Original Article

Burden, Clinical Spectrum, Predictors of Severe Anaemia, and In-hospital Outcomes of Pediatric Severe Malaria: A Retrospective study from a Tertiary Hospital Cohort

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ABSTRACT

Severe malaria (SM) remains a leading cause of childhood morbidity and mortality in Nigeria, with severe malarial anaemia (SMA) driving transfusion demand and poor outcomes. Recent contemporary hospital-based data from Southwestern Nigeria are limited. This study described the burden, clinical spectrum, predictors of severe anaemia, and in-hospital outcomes of paediatric SM at a tertiary hospital in Southwest Nigeria. We retrospectively reviewed case records of children aged 1 month–14 years admitted with SM to Olabisi Onabanjo University Teaching Hospital, between January–December 2023. Demographic, clinical, laboratory, treatment, and outcome data were extracted while predictors of SMA were assessed using logistic regression. Of 699 paediatric admissions, 65 (9.3%) were confirmed SM cases; 55.4% were <5 years, and 72.3% males. Nearly two-thirds were underweight, and 89% belonged to low-middle socioeconomic classes. The most frequent WHO severity criteria were multiple convulsions (35.4%), prostration (33.8%), cerebral malaria (16.9%), and SMA (16.9%). Eleven children developed SMA; with pallor as a presenting complaint being the strongest independent predictor (adjusted OR 8.94, 95% CI 1.60–49.8, p=0.012). All patients received intravenous artesunate, and 87.5% received empiric antibiotics. Median hospital stay was 6 days (IQR 3.5–9.5). Overall survival was 96.9%, with 2 deaths (3.1%). However, 18.5% were discharged against medical advice. Conclusively, severe malaria accounted for nearly one-tenth of paediatric admissions, predominantly affecting under-fives and socioeconomically disadvantaged children. Pallor strongly predicted SMA, underscoring its bedside triage value. High survival with artesunate contrasts with high discharged-against-medical-advice rates, highlighting the need for caregiver support and financial protection.

Keywords: Clinical Spectrum, Outcome, Paediatric Severe Malaria, Severe Malaria Anaemia, Predictors, Tertiary Hospital Cohort.

INTRODUCTION

Malaria remains a major public health challenge in sub-Saharan Africa, disproportionately affecting children under five years of age. In 2023, an estimated 263 million cases and 597,000 malaria-related deaths occurred globally, with the World Health Organization (WHO) African Region accounting for approximately 94% of cases and 95% of deaths.[1] Nigeria alone contributes about 26% of global malaria cases and nearly 31% of malaria deaths, with young children bearing the greatest burden.[1,2] Despite expanded vector control, chemoprevention, and improved case management, malaria-related morbidity and mortality remain unacceptably high in Nigerian children.[1]

Severe malaria (SM), predominantly caused by *Plasmodium falciparum*, represents the most life-threatening spectrum of infection. The WHO criteria include impaired consciousness, metabolic acidosis, hypoglycaemia, acute kidney injury, hyperparasitaemia, and severe malarial anaemia (SMA), defined in children as haemoglobin <5 g/dL or haematocrit <15%.[3,4] Severe malaria anaemia is particularly common in high-transmission settings and is a major driver of paediatric transfusion demand.[3,5] Although timely blood transfusion significantly reduces mortality when haemoglobin falls below 5 g/dL, survival gains are often limited by blood shortages, delayed cross-matching, and constrained

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critical-care capacity in resource-limited hospitals.[5] Hospital-based studies across Nigeria report case fatality rates (CFRs) for severe paediatric malaria ranging from 4–10%, with outcomes influenced by complication type, comorbidities, and timeliness of care.[6-8] Predictors of SMA identified in some northern cohorts are age less than 5 years, fever and high parasite density.[8] However, regional variability exists, and contemporary data from Southwestern Nigeria remain limited.

Given Nigeria's disproportionate contribution to the global malaria burden and persistent health-system constraints, updated hospital-level evidence is needed to quantify the current burden and outcomes of paediatric severe malaria and SMA. We hypothesized that SMA remains a predominant complication of severe malaria in children and that specific clinical parameters predict its occurrence. This study aimed to describe the demographic and clinical characteristics of childhood severe malaria admissions at a tertiary centre in Southwestern Nigeria; determine the prevalence and predictors of SMA; and assess treatment patterns and in-hospital outcomes.

MATERIALS AND METHODS

This was a one-year retrospective descriptive cross-sectional study conducted at Olabisi Onabanjo University Teaching Hospital (OOUTH), Ogun State, Nigeria. The teaching hospital serves as a referral center for many Local Government Areas in Ogun State and receives a high volume of paediatric severe malaria cases. All children aged 1 month to 14 years admitted for severe malaria between January 2023 and December 2023 were eligible for inclusion.

The inclusion criteria were cases with clinical diagnosis of severe malaria supported by a positive rapid diagnostic test (RDT) for *Plasmodium falciparum,* and availability of medical records including demographic data, presenting complaints, laboratory findings, treatment, and outcomes for the cases. Children who were managed for severe malaria but with no documented evidence for malarial parasitaemia (either by MP or RDT) or with significantly incomplete data record were excluded.

Data Collection

Data were extracted from hospital admission records and patient charts using a pre-structured checklist. Collected variables included demographics: age, sex, settlement; Oyedeji's socioeconomic indicators: parental occupation and level of education[9]; clinical data: presenting complaints, nutritional status, severity criteria (based on WHO definitions); packed cell volume (PCV), full blood count (FBC), malaria RDT; use of intravenous artesunate or other antimalarials; use of antibiotics; and duration of hospital stay, discharge status, complications, or death.

Definitions

Severe malaria was defined according to WHO criteria as presence of malaria parasitaemia with life threatening complications (e.g. severe anaemia, prostration, hypoglycaemia, haemoglobinuria, acute kidney injury, altered consciousness, cerebral malaria, multiple convulsions, respiratory distress).[4] Also, undernutrition (underweight) was defined using weight-for-age Z-scores below −2 standard deviations (SD) from the median of the WHO Child Growth Standards, with severe underweight defined as <−3 SD.[10]

Data Analysis

Data were analysed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize patient characteristics and outcomes. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized using means and standard deviations or medians and interquartile ranges (IQRs) as appropriate. Chi-square tests were used to explore associations between clinical variables and outcomes. Univariate and multivariate logistic regression analysis were done to determine predictors of severe anaemia. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee (HREC) of OOUTH, Sagamu (Protocol No: OOUTH/HREC/840/2024AP). All data were anonymized to protect patient confidentiality.

RESULTS

A total of 699 children were admitted to the pediatric wards during the study period. Of these, 75 children were diagnosed with severe malaria. However, only 65 children had positive pfRDT or malaria parasite smear positive results, leaving the prevalence at 9.3%. Of the 65 children with confirmed cases of severe malaria, 36 (55.4%) were aged below 5 years. There was a marked male predominance, with 47 (72.3%) males and 18 (27.7%) females, giving a male to female ratio of 2.6:1. The majority of patients, 46 (70.8%) resided in urban areas, and most of the mothers (49.2%) had secondary education, while 14.3% had no formal education. Nearly 90% of the children came from low (45.3%) and middle (43.8%) socioeconomic classes, Table I.

Nutritional assessments indicated varying degrees of malnutrition among the cohort (Figure 1). The weight of three of the children was not available in the record file. Close to two-thirds of the children were underweight, with 9 (14.5%) being severely underweight. Figure 2 shows the symptoms of malaria while Figure 3 shows the various severity criteria documented, based on the WHO criteria. The most common symptoms at presentation included fever, convulsions, vomiting and paleness of the body; with fever being a constant presenting complaint (100%) for all the cases. Using the WHO criteria, several children met more than one severity criterion such as prostration, impaired consciousness, multiple convulsions, and severe anemia. Multiple convulsions, prostration, cerebral malaria and severe anaemia were the leading severity criteria among the cohort, with 35.4%, 33.8%, 16.9% and 16.9% respectively. Two or more severity criteria were seen in 33.8% of the cases. Of the severe anaemia cases, 5 (45.5%) co-existed with other complications.

All 65 children (100%) tested positive for malaria using the rapid diagnostic test (pfRDT). The mean packed cell volume (PCV) was 26.8% ± 13.2, with a wide range of 6.9% to 41.9%, indicating moderate to severe anemia in some patients. There were 11 (16.9%) cases of severe anamia, defined by packed cell volume <15%. All the

patients received intravenous artesunate, followed by artemisinin-based combination therapy. Additionally, 56 (87.5%) received intravenous antibiotics, while 8 (12.5%) were managed without antibiotics. All the children with severe anaemia received blood transfusion. The median duration of hospitalization was 6 days (IQR: 3.5–9.5), with a mean duration of 7.58 ± 6.22 days. In-hospital outcomes were favorable in most of the cases, with 63 children (96.9%) surviving and 2 deaths (3.1%) recorded, 1 each from cerebral malaria and multiple convulsions, Table II. Notably is also the high rate of discharge against medical advice (DAMA) in the records (18.5%). Table III shows the association between the sociodemographic characteristics of the children managed, their presenting complaints and other severity criteria of malaria, with severe malaria anaemia. Regarding the sociodemographic characteristics, settlement type was significantly associated with severe anaemia ($\chi^2 = 8.000$, $p = 0.018$), with cases occurring more frequently among children from semi-urban (60.0%, 3 out of 5 children) and rural areas (21.4%, 3 out of 14 children) compared to urban areas (10.9%, 5 out of 46 children). There was no significant association between other sociodemographic variables and SMA. With respect to presenting complaints, severe anaemia was significantly associated with convulsions ($\chi^2 = 4.680$, $p = 0.031$), pallor ($\chi^2 = 12.188$, $p < 0.001$), and yellowness of the eyes (jaundice) ($\chi^2 = 4.670$, $p = 0.031$). Other symptoms, including vomiting, diarrhoea, cough, headache, abdominal pain, and loss of consciousness, showed no significant relationship with severe anaemia. Among the other WHO severity criteria documented, only passage of dark urine (haemoglobinuria) showed a significant association with severe anaemia ($\chi^2 = 4.670$, $p = 0.031$).

On univariate logistic regression, the presence of pallor (OR = 15.00, 95% CI: 3.14–77.66, $p < 0.001$), jaundice (OR = 7.14, 95% CI: 1.45–35.23, $p = 0.016$), and passage of dark urine (OR = 7.14, 95% CI: 1.45–35.23, $p = 0.016$) were significant predictors of severe anaemia, Table IV. In the multivariate model, only pallor remained an independent predictor of severe anaemia (adjusted OR = 8.94, 95% CI: 1.60–49.78, $p = 0.012$), Table IV. Jaundice, passage of dark urine, and convulsions were not independently associated after adjustment.

Table 1: Socio -demographic variables of the children

Variable	Frequency, n=65	Percent (%)
Age (years)		
< 5	36	55.4
. .	29	44.6
Sex		
Male	47	72.3
Female	18	27.7
Settlement		
Rural	14	21.5
Semi -Urban	5	7.7
Urban	46	70.8
Mother's level of education		
No formal education	10	14.3
Primary	10	15.9
Secondary	32	49.2
Tertiary	13	20.6
Mother's occupation		
Civil servant	9	13.8
Trading	23	35.4
Farming	10	15.4
Artisan	2	3.1
Clergy	2	3.1
Unemployed	19	29.2
Socioeconomic class		
Upper	7	10.9
Middle	29	43.8
Lower	29	45.3

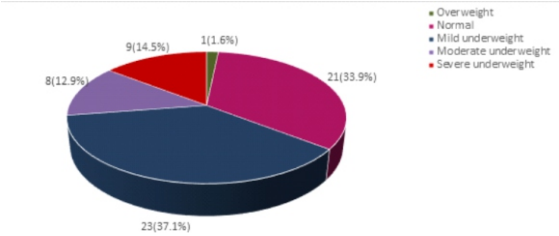

Figure 1: Nutritional status of children with severe malaria.

Figure2: Symptoms of malaria at presentation.