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Malaria Prevalence in Toddlers: A Retrospective Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Malaria is one of the most important public health and life-threatening parasitic infections caused by the protozoan parasite- Plasmodium. The WHO Global technical strategy for malaria 2016–2030, updated in 2021, provides a technical framework for all malaria-endemic countries. It is intended to guide and support regional and country program as they work towards malaria control and elimination.
Objectives: This study assessed the prevalence of malaria in toddlers in a tertiary health facility in developing countries between January and December 2021.
Methodology: The study involved the use of patient's case notes, A total of 104 case notes were selected using simple random technique. A checklist was generated from the collection of data. Data was analyzed using the statistical package for scientific solution (SPSS) software version

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21.0. for descriptive statistics. The Chi square test was used to test for associations. The level of significance was set as $P < 0.05$.

Results: It was discovered that Half (50%) of the toddlers were 2years old, a little above half (52.9%) were male and the mean age was 2.31 with a standard deviation of 3.02. studies. On the financial implication of malaria treatment study revealed that 76.9% spent between ₦1500 - ₦1900 and artesunate was the most common antimalarial used and most children spent up to 3 days on admission

Conclusion: Findings from this study reveals that the prevalence is common among toddlers especially in 2years old. The average amount spent on antimalarial purchase is relatively fair based on the drugs the patients can afford. The highest prevalence was seen in July (62%) and the least prevalence was seen in January (30%).

Keywords: Malaria; toddlers; anti-malaria; income; prevalence; anopheles mosquito.

ABBREVIATIONS

WHO : World Health Organization
ACT : Atermisinin-based Combination Treatment
OOP : Out of Pocket Expenditure
SMC : Seasonal Malaria Chemoprevention
MDA : Mass Drug Administration

1. INTRODUCTION

1.1 Background

"Malaria is one of the most important public health and life-threatening parasitic infections caused by the protozoan parasite- Plasmodium. It is a major concern in tropical and subtropical parts of the world. Plasmodium organisms implicated are: *Plasmodium falciparum*, *P. vivax*, *P. ovale*, *P. knowlesi*, and *P. malariae*. These are the five *Plasmodium* species that cause malaria in humans" [1].

"In 2018, the World Health Organization (WHO) report indicates that globally an estimated 228 million new cases of malaria were documented. The WHO African region accounted for 93% of all cases followed by the Southeast Asia region (3.4%) and Eastern Mediterranean region (2%). Likewise, there were an estimated 405,000 deaths due to malaria in the globe. Children under the age of five-years accounted for two-thirds (67%) of the world's malaria deaths in 2018" [2-6].

"The mode of transmission of malaria is by infected female anopheles mosquito which feed from infected person and then feed on non-infected person thereby leading to spread of the condition. However, other mode of transmission include mother to fetus, through blood transfusions and by sharing needles used to give intravenous medications". [7]

"Categories of people at risk of having malaria are people who leave in the malaria endemic zones which include Sub-Saharan Africa, South and Southeast Asia, Pacific Islands, Central America and Northern South America" [8-11].

"Symptoms of malarial infection are nonspecific and may manifest as a flulike illness with fever, headache, malaise, fatigue, and muscle aches. Some patients with malaria present with diarrhea and other gastrointestinal (GI) symptoms. Immune individuals may be completely asymptomatic or may present with mild anemia" [12].

However, symptoms of malaria have been found to be severe in some young children and infants, older adults, travelers coming from areas with no malaria and pregnant women and their unborn children [13-15].

They go as far presenting with loss of consciousness, acute kidney injury, loss of developmental milestones and severe anemia.

It has been observed that in many countries with high malaria, may owe it to poor environmental conditions [16].

Appropriate history taking, examination, blood investigations and test using the rapid diagnostic test kit for malaria and microscopic view of peripheral blood film of suspected cases is key to effective treatment. Generally, the World health Organization (WHO) advocates the control of malaria through three major ways: effective vector control, use of prophylactic dugs and vaccination.

1. Effective vector control
2. Use of drugs and prophylactic drugs
3. Vaccination

1.2 Statement of the Problem

"Nigeria suffers the world's greatest malaria burden, with approximately 51 million cases and 207,000 deaths reported annually (approximately 30 % of the total malaria burden in Africa), while 97 % of the total population (approximately 173 million) is at risk of infection with children constituting about 53% of such" [17].

"Malaria and poverty are connected intimately, as malaria primarily affects low- and lower-middle income countries, where the poorest communities are affected most severely by malaria due to their poor socioeconomic and environmental status, and inadequate services for prevention, diagnosis, and treatment" [18]. "Hence, these endemic communities are trapped in a vicious cycle of poverty, underdevelopment, and disease" [19].

The damage this can cause to the society and future generation is not farfetched most especially because under 5 children are yet to develop strong immunity against the disease. Other Factors that have been noted to increase the mortality rate among infants especially in sub-sahara Africa include low social economic status, poor nutrition; inadequate healthcare facility, delay in presentation, self-medication leading to drug resistance have been identified [20].

It is also worthy of note and alarming that the WHO reported that four African countries have accounted for just over half of all malaria deaths worldwide: Nigeria (31.9%), the Democratic Republic of the Congo (13.2%), United Republic of Tanzania (4.1%) and Mozambique (3.8%) [21]. Statistics here clearly place Nigeria among the highest with under five children leading the number of death and common presentation to the hospitals.

1.3 Justification of the Study

Numerous studies and research have been done on malaria. That of a prevalence study especially to determine the prevalence among toddlers in the pediatrics department of a tertiary teaching hospital such as Specialist Teaching Hospital Irrua has not been fully exhausted. The fact the study is done in a malaria endemic zone which has received cases and managed malaria complications in children since inception further backs the need for the study to be appreciated and carried out to ascertain the current state and situation of things with regards to those done in other studies.

The results of this research can also help in identifying the presenting complains, complications and cost of treatment of malaria among toddlers. Findings from the studies will help to contribute to policy making and effective decision making the management of malaria among toddlers, infants and children in general.

1.4 Objectives of the Study

The General Objective of the study was to determine Prevalence of malaria in toddlers in the pediatrics department of a tertiary health facility - Specialist Teaching Hospital Irrua. (ISTH) with special consideration to the cost and common drugs used.

2. LITERATURE REVIEW

2.1 Prevalence of Malaria among Toddlers

In a national cross-sectional study done in Guinea. A total of 1984 children aged 6 months to 9 years were enrolled. The mean age was 50 months (SD, 27). The rapid diagnostic test showed high malaria prevalence (44%) countrywide along with regional variation ranging from 38% to 61%. A multivariate analysis showed that living in Forest Guinea (AOR: 2.48; 95% CI: 1.78–3.46), in rural areas (AOR: 1.91; 95% IC: 1.45–2.5) and having a splenomegaly (AOR: 2.66; 95% CI: 1.75–4.04) were highly associated with malaria. This study shows that malaria is still prevalent in Guinea among children aged 6 months to 9 years of age". [22] The researcher sets to find out if similar conditions observed in this study will be reproduced in the ongoing study.

"In a cohort study done for over 18months among 553 children in the republic of Benin, it was observed that in three cross-sectional surveys, malaria incidence showed a marked seasonal distribution with two peaks: the first corresponding to the long rainy season, and the second corresponding to the overflowing of Lake Nokoue. The overall *Plasmodium falciparum* incidence rate was estimated at 84/1,000 person-months, and its prevalence was estimated at over 40% in the two first surveys and 68.9% in the third survey" [23]. This study was restricted to two seasons which doesn't give an over view of an adequate result in the course of the year.

2.2 Cost Implication of Treating Malaria

"In a study to determine the cost implication of treating malaria in Zambia, it was observed that severe malaria in children has been shown to account for over 45% of the total monthly curative healthcare costs incurred by households compared to the mean per capita monthly income. The cost of treating severe malaria depleted 7.67% of the monthly average household income." [24]

"In a study done on three sub-Saharan countries (Ghana, Tanzania and Kenya) to estimate the economic cost of malaria among under 5 using several models, it was observed that household and health system costs per malaria episode ranged from approximately US$ 5 for non-complicated malaria in Tanzania to US$ 288 for cerebral malaria with neurological sequel in Kenya. On average, up to 55% of these costs in Ghana and Tanzania and 70% in Kenya were assumed by the household, and of these costs 46% in Ghana and 85% in Tanzania and Kenya were indirect costs. Expected values of potential future earnings (in thousands) lost due to premature death of children aged 0–1 and 1–4 years were US$ 11.8 and US$ 13.8 in Ghana, US$ 6.9 and US$ 8.1 in Tanzania, and US$ 7.6 and US$ 8.9 in Kenya, respectively. The expected treatment costs per episode per child ranged from a minimum of US$ 1.29 for children aged 2–11 months in Tanzania to a maximum of US$ 22.9 for children aged 0–24 months in Kenya. The total annual costs (in millions) were estimated at US$ 37.8, US$ 131.9 and US$ 109.0 nationwide in Ghana, Tanzania and Kenya and included average treatment costs per case of US$ 11.99, US$ 6.79 and US$ 20.54, respectively" [25].

2.3 Drug Used in Treating Malaria

"In an interviewer's based study in Ethiopia, of 447 children with malaria-like symptoms, only 30% took the recommended first-line treatment (ACT) (all of whom were cured), and 47% took chloroquine (93.4% cured)" [26].

"In a retrospective study done in Nigeria to assess the treatment of under-5 in tertiary hospitals, analysis of the data revealed that more male (213) than female (169) children were admitted for malaria treatment: Fever with convulsion (55.8%) was the commonest presenting symptoms, and anemia was the most frequent complications of malaria recorded. Chloroquine was found to be the most prescribed antimalarial agent and overall antemisinin-based drug was prescribed either as a first or second line treatment in only 18.2% of the cases. The death rate recorded was 16%" [27].

3. METHODOLOGY

3.1 Study Area

The study area was at Irrua Specialist Teaching Hospital (ISTH) which was established in 1993. It is involved in all round healthcare especially the pediatric department made up of special baby care unit, pediatric ward, and children emergency ward.

3.2 Study Design

A descriptive cross sectional retrospective study was employed for this study.

3.3 Study Population

Toddlers who had been admitted in ISTH pediatrics' department over the past 1year constituted the study population.

3.4 Study Duration

The study was carried out for a period 6 months.

3.5 Selection Criteria

Inclusion criteria

- All cases of malaria in toddlers diagnosed between January and December 2022.
- All cases of toddlers between January and December 2021

Exclusion criteria

- All case-notes of toddlers who were not admitted

3.6 Sample Size Estimation

Sample size will be estimated using Cochran's formula for cross sectional surveys

$$\text{Sample size } n = \frac{Z^2 P 6 \quad q}{d^2} = \ldots^{31}$$

For this study

Z = 1.96
P =93.4%i.e 0.934 (using a prevalence rate of 93.4% in an interviewer's based study in Ethopia) [28]
d = 0.05

From the formula above

$$\text{Sample size } n = \frac{Z^2Pq}{d^2}$$

$$\text{or } n = \frac{Z^2P(1-P)}{d^2}$$

$$n = \frac{(1.96)^2 \times 0.934 \times (1-0.934)}{(0.05)^2}$$

$$n = \frac{3.8416 \times 0.934 \times 0.066}{0.0025} = \frac{0.235110216}{0.0025}$$

n = 94.04 approximately 95. With a 10% attrition making up to 104 case notes

3.7 Sampling Technique

Case notes that suites the selection criteria were selected randomly per month until the sample size was completed.

3.8 Method of Collection of Data

The data was collected from case notes.

3.9 Study Instrument

Checklist: a checklist was employed for the study to fit criteria needed for the study, having obtained approval from Department of Community Medicine, Ambrose Alli University, Ekpoma.

3.10 Data Analysis

The data was analyzed using the statistical package for scientific solution (SPSS) software version 21.0(SPSS Inc, Chicago, USA). The chi square test was used to test for statistical associations. P value of less than 0.05 was regarded as significant.

4. RESULTS AND DISCUSSION

104 case notes that met the inclusion d criteria were selected from the pool of case notes in the record office and the following findings were observed and represented in charts and table below:

Half (50%) of the toddlers were 2years old and a little above half (52.9%) were male and the mean age was 2.31 with a standard deviation of 3.02.

It was observed that the number of days spent on admission in this study ranged between 1-4 with the highest- 3 days similar to studies done among countries in Sub-Sahara Africa [25] and in a study in a non-endemic zone (Spain) [8].

Table 1. Socio-demographic characteristics for children

Variable	Frequency	Percent
Age in years	n=104	%
1	25	24.0
2	52	50.0
3	28	26.0
Sex		
Male	55	52.9
Female	49	47.1
MEAN±S.D	2.31±3.02	

Table 2. Sociodemographic characteristics for father

Variable	Frequency	
Age in years	n=104	%
21-30	15	14.4
31-40	67	64.4
41-50	21	20.2
51-60	1	0.9
MEAN±S.D	36.78±5.24	

Variable	Frequency	
Level of education		
No formal Education	8	7.7
Primary	12	11.5
Secondary	36	34.6
Tertiary	48	46.2
Religion		
Christian	94	90.4
Muslim	10	9.6
Occupation[35]		
Managerial and Technical	47	45.2
Entrepreneur	26	25.0
Skilled	17	16.3
Professional	14	13.5
Ethnicity		
Esan	72	69.2
Etsako	11	10.6
Bini	7	6.7
Igbo	5	4.8
Yoruba	4	3.8
Ora	4	3.8
Afemai	1	0.9

Table 3. Sociodemographic characteristics for mother

Variable	Frequency	Percentage
Age in years	n=104	%
21-30	67	64.4
31-40	29	27.9
41-50	6	5.8
51-60	2	1.9
MEAN±S.D	29.58±5.87	
Level of education		
No formal education	9	8.7
Primary	12	28.8
Secondary	53	50.9
Tertiary	30	11.5
Religion		
Christian	92	88.5
Muslim	12	11.5
Occupation [35]		
Entrepreneur	62	59.6
Managerial and Technical	24	23.1
Professional	13	12.5
Unemployed	5	4.8
Ethnicity		
Esan	72	69.2
Etsako	12	10.6
Bini	7	6.7
Igbo	4	4.8
Yoruba	4	4.8
Ora	3	2.8
Afemai	1	0.9

Variable	Frequency	Percentage
Parity		
1-2	51	49.0
3-4	37	35.6
5-6	16	15.4

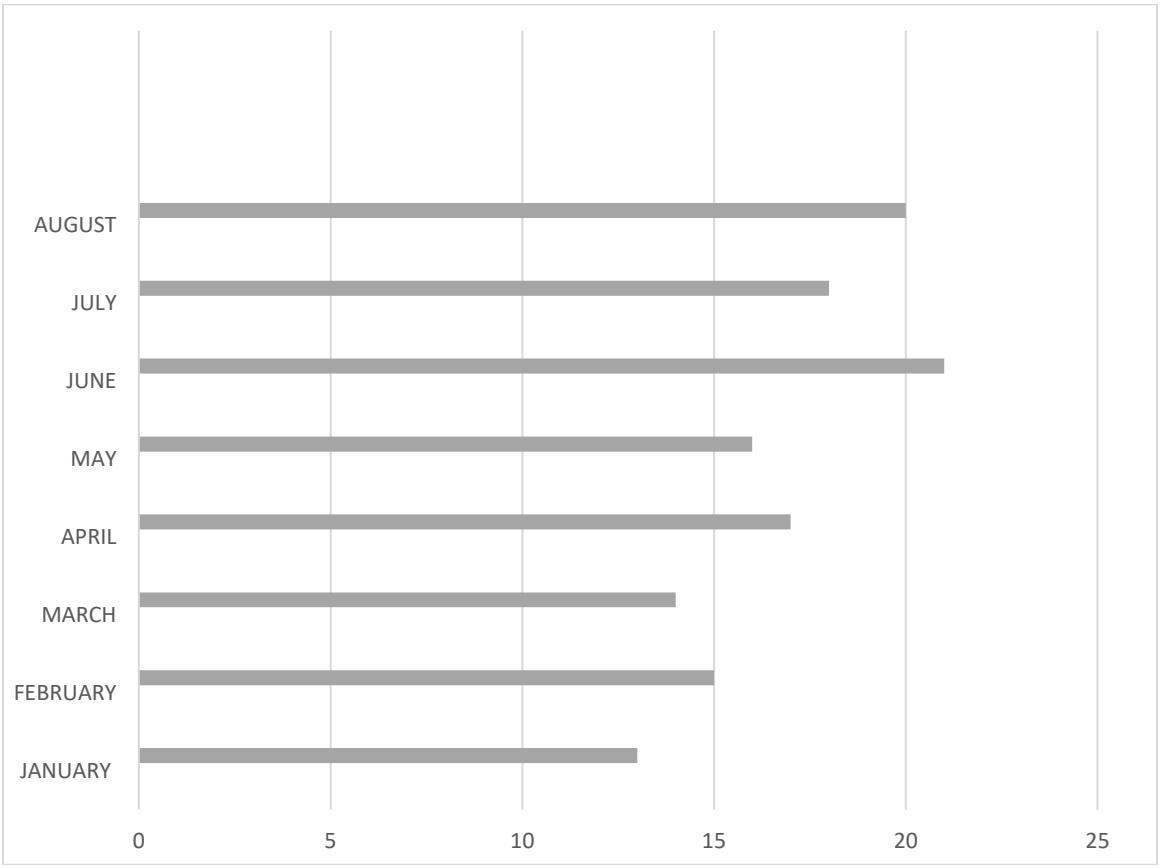

Fig. 1. Bar Chart Showing the highest prevalence was seen in July (62%) and the least was seen in January (30%)

Table 4. Cost of treatment

Variable	Frequency	Percentage
COST (₦)		
1500-1900	80	76.9
2000-2500	14	13.5
2600-3000	10	9.6

Table 5. Antimalaria used and selected social demographic factors

Variable	Sex		Total	F-Exact	P-Value
Antimalaria	**Male**	**Female**	104	10.28	0.53
Artesunate	40	40	80		
Coatem	12	2	14		
Amodiaquine	2	3	5		
Athermeter-lumefatrin	1	2	3		
Hydroxy-chloroquine suspension	0	1	1		

	AGE IN YEARS					
ANTIMALARIA	**1**	**2**	**3**		31.70	0.03*
Artesunate	17	42	21	80		
Coatem	4	6	4	14		
Amodiaquine	2	3	2	7		
Athermeter-lumefatrin	0	0	1	1		
Hydroxy-chloroquine suspension	1	1	0	2		

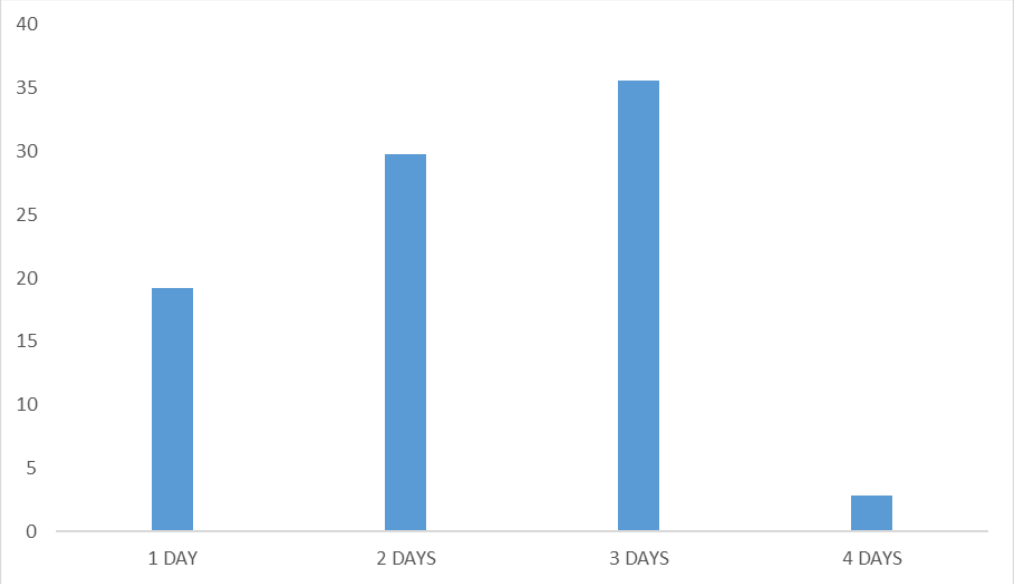

Fig. 2. Number of days on admission

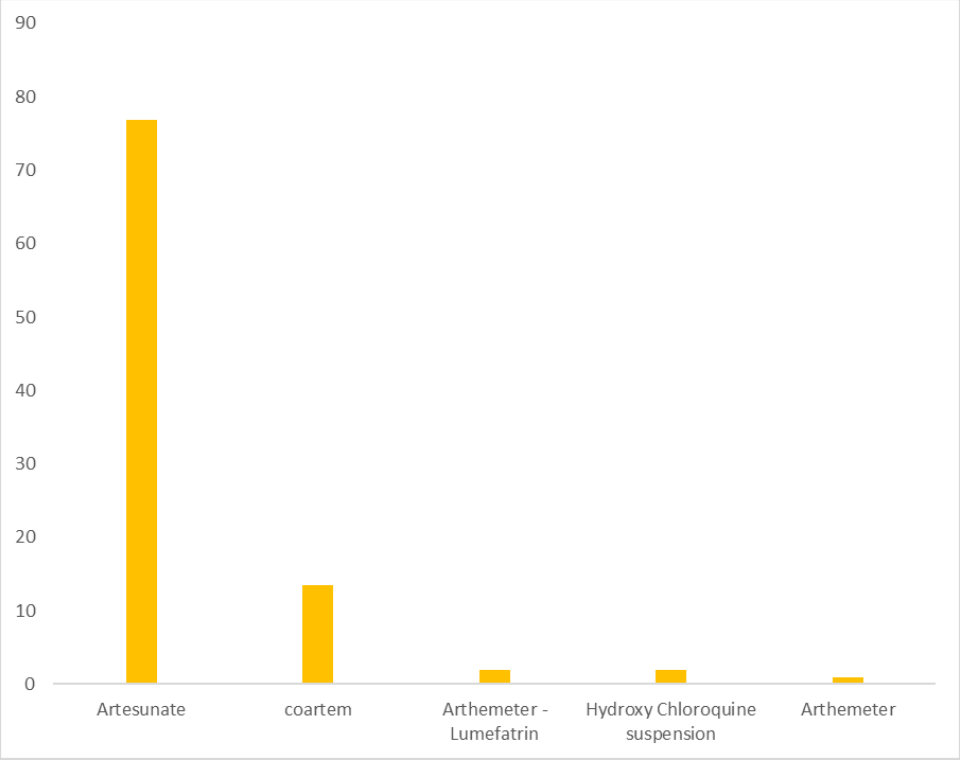

Fig. 3. Frequency of antimalaria used

Table 6. Antimalaria and number days on admission

	NUMBER OF DAYS ON ADMISSION					F-exact	p-value
ANTIMALARIA	**1**	**2**	**3**	**4**	**Total**	21.80	0.04*
Artesunate	10	29	31	10	80		
Coatem	5	4	3	2	14		
Amodiaquine	0	3	2	0	5		
Athermeter-lumefatrin	0	0	2	0	2		
Hydroxy-chloroquine suspension	0	0	1	0	2		

Table 7. Antimalaria and cost of antimalaria

Variable	COST OF ANTIMALRIA (₦)			F-exact	p-value
ANTIMALARIA	**1500-2000**	**>2000**	**Total (104)**	24.1	0.001*
Artesunate	68	12	80		
Coatem	4	10	14		
Amodiaquine	2	3	5		
Athermeter-lumefatrin	2	2	2		
Hydroxy-chloroquine suspension	0	2	2		

In addition, artesunate was found to be the most commonly prescribed antimalarial among the healthcare professionals in this study artesunate with a rate of 79.2%. In other places like Ibadan, it was discovered that the most commonly used drug was chloroquine [29]. In a study in Ghana, it was discovered that the artesunate-amodiaquine combination was preferred [30]. In this study artesunate was the most prescribed drug across sex and age. This was found to be significant as *p=0.03* for age*; p=0.04* for number of days spent on admission *and p=0.001* based on the number of days spent on admission. This therefore reveals that the most prescribed antimalarial drug is largely dependent on availability and response to treatment in the area of prevalence.

There was no adverse or side effect of using antimalarial in this study as reported in other climes in the journal of travel medicine where by most children that received medication like chloroquine, mefloquine came with symptoms like itching, nausea, vomiting, hallucination, changes in sleep pattern after medication which led to stoppage of such medications [28]. It has been advocated that antimalarial combination therapies should be used.

5. CONCLUSION

Findings from this study reveals that the prevalence is common among toddlers especially in 2years old. The average amount spent on antimalarial purchase is relatively fair based on the drugs the patients can afford. In the study artesunate was the most common antimalarial medication prescribed by health care workers prescribed based on its availability, effectiveness and affordability. It was discovered that age had an effect on the drug of choice effective in the treatment of malaria. The use was more effective on the third day. The prevalence of malaria within one year between between January to August 2022. The highest prevalence was seen in July (62%) and the least prevalence was seen in January (30%).

6. RECOMMENDATIONS

To effectively reduce, control and manage the prevalence of malaria among toddlers in our society today, all hands must be on deck. The Government is advised to make strategic policies on effective prevention of malaria should be made and implementation effected. Health workers should undergo training and retraining on prompt diagnosis and treatment for malaria where ever they find themselves especially in rural areas. Good health seeking behavior should be encouraged and cultivated amongst the people in the society.

GENERAL HEALTH IMPLICATION OF THE STUDY

Children are at highest risk for severe disease and death between six months and five years of

age: during this period children are most vulnerable as they have lost maternal immunity and they haven't yet developed specific immunity to infection.

Hence, children must be given critical attention during their early formative years until their immune systems have significantly improved.

CONSENT

It's not applicable.

ETHICAL APPROVAL

An exempt was obtained from the Ethical review board Irrua Specialist Teaching Hospital. Data was anonymously collected and used only for academic purpose.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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