

Patterns and outcomes of Emergency Pediatric Unit admissions in Usmanu Danfodiyo University Teaching Hospital in Sokoto State, Nigeria: a five-year review

Khadijat O. Isezuo,¹ Usman M. Sani,¹ Usman M. Waziri,¹ Bilkisu I. Garba,¹ Asma'u Adamu,¹ Fatima B. Jiya,¹ Baba Jibrin,¹ Idayat A. Adeyemo,¹ Maryam S. Amodu-Sanni,¹ Modupe O. Ugege,¹ Shamsudeen Umar,² Abubakar B. Gusau²

¹Department of Paediatrics, Usmanu Danfodiyo University Teaching Hospital, Sokoto; ²Department of Nursing Services, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

Correspondence: Khadijat Omenke Isezuo, Department of Paediatrics, Usmanu Danfodiyo University Teaching Hospital, PMB 2370, Sokoto, Nigeria.
Tel. +2348036785003.
E-mail: khadisez@yahoo.com

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Abstract

Children are susceptible to illnesses that often require urgent medical attention, with attendant high mortality rates, especially in resource-constrained settings. Periodic audits in tertiary care facilities can guide preventive and therapeutic policies. The aim was to determine the admissions pattern and outcome over five years in the Emergency Paediatric Unit (EPU) of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, a major tertiary facility in North Western Nigeria. This was a retrospective study between January 2017 and December 2021. The admission records of children aged >1 month to 15 years were retrieved, relevant information extracted, and entered into a study proforma. Data was analyzed using SPSS version 23. There were 6088 admissions. Under-fives constituted 4448 (73.1%), and males were 3558 (58.4%). The median age was 24.0 months (Interquartile Range, IQR, 12, 60). Top admissions were severe malaria (1100; 18.1%), acute diarrhoeal disease (631; 10.4%), Sickle Cell Disease (SCD) (624; 10.2%), pneumonia (547; 9.0%), Severe Acute Malnutrition (SAM) (438; 7.2%), febrile convulsions (421; 6.9%), pharyngotonsillitis (402; 6.6%) and sepsis (398; 6.5%). Total discharges were 2483 (40.8%), 2635 (43.3%) were transferred, and mortalities were 679 (11.2%). Case fatality rates of the top admissions were sepsis (19.6%), SAM (19.4%), severe malaria (13.7%), pneumonia (10.6%), febrile convulsions (5.0%), acute diarrhoeal disease (4.9%), pharyngotonsillitis (2.5%) and SCD (2.1%). SCD was the most common non-infectious morbidity and responsible for most re-admissions. Malaria was the top cause of mortality in all age groups except infancy, where sepsis and pneumonia predominated. In conclusion, malaria and other infectious diseases accounted for most admissions. Non-communicable diseases, like SCD, also constitute significant morbidity. Hence, policymakers need to scale up targeted preventive measures.

Introduction

The most common causes of childhood morbidity and mortality in Africa are infectious and communicable diseases, of which the majority are largely preventable.¹ Apart from this high burden of infectious diseases, non-communicable diseases also have a high prevalence, constituting a double burden of diseases and increased overall morbidity and mortality.² There is a general decline in progress in reducing under-five mortality globally, which slowed in the first half of the Sustainable Development Goals era compared to what was achieved in the Millennium Development Goals era. The annual rate of reduction dropped

from 3.8% to 2.1%.³ Nigeria is the second highest contributor to under-five mortality worldwide, with figures of 110.8 per 1000, closely following the neighboring Niger Republic.⁴

The Emergency Pediatric Unit (EPU) is a critical aspect of the health care facility where manpower, facilities, and prompt, decisive actions are harnessed to save lives and ameliorate toxic disease processes, especially in young, vulnerable children. As children are susceptible to illnesses that often require urgent medical attention with attendant high mortality rates, periodic audits in the EPU of tertiary care facilities can guide preventive and therapeutic policies, which also benefit the whole health system.⁵ Tertiary health facilities, being the pinnacle of the referral system in the health care system, receive a widespread number of cases in any region where they are situated and, therefore, represent valuable data sources on the childhood morbidity and mortality pattern in a community or region, even though many are seen in primary and secondary health facilities. Also, some do not present to the hospitals but receive home therapies and may even die at home.⁶

Commonly documented preventable diseases in pediatric emergencies from other regions in Nigeria are infectious diseases, usually topped by malaria, pneumonia, and diarrheal disease. However, other non-communicable and inheritable diseases are also becoming more prevalent.⁷⁻¹² A study done in Gusau, North-West Nigeria,¹³ over a year, revealed the top causes of childhood mortality to be malaria, pneumonia, and gastroenteritis. However, the trend over a longer duration may be more reflective and informative on the causes of morbidity and mortality in children. The 2021 Multiple Indicator Cluster Survey (MICS) revealed Sokoto State to have the highest under-five mortality amongst other States in Nigeria, with 202 per 1000 live births.¹⁴ In the 2018 NDHS, Sokoto was found to have a high burden of malnutrition, which has a vicious cycle with other infectious diseases, in addition to the lowest vaccination coverage.¹⁵

This study was therefore carried out to determine the pattern and outcome of admissions in the EPU of UDUTH, Sokoto, a major tertiary health facility in Northwestern Nigeria, giving the worrisome statistics of childhood morbidity and mortality reported to have more insight into the specific causes and outcomes in the referral facility.

Materials and Methods

Study area

Sokoto State is located in the dry Sahel region and is surrounded by sandy Savannah. Sokoto town lies between latitude 10° and 14°N and longitude 3°31' and 7°71' east of the Equator,¹⁶ with an average annual temperature of 28.3°C, which rises as high as 45°C during the hottest months. The rainy season is short and begins late in May till September.¹⁶ There is intense malaria transmission throughout the year, with peaks during the rainy season.¹⁷ The state's inhabitants are mainly Hausa and Fulani, but many other ethnic groups also live there. A cross-section of all socioeconomic classes resides in the town. Agriculture, petty trading, and craftsmanship are the main occupations of the people in the state.

The study was carried out at the EPU of UDUTH, Sokoto, which is a tertiary health facility and serves as a referral center for more than 10 million people of Sokoto, Zamfara, and Kebbi states, as well as the neighboring states of Niger and Benin Republics in the West African sub-region.¹⁸ Being an accredited tertiary training facility, house officers (interns), resident doctors in training, and supervising consultants of different specialties are available in the department. The EPU is a 25-bed facility with an average of 6-

8 admissions daily. Patients are admitted via an emergency room to ensure doctors concentrate on the critical cases before they are stabilized and transferred to the main EPU.

Study design and subjects

This was a retrospective review of five-year records (1st January 2017 to 31st December 2021)

The study comprised all children aged one month to 15 years admitted into the EPU with acute/acute on-chronic clinical conditions warranting emergency care. Excluded were cases that did not have full documentation of their diagnosis after review and resuscitation. The records of those who satisfied the eligibility criteria were recruited.

Procedure of recruitment

The daily admission record in the unit is constantly updated manually by the nurses on duty while the health information officer handles the register daily. The records for the five years were retrieved, and relevant information was extracted. These include socio-demographic characteristics (age, gender), admission and final diagnosis, duration of admission, and outcome. Age was categorized using standard pediatric age group classification into neonates ≤ 28 days, infants – one month to one year, toddlers – one to three years, preschool – four/five years, school-age – 6-12 years, and adolescents > 12 years. The initial diagnosis on admission was changed in some cases due to the progression of illness or the availability of results. The diagnosis was classified according to the affected organ system clinically under the sub-groupings in the ICD-10 manual.¹⁹ Duration of admission was captured, and the outcome was categorized into 'discharged,' 'mortality,' 'discharged against medical advice, and 'transferred out.' On admission, relevant medications and other necessary supportive care were provided as required.

Data entry and analysis

All relevant data were entered into an electronic spreadsheet via ODK and then transferred into IBM Statistical Package for Social Sciences (SPSS) software version 23 for analysis. Quantitative data were expressed as means and standard deviation, while categorical variables were expressed as proportions. Chi-square or, where necessary, Fisher's Exact test was used to test for statistical significance. A p-value of < 0.05 was considered statistically significant.

Ethical approval

Approval for the study was obtained from the Ethics and Research Committee of the UDUTH, Sokoto.

Results

Age and gender distribution of admitted children

Total number of admissions was 6088. Infants aged > 1 month to 12 months were 1776 (29.2%), and toddlers aged > 1 year to 3 years were 1968 (32.3%), and accounted for almost 2/3 of total admissions (61.5%). Total under-fives were 4448 (73.1%), while adolescents above 12 years constituted 341 (5.6%). Males were 3558 (58.4%) and constituted the greater proportion of all the age groups, and this was statistically significant. The data was not normally distributed by age using the Kolmogorov-Smirnov test ($p < 0.05$). Median age was 24.0 months (IQR-12, 72). These findings are detailed in Table 1.

Yearly trend of admissions and mortalities

Figure 1 shows the highest number of admissions per year in 2019 (1406; 23.1%), followed by 2017 (1247; 20.5%). The lowest admissions were in 2018 (1110; 18.2%) and 2020 (1116; 18.3%). The secondary axis shows the highest number of deaths in 2019 and 2020 (despite the low number of admissions in 2020).

Monthly trend of admissions and mortalities

Figure 2 shows the cumulative monthly admissions for the 5-year period. They were highest in the rainy months of August (631; 10.4%), September (666; 10.9%) and October (659; 10.8%). The number was lowest in May (388; 6.4%) and June (386; 6.3%). The secondary axis shows the number of deaths was highest in April and October.

Case distribution by diagnoses

Table 2 shows the top admissions were; severe malaria (1100;18.1%), acute diarrheal disease (631; 10.4%), SCD (624; 10.2%), pneumonia (547;9.0%), SAM (438;7.2%), febrile convulsions (421;6.9%), pharyngotonsillitis (402;6.6%) sepsis (398;6.5%), meningitis (175; 2.9%) and urinary tract infection (152; 2.5%). The top ten causes of admissions constituted 80.3% (4888 out of 6088) of the total admissions.

Age distribution of cases

Acute diarrheal disease, pneumonia, sepsis, severe malaria, and pharyngotonsillitis were the top diagnoses by proportion among infants. Among toddlers, severe malaria, febrile convulsions, and SAM predominated. Severe malaria, sickle cell disease, and febrile convulsions were top among pre-schoolers. Severe malaria, sickle cell disease, urinary tract infection, and enteric fever were higher in school-aged children. Those above 12 years had more sickle cell disease, severe malaria, and sepsis as the top three diagnoses (Table 3).

Gender distribution of cases

Males accounted for a higher proportion of most conditions than females. For some infections, like bronchiolitis, tetanus, and pertussis, males accounted for up to 70% of the proportion compared to females. For some non-communicable conditions, males also accounted for a higher proportion, such as snake bites, malignancies, neurological sequelae, upper airway obstruction, and bleeding diatheses (Table 2). Those more common in females were acute flaccid paralysis, including Guillain-Barré syndrome, diphtheria, peptic ulcer disease, and congenital heart disease, while tuberculosis and acquired heart disease had equal gender proportions.

Outcome of admissions

Table 4 shows total discharges were 2483 (40.8%), 2635 (43.3%) were transferred to the wards, and mortalities were 679 (11.2%). Case Fatality Rates (CFR) of the top admissions were sepsis (19.6%), SAM (19.4%), severe malaria (13.7%), pneumonia (10.6%), febrile convulsions (5.0%), acute diarrheal disease (4.9%), pharyngotonsillitis (2.5%) & SCD (2.1%). The highest case fatality rates were from hemorrhagic fever (100%), hypertensive emergencies (80%), diphtheria (75%), tetanus (48.6%), and chronic kidney disease (42.9%).

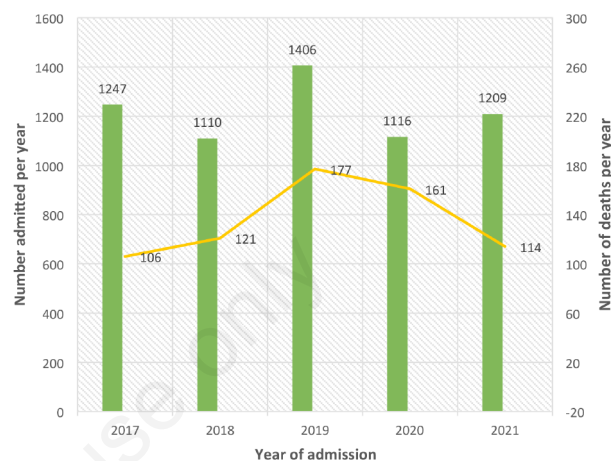


Figure 1. Number of admissions and mortalities per year (2017-2021).

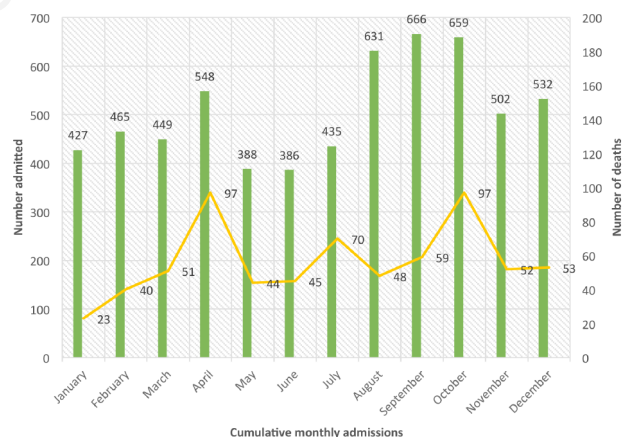


Figure 2. Cumulative monthly admissions and mortality (2017-2021).

Table 1. Age and gender distribution of admitted children.

| | Gender | | Total |
|------------------|--|-------------|--------------|
| | Male | Female | |
| Age range | | | |
| 1 month - 1 year | 1030 (58.0) | 746 (42.0) | 1776 (29.2) |
| 1.1-3 years | 1193 (60.6) | 775 (39.4) | 1968 (32.3) |
| 3.1-5 years | 421 (59.8) | 283 (40.2) | 704 (11.6) |
| 5.1-12 years | 705 (54.3) | 594 (45.7) | 1299 (21.3) |
| >12 years | 209 (61.3) | 132 (38.7) | 341 (5.6) |
| | 3558 (58.4) | 2530 (41.6) | 6088 (100.0) |
| Mean age | (x ² =15.0, p=0.005) 24.0 months (IQR=12,72) | | |

Table 2. Distribution of cases by gender.

| Diagnoses | Male (%) | Female (%) | Total (%) |
|---|-------------|-------------|-------------|
| Severe malaria | 649 (59.0) | 451 (41.0) | 1100 (18.1) |
| Acute diarrheal disease | 379 (60.1) | 252 (39.9) | 631 (10.4) |
| Sickle Cell Disease | 336 (53.8) | 288 (46.2) | 624 (10.2) |
| Pneumonia | 312 (57.0) | 225 (43.0) | 547 (9.0) |
| Severe acute malnutrition & failure to thrive | 243 (55.5) | 195 (44.5) | 438 (7.2) |
| Febrile convulsions* | 287 (68.2) | 134 (31.8) | 421 (6.9) |
| Pharyngotonsillitis | 229 (57.0) | 173 (43.0) | 402 (6.6) |
| Sepsis | 220 (55.3) | 178 (44.7) | 398 (6.5) |
| Meningitis | 112 (64.0) | 63 (36.0) | 175 (2.9) |
| Urinary Tract Infection | 90 (59.2) | 62 (40.8) | 145 (2.4) |
| Uncomplicated malaria | 69 (53.5) | 60 (46.5) | 129 (2.4) |
| Heart failure# | 60 (62.5) | 36 (37.5) | 96 (1.6) |
| Measles | 56 (62.9) | 33 (37.1) | 89 (1.4) |
| Bronchiolitis | 59 (72.8) | 22 (27.2) | 81 (1.3) |
| Enteric fever/typhoid fever | 38 (55.1) | 31 (44.9) | 69 (1.1) |
| Congenital heart disease | 25 (42.4) | 34 (57.6) | 59 (1.0) |
| Afebrile seizures/seizure disorder | 27 (48.2) | 29 (51.8) | 56 (0.9) |
| Acute glomerulonephritis | 21 (45.7) | 25 (54.3) | 46 (0.8) |
| Severe anemia | 26 (57.8) | 19 (42.2) | 45 (0.7) |
| Acute kidney injury | 21 (51.2) | 20 (48.8) | 41 (0.7) |
| Food poisoning | 28 (57.1) | 21 (42.9) | 49 (0.7) |
| Tetanus | 27 (77.1) | 8 (22.9) | 35 (0.6) |
| Tuberculosis | 17 (50.0) | 17 (50.0) | 34 (0.6) |
| Acquired heart disease | 15 (50.0) | 15 (50.0) | 30 (0.5) |
| Nephrotic syndrome | 21 (70.0) | 9 (30.0) | 30 (0.5) |
| Bone, joint & soft tissue infections | 20 (51.3) | 19 (48.7) | 39 (0.5) |
| Malignancies | 21 (80.8) | 5 (19.2) | 26 (0.4) |
| Acute asthma attack/acute severe asthma | 13 (52.0) | 12 (48.0) | 25 (0.4) |
| Accidents & poisoning | 14 (60.9) | 09 (39.1) | 23 (0.4) |
| Retroviral disease | 12 (60.0) | 8 (40.0) | 20 (0.3) |
| Intussusception & intestinal obstruction | 11 (57.9) | 8 (42.1) | 19 (0.3) |
| Diabetic ketoacidosis | 11 (64.7) | 6 (35.3) | 17 (0.3) |
| Diphtheria & pertussis | 7 (41.2) | 10 (58.8) | 17 (0.3) |
| Peptic ulcer disease | 7 (43.8) | 9 (56.2) | 16 (0.3) |
| Neurological sequelae & cerebral palsy | 13 (92.8) | 1 (7.2) | 14 (0.2) |
| Upper airway obstruction | 9 (75.0) | 3 (25.0) | 12 (0.2) |
| Snake bite | 8 (72.7) | 3 (27.3) | 11 (0.2) |
| Others | 15 (55.6) | 12 (44.4) | 27 (0.4) |
| Bleeding diatheses | 9 (90.0) | 1 (10.0) | 10 (0.2) |
| Hepatitis & Chronic Liver Disease | 6 (60.0) | 4 (40.0) | 10 (0.2) |
| Acute flaccid paralysis (Poliomyelitis & GBS) | 2 (22.2) | 7 (77.8) | 9 (0.15) |
| Skin diseases including infections | 5 (55.6) | 4 (44.4) | 9 (0.3) |
| Chronic Kidney Disease | 4 (57.1) | 3 (42.9) | 7 (0.1) |
| Hypertensive emergencies | 3 (60.0) | 2 (40.0) | 5 (0.08) |
| Covid infection | 2 (66.7) | 1 (33.3) | 3 (0.05) |
| Rabies & dog bite | 2 (100.0) | 0 (0.0) | 2 (0.03) |
| Viral hemorrhagic fever | 2 (100.0) | 0 (0.0) | 2 (0.03) |
| Total | 3558 (58.4) | 2530 (41.6) | 6088 (100) |

*Febrile convulsions causes: malaria, acute pharyngitis, Urinary Tract Infection (UTI), diarrheal disease. #Heart failure causes: congenital heart disease, rheumatic heart disease, anemia, pneumonia, sepsis. GBS, Guillaine-Barré Syndrome.

There were 227 (3.7%) re-admissions in total, of which the majority were due to sickle cell anemia (22.5%), severe malaria (11.0%), pneumonia (10.6%), diarrheal disease (8.8%), and febrile convulsions (5.7%), amongst others in Table 4.

Pattern of mortality by age group and gender

Mortality rate was highest among the youngest age group of ≤ 1 year and reduced with age. However, it was similar for those aged above 5 to 12 years and above 12 years, as seen in Table 5 ($\chi^2=9.3$, $p=0.05$). The top cause of mortality across all age groups was

Table 3. Age distribution of cases.

| Diagnoses | 1 mo - 1 yr | 1.1-3 yrs | 3.1-5 yrs | 5.1-12 yrs | >12 yrs |
|---|-------------|-------------|------------|------------|-----------|
| Severe malaria | 202 (18.4) | 377 (34.3) | 204 (18.5) | 266 (24.2) | 51 (4.6) |
| Acute diarrheal disease | 328 (52.0) | 225 (25.7) | 26 (4.1) | 41 (6.5) | 11 (1.7) |
| Sickle Cell Disease | 35 (5.6) | 144 (23.1) | 90 (14.4) | 257 (41.2) | 98 (15.7) |
| Pneumonia | 280 (51.2) | 153 (27.8) | 44 (8.0) | 64 (11.7) | 7 (1.3) |
| Febrile convulsions | 56 (13.3) | 244 (58.0) | 81 (19.2) | 40 (9.5) | - |
| Severe acute malnutrition & failure to thrive | 154 (35.2) | 267 (61.0) | 17 (3.9) | - | - |
| Pharyngotonsillitis | 143 (35.6) | 130 (32.3) | 43 (10.7) | 74 (18.4) | 12 (3.0) |
| Sepsis | 211 (53.0) | 81 (20.4) | 27 (6.8) | 63 (15.8) | 16 (4.0) |
| Meningitis | 53 (30.3) | 41 (23.4) | 20 (11.4) | 50 (28.6) | 11 (6.3) |
| Uncomplicated malaria | 22 (17.1) | 32 (24.8) | 15 (11.6) | 45 (34.9) | 15 (11.6) |
| Urinary Tract Infection | 41 (27.0) | 31 (20.4) | 14 (9.2) | 53 (34.9) | 13 (8.6) |
| Heart failure | 17 (17.7) | 27 (28.1) | 12 (12.5) | 25 (26.0) | 15 (15.6) |
| Measles | 32 (36.0) | 34 (38.2) | 8 (9.0) | 15 (16.9) | - |
| Bronchiolitis | 68 (84.0) | 12 (14.8) | 1 (1.2) | - | - |
| Enteric fever/typhoid fever | - | 4 (10.6) | 4 (10.6) | 49 (71.0) | 12 (17.4) |
| Congenital heart disease | 31 (52.5) | 15 (25.4) | 4 (6.8) | 9 (15.3) | - |
| Afebrile seizures/seizure disorder | 8 (14.3) | 17 (30.4) | 14 (25.0) | 16 (28.6) | 1 (1.8) |
| Acute glomerulonephritis | - | 6 (13.0) | 9 (19.6) | 19 (41.3) | 12 (26.1) |
| Severe anemia | 7 (15.6) | 8 (17.8) | 9 (20.0) | 16 (35.6) | 5 (11.1) |
| Acute kidney injury | 15 (36.6) | 9 (22.0) | 7 (17.1) | 5 (12.2) | 5 (12.2) |
| Food poisoning | 10 (20.4) | 24 (49.0) | 4 (8.2) | 11 (22.4) | - |
| Tetanus | 3 (8.6) | 7 (20.0) | 3 (8.6) | 19 (54.3) | 3 (8.6) |
| Tuberculosis | 5 (14.7) | 6 (17.6) | 4 (11.8) | 13 (38.2) | 6 (11.6) |
| Acquired heart disease | 5 (16.7) | 3 (10.0) | 3 (10.0) | 12 (40.0) | 7 (23.3) |
| Nephrotic syndrome | 1 (3.3) | 3 (10.0) | 1 (3.3) | 20 (66.7) | 5 (16.7) |
| Bone, joint & soft tissue infections | 6 (15.4) | 10 (25.6) | 6 (15.4) | 15 (38.5) | 2 (5.1) |
| Malignancies | 4 (15.4) | 4 (15.4) | 4 (15.4) | 12 (46.2) | 2 (7.7) |
| Acute asthma attack/acute severe asthma | 5 (20.0) | 7 (28.0) | 7 (28.0) | 5 (20.0) | 1 (4.3) |
| Accidents & poisonings | 3 (13.0) | 11 (47.8) | 3 (13.0) | 5 (21.7) | 1 (4.3) |
| Retroviral disease | 4 (20.0) | 5 (25.0) | - | 7 (35.0) | 4 (20.0) |
| Intussusception & intestinal obstruction | 7 (36.8) | 4 (21.1) | 1 (5.3) | 3 (15.8) | 4 (21.1) |
| Diabetic ketoacidosis | - | - | 2 (11.8) | 8 (48.7) | 7 (41.2) |
| Diphtheria & pertussis | 1 (5.9) | 7 (41.2) | 5 (29.4) | 3 (17.6) | 1 (5.9) |
| Peptic ulcer disease | - | - | 1 (6.3) | 11 (68.8) | 4 (11.5) |
| Neurological sequelae & cerebral palsy | 1 (7.1) | 7 (50.0) | 1 (7.0) | 5 (35.7) | - |
| Upper airway obstruction | 4 (33.3) | 4 (33.3) | 3 (25.0) | 1 (8.3) | - |
| Snake bite | - | 3 (27.3) | - | 6 (54.5) | 2 (18.2) |
| Others | 4 (40.0) | 3 (30.0) | 2 (20.0) | 1 (10.0) | - |
| Bleeding diatheses | 1 (10.0) | 1 (10.0) | - | 7 (70.0) | 1 (10.0) |
| Hepatitis & Chronic Liver Disease | 2 (20.0) | 3 (30.0) | - | 5 (50.0) | - |
| Acute flaccid paralysis (Poliomyelitis & GBS) | - | - | 2 (22.2) | 7 (77.8) | - |
| Chronic Kidney Disease | - | - | 1 (14.3) | 2 (28.6) | 4 (57.1) |
| Hypertensive emergencies | - | 1 (20.0) | - | 4 (80.0) | - |
| Covid infection | - | - | 1 (33.3) | 2 (66.7) | - |
| Rabies & dog bite | - | - | - | 1 (50.0) | 1 (50.0) |
| Viral hemorrhagic fever | - | - | - | 2 (100.0) | - |
| Total | 1776(29.2) | 1968 (32.3) | 704(11.6) | 1299(21.3) | 341(5.6) |

GBS, Guillaine-Barré Syndrome.

severe malaria except for those aged one month to one year, which was sepsis, as shown in Table 6 and Figure 3. Pneumonia and severe malaria, followed by severe malnutrition, were the next common causes in infants. Severe malnutrition was the second most common in toddlers. Sepsis, meningitis, and heart failure were among the top causes in all the age groups, while SCD, tetanus, and renal diseases were more common in the older age groups as causes of mortality, as seen in Table 5.

Figure 3 shows the color-coded bar graph with the highest cause of mortality as sepsis in infants, while severe malaria topped all other age groups.

The mortality rate was higher in females than males (12.1% vs 10.5%) but not statistically significant ($\chi^2=3.56$, $p=0.06$), as shown in Table 6.

Discussion

The main findings from this study showed that infections were responsible for the majority of admissions in the children's emergency unit in Sokoto. Malaria was the top diagnosis in all age groups except infancy, where sepsis predominated. The burden of diseases was greater in the under-five children, and the top causes of mortality were of infective origin.

This study was conducted over a five-year period, while many other reports were conducted over a shorter period, ranging from

Table 4. Outcome of admissions into Emergency Pediatric Unit (EPU).

| Outcome (n=6088) | Frequency | % |
|--|-----------|-------|
| Discharged | 2483 | 40.8 |
| Transferred out | 2635 | 43.3 |
| Left Against Medical Advice (LAMA) | 64 | 1.1 |
| Readmissions | 227 | 3.7 |
| Death | 679 | 11.2 |
| Readmissions (n=227) | | |
| Sickle cell anemia | 51 | 22.5 |
| Severe malaria | 25 | 11.0 |
| Pneumonia | 24 | 10.6 |
| Case fatality rate of topmost admissions | | |
| Sepsis (398) | 78 | 19.6 |
| Severe Acute Malnutrition (SAM) (438) | 85 | 19.4 |
| Severe malaria (1100) | 151 | 13.7 |
| Pneumonia (547) | 55 | 10.1 |
| Febrile convulsions (421) | 21 | 5.0 |
| Acute diarrheal disease (631) | 31 | 4.9 |
| Pharyngotonsillitis (402) | 10 | 2.5 |
| Sickle cell disease (624) | 13 | 2.1 |
| Highest Case-Fatality Rate (CFR) | | |
| Hemorrhagic fever (2) | 2 | 100.0 |
| Hypertensive emergencies (5) | 4 | 80.0 |
| Diphtheria (16) | 12 | 75.0 |
| Tetanus (35) | 17 | 48.6 |
| Chronic Kidney Disease (7) | 3 | 42.9 |

Table 5. Top causes of mortality by age category.

| Age range | Alive (%) | Dead (%) | Cause of highest mortality | n (%) |
|------------------------|-------------|------------|--|--|
| 1 mo – 1 yr | 1553 (87.4) | 223 (12.4) | Sepsis Pneumonia Severe malaria SAM Diarrhoeal disease Meningitis | 47 (21.1) 40 (17.9) 27 (12.1) 25 (11.2) 20 (9.0) 10 (4.5) |
| 1.1-3 yrs | 1742 (88.5) | 226 (11.5) | Severe malaria SAM Sepsis Heart failure Pneumonia Diarrheal disease | 68 (30.1) 56 (24.8) 16 (7.1) 11 (4.9) 10 (4.4) 10 (4.4) |
| 3.1-5 yrs | 627 (89.1) | 77 (10.9) | Severe malaria Heart failure SCD Febrile convulsion SAM Pneumonia | 31 (40.3) 7 (9.1) 6 (7.8) 5 (6.5) 4 (5.2) 3 (3.9) |
| 5.1-12yrs | 1178 (90.7) | 121 (9.3) | Severe malaria Meningitis Sepsis Tetanus AGN SCD | 19 (15.7) 12 (9.9) 11 (9.1) 7 (5.8) 7 (5.8) 5 (4.1) |
| >12yrs | 309 (90.6) | 32 (9.4) | Severe malaria Meningitis Heart failure Sepsis CKD SCD | 6 (18.8) 4 (12.5) 4 (12.5) 3 (9.4) 2 (5.8) 2 (5.8) |
| Total | 5409 (88.8) | 679 (11.2) | | |
| $(\chi^2=9.3, p=0.05)$ | | | | |

AGN, Acute Glomerulonephritis; CKD, Chronic Kidney Disease; SAM, Severe Acute Malnutrition; SCD, Sickle Cell Disease.

one to three years.^{5,9,16-20} The number of admissions seen over the five-year period was higher than the 1,949 reported by Duru *et al.*²⁰ in a recent study from Bayelsa, South-South Nigeria, but it is lower than the 10,267 reported from Enugu, South-Eastern Nigeria, by Ibeziako *et al.*⁸ The age range in these studies should also be considered. While some included neonates, like Ibeziako's study,⁸ this study and others did not include neonates due to the different sites of admission of neonates within the hospital, away from the children's emergency (closer to the maternity wards). The upper age limit of admission also differs in different facilities based on local hospital policy. This study's upper limit is 15 years, while others may be 12 or 18 years. This may also account for the disparity in the figures reported. Also, the wide disparity in these figures emanating from tertiary facilities could be due to the cosmopolitan nature of the cities and the relative access to these facilities compared to other health facilities in the metropolis.

Males accounted for the majority of the admissions in this study, with a ratio of 1.4:1, similar to most other reports in the country.^{5,7,8,20,21} Male preponderance has been seen in some infectious diseases; likewise, they may also have a higher risk of exposure to other non-infectious diseases and complications due to their adventurous nature.⁵ Increased parental health-seeking behavior for male children has also been adduced.¹¹ Under-fives constituted 78.0 % of the total admissions. The proportion of under-fives amongst EPU admissions was 60.8%, 64.9%, 70.2%, 74.9%, 89.1%, and 90.3% in Ekiti, Gusau, Benin, Port Harcourt, Bauchi, and Enugu, respectively.^{9,11,13,22,23} This reflects the high burden of child morbidity among under-five children in our country. In other countries, under-five constituted 58.8%, 62.8%, and 60.8% of admissions in tertiary facilities in Sudan, India, and Australia.²⁴⁻²⁶ Whereas this may reflect the age-related susceptibility of children of that age to infectious disease due to lower immunity,²⁷ the higher figures in this country may also be due to different child health burdens in some locations. It may also reflect the availability of trained pediatric health professionals in that facility, especially in developing countries.

The lower number of admissions in the year 2020 could be due to the lockdown from the COVID pandemic, social distancing, and improved cough and hand hygiene, which led to a reduction in transmission of some infectious agents; however, mortality was relatively higher that year due to increased cardiorespiratory causes of mortality as was described in a related study.^{28,29} The low admission rate seen in 2018 was probably due to the prolonged industrial action by health workers from April to June 2018, as also adduced by Nyango in Jos³⁰ and Agbesanwa in Ekiti, Nigeria.²¹ Cumulative monthly admissions were highest in September, similar to Sa'ad's¹¹ study from Bauchi, North-east Nigeria, while this was in January, followed by September for Ibeziako's study.⁸ The peak months of August, September, and October reflect the rainy season, with attendant high transmission of malaria, and are also a peak period of respiratory infections. The lowest number was in May and June, similar to the study in Enugu.⁸ The nationwide health workers' strike from May to June 2018 could account for the lower cumulative number of admissions in both months and the lockdown period from April to May 2020, when admissions

sharply declined.²⁸ The highest cumulative monthly mortality in October and April could be due to seasonal patterns of some diseases. For instance, complicated malaria has been reported to peak by September to October, according to a report from the hospital by Jiya *et al.*³¹ Measles and meningitis infections were also found to peak in April from similar reports in the study center.^{32,33} It is noteworthy that April is within the hottest period while October is a peak rainy month in Sokoto, further supporting the spread of measles, meningitis, and malaria, respectively.¹⁶

Overall, a severe form of malaria was the most common diagnosis, similar to other studies in parts of the country except for Ibeziako,⁸ who reported febrile convulsions as the top admission diagnosis, followed by severe malaria. The proportion of malaria in this study was 18.0%, similar to findings by Onubogu⁵ in Port Harcourt, which was 18.3%. Other studies from Gusau¹³ and Bauchi¹¹ in the northwest and northeast reported 29.7% and 44.8%, possibly higher due to local endemic patterns based on rainfall that particular period and environmental preventive measures. This coincides with the rainy season in most areas where transmission ranges from hyperendemic to holoendemic. After acute diarrhoea disease, which was the second, the next common cause of admission was SCD, followed by pneumonia, while SAM ranked fifth, closely followed by sepsis. SCD was the fifth most common cause in Gusau and ninth in Port Harcourt, respectively.^{5,13} However, it ranked third in the Bauchi and fourth in Enugu.^{8,11} Malaria, diarrhea disease, pneumonia, sepsis, other infectious diseases, and SCD accounted for 78.7% of the total admissions, similar to a report by Adeyemi from Ido-Ekiti, South-western Nigeria, where malaria with complications, sepsis, sickle cell crisis, pneumonia, pharyngotonsillitis, and acute watery diarrhea constituted 72.4% of all admissions. This shows that similar patterns and burdens of diseases constitute morbidity in Nigerian children across regions, with implications for setting up lasting preventive programs.

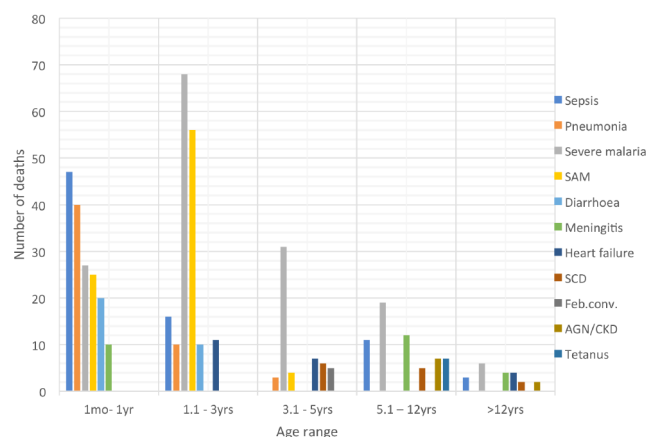


Figure 3. Top mortality per age group.

Table 6. Outcome.

| Outcome | Gender | | Total |
|---------|-------------|-------------|--------------|
| | Male | Female | |
| Alive | 3194 (89.5) | 2225 (87.9) | 5409 (88.8) |
| Dead | 374 (10.5) | 305 (12.1) | 679 (11.2) |
| Total | 3558 (58.4) | 2530 (41.6) | 6088 (100.0) |

$\chi^2=3.56$, $p=0.06$.

SCD was the most common non-infectious cause of admission, similar to studies from different regions of the country, including Calabar, Enugu, Bauchi, Nguru, and Asaba.^{7,8,11,12,21,34} Onubogu reported trauma as the most common non-infectious cause of admission, while another study from Abia reported acute asthmatic attack as the most common.^{5,10} SCD is the most common genetic disease in Nigeria, which has the largest pool of people with SCD, having about 150,000 births annually.³⁵ This difference could also be due to the varying geographic locations. This burden shows that more is to be done in the study area with respect to premarital counseling of young people, including adolescent school children, to know their genotypes.⁸ Sickle cell anemia was responsible for most re-admissions, understandably due to the chronic nature of the disease with acute exacerbations (crises).

By age group, diarrheal disease, pneumonia, and sepsis, which are all infections, were the most common diagnoses in infants. This was similar to the pattern seen by Onubogu⁵ in Port Harcourt, even though they categorized age >1 month up to 2 years together in their study. Severe malaria predominated in older children except those above 12 years, where SCD was the most common. This also brings to the fore the burden of SCD as it rose from second most common in preschool age to the most common after 12 years. Other conditions like renal diseases, enteric fever, and tetanus were more common in school-aged children, similar to Agbesanwa's²¹ findings, while trauma, asthma, and SCD were reported in another study.⁵

The discharge rate was 40.8% lower than the 45.5% and 50.1% reported by the EPU in Southern Nigeria.^{5,8} Likewise, the mortality rate of 11.2% was higher than other studies with figures of 3.2%, 4.4%, 5.0%, 5.1%, 7.0%, 7.1% and 10.6% reported by Onubogu,⁵ Iyoha,²³ Adeyemi,⁹ Ibeziako,⁸ Agbesanwa,²¹ Duru,²⁰ Sa'ad,¹¹ in Port Harcourt, Benin-City, Ekiti, Enugu, Ado-Ekiti, Bayelsa, and Bauchi. The rate was similar to the figure for the neighboring North-Western city of Gusau, which was 11.2%.¹³ A very low mortality rate of 0.5% was reported from Calabar by Enyuma⁷, attributed to structural changes in their emergency unit administration and active use of a triage score at admission, which is also being advocated for in our setting.

Among the top admissions, sepsis, followed by SAM, severe malaria, and pneumonia, had the highest CFR. This was similar to a trend reported in a review by Edelu³⁶ on the pattern of mortality in children emergency units across Nigeria, where they found sepsis to have top CFR, followed by severe anemia, severe malnutrition, and Human Immunodeficiency Virus (HIV)/Acquired Immunodeficiency Syndrome (AIDS). This highlights the trend in the pattern of some diseases across the country, which may be generally similar, with some patterns having some local contributory factors.³⁶

The highest proportion of mortality was due to severe malaria in all age groups except those aged ≤1 year, where sepsis was the topmost, followed by pneumonia before severe malaria. In a study on infant mortality carried out about 33 years ago in the same hospital by Ibrahim,³⁷ the top causes of infant mortality were diarrhea, pneumonia, and sepsis, which probably shows that mortality from diarrhea has reduced in the hospital presently compared to before. However, this still reflects infections as common causes of mortality in infants after many years. Ibeziako⁸ and Agbesanwa²¹ also reported pneumonia, diarrheal disease, and severe malarial anemia as the top causes of mortality in infants.

Severe malnutrition was the second most common cause of mortality after malaria in toddlers, similar to what was reported from the study area by Ugege and Garba, where SAM was the most common in those less than four years.³⁸ Malnutrition results in a vicious cycle of infection, and since immunity is less well-

developed in younger children, it may contribute to higher mortality if malnourished. Edelu also reported deaths were mostly from infective causes, which reflects the fact that infection still remains the bane of our healthcare delivery system.³⁶

In this study, mortality was highest among those less than one year old, which is not unexpected due to the higher vulnerability of children of that age. This was similar to Edelu's finding but unlike what was reported by Adeyemi (five to 15 years) and Onubogu (>12 years).^{5,9,36}

Mortality was higher among female admissions than males, similar to Onubogu⁵ and Edelu's³⁶ findings but unlike findings by Adeyemi.⁹ Sex differences in genetic and biological compositions, with males being biologically weaker and more susceptible to disease, have been reasons adduced for higher mortality in males.⁵ However, reasons for higher female mortality have been linked to delayed health-seeking behavior for female children in preference for males.⁵

Conclusions

Severe malaria constitutes the majority of the admissions in all age groups except less than one year, where diarrhea disease predominated. Severe malaria was also the top cause of mortality except in infancy, where sepsis and other infections predominated. SCD was the third most common cause of admission and was a major cause of morbidity in older children, as well as being responsible for most re-admissions. Among the top causes of admissions, sepsis and SAM had the highest fatality; however, overall, the highest case fatality was from diseases of infectious origins.

Recommendations

It is necessary to scale up preventive measures targeted at the topmost causes of morbidity and mortality. This includes health education in the community, more government efforts at malaria elimination, and ensuring vaccination and environmental hygiene. Further studies on the pattern and outcome of all childhood admissions should not be limited to the emergency unit alone.

Limitations

Conditions such as febrile convulsions and heart failure were captured even though the underlying causes would have been preferred. However, the underlying diagnoses were captured as table footnotes.

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