Kaur J. A study of neonatal admission pattern and outcome from rural Haryana Original Research Paper Paediatrics A Study Of Neonatal Admission Pattern And Outcome From Rural Haryana. Glob J Res Anal. 2018;7:73-5.
26. Tekleab AM, Amaru GM, Tefera YA. Reasons for admission and neonatal outcome in the neonatal care unit of a tertiary care hospital in Addis Ababa: a prospective study. Res Reports Neonatol. 2016;17.
27. Shining a spotlight on maternal and neonatal sepsis: World Sepsis Day 2017. 2017. Available at: https://www.who.int/reproductivehealth/topics/mate

rnal_perinatal/world-sepsis-day/en/ Accessed on: 24 December 2020.

28. Amare D, Mela M, Dessie G. Unfinished agenda of the neonates in developing countries: magnitude of neonatal sepsis: systematic review and meta-analysis. Heliyon. 2019;5(9):e02519.

29. Mukhtar-yola M, Iliyasu Z. A reviewof neonatal morbidity and mortality in Aminu KanoTeaching Hospital, northern Nigeria. Trop Doct. 2007;37(3):130-2.

30. Ekwochi U, Ndu IK, Nwokoye IC, Ezenwosu OU, Amadi OF, Osuorah DIC. Pattern of morbidity and mortality of newborns admitted into the sick and special care baby unit of Enugu State University Teaching Hospital, Enugu state. Niger J Clin Pract. 2014;17(3):346-51.

31. Hanson C, Singh S, Zamboni K, Tyagi M, Chamarty S, Shukla R, et al. Care practices and neonatal survival in 52 neonatal intensive care units in Telangana and Andhra Pradesh, India: A cross-sectional study. PLoS Med. 2019;16(7):1-20.

32. Olusanya BO, Kaplan M, Hansen TWR. Neonatal hyperbilirubinaemia: a global perspective. Lancet Child Adolesc Heal. 2018;2(8):610-20.

33. Osman MO, Nur AM, Nour TY, Hashi MH. Prevalence and Causes of Neonatal Mortality Among Neonates Admitted in Neonatal Intensive Care Unit at Sultan Hassan Yabare Referral Hospital, East Ethiopia 2019. 2020;9(1):11-7.

34. Karimi P, Mahmudi L, Azami M, Badfar G. Mortality in neonatal intensive care units in Iran: A systematic review and meta-analysis. Iran J Neonatol. 2019;10(3):70-80.

35. Feng Y, Abdel-latif ME, Bajuk B, Lui K, Oei JL, Intensive N. Causes of death in infants admitted to Australian neonatal intensive care units between 1995 and 2006. 2013;17-23.

36. Eventov-friedman AS. Neonatal End-of-Life Care : A Single-Center NICU Experience in Israel Over a Decade. 2015;131(6).

37. Mengesha HG, Sahle BW. Cause of neonatal deaths in Northern Ethiopia : a prospective cohort study. BMC Public Health. 2017;1-8.