

Presentation, Risk Factors and Management of Malaria in Children attending Pediatrics Teaching Hospital, Gezira State, Sudan

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Abstract: Malaria is a protozoan vector borne disease caused by well-known five species in human, *Plasmodium(P) falciparum*, *P. vivax*, *P. malari*, *P. ovale*. And *P. knowlesi* which is common exclusively in Southeast Asia with most prevalent to *P.falciparum*. Children are included in the groups of high risk of getting malaria with pregnant women and HIV/ AIDS patients. About 80% of death due to malaria in Africa region is in children less than five years old. The cornerstone test and the gold standard one for diagnosis and clinical trials is the microscopy on blood smears using thick and thin blood films. This study aims to estimate presentation, risk factors and management of malaria in children attending to pediatrics teaching hospital in Wad Medani city, Gezira state, Sudan. Total of 140 samples were collected from children aged between month – 18 years during the period May – July 2021. All children were positive to *P.falciparum*, The parasitemia was detected using plus system and parasite percentage. Most of these children are in age of month – 6 years (85%) of the sample size and (85.7%) of them were had severe malaria (++++ and +++) and (83.9%) had parasite percentage of (0.1-2.0)%. Also fever was found to be the major symptom with (45.7%) from all symptoms. There was significant correlation between disease severities with water stagnant with *P.value* (0.001). Also there was significant correlation between history of infection correlated with treatment with *P.value* (0.006). The study reveal the need for strong interval ling and control program to stop the high risk of morbidity and mortality regarding the study group. Also there is strong need for education about the type a, dose and timing of drugs.

Keywords: *Plasmodium*, Pediatrics, Children, Wad Medani, Plus System, Parasite percentage.

Introduction

Malaria is a protozoan vector borne disease(1,2 3)caused by well-known five species in human, *Plasmodium(P) falciparum*, *P. vivax*, *P. malari*, *P. ovale*. And *P. knowlesi* which is common exclusively in Southeast Asia (4,5,6,7,8,9). The most prevalent species globally with the high rate of morbidity and mortality are *P.falciparum* and *P.vivax*. (10,11,12,13). According to World Health Organization report of year 2020 (14), there 241 million cases of malaria 627 deaths due to the disease worldwide. Comparing with the report of 2019, there is more 14 million cases in 2020 rather than 2019, with 69,000 more death. 90% of the cases are in Africa region (15,16,17,18). Children are included in the groups of high risk of getting malaria with pregnant women and HIV/ AIDS patients. About 80% of death due to malaria in Africa region is in children less than five years old (14). Every minute a child on the African continent dies due to malaria (1,19). Human are getting the infection primarily through the bite of infected the female of Anopheles mosquito with sporozoites during the blood feeding (4,20). These sporozoites in human go to liver and replicate in many cycles. Then the red blood cycle started through infection and replication in RBCs which appear as signs and symptoms (4,21). Symptoms usually appear within 10 to 15 days after inoculation of sporozoites. These symptoms include headache, fever and vomiting, and if not treated malaria can lead to death due to disturbance of blood supply to vital organs (22). The effective treatment and strong prevention strategies are completely depend on the early and accurate diagnosis of malaria (1,23). The cornerstone test and the gold standard one for diagnosis and clinical trials is the microscopy on blood smears (24,25). As for quantifying for malaria parasite against WBCs, Parasitized RBCs or using the plus system, light microscope is remain the only practical and available method. (26,27,28). The thin film is used for a lot of various purposes. It is used for identification, differentiation of species and counting of parasite in high parasitemia cases. Regarding this, in developing countries thin blood film is not preferred that due to and even may not be prepared due to its low sensitivity of it in detection of low parasitemia and time consuming. In different view of point technicians in the developed countries mainly depend on thin film for accurate diagnosis due to they believe it is easy to prepare and interpret. (29). Up to date microscopy is the significant tool in research, evaluation of drug and drug resistance and diagnosis of malaria (30,31,32).

Methods and Materials

Study Design: A cross-sectional parasitological hospital based study was conducted from May to July 2021 to evaluate the status of malaria disease in the children using parasite count with plus system and parasite percentage in thick and thin blood film examination respectively via microscope.

Study area: This study was carried out in Wad Medani Pediatrics teaching hospital. Wad Medani City is located in Gezira state, Central Sudan, lies in the west bank of the Blue Nile between 14° 24' N and 33° 31' E. , It is the headquarter of Gezira Agricultural scheme also it is the home of Gezira university . Most of its residence work as farmers or sealers. The area is characterized by its endemicity regarding malaria and *Plasmodium falciparum* is the main prevalent species.



Inclusion criteria: Children attended to pediatrics teaching hospital complaining from Malaria. Children who their parents or the responsible willing for enrolling them in the study.

Exclusion Criteria: Children who complaining from other disease rather than malaria. Children who their parents or the responsible refuse to enroll them in the study.

Sample size: Children who were attended to pediatrics hospital and agreed with inclusion criterias enrolled in this study. Samples were collected randomly based on two-sided hypothesis tests using Epi Info with 80% power and a confidence interval of 95%. The complete number of samples was 140 thick and thin blood films.

Ethical Considerations: Ethical approval was obtained from Faculty of Medical laboratory sciences, Gezira University and Ministry of Health Gezira State. Also an informed consent by mother, father or the responsible from the child was obtained.

Sample Collection: After signing consent by mother, father or the responsible from the child, children were screened for malaria. Information on social demographics were collected using a pre-tested questionnaire. Finger puncture is used to obtain Capillary blood using new sterile lancet. 70% ethyl alcohol was used to clean each patient's finger. After wiping away the first drop, a small drop of blood added to the center of the slide and a larger drop about 15 mm to the right for thin and thick blood film preparation respectively, thin film was spread using a smooth edged slide spreader, absolute methanol was used to fix thin blood films., the thick smear was prepared by spread the large drop of blood.

Laboratory Analysis: Thick and Thin Blood Films stained with 10% Giemsa Prepared by adding 10 ml of stock Giemsa to 90 ml of buffer for 10 minutes and then examined microscopically using the oil emerge lens (100) . Asexual parasite stages and gametocytes were counted separately from each positive smear and report the result using plus system and against parastained RBCS in thick and thin blood films repectivly .(monica)

Data Analysis: Data were coded, entered, cleaned, and analyzed using excel and Statistical Package for Social Science Software version 20. Associations were considered as significant only if *P* value was less than 0.05.

Results:

On this study 140 of thin and thick blood samples were collected from children between month to 18 years old attended to pediatrics hospital, Gezira state ,Sudan for screening of *P.falciparum*. Both sexes are included males (47.9%) and females (52.1%). regarding the age (month – 6 years) were 62.1%, (7 – 12) years were 27.1% and (13 -18) years were 10.2% with mean of 9 years. Most of them reside in Medani city with present of 77.1% and the rest are reside outside Medani city with present of 22.9%.These children belong to tribes of Hawsa (33.6%), Falata (5.7%), Nuba (17.1%),and other tribes (43%). Fifty five percent had history of infection most of them(39%) with in more than one month, the rest (44%) were with no history of infection. Those who had history of infection ,had last treatment ; artusenate (15%) artmethere (1.4%) Quartum (30.7%), quinine (2.9%) and the rest with no history of treatment (50%). The most common symptom was fever with (45.7%) from the whole symptoms. Ninety five percent of them reside nearby water surfaces. 85.7% suffering from severe malaria (70.7% with +++++ , 15% with ++++) while 14.3%(with ++) have non severe malaria .From the whole patients ,82.9% have parasite density of 0.1 -2 % while 17.1% have parasite density of 3 – 4 % .

Table 1 Demographic Data

		Frequency	Percent
Age group	Month - 6 years	87	62.1
	7 - 12 years	38	27.1
	13 - 18 years	15	10.7
	Total	140	100
Gender	Male	67	47.9
	Female	73	52.1
	Total	140	100
Res	Medani	108	77.1
	out of medani	32	22.9
	Total	140	100
tribe	Hawsa	47	33.6
	Falata	8	5.7
	Noba	24	17.1
	Others	61	43.6
	Total	140	100

Table 2 Plus system results

	Frequency	Percent
++++	99	70.7
+++	21	15.0
++	20	14.3
Total	140	100.0

Table 3 percentage Results

Percentage	Frequency	Percent
(0.1 - 2.0) %	116	82.9
(3.0 - 4.0) %	24	17.1
Total	140	100.0

Table 4 Correlation Between risk Factors and Parasite percentage

		(0.1 - 2.0) %		(3.0 - 4.0) %		P. Value
		F	%	F	%	
Age groups	Month - 6 years	75	64.7	12	50.0	0.350
	7 - 12 years	30	25.9	8	33.3	
	13 - 18 years	11	9.5	4	16.7	
	Total	116	100.0	24	100.0	
Residence	Medani	88	75.9	20	83.3	0.308
	out of medani	28	24.1	4	16.7	
	Total	116	100.0	24	100.0	
Tribe	Hawsa	35	30.2	12	50.0	0.204

	Falata	8	6.9	0	0.0	
	Noba	21	18.1	3	12.5	
	Others	52	44.8	9	37.5	
	Total	116	100.0	24	100.0	
Last Infection	Two Weeks	8	6.9	2	8.3	0.993
	Month	10	8.6	2	8.3	
	more than one month	46	39.7	9	37.5	
	infected for first time	52	44.8	11	45.8	
	Total	116	100.0	24	100.0	
Infection	has history of infection	64	55.2	13	54.2	0.552
	with no history of infection	52	44.8	11	45.8	
	Total	116	100.0	24	100.0	
Last treatment	Artesunate	21	18.1	0	0.0	0.217
	Artemether	2	1.7	0	0.0	
	Artemether/Lumefantrine (Quartum)	34	29.3	9	37.5	
	Quinine (Qulaquin)	3	2.6	1	4.2	
	With no history of treatment	56	48.3	14	58.3	
	Total	116	100.0	24	100.0	
Treatment	has treatment	60	51.7	10	41.7	0.251
	has not treatment	56	48.3	14	58.3	
	Total	116	100.0	24	100.0	
Current Symptoms	Fever	54	46.6	10	41.7	0.257
	Headache	3	2.6	3	12.5	
	Vomiting	1	0.9	0	0.0	
	Diarriah	2	1.7	0	0.0	
	all symptoms	56	48.3	11	45.8	
	Total	116	100.0	24	100.0	

Water Stagnant	Yes	110	94.8	23	95.8	0.656
	No	6	5.2	1	4.2	
	Total	116	100.0	24	100.0	
Gender	Male	55	47.4	12	50.0	0.497
	Female	61	52.6	12	50.0	
	Total	116	100.0	24	100.0	

The table shows that there is no correlation between all risk factors and parasite percentage.

Table 5 correlation Between Risk Factors and Result of Plus System

		++++ N=99		+++ N= 21		++ N=20		P. Value
		F	%	F	%	F	%	
Age	Month - 6 years	58	58.6	16	76.2	13	65.0	0.501
	7 - 12 years	28	28.3	4	19.0	6	30.0	
	13 - 18 years	13	13.1	1	4.8	1	5.0	
	Total	99	100.0	21	100.0	20	100.0	
RES	Medani	78	78.8	18	85.7	12	60.0	0.113
	out of medani	21	21.2	3	14.3	8	40.0	
	Total	99	100.0	21	100.0	20	100.0	
tribe	Hawsa	36	36.4	4	19.0	7	35.0	0.439
	Falata	7	7.1	1	4.8	0	0.0	
	Noba	18	18.2	4	19.0	2	10.0	
	Others	38	38.4	12	57.1	11	55.0	
	Total	99	100.0	21	100.0	20	100.0	
L I	Two Weeks	9	9.1	1	4.8	0	0.0	0.505
	Month	7	7.1	3	14.3	2	10.0	
	more than one month	36	36.4	8	38.1	11	55.0	
	infected for first time	47	47.5	9	42.9	7	35.0	
	Total	99	100.0	21	100.0	20	100.0	
L T	Artusnate	16	16.2	3	14.3	2	10.0	0.197
	Artemither	2	2.0	0	0.0	0	0.0	

	Quartum	23	23.2	9	42.9	11	55.0	
	QUININE	4	4.0	0	0.0	0	0.0	
	With no history of treatment	54	54.5	9	42.9	7	35.0	
	Total	99	100.0	21	100.0	20	100.0	
CS	Fever	48	48.5	8	38.1	8	40.0	0.546
	Headache	6	6.1	0	0.0	0	0.0	
	Vomiting	1	1.0	0	0.0	0	0.0	
	Diarriah	1	1.0	1	4.8	0	0.0	
	all symptoms	43	43.4	12	57.1	12	60.0	
	Total	99	100.0	21	100.0	20	100.0	
G	Male	50	50.5	10	47.6	7	35.0	0.449
	Female	49	49.5	11	52.4	13	65.0	
	Total	99	100.0	21	100.0	20	100.0	

The table reveal that there is no correlation between Risk factors -except water stagnant- and result of plus system

Table 6: Correlation Between the degree of severity and residence of the participants:

RES		Dgree		Total
		severe	non severe	
	Medani	96	12	108
		88.9%	11.1%	100.0%
	out of medani	24	8	32
		75.0%	25.0%	100.0%
Total		120	20	140
		85.7%	14.3%	100.0%
		100.0%	100.0%	100.0%

In the table above , there is correlation between the severity and non-severity and the residence of the participants with p.value (0.051).

Table 7: Correlation of water stagnants and parasite count using plus system

Water Stagnant		Plus			Total	
		++++	+++	++		
yes	Count	98	19	16	133	
	% within W S	73.7%	14.3%	12.0%	100.0%	
	% within plus	99.0%	90.5%	80.0%	95.0%	
no	Count	1	2	4	7	
	% within W S	14.3%	28.6%	57.1%	100.0%	
	% within plus	1.0%	9.5%	20.0%	5.0%	
Total		Count	99	21	20	140

	% within W S	70.7%	15.0%	14.3%	100.0%
	% within plus	100.0%	100.0%	100.0%	100.0%

In the table above there is a significant correlation between parasite count using plus system and water stagnant with P.value (0.00). Also there is a significant correlation between water stagnant and degree of with P.value (0.001)

Table 8: Correlation between last infection and last treatment

Last infection * L treatment Crosstabulation						
Last Infection		L T				Total
		Artusnate	Artemith er	Quartu m	QUININE	
	Two Weeks	5	0	5	0	10
		50.0%	0.0%	50.0%	0.0%	100.0%
	Month	0	2	9	0	11
		0.0%	18.2%	81.8%	0.0%	100.0%
	more than one month	16	0	29	4	49
		32.7%	0.0%	59.2%	8.2%	100.0%
Total		21	2	43	4	70
		30.0%	2.9%	61.4%	5.7%	100.0%
		100.0%	100.0%	100.0%	100.0%	100.0%

The table above reveal the last treatment significantly correlates to last infection, with p.value (0.006)

Discussion

Malaria remains a leading cause of morbidity in Africa including Sudan. Infants and children under five years are in risk of contracting malaria more than other groups (WHO,2022 . Microscopy of Giemsa-stained thick and thin blood films is the gold standard method for diagnosis of malaria. Patients with severe malaria (+++,++++) were 85.7% and 83% had parasite percentage between (0.1-2.0)% while 17% had parasite percentage between (3.0 – 4.0)% from the whole study subject, this indicate high prevalence of sever malaria among children . These finding agree with WHO in its report in Africa region 2021 that reveal clearly the high incidence of malaria in sub Saharan Africa countries including Sudan which represents that more than 90% of the disease burden. In this study,87% of patients were in age group of month – 6 years , in which (62.1%) with severe malaria ,this may due to their immunological status regarding their ages and difficulties to apply control measures for this age group. The noticeable regarding age and degree of parasitemiain, that there is a decrease in parasitemia when the age is increased in children due to their immunological status regarding their ages. Hawsa was found to be the most affected tribe (33.6%) and that might be due to genetic predisposing factor. Fever is the most prevalent symptom in this study with 45.7% from all symptoms and this is due to that it is already the first sign start to appear in patient (WHO 2022) which agree with Negatu etal 2021. Fifty five percent of participant had a history of malaria this may due to indemicity of the malaria in the area which dis agree with Negatu etal 2021 who found that most of participants had no history of malaria. There was significant difference between residence of participants and degree of the severity (0.05) ,most of patients reside in the rural area (wad Medani city) which have very known endemic foci. Almost 31% has Quartum as last treatment in their last infection, this may due to miss use or incomplete drug dose or it is a hazard for increasing Quartum drug resistance in this endemic area. There were 95% of participants reside around water stagnant when this percentage correlated with parasite count using plus system and the degree of the disease, showed significant difference (P.value 0.000 ,0.001) respectively ,this obviously due to the availability of the vectors and a very rich breeding site for it. There were no significance difference between age, residence, tribe, last infection, last treatment, symptoms, water stagnant, and gender when correlated to parasite percentage. With P.value of (0.350, 0.308, 0.204, 0.993, 0.217, 0.257, 0.656, 0.497) respectively. There were no correlation between age, residence, tribe, last infection ,last treatment ,symptoms, and gender when correlated to parasite count using plus system(0.501, 0.113, . 0.439, 0.505, 0.197, 0.546, 0.449). Females are slightly more affected than males with incidence of 52.1% again agree with Negatu etal 2021. There was strong correlation between last time of infection and last treatment administrated via that last infection with p.value 0.006

Conclusion

On this study 140 of thin and thick blood samples were collected from children between month to 18 years old attended to pediatrics hospital, Gezira state, Sudan. Both sexes are included males (47.9%) and females (52.1%). Age of (month – 6 years) were 62.1% which are the highest incidence of participants. Most participants (85.7%) -most of them from age group month – 6 years- suffering from severe malaria (70.7% with ++++ , 15% with +++) while 14.3%(with ++) have non severe malaria. From the whole patients ,82.9% have parasite density of 0.1 -2 % while 17.1% have parasite density of 3 – 4 % .

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