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Assessment of Health Worker's Pattern of Managing Severe Malaria in Children Under the Age of Five (0-5years) in Northwestern Nigeria - A Cross-Sectional Study of Hospitals in Kebbi State

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Abstract

While severe malaria (SM) contributes to high mortality in children in Nigeria, appropriate treatment is cardinal in reducing SM death. However, there exist limited studies on how health workers (HWs) manage SM in children in Nigeria. The study aimed to assess the health worker's treatment practices for severe malaria in children. A cross-sectional survey of severe malaria (SM) management in children (0- 5 years) was conducted in 377 participants across randomly selected 5 hospitals in Kebbi State. Data abstraction form was used to obtain parameters for SM from the patient's record. A structured questionnaire was utilized to get information from HWs regarding the management of SM. Statistical analysis was done using SPSS version 23.0. A total of 377 cases of SM were identified. Documented symptoms for SM symptoms included fever (43.2 %), convulsion –seizure (26.3%), pallor (10.3%), and loss of consciousness (3.2%). All the cases (100%) were tested for malaria, with RDT being the commonest (60.2%) technique used, while 71 (18.83%) cases received intra-artesunate, 24 (6.36%) received intravenous quinine. 125 (33.16%) children fully recovered, with 87 (23.08%) discharge cases, and 41 (19.80%) received a follow-up dose of ACT. However, a mortality rate of 26.79% was observed. The pattern of managing severe malaria in this study resulted in improved quality of life in above half of the studied population. However, a higher rate is possible should health workers be given more on-the-job supervision. Besides, further study would be required to ascertain the source of knowledge of severe malaria management in the region.

Keywords: *Anti-malarial, Compliance, Guideline, Knowledge, Kebbi State, Malaria, Nigeria, Providers, Supportive treatment.*

Introduction

Malaria is a complex disease that varies in epidemiology as well as public health impact in different countries across the globe [1]. According to the recent World Health Organization malaria report, in 2020 alone, about 241 million cases were recorded worldwide, with a mortality rate of 627000 [2]. Surprisingly, the African continent carries a disproportionately high share of the global malaria burden by accounting for 95% of all malaria cases and 96% of deaths worldwide [2]. Moreover, four countries account for approximately over half of all the malaria deaths globally: Nigeria (31.9%), the Democratic Republic of the Congo (13.2%), the United Republic of Tanzania (4.1%), and Mozambique (3.8%). Children under 5 years of age accounted for about 80% of all Malaria deaths in the region [2]. Besides, the report indicates that Nigeria alone accounts for 30% of the total malaria burden in Africa, with over 51 million cases and 207 000 deaths annually [3]. Shockingly, according to the 2019 World Malaria Report,

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children under the age of five years (0-5years) remain the most vulnerable group affected by malaria, with about 67% (27,2000) malaria deaths worldwide [4].

However, severe malaria - an acute form of malaria - with signs of organ dysfunction, is associated with high mortality, especially in children. Most often, it occurs due to delayed treatment of uncomplicated malaria and is characterized by vital organ dysfunction. While almost all deaths from severe malaria result from infection with P. falciparum, P. vivax, and P. knowlesi have also been documented to cause severe disease [5]. However, the resistance of malaria parasites to antimalarial agents continues to be a threat to malaria control and elimination efforts globally [6]. Infections with Plasmodium falciparum can be fatal in the absence of prompt recognition of the disease and its complications and urgent, appropriate patient management [4]. And the World Health Organization already recognizes that early diagnosis and prompt treatment, within 24 hours of the onset of symptoms, is an essential element of malaria control [7]. However, in children, a delay in prompt recognition and appropriate treatment of malaria cases increases morbidity and mortality [8], resulting from their weak immune system that is not yet fully developed to fight severe forms of the disease [9].

Considering the clinical spectrum of malaria in children, symptoms usually range from an asymptomatic state of malaria parasites to a febrile disease that may evolve into a severe, life-threatening illness if untreated [10]. The parasite's ability to induce complications such as cerebral malaria, severe anemia, and respiratory distress is associated with the mortality resulting from malaria. In addition, other common severe malaria presentations include hyperlactatemia, multiple or prolonged convulsions, hyperparasitaemia, circulatory collapse, hypoglycemia, prostration, jaundice, persistent vomiting, and intravascular hemolysis [11, 12]. Besides, the management of severe malaria in Nigeria especially continues to pose a serious challenge [13] due to the similar symptoms its shares with many other prevalent diseases states such as bacterial sepsis, enteric fever, pneumonia, meningitis, urinary tract infection, otitis media, malnutrition and sickle cell anemia [14, 15]. Besides, the management of severe malaria in children is complex and involves prompt identification of the manifestations of severe malaria, followed by initiation of appropriate treatment, monitoring of disease progression, and management of comorbidities [16]. Additionally, all these steps rely heavily on the availability of skilled health workers (HWs) and other health system resources such as diagnostic and treatment supplies. However, given the multilayered strategies of severe malaria management, especially in children, few studies have sought to shed light on the various ways the HWs utilize in the management of severe malaria of patients in care in sub-Saharan Africa [16].

According to a 2009 survey of health facilities for severe malaria case management practices in Uganda, it was found that, out of all patients assessed, only 27 % were correctly diagnosed with severe malaria, and 30 % did not receive the correct initial parenteral antimalarial at the appropriate dose and frequency. While about 54 % of the health facilities reported no stock-outs of the recommended parenteral quinine in the 3 months before the survey, shockingly, no facilities had consistent availability of all supplies required for the management of severe malaria [17]. In Nigeria, it has even become more pertinent to follow the laydown protocols in the management of severe malaria in children considering the huge impact this is having on the country's children population health outcome. More so, studies have shown that the risk of developing severe malaria among children in resource-poor settings varies considerably due to the environmental, socioeconomic, and available interventional factors [18, 19]. And poses a serious threat to the control of severe malaria in children from Nigeria [20]. Thus, considering all of these, Health workers (HWs) need to be more

knowledgeable about the recommended management strategies and to strictly comply with the treatment guidelines.

Although Nigeria has since adopted the WHO Guidelines for the treatment of malaria since 2015, which form an important step in standardizing diagnosis and treatment practices, evidence suggests that there is limited data on the effect of adherence to clinical guidelines on inpatient management in children managed for severe malaria [3].

Most importantly, the various challenges and the burden of severe malaria in children in Nigeria further underscore the need to assess severe malaria case management practices. Therefore, the study aimed to better understand how severe malaria in children is currently managed at public inpatient health facilities in Nigeria. Specifically, the quality of care given to severe malaria patients admitted to pediatric inpatient health facilities concerning the 2021 WHO Guidelines for Diagnosis and Treatment of malaria [21].

Material and Methods

Study Location

Kebbi is a state in north-western Nigeria with its capital at Birnin Kebbi. The state was created out of a part of Sokoto State in 1991. Kebbi State is bordered by Sokoto State, Niger State, Zamfara State, Dosso Region in the Republic of Niger, and the nation of Benin. It has a total area of 36,800 km^2 [22]. The state has Sudan and Sahel-savannah. The southern part is generally rocky, with the Niger River traversing the state from Benin to Ngaski LGA.The northern part of the state is sandy, with the Rima River passing through Argungu to Bagudo LGA, where it empties into the Niger. Agriculture is the main occupation of the people, especially in rural areas, Crops produced are mainly grains; animal rearing and fishing are also common. Christianity and Islam are the dominant religions of the people.

There are 225 political wards, 3000 settlements, and 1036 hard-to-reach settlements in the 21 Local Government Areas in the State [22].

Study Design

A cross-sectional survey of inpatient malaria case management was conducted in 5 general hospitals using multistage sampling techniques. Hospitals were selected with an equal probability from a list of all general hospitals in kebbi state that admit children patients with severe malaria.

Study Population

The reference population was children admitted with severe malaria in the kebbi state. The target populations were children aged 0-5 years hospitalized in a paediatric emergency unit (EPU).

Selection of Study Participants

The case folder of the child was randomly selected from all the general hospitals that had a positive thick blood smear and/or a positive RDT from 1st January 2018 to 30th December 2019. Patient records were abstracted by medically trained personnel on a standardized form. The abstracted forms were electronically entered independently by five data entry clerks, and all discrepancies were resolved by consulting the data abstraction forms.

Sample Size Determination

The sample size was calculated using the Bamgboye formula.

$$n = \frac{Z^2 Pq}{d^2}$$ [23]

Where

n = Minimum sample size desired.

z = Standard normal deviate at 95% confidence interval = 1.96.

p = Prevalence of malaria 0–5-year use = (66.3%) = 0.663(33).

q = complementary probability of p (q = 1- p).
= 1-0.38= 0.205.

d = Level of precision.
5% = 0.05.

$$n = \frac{1.96^2 \times 0.663 \times 0.337}{(0.05)^2}$$

$$n = 343.$$

Adjusting the rate of 10%

$$n_1 = n\,(1 + f)$$

where 'n' is the minimum sample size and 'f 'is the non-response rate.

Therefore,

$$n_1 = 343^{*}(1 + 0.1) = 343^{*}1.1 = 377.$$

Sampling Methods

A multi-stage sampling method was adopted in sample selection. In stage I, two out of 3 senatorial districts in the State were selected through simple random sampling employing simple balloting. In stage 2, lists of general hospitals per district were obtained from the Ministry of Health, and the general hospitals were selected through simple random sampling employing simple balloting. In stage three, four general hospitals and one specialist hospital were also randomly selected from a list of general hospitals in two senatorial districts namely. General Hospital Zuru, General Hospital Koko, General Hospital Arugungu, General Hospital Yawuri and Sir Yahaya specialist Hospital. Equal proportions of severe malaria from each hospital were collected. The total number of severe malaria cases = 75.

The Instrument for Data Collection and Study Variables

Data abstraction form was used to extract the relevant parameters for severe malaria from each eligible pediatric patient's record. A structured questionnaire was employed by trained research assistants who interviewed health workers involved in the management of severe malaria. Reliability of the instrument was ensured by pre-testing (pilot testing) of the questionnaires among 10 healthcare workers involved in the management of severe malaria in children in Sir Yahaya Specialist Hospital; this was used in modifying the questionnaire for better clarity. Validity was carried out by ensuring that the content of the questionnaire was full and comparable to guidelines for the management of severe malaria in children. Study variables include information on demographic characteristics of the respondents, knowledge on the management of severe malaria among children, and training participation.

Ethical Consideration and Approval

Ethical approval to conduct this study was obtained from the Research Ethics Committee of Kebbi State Ministry of Health (KSHREC Registration Number: 105:29/2020). Permissions were also taken from the medical director of the general hospitals. Written informed consent was obtained from each respondent who took part in this study.

Data Analysis and Management

Data validation was done in Microsoft Excel version 13 and exported to SPSS version 23.0 (Chicago IL) for windows for statistical analysis. All variables were coded as binary dummy variables. For sex (male = 1, female = 2). Data presented as charts and frequency distribution generated for all categorical variables while mean and standard deviation for numerical variables. Descriptive and inferential statistics (Chi-square Fisher exact test) were applied between the demographic and clinical presentation of severe malaria variables. Bivariate spearman ranking correlation analysis was used to determine patient characteristics predicting severe malaria among the study population. To determine the strengths of association in a Bivariate analysis, P-value < 0.05 was considered statistically significant.

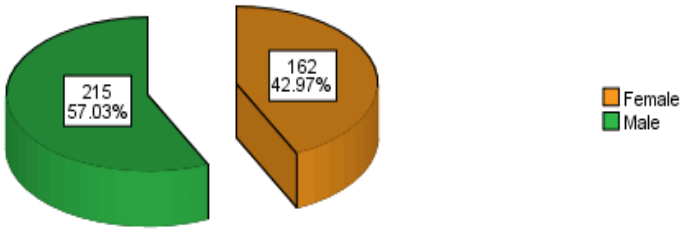
Result

There were a total of 377 cases of severe malaria identified from five general hospitals in kebbi state, with an equal proportion from each cluster. From Figure 1, there were more male children, 215(57%) with severe malaria, compared to counterpart females 162(43%), with a male to female ratio of 1.3:1. While according to Figure 2, the mean age of the children was 24.2 ± 14 months. The overall

average length of hospital stay during the period was 4.2 ± 4, with a range of (0 - 32) days. The mean temperature and overall weight of children with severe malaria were [13.7 ± 6.5 Kg and 33.1 ± 3.8^0 Celsius]. Table 2 showed the age distribution of children; the peak incidence occurred within the range of 12-23 months accounted for 110(29.18%), followed by 24 -35 months 100(26.53), 36-47 months 66(17.51%), 61(16.18%) 0-11 months and 40(10.61%) 48-60 months. The most commonly documented severe malaria symptoms according to Table 1 among the study participant fever was documented in 163 (43.2 %) of all patient records, followed by convulsion –seizure 99(26.3%), pallor 39(10.3%) loss of consciousness, 12(3.2%), jaundice accounted for 5(1.3%). One hundred and thirty patients (34.5%) presented with co-morbidities, of which 78(20.7%) were sickle cell anemia, sepsis 23(6.1%), severe malnutrition 11(2.9%), pneumonia 7(1.9%) acute gastroenteritis 6(1.6%), meningitis 3(0.8%) and Urinary tract infection 2(0.5%).

Figure 1 depicts the age versus gender among children with severe malaria, were 0 -11 months significantly differ between the age categories ($P<0.05$), there was more female child accounted for 35(57.40%) while males had 26(42.6%). Within the age group of 12 – 23 months, 61(55.5%) were males while 49(44.5%) were females. There was no significant difference in the distribution of severe malaria within the age range of 12 - 23 months between the males and females ($P>0.05$). Based on Table 3, RDT was the commonest 227/377(60.2%) method used for malaria parasite test (MP) among all the general hospitals, while those used both RDT and Microscopic accounted for 91/377(24.1%) and 59/377(15.64%) tested for parasitemia using microscopy. The mode of use among the general hospitals was significantly varied ($P = 0.01$). And based on the result in Table 3, laboratory investigation for malaria parasite test showed that 228/377(60.5%) Malaria RDT was administered, of which 189/228(82.9%) were positive and 39/228(17.1%) were negative, the distribution of severe malaria test using RDT significantly differed across all the starter ($P<0.05$). From Table 4, other laboratory investigations for severe malaria showed half of the patients 190/377(50.39%) done PCV test, in which general hospital zuru had the highest proportion 69(36.3%), followed by sir Yahaya specialist hospital had 40(21.1%), general hospital Koko accounted for 34(17.9%). The majority of laboratory investigations such as full blood count, Electro-light urea and creatinine, blood sugar were not done.

From Table 5, regarding the documented treatment of severe malaria, one hundred and one of the patients were received intravenous antibiotics, of which 60(59.4%) were male while 41(40.6%) were female, 83 children patients received blood transfusion; males accounted for 41(49.4%, female had 42(50.6%), the proportion of child patients received intra-artesunate were 71 individuals 29(40.8%) were male while 42(59.2%) were females. Out of 377 patients admitted with severe malaria, 125(33.16%) recovered. While the rate of mortality cases during the period of admission was raised to 101(26.79%) and 87(23.08%) patients were discharged home as evident in Figure 3.



Gender of the study participants

Figure 1. A Pie Chart showing the Gender Distribution of the Study Participants

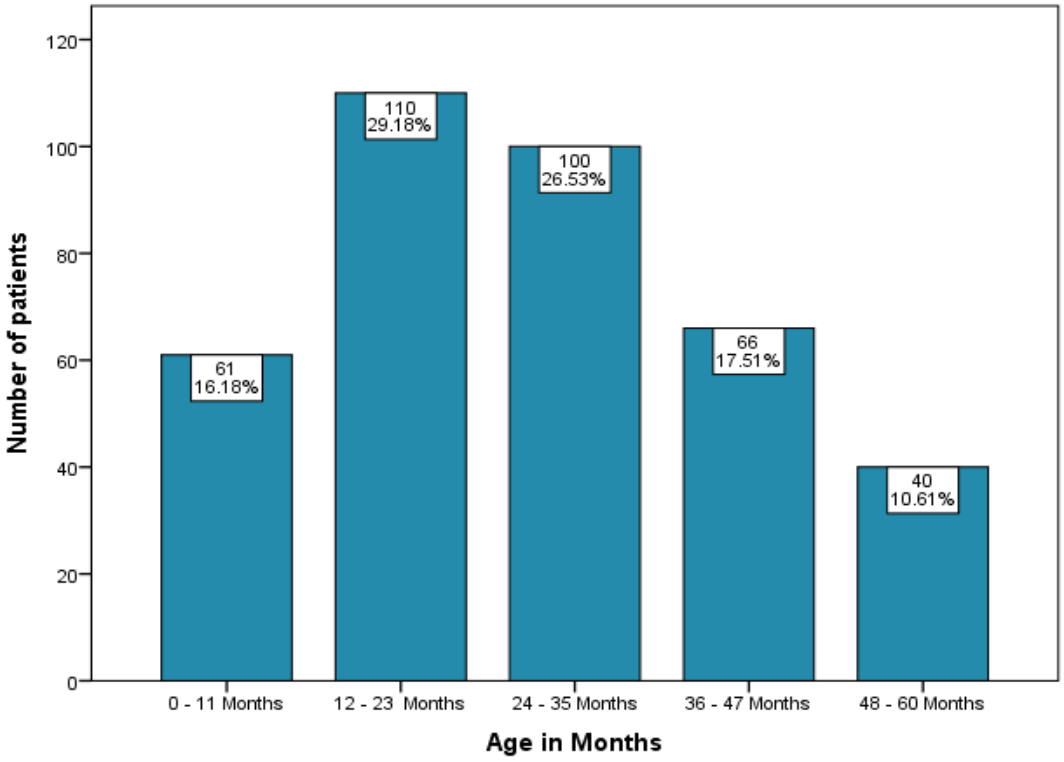


Figure 2. A Histogram that Depicts the Age Disaggregation of the Study Participants

Table 1. Clinical Characteristics of Severe Malaria

Clinical Feature of Severe Malaria	**Frequency**	**Percent**
Fever	163	43.2
Convulsions-Seizure	99	26.3
Pallor	39	10.3
Multiple convulsions	17	4.5
Loss-of-consciousness	12	3.2
Jaundice	5	1.3
Severe-malarial-anaemia	4	1.1
Impaired consciousness	3	0.8
Pulmonary oedema	3	0.8
Prostration	1	0.3
Significant bleeding	1	0.3
Others	30	8
Co-morbidities		
Sickle-Cell-Anaemia	78	20.7
Sepsis	23	6.1
Severe malnutrition	11	2.9
Pneumonia	7	1.9
Acute gastroenteritis	6	1.6
Meningitis	3	0.8
UTI	2	0.5
None	247	65.5
Total	377	100

Table 2. Uni-Variate Analysis of Age and Gender among 377 Children Patient Admitted with Severe Malaria

Ages in Months	**Total**		**Gender**		**P-values**
			Male	**Female**	
0 - 11 Months	61	Count	26	35	0.016
		Percent	42.6%	57.4%	
12 - 23 Months	110	Count	61	49	0.735
		Percent	55.5%	44.5%	
24 - 35 Months	100	Count	63	37	0.195
		Percent	63.0%	37.0%	
36 - 47 Months	66	Count	43	23	0.171
		Percent	65.2%	34.8%	
48 - 60 Months	40	Count	22	18	0.866
		Percent	55.0%	45.0%	

Table 3. Various Forms of Laboratory Test for severe malaria by Study Location

Form of Lab Test		Total	Location of Study			P-value		P-value
			GH Argungu	Sir Yahaya SH	GH Yawuri	GH Zuru	GH Koko	
RDT	Count	227	13	61	20	66	67	0.01
	Percent		5.7%	26.9%	8.8%	29.1%	29.5%	
Microscopic	Count	91	62	14	1	6	8	0.01
	Percent		68.1%	15.4%	1.1%	6.6%	8.8%	
Both RDT and Microscopic	Count	59	0	0	56	3	0	0.01
	Percent		0.0%	0.0%	94.9%	5.1%	0.0%	
Result status								
One Plus (1+)	Count	10	2	2	3	3	0	0.55
	Percent		20.0%	20.0%	30.0%	30.0%	0.0%	
Two Plus (2+)	Count	88	43	4	35	6	0	0.01
	Percent		48.9%	4.5%	39.8%	6.8%	0.0%	
Two Plus (3+)	Count	51	17	8	18	0	8	0.01
	Percent		33.3%	15.7%	35.3%	0.0%	15.7%	
RDT (Positive)	Count	189	10	39	21	64	55	0.01
	Percent		5.3%	20.6%	11.1%	33.9%	29.1%	
RDT (Negative)	Count	39	3	22	0	2	12	0.01
	Percent		7.7%	56.4%	0.00%	5.1%	30.8%	

Table 4. Other Laboratory Investigation for Severe Malaria

Hematological Parameters	Response		Total	Study Location				
				GH Argungu	Sir Yahaya SH	GH Yawuri	GH Zuru	GH Koko
PCV	Yes	Count	190	21	40	26	69	34
		Percent		11.10%	21.10%	13.70%	36.30%	17.90%
	No	Count	187	54	35	51	6	41
		Percent		28.90%	18.70%	27.30%	3.20%	21.90%
Full Blood Count	Yes	Count	76	37	33	2	4	0
		Percent		48.70%	43.40%	2.60%	5.30%	0.00%
	No	Count	301	38	42	75	71	75
		Percent		12.60%	14.00%	24.90%	23.60%	24.90%

EUCR	Yes	Count	50	41	9	0	0	0
		Percent		82.00%	18.00%	0.00%	0.00%	0.00%
	No	Count	327	34	66	77	75	75
		Percent		10.40%	20.20%	23.50%	22.90%	22.90%
Blood sugar	Yes	Count	24	20	3	0	0	1
		Percent		83.30%	12.50%	0.00%	0.00%	4.20%
	No	Count	353	55	72	77	75	74
		Percent		15.60%	20.40%	21.80%	21.20%	21.00%
Urinalysis	No	Count	352	53	74	77	73	75
		Percent		15.10%	21.00%	21.90%	20.70%	21.30%
	Yes	Count	25	22	1	0	2	0
		Percent		88.00%	4.00%	0.00%	8.00%	0.00%
CSFMCS	Yes	Count	27	25	2	0	0	0
		Percent		92.60%	7.40%	0.00%	0.00%	0.00%
	No	Count	350	50	73	77	75	75
		Percent		14.30%	20.90%	22.00%	21.40%	21.40%
CSF Chemistry	Yes	Count	37	37	0	0	0	0
		Percent		100.00%	0.00%	0.00%	0.00%	0.00%
	No	Count	340	38	75	77	75	75
		Percent		11.20%	22.10%	22.60%	22.10%	22.10%
Liver Function Test	Yes	Count	30	25	3	0	2	0
		Percent		83.30%	10.00%	0.00%	6.70%	0.00%
	No	Count	347	50	72	77	73	75
		Percent		14.40%	20.70%	22.20%	21.00%	21.60%
Blood culture MCS	Yes	Count	27	25	1	0	1	0
		Percent		92.60%	3.70%	0.00%	3.70%	0.00%
	No	Count	350	50	74	77	74	75
		Percent		14.30%	21.10%	22.00%	21.10%	21.40%

Table 5. Treatment of Severe Malaria among Children 377 Patients Admitted

Form of Treatment		Gender		Total
		Male	Female	
Anticonvulsant	Count	26	9	35
	Percent	74.3%	25.7%	
Antipyretics	Count	5	1	6
	Percent	83.3%	16.7%	
Blood transfusion	Count	41	42	83
	Percent	49.4%	50.6%	
Follow-up-dose-with-ACT	Count	31	10	41
	Percent	75.6%	24.4%	
Intra-Artesunate	Count	29	42	71
	Percent	40.8%	59.2%	
Intra-glucose	Count	10	6	16
	Percent	62.5%	37.5%	
Intra-Quinine	Count	13	11	24
	Percent	54.2%	45.8%	
Intravenous antibiotics	Count	60	41	101
	Percent	59.4%	40.6%	
Total	Count	215	162	377
	Percent	57.0%	43.0%	

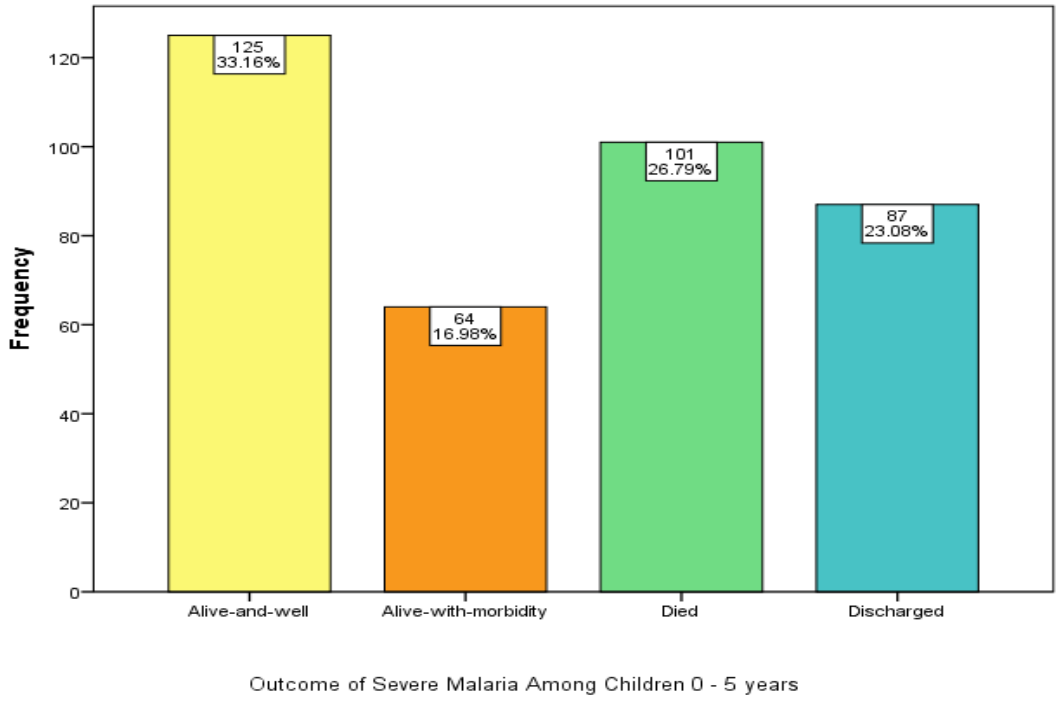


Figure 3. The Outcome of Severe Malaria among Children

Discussion

Following the treatment guidelines, malaria case-management services, including both diagnostics and treatment, were widely available in inpatient health facilities (HFs) in Kebbi State, Nigeria, representing tremendous progress over the years.

Testing with RDTs was observed to be the most common laboratory testing mode employed by the HFs as against the microscopy testing that is considered the gold standard requiring stringent conditions [24, 25]. This appears to contradict findings from other studies where it was observed that RDTs availability was limited in the studied HFs [26]. This could probably be attributed to the wide availability and supply of RDT to government HFs in the country through the support from the National Malaria Elimination Programme (NMEP) and the little time it takes to make malaria diagnosis in high volume HFs using the RDTs, couple with its acceptability by the health workers (HWs) in the surveyed facilities. Additionally, the epileptic nature of the electricity supply in some parts of the country can also limit the use of microscopy testing in facilities that rely on the national electric supply.

Moreover, the majority of HWs carried out laboratory testing to detect and confirm the presence of malaria parasites. This was evident by the 100% testing for severe malaria in the sampled patients admitted to the pediatric wards and followed the laid down protocol of "test and treat policy".

In the National Guidelines for Diagnosis and Treatment of malaria. Besides, this also conforms to the finding reported in Kenya when both microscopy and RDT were available at HFs [27]. However, this was higher than that reported in many other malaria-endemic settings since the release of the WHO recommendation for universal access to malaria diagnostics testing [28, 29, 30], indicating higher improvement in laboratory testing capacities in the health facilities.

From the retrospective Patient records evaluation for severe malaria case management in this survey, it was observed that the majority of the admitted patients (87.53%) demonstrated clear symptoms of severe malaria that include fever, convulsion-seizure, pallor, Multiple convulsion, and loss of consciousness. This could be an improvement in the documentation practice in the HFs through the introduction of structured admission record forms for patients to facilitate data collection and performance monitoring [31, 32].

The study also shows that in the treatment of severe malaria, artesunate was used more than quinine, with other supportive care to reduce mortality. Interestingly, after seven years of change of treatment policy from quinine to artesunate, it could be said that the policy is taking effect in the sampled facilities as there is a substantial shift to the use of artesunate, probably due to increased training awareness among the HWs. While it has been recently reported in Uganda, [33] this survey finding showing low levels of ACT follow-on treatment is worrisome and requires further investigations to unravel the reasons for such practice, which invariably contributes to the compromised cure rates [34]. Factors such as ACT availability and knowledge of the prescribers about this standard will go a long way in improving patient's health outcomes in HFs. Although the rate of mortality in the sampled patients was 26.79%, the figure still appears alarming despite the availability of relevant testing materials and parenteral medications as found from the result. While this study could not measure HWs supervision, a further assessment of these HWs may be needed to support this finding and to engender the practice of HWs in handling severe malaria cases. However, immediate priority should be given to ensuring that these HWs have at least regular supervision.

Limitation

This study has several limitations. As the study was only limited to pediatric patients aged 0-5 years admitted with severe malaria in the paediatric emergency unit. Besides, in this study, survey teams did not directly observe patient-HW interactions and relied on patient reports, which is subject to recall bias. However, all the patients had their clinical encounters recorded in the health booklet which was examined by the survey teams. The presence of the survey teams

at HFs likely influenced HW practices even though they did not directly observe their work. This may have overestimated appropriate treatment since HWs may have been more likely to follow guidelines under assumed supervision. In addition, the accuracy and validity of the testing materials/equipment were not evaluated to make sure that HWs followed manufacturer instructions and that the kits were in good condition. And given the retrospective nature of reviewing patient records, it was not possible to verify information from the caregiver or patients in real-time to ascertain or obtain information regarding the onset of the signs of severe malaria in the patients.

Furthermore, the multivariable analysis for appropriate treatment was limited to 377 presumed severe malaria patients seen at five HFs, a small sample size that may have underpowered the analysis.

Conclusion

While severe malaria accounts for a considerable burden of hospital admission in Nigeria, in this survey, a majority of patients diagnosed with severe malaria were tested and confirmed to have malaria through appropriate laboratory testing before receiving the recommended IV therapy per National Guidelines for Diagnosis and Treatment of Malaria. Moreover, the pattern of managing severe malaria in this study resulted in improved quality of life in above half of the studied population. While further study would be required to ascertain the source of knowledge of severe malaria management in the region, the rate of mortality in this study is quite alarming. Efforts should be directed at enhancing supervision and support to younger health workers (HWs). And training to further keep the HWs abreast of the ways of managing severe malaria, particularly within the context of the National Guidelines for Diagnosis and Treatment of Malaria.

Although further study would be required to ascertain the source of knowledge of severe malaria management in the HWs in this region, there is a need to ensure the availability of the National Guidelines for Diagnosis and Treatment of Malaria in the health facilities to support the treatment rendered by the HWs.

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Conflict of Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Written informed consent was obtained from all enrolled health workers before conducting interviews. Ethical approval (KSHREC Registration Number: 105:29/2020) was provided by the Research Ethics Committee of Kebbi State Ministry of Health. And Permissions were also taken from the medical director of the general hospitals used as the study sites.

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