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Original Research Article

Study on the Epidemiological Characteristics of Falciparum Malaria among Pediatric Population

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Abstract

Introduction: There were estimated 229 million cases of malaria worldwide in 2018. In South-East Asia, the Eastern Mediterranean, and the Western Pacific, P. falciparum is also very common. Children under the age of five and primigravidae are the most at risk for contracting malaria in places with high transmission rates; their deaths account for 67.3% of all malaria-related deaths worldwide. P malariae has a similar geographic distribution to P. falciparum. The availability of more preventive measures, such as bed nets, as well as efficient new diagnoses and therapies, has expanded over the past 15 years, contributing to a 60.2% decrease in the fatality rate from malaria worldwide.

Aims and Objectives: To evaluate the epidemiological characteristics of falciparum malaria among pediatric population.

Methods: The prospective research was carried out on 51 patients who underwent clinical examination, and basic blood examination. The study has analyzed the baseline characteristics, distribution of the clinical features and Types of parasites, grading of parasitemia and result of LDH antigen test. Incidence rate and respective percentage of the patients have been determined.

Results: The study found that 52.94 % of the patients are male and rest are female. The study also showed that 33.33% of the patients belong to Class V Socio-Economic Class (SEC), 31.37% of the patients in Class IV and 19.62% in Class III.. The study further found that all the patients had fever, 74.50% of patients had vomiting and 41.17% of patients had headache. The study also found that 52.94% of the patients had abdominal pain while 15.68% had diarrhea. The current study has presented that Trophozoites 29 (56.86%), Schizonts 13 (25.49%, and Gametocytes 9 (17.65%) of patients were discovered. In addition, Out of 51 patients with smear positive for P. Falciparum, 48 had also positive p-LDH antigen test for P. Falciparum.

Conclusion: The study concluded that malarial incidence was found to be 0.36% while 64.70% of all patients were between 7 years old and 12 years old.

The study further concluded that there is relative increase of percentage of patients with decrease of socio-economic classes. The study concluded that the fever, vomiting, abdominal pain and headache are the most common clinical features of falciparum infection.

Keywords: malaria, falciparum, socio-economic class, plasmodium, epidemiology.

Introduction

The five protozoa that cause malaria—*Plasmodium falciparum*, P. malariae, P. vivax, P. ovale, and most recently P. knowlesi—are spread by mosquitoes [1]. More than 90.5% of malaria-related deaths worldwide are attributed to *P. falciparum* infection, which means that the disease still poses a serious public health risk on a worldwide scale. The risk of contracting malaria increases with travel to countries where it is endemic, thus it is important to understand the symptoms, which are frequently vague, the challenges associated with diagnosing malaria, and the available treatments [2,3].

According to the WHO World Malaria Report 2019, there were estimated 229 million cases of malaria worldwide in 2018 [3]. The report also notes a steady decline in cases since 2010. In 2018, 19 sub-Saharan African nations and India were responsible for 85.5% of the world's malaria load. *P. falciparum*, which accounts for 99.9% of malaria cases, is the most common and harmful malaria parasite and is most frequently linked to serious illness and death, particularly in the WHO African area [4]. In South-East Asia, the Eastern Mediterranean, and the Western Pacific, *P. falciparum* is also very common. Children under the age of five and primigravidae are the most at risk for contracting malaria in places with high transmission rates; their deaths account for 67.3% of all malaria-related deaths worldwide [5,6].

In sub-Saharan Africa, malaria is a disease that is highly correlated with morbidity and mortality, particularly in children (SSA). The WHO estimates that malaria caused 215 million infections and 439,000 deaths in 2015 [7]. The great majority of incidents and fatalities in SSA involved minors. The incidence of malaria has been dropping globally in recent years; compared to 2000, the incidence and the number of malaria-related deaths have reduced by 18.3% and 48.5%, respectively. The incidence of pediatric malaria declined from 33.2% in 2000 to 16.8% in 2015, following a similar trend [8-10].

Although the prevalence of malaria is declining, there has hardly been any improvement in the disease's prominence as a leading cause of infant mortality, especially in SSA, where a kid dies from the disease every two minutes [11]. The clinical spectrum of malaria in children often includes asymptomatic parasite carriage to a fever illness that can progress to a serious, life-threatening condition. The potential of the parasite to cause complications such as respiratory distress, severe anemia, and cerebral malaria is largely responsible for the mortality caused by malaria (also known as acidotic breathing) [12-15].

Although it is not common in the United States, malaria puts over 45% of the world's population at risk of contracting the disease. The two most prevalent parasites that cause human malaria, P falciparum, and P vivax, have different geographic distributions. P ovale is mostly found in West Africa, but cases have been observed in other sub-Saharan African nations [16,17]. P malariae has a similar geographic distribution to *P. falciparum*. The availability of more preventive measures, such as bed nets, as well as efficient new diagnoses and therapies, has expanded over the past 15 years, contributing to a 60.2% decrease in the fatality rate from malaria worldwide [18].

The number of malaria cases in the United States has been steadily rising. Children under the age of five had a higher prevalence of severe malaria infection than adults and older children, which is an illness linked to major organ damage. However, there were no children among the 10 deaths brought on by malaria in the U. S [19,20].

Materials and Methods

Research Design

The prospective research was carried out at an educational institution during the period of two years. 51 patients were considered in total. Occurrences with *Plasmodium falciparum*-positive peripheral smears were chosen for the study. Based on the proforma, all of these patients had undergone a comprehensive overview, clinical examination, and basic blood examination. Those patients with *Plasmodium falciparum* malaria had been given various antimalarial drugs in conformance with the most recent National and WHO recommendations. The study has analyzed the baseline characteristics, distribution of the clinical features and Types of parasites, grading of parasitemia and result of LDH antigen test. Incidence rate and respective percentage of the patients have been determined.

Inclusion and Exclusion criteria

The patient who visited our hospital, did not show any other underlying disorder, provided the consent for the study, were only included.

From 1 August 2008 to 31 July 2010 around 51 patients had *Plasmodium falciparum*-positive peripheral smears. The majority of the 22 patients had 7-10 gm/dl Hemoglobin, 8 patients, had > 10 gm/dl Hemoglobin, 12 patients had <5 gm/dl Hemoglobin, and 9 patients had 5-7 gm/dl Hemoglobin.

Statistical Analysis

The study has used SPSS 25 and MS Excel for effective analysis. The continuous variables were expressed as mean±standard deviation. The discrete variables were expressed as counts and its respective percentage. The statistical method employed for analyzing continuous variables was ANOVA while for discrete variables was chi-square. The level of significance was considered to be α=0.05.

Ethical Approval

The authors explained the study process to each participant thoroughly before collection of data and obtained written consent from each participant before gathering the information from them. The study method was approved by the Ethical Committee of the institution.

Results

As per the Table 1 analysis,13836 of people had admitted during this time and 51 patients had *P. falciparum* malaria and 0.36% of patients had been admitted to the hospital. On the other hand, 172 of the patients had suffered from malaria, and 51 patients had *P. falciparum* malaria and 29.65% of malaria cases had "*Plasmodium falciparum* malaria". The study found that 52.94 % of the patients are male and rest are female. The study also showed that 33.33% of the patients belong to Class V Socio-Economic Class (SEC), 31.37% of the patients in Class IV and 19.62% in Class III. Hence, the study found that number of patients are more in Class V, IV and III (Lower, Upper Lower, Lower Middle class). The study found that 64.70% of patients are 12 years old. Table 1 shows the baseline characteristics of the patients in this study.

Table 1: Baseline characteristics of the patients in this study

Total no of admissions	**No of patients with P. falciparum malaria**	**Incidence**
13836	51	0.36%
Age group in years		**Number of patients**
<1 year		2 (3.93%)
1-3 year		5 (9.80%)
3-7 year		11 (21.57%)

7-12 year	33 (64.70%)
Sex	**Number of patients**
Male	27 (52.94 %)
Female	24 (47.60%)
Socio-Economic Class*	**Number of patients**
Class I	1 (1.96%)
Class II	7 (13.72%)
Class III	10 (19.62%)
Class IV	16 (31.37%)
Class V	17 (33.33%)

*Based on Kuppuswamy Classification

As per the Table 2, the analysis found a different number of patients and their multiple symptoms including fever, vomiting, headache, abdominal pain and many more. The study found that all the patients had fever, 74.50% of patients had vomiting and 41.17% of patients had headache. The study also found that 52.94% of the patients had abdominal pain while 15.68% had diarrhea. Meningeal irritation and murmur were found in small percentage of patients. Table 2 shows the distribution of clinical features in details.

Table 2: Distribution of clinical features of the patients in this study

Symptoms		**No of patients**
Fever		51 (100%)
Vomiting		38 (74.50%)
Headache		21 (41.17%)
Abdominal Pain		27 (52.94%)
Diarrhoea		8 (15.68%)
Convulsion		8 (15.68%)
Altered sensorium		12 (23.52%)
Decreased urine output		6 (11.76%)
Burning micturition		4 (7.84%)
Pallor		13 (25.49%)
Yellowish discolouration of the sclera		7 (13.72%)
Yellowish discolouration of urine		5 (9.80%)
Cough		9 (17.64%)
Breathlessness		1 (1.96%)
Bleeding		1 (1.96%)
Cola-coloured urine		1 (1.96%)
System	**Signs**	**No of Patients**
General examination	Pallor	41 (80.39%)
	Jaundice	11 (21.56%)
	Oedema	5 (9.80%)
	Petechiae	3 (5.88%)
Per Abdomen examination	Splenomegaly	40(78.43%)
	Hepatomegaly	29(56.86%)
RS examination	Crepitations	3(5.88%)
	Wheezing	1(1.96%)
	Kussmaul's breathing	1(1.96%)
CVS examination	Murmur	1(1.96%)
CNS examination	Signs of meningeal irritation	1(1.96%)

The above study has presented that Trophozoites 29 (56.86%), Schizonts 13 (25.49%, and Gametocytes 9 (17.65%) of patients were discovered. In addition, out of 51 patients, 48 suffered positive for *P. falciparum* and it has been discovered by the diagnostic test. On the other hand, the majority of the 22 patients had 7-10 gm/dl Hemoglobin, 8 patients, had > 10 gm/dl Hemoglobin, 12 patients had <5 gm/dl Hemoglobin, and 9 patients had 5-7 gm/dl Hemoglobin. Table 3 shows types of parasites, grading of parasitemia and result of LDH antigen test.

Table 3: Types of parasites, grading of parasitemia and result of LDH antigen test

Form of parasite		**No of patients**
Trophozoites		29 (56.86%)
Schizonts		13 (25.49%)
Gametocytes		9 (17.65%)
Grading of Parasitemia		**No of Patients**
Grade I		17 (33.33%)
Grade II		23 (45.09%)
Grade III		8 (15.61%)
Grade IV		3 (5.89%)
Total no of patients	**No of Patients having p-LDH antigen test positive for P. Falciparum**	**Sensitivity**
51	48	94.11%
Hemoglobin level in gm/dl		**No of Patients**
<5		12 (23.52%)
5-7		9 (17.65%)
7-10		22 (43.73%)
>10		8 (15.70%)

Discussion

Many african nations, asian nations have high prevalence of malaria. Past assessments made as part of the plan for the Integrated Treatment of Childhood Disease revealed that 64.5% of common cases and 84.3% of severe instances of malaria are not properly addressed. The survey's goal was to evaluate the epidemiologic, biological, and clinical characteristics of malaria among children under the age of five in the pediatric unit.There are studies which shows thrombopenia was more typical in confirmed malaria patients. 86% of people had severe malaria, which included neurological manifestations after the age of two and instances of severe anemia in children under two. The overall death rate was 21.2% for severe cases and 20.3% for confirmed cases. Many past works confirms that the clinical features were severespecially in them whose nutrition and preventive awareness was less. Malaria-hospitalized children came from disadvantaged backgrounds. The incidence of severe malaria and a high fatality rate were two distinguishing characteristics [21,22].

The pediatric populations in the neighborhood, those reporting to outpatient facilities, and those hospitalized at the district hospital were studied for the epidemiological and clinical appearance of serious life-threatening malaria in Humera, northwestern Ethiopia. Only 12% of local children aged 0 to 9 years had *P. falciparum* parasites overall, supporting the region's low level of endemicity. Infections with P. vivax were found in 5%

of kids. With an estimated 4.75% of the high-risk child population necessitating intense clinical therapy each year, malaria was a significant factor in pediatric admissions to the neighborhood district hospital. High case fatality rates and a prevalence of cerebral malaria cases were indicated by the clinical spectrum of serious disease. Additionally, 12% of malaria admissions included a diagnosis of respiratory distress [23].

Few quantitative figures are known about the effect of malaria on children's health, despite the fact that *Plasmodium falciparum* malaria is a major cause of pediatric mortality and morbidity in Africa. The lowest population-based mortality rates for malaria were found among children under the age of one. More than 70.5% of kids who were diagnosed with malaria and more than 80% of kids who died from the illness were under 5 years old. According to the study's findings, malaria is a significant contributor to pediatric mortality and morbidity in the city. The study also suggests that hospital-based surveillance may be helpful for tracking disease-specific mortality and morbidity in other parts of Africa [24].

It is essential to explain the epidemiology of malaria in a country in order to inform control plans in the wake of a drop in worldwide malaria Epidemiologic strata of malaria in India, a study recently conducted sought to define the clinical and epidemiological profile of pediatric malaria. A glucometer was used to evaluate blood sugar levels, a Giemsa microscope was used to determine parasitemia from malaria, and an automated hematologyanalyzer was used to produce a full blood count. Based on WHO guidelines, severe malaria cases were evaluated and classified. The long terms studies show that fatality rates grew in the same direction, malaria prevalence consistently declined from 90s to late 2020, in some asian nations. Contrarily, the incidence of severe malaria attacks was comparable across all epidemiological strata. It will be necessary to conduct immunoepidemiological research to clarify the tendencies that have been noticed [25,26].

Conclusion

The study concluded that malarial incidence was found to be 0.36% while 64.70% of all patients were between 7 years old and 12 years old. Almost similar proportion of males and females were found among the patients with malarial infection. The study further concluded that there is relative increase of percentage of patients with decrease of socio-economic classes. The study concluded that the fever, vomiting, abdominal pain and headache are the most common clinical features of falciparum infection. Splenomegaly and hepatomegaly were found to be most common features. Hence, the current study has pointed out important epidemiological aspects of falciparum malarial infection. The study further added that hemoglobin level decreases significantly which needs to be managed in these patients, mainly with good nutrition. LDH antigen also showed 94.11% sensitivity in positive patients.

The authors suggested that there is a need to conduct more similar studies with more positive patients and in varied population to find out more validated conclusion. However, this current study has brought forward important findings which would contribute in the overall epidemiology and preventive management of falciparum malarial infection.

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