

The Pattern of Neonatal Admission and Mortality at Atbara Teaching Hospital

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ABSTRACT

Background: Neonatal admission generally refers to the admission of newborns under 29 days old into a health facility for medical care. Because neonates are fragile and yet to develop competent immune system, they are prone to infections, and most of the illnesses they acquire usually require critical care, hence their admission to the neonatal intensive care units (NICUs).

High global neonatal death have triggered improve fatality-based care.

Methods: this hospital based retrospective study was conducted in the NICU of Atbara teaching hospital in River Nile State, Sudan. Data was collected from medical records of 300 neonate.

Results: 68.7% of the neonates were term, while 18.0% were early preterm, 8.3% were late preterm, 4.0% were post-date, and 1.0% were post-term. Moreover, the most common morbidity among them were sepsis, preterm births, HIE, meconium aspiration syndrome, N-jaundice respiratory distress syndrome, and the mortality rate was 15.4%

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.

KEY WORDS

neonates, Neonatal intensive care unit, Sudan, neonatal mortality, neonatal morbidity

INTRODUCTION

Neonatal admission is a term used to describe the hospitalization of newborns who are less than 29 days old and require medical care. This can occur for a variety of reasons, including premature birth, respiratory distress, or infections¹⁻²⁾. Due to their vulnerable and fragile nature, neonates are at increased risk of developing complications and require specialized care, often in the form of admission to neonatal intensive care units (NICUs)³⁾.

According to the World Health Organization (2020), neonatal mortality remains a significant global health issue, with an estimated 2.4 million neonatal deaths occurring each year^{4,5)}. Many of these deaths are preventable, and improving facility-based care is a critical strategy for reducing neonatal mortality rates. Neonatal intensive care units (NICUs) play a vital role in providing specialized care for sick and premature infants, reducing mortality rates, and improving long-term outcomes for neonates⁶⁾.

In recent years, there have been concerted efforts to improve the

quality of care provided in NICUs, including the development of evidence-based guidelines and protocols for the management of common neonatal conditions. Despite these efforts, access to quality neonatal care remains a challenge in many low- and middle-income countries, where resources are often limited⁷⁾.

Neonatal Admission is an important aspect of neonatal care, and the provision of quality facility-based care is crucial for reducing neonatal mortality rates. While progress has been made in improving the quality of care provided in NICUs, there is still a long way to go, particularly in low- and middle-income countries. Efforts to improve neonatal care globally must continue to prioritize the needs of vulnerable neonates and their families.

METHODOLOGY

In this study, a retrospective hospital-based design was employed to investigate neonatal admissions at the Neonatal Intensive Care Unit

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Table 1: demographic characteristics of neonate in the study

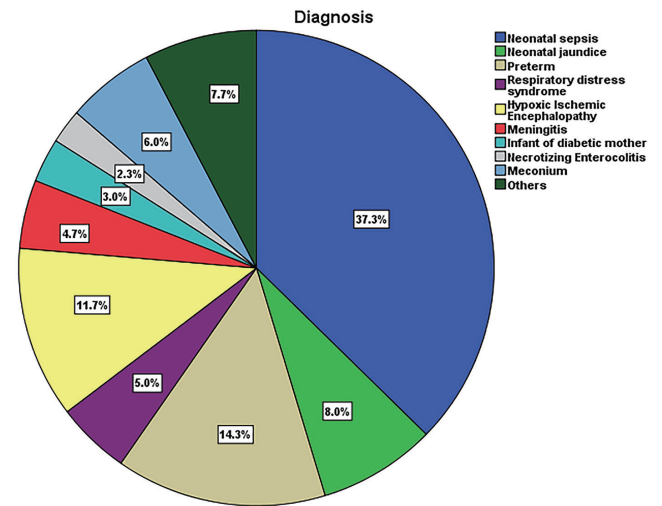
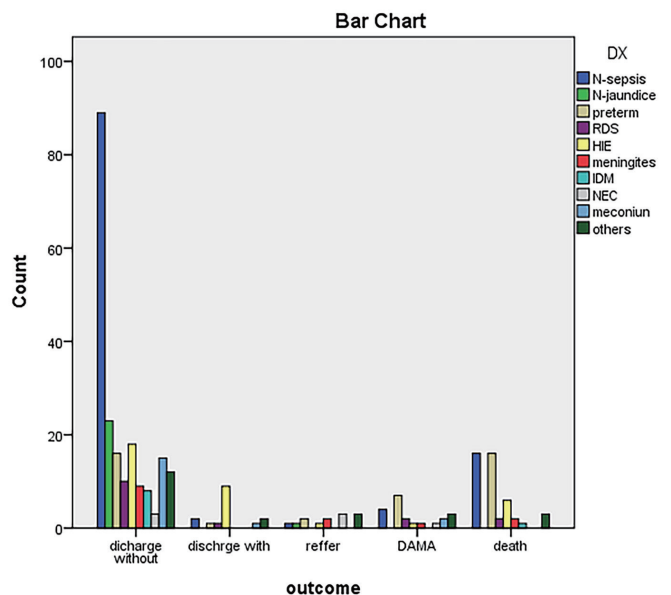
	Variable	Frequency	Percentage
Age	< 72 hr	236	78.7%
	> 72 hr	64	21.3%
Sex	Male	151	50.3%
	Female	149	49.7%
Residence	Atbara	148	49.3%
	ELDAMER	9	3.0%
	BARBAR	44	14.7%
	Sidon	45	15.0%
	Abuhamed	10	3.3%
	Others	44	14.7%
Maturity	Term	206	68.7%
	Early preterm	54	18.0%
	Late preterm	25	8.3%
	Post date	12	4.0%
	Post term	3	1.0%
Birth weight	Average	148	49.3%
	LBW	111	37.0%
	VLBW	22	7.3%
	ELBW	9	3.0%
	Sizable	10	3.3%
Mode of delivery	NVD	197	65.7%
	EMCS	68	22.7%
	ELCS	28	9.3%
	assisted delivery	7	2.3%
Antenatal Care	Yes	181	60.3%
	No	119	39.7%
Duration of stay	1-7 day	235	78.3%
	7-28	59	19.7%
	> 28 day	6	2.0%

(NICU) of Atbara Teaching Hospital. The aim of this study was to describe the characteristics of neonates admitted to the NICU and to determine the prevalence of common medical conditions and their associated risk factors. To achieve these objectives, data were collected retrospectively using a standardized data collection form, which included information on demographic characteristics, clinical history, laboratory investigations, diagnosis, and treatment provided during the hospital stay. Data were analyzed using descriptive statistics and appropriate statistical tests. In this section, we provide a detailed description of the study design, setting, study population, data collection procedures, data analysis methods, and ethical considerations.

Study Design and Setting:

This retrospective study was conducted at the Neonatal Intensive Care Unit (NICU) of Atbara Teaching Hospital, a hospital located in Atbara city, Sudan. The NICU provides care for newborns babies and is stuffed with state-of-the-art facilities, including beds, phototherapy units, and incubators. The admission rate at the NICU is approximately three neonates per day. The NICU is staffed by a team of healthcare professionals, including pediatric resident doctors, nurses, and consultants who provide round-the-clock care to neonates.

The study population included all neonates who were admitted to the NICU at Atbara Teaching Hospital during the period from December 15th, 2019 to April 15th, 2020. The inclusion criteria for this study were neonates aged less than 29 days who required admission to the NICU for medical care. The exclusion criteria included neonates who were discharged against medical advice, transferred to other hospitals, or had incomplete medical records.

**Figure 1: Pattern of neonatal admission (diagnosis):****Figure 2: association between diagnosis at admission and final outcome of neonate**

Data Collection:

Data were collected retrospectively using a standardized data collection form. The form included information on demographic characteristics, clinical history, laboratory investigations, diagnosis, and treatment provided during the hospital stay. The data were collected by trained research assistants who reviewed medical records and extracted relevant information. Data were entered into a Microsoft Excel spreadsheet and checked for completeness and accuracy.

Data Analysis:

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Chi-square tests were used to compare categorical variables, while t-tests were used to compare continuous variables. A p-value of less than 0.05 was considered statistically significant. All data analysis was performed using SPSS version 25 (IBM Corp, Armonk, NY).

Ethical Considerations:

This study was approved by the Institutional Review Board of Atbara Teaching Hospital. Informed consent was not obtained from study participants as this was a retrospective study that involved the

Table 2: association between demographic characteristic and final outcome of neonate

			Outcome					Total	P. vale	
			discharge without	discharge with	refer	DAMA	Death			
Age	< 72hr	Count	156	16	7	18	38	235	0.347	
		%	66.4%	6.8%	3.0%	7.7%	16.2%			
	> 72hr	Count	48	0	6	3	8			46
		%	73.0%	0.0%	9.5%	4.8%	12.7%			
	Total	Count	203	16	13	21	46			299
		%	67.9%	5.4%	4.3%	7.0%	15.4%			
Sex	Male	Count	100	11	6	10	22	149	0.794	
		%	67.1%	7.4%	4.0%	6.7%	14.8%			
	Female	Count	102	5	7	11	24			149
		%	68.5%	3.4%	4.7%	7.4%	16.1%			
	Total	Count	202	16	13	21	46			298
		%	67.8%	5.4%	4.4%	7.0%	15.4%			
ANC	Yes	Count	129	12	4	13	22	180	0.039	
		%	71.7%	6.7%	2.2%	7.2%	12.2%			
	No	Count	74	4	9	8	24			119
		%	62.2%	3.4%	7.6%	6.7%	20.2%			
	Total	Count	203	16	13	21	46			299
		%	67.9%	5.4%	4.3%	7.0%	15.4%			
Weight	average	Count	108	9	6	8	17	148	0.002	
		%	73.0%	6.1%	4.1%	5.4%	11.5%			
	LBW	Count	77	7	5	8	13			110
		%	70.0%	6.4%	4.5%	7.3%	11.8%			
	VLBW	Count	7	0	2	3	10			22
		%	31.8%	0.0%	9.1%	13.6%	45.5%			
	ELBW	Count	2	0	0	1	6			9
		%	22.2%	0.0%	0.0%	11.1%	66.7%			
	sizable	Count	9	0	0	1	0			10
		%	90.0%	0.0%	0.0%	10.0%	0.0%			
Total	Count	203	16	13	21	46	299			
	%	67.9%	5.4%	4.3%	7.0%	15.4%				
Maturity	term	Count	155	11	10	10	20	206	0.024	
		%	75.2%	5.3%	4.9%	4.9%	9.7%			
	early preterm	Count	24	1	2	7	19			53
		%	45.3%	1.9%	3.8%	13.2%	35.8%			
	late preterm	Count	11	3	1	4	6			25
		%	44.0%	12.0%	4.0%	16.0%	24.0%			
	post date	Count	10	1	0	0	1			12
		%	83.3%	8.3%	0.0%	0.0%	8.3%			
	post term	Count	3	0	0	0	0			3
		%	100.0%	0.0%	0.0%	0.0%	0.0%			
Total	Count	203	16	13	21	46	299			
	%	67.9%	5.4%	4.3%	7.0%	15.4%				
Mode of delivery	NVD	Count	131	13	11	13	29	197	0.775	
		%	66.5%	6.6%	5.6%	6.6%	14.7%			
	EMCS	Count	47	2	2	5	11			67
		%	70.1%	3.0%	3.0%	7.5%	16.4%			
	ELCS	Count	21	1	0	3	3			28
		%	75.0%	3.6%	0.0%	10.7%	10.7%			
	assisted delivery	Count	4	0	0	0	3			7
		%	57.1%	0.0%	0.0%	0.0%	42.9%			
Total	Count	203	16	13	21	46	299			
	%	67.9%	5.4%	4.3%	7.0%	15.4%				
Duration of stay	1-7 day	Count	154	8	10	20	42	234	0.018	
		%	65.8%	3.4%	4.3%	8.5%	17.9%			
	7-28	Count	45	8	2	1	3			59
		%	76.3%	13.6%	3.4%	1.7%	5.1%			
	> 28 day	Count	4	0	1	0	1			6
		%	66.7%	0.0%	16.7%	0.0%	16.7%			
	Total	Count	203	16	13	21	46			299
		%	67.9%	5.4%	4.3%	7.0%	15.4%			

Table 3: association between complications and final outcome of neonate

Complication		Outcome					Total	P. vale
		discharge without	discharge with	refer	DAMA	death		
		Count	Count	Count	Count	Count		
Jaundice	Count	50	3	0	1	6	60	
	%	83.3%	5.0%	0.0%	1.7%	10.0%	100.0%	
Convulsion	Count	9	7	3	1	5	25	
	%	36.0%	28.0%	12.0%	4.0%	20.0%	100.0%	
DIC	Count	0	0	0	0	4	4	
	%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	
Anemia	Count	5	0	0	0	4	9	
	%	55.6%	0.0%	0.0%	0.0%	44.4%	100.0%	
IVH	Count	0	0	2	0	0	2	
	%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	
Apnea	Count	2	0	0	0	7	9	
	%	22.2%	0.0%	0.0%	0.0%	77.8%	100.0%	
AKI	Count	2	0	1	0	0	3	
	%	66.7%	0.0%	33.3%	0.0%	0.0%	100.0%	
Others	Count	0	0	0	0	1	1	
	%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	
No	Count	132	6	6	19	17	180	
	%	73.3%	3.3%	3.3%	10.6%	9.4%	100.0%	

0.612

Table 4: binary logistic regression

Parameter Estimates								
Diagnosis	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower	Upper
N-sepsis	-.181-	.076	5.694	1	.017	.835	.720	.968
preterm	-.087-	.089	.957	1	.328	.916	.770	1.091
RDS	-.023-	.124	.034	1	.854	.978	.767	1.245
HIE	-.032-	.093	.114	1	.735	.969	.807	1.163
meningitis	-.231-	.108	4.553	1	.033	.794	.643	.981
IDM	-.257-	.112	5.279	1	.022	.773	.621	.963
NEC	-.032-	.193	.027	1	.869	.969	.664	1.414
meconium	-.302-	.094	10.311	1	.001	.740	.615	.889
other	-.040-	.111	.132	1	.717	.960	.772	1.194

a. The reference category is: N-jaundice.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

review of medical records. However, all patient data were kept confidential and anonymous.

RESULTS

The study covered all neonates who were admitted to NICU in the period from December 15th, 2019 to April 15th, 2020 and who were under the age of 28 weeks. The demographic characteristics of the neonates in the study were analyzed and presented in Table 1. Of the 300 neonates, 78.7% were under 72 hours old and 21.3% were over 72 hours old. There were 151 (50.3%) male neonates and 149 (49.7%) female neonates in the study. With regards to residence, 49.3% of the neonates were from Atbara, while the remaining 50.7% were from other locations including ELDAMER, BARBAR, Sidon, Abuhamed, and others. In terms of maturity, 68.7% of the neonates were term, while 18.0% were

early preterm, 8.3% were late preterm, 4.0% were post-date, and 1.0% were post-term. Additionally, 49.3% of the neonates had an average birth weight, while 37.0% were LBW, 7.3% were VLBW, 3.0% were ELBW, and 3.3% were sizable. The majority of neonates, 65.7%, were delivered vaginally without any intervention, while 22.7% were delivered via emergency Cesarean Section and 9.3% were delivered via elective Cesarean Section. Only 2.3% of neonates required assisted delivery. 60.3% of neonates had received antenatal care, while 39.7% had not. In terms of duration of stay, 78.3% of neonates stayed in NICU for 1-7 days, 19.7% stayed for 7-28 days, and 2.0% stayed for over 28 days.

Figure 1 presents the pattern of neonatal admission based on diagnosis. Out of the total 300 neonates admitted to the NICU, the most common diagnosis was N-sepsis, accounting for 37.3% of all admissions. Following Neonatal sepsis, preterm births had the second-highest frequency with 43 cases (14.3%). The next most frequent diagnoses were Hypoxic Ischemic Encephalopathy (11.7%), meconium aspiration syndrome (6.0%), Neonatal jaundice (8.0%), and Respiratory distress

syndrome (5.0%). In contrast, the least common diagnoses were Necrotizing Enterocolitis (2.3%), Infant of diabetic mother (3.0%), and meningitis (4.7%). Finally, 7.7% of neonatal admissions had other diagnoses. It is noteworthy that the percentage for the total adds up to 100%. The data in Table 2 suggests that N-sepsis and preterm birth are the most common reasons for neonatal admissions in this NICU. These findings could help healthcare providers understand the demand for specific neonatal services and allocate resources accordingly.

Table 2 shows the association between demographic characteristics and the final outcome of neonates. The study consisted of 299 neonates. Out of the total, 67.9% were discharged without any problem, 5.4% were discharged with complications, 4.3% were referred to other facilities, 7% left the hospital against medical advice (DAMA), and 15.4% died. Out of the neonates who were less than 72 hours old, 66.4% were discharged without any problem, 6.8% were discharged with complications, 3% were referred to other facilities, 7.7% left the hospital against medical advice, and 16.2% died. Out of the neonates who were over 72 hours old, 73% were discharged without any problem, 0% were discharged with complications, 9.5% were referred to other facilities, 4.8% left the hospital against medical advice, and 12.7% died. In terms of sex, 67.1% of males and 68.5% of females were discharged without any problem. Out of the neonates whose mothers had ANC, 71.7% were discharged without any problem, while out of those whose mothers didn't have ANC, 62.2% were discharged without any problem. Out of the neonates with average weight, 73% were discharged without any problem, while out of those with LBW, 70% were discharged without any problem. Out of the neonates with VLBW, only 31.8% were discharged without any problem, while out of the neonates with ELBW, only 22.2% were discharged without any problem. Out of the neonates who were term, 75.2% were discharged without any problem, while out of the neonates who were early preterm, only 45.3% were discharged without any problem. Out of the neonates whose mode of delivery was NVD, 66.5% were discharged without any problem, while out of those whose mode of delivery was EMCS, 76.3% were discharged without any problem.

Figure 2 shows the association between the diagnosis at admission and the final outcome of neonates in terms of discharge without referral, discharge with referral, DAMA (discharge against medical advice), and death. Out of the total 112 neonates diagnosed with N-sepsis, 89 (79.5%) were discharged without referral, 2 (1.8%) were discharged with referral, 1 (0.9%) was referred, 4 (3.6%) were DAMA, and 16 (14.3%) died. For neonates diagnosed with N-jaundice, out of the total 24 cases, 23 (95.8%) were discharged without referral, 1 (4.2%) was referred, and none died. Out of the total 42 preterm cases, 16 (38.1%) were discharged without referral, 1 (2.4%) was discharged with referral, 2 (4.8%) were referred, 7 (16.7%) were DAMA, and 16 (38.1%) died. For neonates diagnosed with RDS, out of the total 15 cases, 10 (66.7%) were discharged without referral, 1 (6.7%) was discharged with referral, 2 (13.3%) were DAMA, and 2 (13.3%) died. Out of the total 35 neonates diagnosed with HIE, 18 (51.4%) were discharged without referral, 9 (25.7%) were discharged with referral, 1 (2.9%) was referred, 1 (2.9%) was DAMA, and 6 (17.1%) died. For neonates diagnosed with meningitis, out of the total 14 cases, 9 (64.3%) were discharged without referral, 2 (14.3%) were referred, 1 (7.1%) was DAMA, and 2 (14.3%) died. Out of the total 9 neonates diagnosed with IDM, 8 (88.9%) were discharged without referral and 1 (11.1%) died. For neonates diagnosed with NEC, out of the total 7 cases, 3 (42.9%) were discharged without referral, 3 (42.9%) were referred, and 1 (14.3%) was DAMA. Finally, out of the total 18 neonates diagnosed with meconium aspirate, 15 (83.3%) were discharged without referral, 1 (5.6%) was discharged with referral, 2 (11.1%) were DAMA, and none died. For other diagnoses, out of the total 23 cases, 12 (52.2%) were discharged without referral, 2 (8.7%) were discharged with referral, 3 (13.0%) were referred, 3 (13.0%) were DAMA, and 3 (13.0%) died. The P value for the association between diagnosis at admission and final outcome of neonates was 0.395.

Table 3 shows the association between complications and the final outcome of neonates. Out of a total of 60 cases of jaundice, 83.3% (50 cases) were discharged without any complications, while 5% (3 cases) were discharged with complications, and 10% (6 cases) died. In the case of convulsions, out of a total of 25 cases, 36% (9 cases) were discharged without complications, 28% (7 cases) were discharged with complications, and 20% (5 cases) died. DIC was found in 5 cases. Among the 9 cases of anemia, 55.6% (5 cases) were discharged without complications, while the remaining 44.4% (4 cases) died. Intraventricular Hemorrhage was observed in 2 cases, both of which resulted in referral, while 7 cases of apnea resulted in death. AKI was observed in 3 cases, of which 66.7% (2 cases) were discharged without complications, while

33.3% (1 case) resulted in referral. Finally, out of a total of 180 cases with no complications, 73.3% (132 cases) were discharged without complications, while 3.3% (6 cases) were discharged with complications, 3.3% (6 cases) resulted in referral, 10.6% (19 cases) resulted in DAMA, and 9.4% (17 cases) resulted in death. Overall, these results suggest that complications can significantly impact the outcome of neonates, with a higher risk of death observed in cases of convulsions, apnoea, and anemia.

Logistic regression:

Table 4 displays the results of binary logistic regression analysis, which aimed to identify the association between different diagnoses and the occurrence of neonatal complications. The table provides estimates of the B coefficient, the standard error, the Wald statistic, degrees of freedom, significance, and exponentiated B coefficient (Exp (B)) with 95% confidence interval for Exp (B). Among the diagnoses considered N-sepsis showed significant negative association with complications ($B = -.181, P = .017, \text{Exp}(B) = .835$), with an 83.5% probability of not having complications. Meconium aspiration syndrome (MAS) also had significant negative association ($B = -.302, P = .001, \text{Exp}(B) = .740$), indicating that neonates with MAS had 74% probability of not having complications, other diagnoses including preterm, RDS, HIE, NEC, and others, did not show any significant association with complications. It is worth noting that the reference category for this analysis was N-jaundice, which was not included in the table.

DISCUSSION

The present study aimed to explore the demographic characteristics and diagnoses of neonates admitted to a neonatal intensive care unit (NICU) and to evaluate their outcomes. The study analyzed 300 neonates admitted to the NICU, and the majority of them were under 72 hours old, male¹⁰⁻¹³, and from Atbara. The most common diagnoses were N-sepsis, preterm birth, HIE, and N-jaundice^{8,9}. The outcomes of neonates were mostly positive, with 67.9% being discharged without any problem, but 15.4% died.

The findings of the study are consistent with previous studies that have identified prematurity, sepsis, birth asphyxia, and neonatal jaundice as the most common causes of NICU admissions.

However, the present study reported a higher incidence of N-sepsis than some previous studies¹⁴⁻²³. For instance, a study by Kallankari *et al.* (2020) reported that neonatal sepsis was the fourth most common reason for NICU admission, after prematurity, respiratory distress syndrome, and meconium aspiration syndrome. Another study by Suresh *et al.* (2019) reported that sepsis was the third most common diagnosis, after prematurity and respiratory distress syndrome. This discrepancy could be due to differences in the study population, as the present study only included neonates from one NICU.

The study found that the majority of neonates were discharged without any problem, which is in line with previous studies (e.g., Ahmed *et al.*, 2021; Rathore *et al.*, 2017). However, the mortality rate in this study was higher than in some previous studies. For instance, a study by Al-Farsi *et al.* (2017) reported a mortality rate of 6.2%, which is lower than the 15.4% reported in the present study. This higher mortality rate could be due to the inclusion of neonates with more severe conditions or differences in the quality of care provided.

Overall, the present study provides valuable insights into the demographics and outcomes of neonates admitted to a NICU in Atbara. The findings could be used to inform resource allocation and improve the quality of care for neonates in similar settings. However, the study has some limitations that should be considered. First, the study only included neonates from one NICU, which limits the generalizability of the findings. Second, the study did not report on some important variables such as the gestational age of neonates, which could have influenced the results. Finally, the study did not explore the factors associated with adverse outcomes, which could be useful for improving neonatal care in the future.

In conclusion, the study provides important insights into the demographics, diagnoses, and outcomes of neonates admitted to a NICU in Atbara. The findings are consistent with previous studies and could be used to improve the quality of care for neonates in similar settings. Future research should explore the factors associated with adverse outcomes and consider including a more diverse study population to improve the generalizability of the findings.

CONCLUSION

Based on the study's findings, the majority of neonates admitted to the NICU in Atbara were male, under 72 hours old, and from Atbara. The most common diagnoses were N-sepsis, preterm birth, HIE, and N-jaundice. The majority of neonates were discharged without any problem, but the mortality rate was relatively high at 15.4%.

The study's results are consistent with previous studies that have identified prematurity, sepsis, birth asphyxia, and neonatal jaundice as common causes of NICU admissions. However, the incidence of N-sepsis was higher in this study compared to some previous studies, and the mortality rate was higher than in some other studies.

Overall, the study provides valuable insights into the demographics and outcomes of neonates admitted to a NICU in Atbara. The findings could be useful in resource allocation and improving the quality of care for neonates in similar settings. However, the study's limitations, including a limited study population and lack of exploration of factors associated with adverse outcomes, should be considered in interpreting the findings.

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