Severe Falciparum Malaria: Prevalence, Comorbidities and Outcome in children in Port Harcourt, Nigeria

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Abstract
Severe malaria is a paediatric emergency of public health importance globally but is worse in Sub-Saharan Africa including Nigeria where it claims millions of under-fives lives annually, if not promptly treated.
The study aimed to find the prevalence of severe malaria, its comorbidities and outcome of treatment among children presenting into the children emergency ward (CHEW) of the University of Port Harcourt Teaching Hospital (UPTH).
This was a retrospective study carried out in January 2014 to December 2018 at the CHEW of the University of Port Harcourt teaching Hospital, Port Harcourt. The admission register in the CHEW and the patients case notes were used to obtain the total number of admissions and to identify the children who presented with a diagnosis of severe malaria. Using a structured questionnaire, their biodata, occupation and educational level of parents, month of admission, type of severe malaria, duration of hospital stay, comorbidities and outcome of treatment were obtained. socioeconomic class was determined using Oyedeji classification. Obtained data was analysed using SPSS version 20 and relationship between variables was tested using chi square and a P value of <0.05 was regarded as statistically significant. Result is presented in prose, frequencies, tables and charts. There were 503 children with severe malaria, giving a prevalence of 8.6%. 282 males and 221 females with a M:F ratio of 1.28: 1. Their ages ranged from 2 months to 16 years, with a mean age of 4 years ± 1.5 years. 57.1% of the children were between 1-5years and 65% of them were from the lower socioeconomic class. Severe malaria anaemia (SMA) 289 (57.5%) was the commonest form of severe malaria seen in this study, but for Disseminated intravascular coagulation all the various manifestations of severe malaria were more common in children from the lower socioeconomic class and this difference was statistically significant p=0.0001. Sepsis was the most occurring comorbidity seen in 40% of cases. Case fatality rate in this study was 10.7%, this was not significantly affected by sex or age p=0.6147, p=0.8958 respectively Severe falciparum malaria is high in children in Port Harcourt Nigeria. The case fatality is high with SMA presenting more commonly in children between one to five years and sepsis as the commonest comorbidity
Every under-five child coming to any health facility in Nigeria, should be screened for malaria. Malaria diagnostic tools should be made available to all primary health facilities and pharmacy shops where these patients first present to, before coming to the hospital. There should be improvement in our blood transfusion services to reduce the long hours spent waiting for blood. Every child diagnosed for severe malaria should also be screened for sepsis.

Keywords — *Severe Falciparum malaria, prevalence, comorbidities, outcome.*

I. INTRODUCTION

Severe malaria is acute malaria with life threatening complications and or a high level of malaria parasitemia. [1] It is characterized by clinical or laboratory evidence of vital organ dysfunction and typically occurs due to delayed treatment of uncomplicated malaria. It is a medical emergency because it may rapidly progress to death without prompt and Severe malaria is acute malaria with life threatening complications and or a high level of malaria parasitemia. [1] It is characterized by clinical or laboratory evidence of vital organ dysfunction and typically occurs due to delayed treatment of uncomplicated malaria. It is a medical emergency because it may rapidly progress to death without prompt and appropriate treatment especially in under-fives and pregnant women. [1]
In 1990, the World Health Organization (WHO) standardized the criteria for the diagnosis of severe malaria in order to assist new clinical and epidemiological studies [2]. These criteria were revised by the WHO in 2000, to include other clinical manifestations and laboratory values that presage a poor prognosis based on clinical experience in semi-immune patients. [3].
Despite an estimated 18% global decrease in malaria incidence, from 76 to 63 cases per 1000 population at risk, between 2010 and 2016, an estimated 216 million cases of malaria occurred worldwide in 2016 with 90% of these cases occurring in sub-Saharan

Africa. [4] In 2016, there were an estimated 445, 000 deaths from malaria globally with 91% of malaria deaths occurring in sub-Saharan Africa. [4] Nearly all deaths from severe malaria result from infections with P. falciparum, although P. vivax and P. knowlesi can also cause severe disease. [5]

The gold standard for the diagnosis of malaria is microscopy. [6] but where microscopy is not available or feasible, the WHO recommends a rapid diagnostic test (RDT). [6] RDTs for detecting Histidine rich protein 2 (*pf*HRP2) antigen can be useful for diagnosing malaria in patients who have recently received antimalarial treatment and in whom blood films are transiently negative for malaria parasites. [6]

The components of severe malaria include cerebral malaria, severe anaemia, pulmonary edema, acute kidney injury, bleeding disorders (DIC), acidosis and hypoglycaemia, hyperbilirubinaemia, algid malaria(shock), Hyperpyrexia, multiple convulsions, haemoglobinuria, persistent vomiting and prostration. [7] In many patients, several of these complications coexist or evolve in rapid succession within a few hours. [7], [8]

Management of severe malaria requires clinical expertise as it may present like or coexist with other diseases that are prevalent in malaria-endemic areas such as, meningitis, bacterial sepsis, sickle cell anaemia, enteric fever, pneumonia, urinary tract infection, otitis media and malnutritionn. [9],[10],[11],[12] These will require further laboratory investigations and treatment options which may be cost intensive, also, management of severe malaria is challenging as there is need for a good referral system, skilled personnel, cost-intensive supportive measures, blood transfusion services and an organized hospital service system. [13] This study therefore seeks to find the prevalence of severe malaria among children presenting into the children emergency ward (CHEW) of the University of Port Harcourt Teaching Hospital, its common types, risk factors, comorbidities and outcome of treatment.

II. METHODOLOGY

This was a retrospective study carried out in January 2014 to December 2018 at the CHEW of the University of Port Harcourt teaching Hospital, Port Harcourt. The CHEW admission register was used to obtain the total number of admissions and to identify the children who presented over the period of the study with a diagnosis of severe malaria. Their case records were retrieved and the necessary information obtained using a structured questionnaire. Obtained data included their biodata, the occupation and educational level of parents, month of admission, type of severe malaria, duration of hospital stay, comorbidities and outcome of treatment. Those without laboratory evidence of malaria and no documented feature of severe malaria were excluded. The age range, sex distribution, socioeconomic class (based on Oyedeji), [13] and outcome of treatment were described. Relationship between variables was tested using chi square and a P value of <0.05 was regarded as statistically significant. Results were presented in prose, frequencies, tables and charts. In this study, severe malaria was defined as one or more of the following, occurring in the absence of an identified alternative cause and in the presence of *P. Falciparum* asexual parasitaemia diagnosed either using a rapid diagnostic test (PfHRP2), microscopy or both: [8] Cerebral malaria: Impaired consciousness with a Blantyre coma score <3 in children less than 2 years or a Glasgow Coma Score <11 in older children. Severe malarial anaemia: A haemoglobin concentration <5 g/dl or a haematocrit of <15% in children <12 years of age, (<7 g/dl or <20%, in children 12 years and above). Multiple Convulsions: Three or More convulsions in a 24-hour period. Prostration: Generalized weakness such that the child is unable to sit, stand or walk without assistance. Hypoglycaemia: Blood or plasma glucose <2.2 mMol/l (<40 mg/dl). Acute kidney injury: Urine output <0.5ml/kg/hr or plasma or serum creatinine >265 □ M/l (3 mg/dl) or blood urea >20mM. Jaundice: clinical jaundice or plasma or serum bilirubin >51 □ mol/l (3 mg/dl). Respiratory distress (acidosis/pulmonary oedema): oxygen saturation <92% on room air with a respiratory rate >30/min, with laboured breathing. Shock: capillary refil ≥3 s or a systolic blood pressure <70 mm Hg in children <12 years or <80 mm Hg in children12 years and above with evidence of impaired perfusion (cool peripheries or prolonged capillary refil). Haemoglobinuria: presence of haemoglobin on urine dipstick. Abnormal bleeding: including recurrent or prolonged bleeding from nose, gums or venepuncture sites; haematemesis or melaena.

III. RESULT

A. Sociodemographic of study population

During the study period (January 2014 to December 2018) 5877 children were admitted. 2810 males and 3067 females, of which 532 were documented to have severe malaria either singly or with other comorbidities. A total of 517 (97.2%) case records were retrieved, of which only 503 (8.6%%) met the inclusion criteria for this study. They were 282(56.1%) males and 221(43.9%) females with a M:F ratio of 1.28: 1 Their ages ranged from 2 months to 16 years, with a mean age of 4 years ± 1.5 years. Duration of symptoms before presentation ranged from 2days to 15 days. Mean duration of symptoms before presentation was 6.1 ± 3.4days. Presentation within 3 days of symptoms was 122 (24.3%) while cases referred from other health centers was 168 (33.4%). For length of stay, 340(67.6%) were on admission for more than 3days and up to 7days in the hospital while 163 (32.4%) stayed for over 7days.

There were more children in the age group 1-5years287 (57.1%) and most of these children where from the lower socio-economic class 327 (65%) as seen in table 1.

B. Clinical manifestations of severe malaria.

Severe malaria anaemia (SMA) 289 (57.5%) was the commonest form of severe malaria seen in this study, this was followed by cerebral malaria57(11.3%) and prostration 55(10.9%) as presented in table 2.

Table 1: Socio demographic characteristics

Characteristics	Frequency	Percentage
Age		
1-<12months	89	17.7
1-5yrs	287	57.1
>5years	127	25.2
Sex		
Male	282	56.1
Female	221	43.9
Social Class		
Class 1	68	13.5
Class 2	108	21.5
Class 3	327	65.0
Year of admission		
2014	94	18.7
2015	97	19.3
2016	88	17.5
2017	106	21.1
2018	118	23.4
Total	**503**	100.0%

Table 2: Type of Severe Malaria (SM) seen in the study Population (n=503)

Type of SM	Frequency	Percentage
Severe Malaria Anaemia (SMA)	**289**	**57.5**
Cerebral Malaria (CM)	**57**	**11.3**
Prostration (PR)	**55**	**10.9**
Persistent Vomiting (PV)	**53**	**10.5**
Multiple convulsions (MC)	**37**	**7.4**
Shock	**36**	**7.2**
Jaundice	**33**	**6.6**
Hyperpyrexia	**27**	**5.4**
DIC	**9**	**1.8**
Acute Kidney Injury (AKI)	**8**	**1.6**
Haemoglobinuria (HGN)	**7**	**1.4**
Hypoglycaemia (HG)	**5**	**1.0**

Note: Some had multiple components of Severe Malaria

All the children presented with fever

C. Types of Severe Malaria and age, sex social class and comorbidities.

All the various manifestations of severe malaria were most common in age group 1-5years as shown in table 3. There was no statistically significant difference between the various manifestations of severe malaria and sex. as shown in table 4. Table 5 shows that all the different manifestations of severe malaria where highest in the lower socioeconomic class except for disseminated intravascular coagulation (DIC) which was the same for all the socioeconomic classes upper 3(33.3%) middle 3 (33.3%) lower3 (33.3%) and this difference was statistically significant p=0.0001. Sepsis was the most occurring comorbidity seen in 50(40%) of cases as represented in table 6.

Table 3: Type of severe Malaria and Age

Type of SM	0-<1year n (%)	1-5yrs n (%)	>5 years n (%)	Total n (%)
Severe Malaria Anaemia (SMA)	51 (17.6)	166 (57.4)	72 (24.9)	**289 (57.5)**
Cerebral Malaria (CM)	9 (15.8)	33(57.9)	15 (26.3)	**57 (11.3)**
Prostration (PR)	9 (16.4)	32 (58.2)	14 (25.4)	**55 (10.9)**
Persistent Vomiting (PV)	10 (18.9)	30 (56.6)	13 (24.5)	**53 (10.5)**
Multiple convulsions (MC)	10 (27.0)	19(51.4)	8 (21.6)	**37 (7.4)**
Shock	8 (22.2)	22 (61.1)	6 (16.7)	**36 (7.2)**
Jaundice	7 (21.2)	19 (57.6)	7 (21.2)	**33 (6.6)**
Hyperpyrexia	5 (18.5)	16 (59.3)	6 (22.2)	**27 (5.4)**
DIC (Disseminated Intravascular Coagulation)	2 (22.2)	5 (55.6)	2 (22.2)	**9 (1.8)**
Acute Kidney Injury (AKI)	2 (25.0)	5 (62.5)	1 (12.5)	**8 (1.6)**
Haemoglobinuria (HGN)	1 (14.3)	4 (57.1]	2 (28.6)	**7 (1.4)**
Hypoglycaemia (HG)	0 (0.0)	4 (80.0)	1(20.0)	**5 (1.0)**

Chi-square = 161.6, p = 0.0001 (distribution is statistically significant)

Table 4: Type of Severe Malaria (SM) and sex (n=503)

Type of SM	Male n (%)	Female n (%)	Total n (%)
Severe Malaria Anaemia	169 (58.5)	120 (41.5)	**289 (57.5)**
Cerebral Malaria	28 (49.1)	29 (50.9)	**57 (11.3)**
Prostration (PR)	34 (61.8)	21 (38.2)	**55 (10.9)**
Persistent Vomiting (PV)	29 (54.7)	24 (45.3)	**53 (10.5)**
Multiple convulsions (MC)	19 (51.4)	18 (48.6)	**37 (7.4)**
Shock	21 (58.3)	15 (41.7)	**36 (7.2)**
Jaundice	19 (57.6)	14 (42.4)	**33 (6.6)**
Hyperpyrexia	16 (59.3)	11(40.7)	**27 (5,4)**
DIC (Disseminated Intravascular Coagulation)	3 (33.3)	6 (66.7)	**9 (1.8)**
Acute Kidney Injury	4 (50.0)	4 (50.0)	**8 (1.6)**
Haemoglobinuria (HGN)	4 (57.1)	3 (42.9)	**7 (1.4)**
Hypoglycaemia	2 (40.0)	3 (60.0)	**5 (1.0)**

Chi- square= 5.62 p = 0.8970 (Distribution is not statistically significant)

Table 5: Type of Severe Malaria (SM) and Social Class

Type of SM	Upper Class n (%)	Middle Class n (%)	Lower Class n (%)	Total n (%)
Severe Malaria Anaemia	31(10.7)	49 (17.0)	209 (72.3)	**289 (57.5)**
Cerebral Malaria	9 (15.8)	18 (31.6)	30 (52.6)	**57 (11.3)**
Prostration (PR)	9 (16.3)	15 (27.3)	31(56.4)	**55 (10.9)**
Persistent Vomiting (PV)	11 (20.7)	15 (27.3)	27 (50.9)	**53 (10.5)**
Multiple convulsions (MC)	8 (21.6)	9 (24.3)	20 (54.1)	**37 (7.4)**
Shock	7 (19.4)	10 (27.8)	19 (52.8)	**36 (7.2)**
Jaundice	6 (18.2)	9 (27.3)	18 (54.5)	**33 (6.6)**
Hyperpyrexia	6 (22.2)	9 (33.3)	12(44.5)	**27 (5.4)**
DIC (disseminated intravascular coagulation)	3(33.3)	3 (33.3)	3 (33.4)	**9 (1.8)**
Acute Kidney Injury	1 (12.5)	1 (12.5)	6 (75.0)	**8 (1.6)**
Haemoglobinuria (HGN)	2 (28.6)	2 (28.6)	3 (42.8)	**7 (1.4)**
Hypoglycaemia	1 (20.0)	1 (20.0)	3 (60.0)	**5 (1.0)**

Chi-square = 195.6, p = 0.0001 (Distribution is statistically significant)

Table 6: Comorbidities found among the children

Comorbidities	Frequency	Percentage
Sepsis	50	40.0
Sickle cell Anaemia	21	16.8
Meningitis	15	12.0
Acute watery Diarrhoea	14	11.2
Severe Undernutrition	11	8.8
UTI- Urinary Tract Infection	6	4.8
Bronchopneumonia	5	4.0
Otitis Media	3	2.4
Total	**125**	**100.0**

IV. Outcome and sex, age. Monthly admissions.

Case fatality rate in this study was 54 (10.7%,) this was not significantly affected by sex or age p=0.6147, p=0.8958 respectively as shown in tables 7 and 8. Table 9 shows that the highest cases of severe malaria were seen in the months of August 58 (11.53%), September 60(11.83%), October 57(11.332%) to November 61(12.13%).

Table 7: Outcome by Sex

Sex	DAMA n (%)	Discharged n (%)	Transferred to Dialysis ward n (%)	Died n (%)	Total n (%)
Male	2 (40.0)	244 (55.3)	2 (66.7)	34 (63.0)	**282 (56.1)**
Female	3 (60.0)	197 (44.7)	1 (33.3)	20 (37.0)	**221 (43.9)**
Total	**5 (100.0)**	**441 (100.0)**	**3 (100.0)**	**54 (100.0)**	**503 (100.0)**

Chi-square = 1.80, p = 0.6147 (distribution is not statistically significant)
DAMA (Discharged against medical adv

Table 8: Outcome by Age

Age (Years)	DAMA n (%)	Discharged n (%)	Transferred to Dialysis ward n (%)	Died n (%)	Total n (%)
0-<1	1 (20.0)	76 (17.2)	0 (0.0)	12 (22.2)	**89 (17.7)**
1-5	2 (40.0)	253 (57.4)	2 (66.7)	30 (55.6)	**287 (57.1)**
>5	2 (40.0)	112 (25.4)	1 (33.3)	12 (22.2)	**127 (25.2)**
Total	**5 (100.0)**	**441 (100.0)**	**3 (100.0)**	**54 (100.0)**	**503 (100.0)**

Chi-square = 2.26, p = 0.8938
DAMA (Discharged against medical advice)

Table 9: Monthly Admissions and mortality rate (2014- 2018)

Months	Number of Admissions	Percentage (%)	Deaths
January	20	3.98	3
February	21	4.175	2
March	31	6.163	3
April	30	5.96	2
May	40	7.95	3
June	40	7.95	4
July	38	7.555	9
August	58	11.53	6
September	60	11.93	7
October	57	11.332	4
November	61	12.13	3
December	47	9.345	8
Total	**503**		**54**

DISCUSSION

This study found a Prevalence of severe malaria of 8.6%, which is lower than 11.3% and 17.0% reported previously in studies in Nigeria and Yemen respectively [15], [16]. This decline in malaria cases is in keeping with the WHO world malaria report of an 18% decline in malaria cases globally from seventy-six to sixty-three per 1000 population at risk from 2010 to 2016. The largest reductions of 48%, 22% and 20% were recorded in the WHO south -East Asia region, the America and WHO African region respectively [4]. Despite these reductions, the incidence of malaria is still high in Nigeria according to the Nigeria demographic and health survey of 2013 [17] However, efforts are being made by the Nigerian government through the national malaria control strategic plan (NMCSP) which addresses lowering malaria related death, lowering malaria parasite prevalence rates in Paediatric patients less than 5years, accelerating ownership and use of insecticide-treated nets (ITNs) and long-lasting insecticidal nets (LLINs), presenting and increasing the number of people who practice indoor residual spraying (IRS), scaling up the use of diagnostic tests for fever patients, enhancing efforts related to apt and timely treatment of malaria, and accelerating coverage of intermittent preventive treatment (IPT) of malaria during pregnancy. [17]

In this study over fifty percent of the children with severe malaria were aged between one to five years old, this is in keeping with the report of other workers in Nigeria, Yemen, Congo Kinshasa [15],[16],[18]. This may have arisen from the fact that these children are yet to fully develop immunity against malaria which protects individuals in malaria endemic areas from having severe forms of malaria. A quarter of the children with severe malaria were over the age of five years which is similar to what was reported in Enugu, Nigeria and Kinshasa Congo [9] , 18] where, children up to 15years in Enugu and 13 years in Kinshasa were reported to have had severe malaria [9], [18] so we may not exclude severe malaria as a diagnosis in older children presenting with symptoms and signs suggestive of severe malaria, they should be properly investigated for malaria.

There were more males(56.1%) with severe malaria in this study than females(43.9%) which is consistent with reports from other workers [9], [15],[16], [19],[20] Although this difference was not statistically p = 0.8970 However, Edelu et al [9] working in Enugu found that males were significantly more affected than females and they could not explain it, but, proposed that females have more improved immunity to parasitic diseases which is said to arise from genetic and hormonal factors[21] Although there was no statistical significant difference in features of severe malaria in females when compared with that of males.

Interestingly in this study severe malaria did not spare children from any social class. Children from upper (13.5%), middle (21.5%) and lower social class (65%) were affected but as it's expected, the children from the lower social class constituted over half of the children with severe malaria (65%) in this study. Also, all the features of severe malaria were higher in children from the lower socioeconomic class when compared to those from middle and upper socioeconomic class and this difference was statistically significant (p = 0.8970). Similar to what was found in another study from a government hospital in Enugu, eastern Nigeria, where, children from lower socioeconomic class constituted 88.6% of cases of severe malaria [9]. This may not be a true representation as both studies were done in government hospitals. In Nigeria, most people in the upper social class would not patronize the government hospitals as the environment is not conducive, a lot of time is spent waiting on very long queues, with very few doctors to attend to so many patients. Individuals from the upper social class would rather go to private hospitals with more sophisticated environment, better services and less time wastage, although more expensive. So, it is not surprising that we have more children from the lower social class having severe malaria in these studies. Although people from the upper social class are more likely to start treatment for malaria as soon as symptoms arise and diagnosis made to avoid progression to its severe form, as such, we may find out that even if this study is replicated in a private clinic, we may find more children with severe malaria in upper socioeconomic class having severe malaria not necessarily because they are more but because they are the ones that can afford such services.

The year 2018 had the highest number of admissions of cases of severe malaria (23.4%), this is not a true representation as the previous years of 2014- 2016 had a lot of industrial actions by the health workers in Nigeria, and as such, a lot of the government hospitals were short down, including university of Port Harcourt Teaching Hospital where this study was carried out, this resulted in the decrease in the number of cases of severe malaria being observed in this study.

The months of August to November had the highest percentage admissions of cases of severe malaria in to the children emergency room, 11.53, 11.93, 11.332, 12.13 respectively, of cases of severe malaria. In Nigeria, during this period as a country we experience what we call the August break meaning that the heavy rainfalls experienced in the preceding months begin to disappear leaving pools of stagnate water along with overgrown shrubberies which are effective breeding places for mosquitos this might have accounted for the finding in this study and is similar to the report of Edelu et al[9] in Enugu who reported that the highest number of admissions in to their children emergency room occurred between the months of August to November accounting for

70%(71/102) of the total cases of severe malaria in their study [9]

Not starting treatment on time is one of the key factors why malaria progresses to its severe form. Only about 24.3% of caregivers in this study brought ward/ children within 72 hours of onset of symptoms, with a range of duration of symptoms before presentation of two days to fifteen days. This delay in presentation results from the meagre health seeking conduct of Nigerians who will choose preliminary self- medication, followed by consulting herbalist, buying drugs over the counter, before going to the hospital [9], [22],[23] This findings are similar to what was reported by Edelu et al in Enugu Nigeria, where about 30% of the patients in their study presented after one week of symptoms while 22% presented within 48hours of onset of symptoms. Also, in the study in Enugu [9], over 80% of the children had received one drug or another, mostly combinations bought over the counter. These over the counter drugs in Nigeria are not dispensed by pharmacists, so often times the drugs given to these patients may not be appropriate and may accelerate the progression of the disease. This situation is not different from what is reported from Gabon, Uganda where self-medication was reported in 50% and 62% respectively in children who presented with severe malaria. [20],[24]

Severe malaria anaemia (SMA) was the commonest clinical form of severe malaria seen in this study 57.5%. This falls within the range of 11.1% to 79.2% observed in other African countries. [9], [18], [20], [24],[25], [26],[27]. However this study found severe malaria anaemia (SMA) to be higher in children 1-5years of age 57.4% as against 24.9% in children over 5years of age, similar findings were observed in Enugu 77% vs 22.4%,[9], Gabon where severe malaria anaemia was highest in children less than 2years of age 68% and against 67.8% for the entire population of children in their study[20] Libreville 66.9% vs 32.9%, [9],[20], [25] This findings are not surprising, as SMA is a shared presenting feature of severe falciparum malaria in young children from Africa, [28] the mechanism explaining its occurrence is the breakdown of both parasitized and unparasitized red blood cells and worsened by reduced erythropoiesis.[29] In different African countries within WHO guideline different definitions have been adopted for severe malaria anaemia, and this influences the level at which transfusion is done in the respective countries, however, for this work and the recent WHO definition of severe malaria anaemia is haemoglobin less than 5g/dl in the presence of parasitized erythrocytes. [30]

All the features of severe falciparum malaria were observed in children in this study, at varying degrees, (Severe malaria anaemia (SMA) 57.5%, Cerebral malaria (CM) 11.3%, Prostration (PR) 10.9%, Persistent vomiting (PV) 10.5% Multiple convulsions (MC) 7.4%, shock 7.2%. Jaundice 6.6% hyperpyrexia 5.4%, DIC 1.8%. Acute kidney injury (AKI) 1.6%, Haemoglobinuria (HGN) 1.4%, Hypoglycaemia (HG) 1%) however, when we compared these features between children aged 1-5years and children over 5years, we observed that all features of severe falciparum malaria were higher in children 1-5years. and this difference was statistically significant. $p = 0.0001$ This is not surprising as severe malaria has been described as a disease of children under five years of age and ninety percent of which affects children in sub-Saharan Africa including Nigeria where this study was carried out. [31],[32] Similar findings were reported by other workers. In Enugu and Kinshasa, [9],[18], however in Enugu Acute renal failure and haemoglobinuria were higher in children over 5years of age [9]

Sepsis was the commonest comorbidity 40% observed in this study, other studies have reported the co-existence of sepsis in children with severe malaria. Bacteriaemia has also been documented to co-exist with severe malaria in other African countries. [33],[34],[35],[36],[37] Data have emerged from hospitals linked to program to suggest a biological link between malaria and susceptibility to invasive bacterial infection. Kathryn Maitland [38] reported that bacteriamia is an important complication of severe malaria in African children with severe malaria but it is often under diagnosed due to inadequate and poorly sustained facility for microbiological services.[38] WHO also documented the high occurrence of malnutrition and sepsis among children with severe malaria and has suggested the simultaneous use of broad spectrum antibiotics in children with severe malaria in moderate to high malaria transmission zones, until sepsis can be excluded.[39]

There was a duration of hospital stay of over 3 days to less than 7 days of 67.6% observed in this study, this is comparable to the report of Kamgaing et al [25] in Libraville where the average duration of stay was 4.7days for children with severe malaria. The reason they gave for this was that as a nation their national malaria program adopted the use of IV artesunate for the treatment of severe malaria which takes up to 3days.[25] However although Nigeria as a Nation also adopts the use of IV artesunate ours is completed in a 24hour period. [40]

The case fatality rate observed in this study was 10.7%. This is higher than a range of 0.3% to 8.9% observed in other African countries. [9], [19], [20], [24], [26] The reason for this may be the high presence of features of severe falciparum malaria in this study (such as severe malaria anaemia, cerebral malaria, shock, DIC) which are associated with high case fatality. [19],[24]. Also, some of these studies had much lower sample size for severe malaria 117 and 206 in Uganda and Libreville respectively. [24],[25] It is therefore naturally expected that with a much higher sample size of 503, and the presence features of severe malaria which are associated with a

high case fatality (such as severe malaria anaemia, cerebral malaria, shock, DIC) that the case fatality rate in this study would be higher. In Kinshasa, a low case fatality due to SMA of 0.6% was observed.[18] They attributed their low mortality from SMA to their efficient transfusion services, our transfusion service in our center is rather cumbersome and might take up to 4-5 hours for a patient with severe malaria anaemia, to have blood available for transfusion. The above factor may also have contributed to our higher case fatality rate. Also, the fact that severe malaria anaemia was very high in this study (57.5%) may also have contributed.

CONCLUSIONS

This study found out that the prevalence of severe falciparum malaria in children in Port Harcourt is still high, Sepsis was the commonest comorbidity associated with severe malaria and the severe manifestations associated with high case fatality are still being seen in our facility. Our case fatality is higher than what is obtained in other African countries. There is therefore a need to strengthen our malaria preventive services, review our blood transfusion services to cope with the high need of blood transfusion for the cases of SMA.

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