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High prevalence of asymptomatic malaria in apparently healthy schoolchildren in Aliero, Kebbi state, Nigeria

Rupashree Singh[1], Igboanua Ifeanyi Godson[1], Sanjay Singh[2], Rajendra Bahadur Singh[1], Nike Tawakaltu Isyaku[1] & Ukatu Victoria Ebere[1]

[1]*Department of Biological Sciences, Kebbi State University of Science and Technology, Aliero, Kebbi State;* [2]*Department of Family Medicine, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria*

ABSTRACT

Background & objectives: In malaria endemic areas, continuous exposure to *Plasmodium* parasites leads to asymptomatic carriers that provide a reservoir, contributing to the persistence of malaria transmission. Thus, a study of the degree of prevalence of asymptomatic parasitaemias will help in assessing the level of reservoir of infection.

Methods: All the consented participants without any signs and symptoms, suggestive of malaria were interviewed and thick blood smears were made to detect malaria parasites. The children presenting with malaria or any other severe illness, and those declining to give consent were excluded from the study.

Results: A total of 118 (59.6%) children out of 198 apparently healthy children were positive for malaria parasites while 80 (40.4%) children were negative for malaria parasites. Prevalence of asymptomatic malaria was higher in males 75 (63.6%) compared to females 43 (36.4%), but the difference was not statistically significant. Incidence of asymptomatic malaria was highest with 76.1% in the children aged 6–10 yr. There was statistically significant association of the use of bednet on prevalence of asymptomatic malaria.

Interpretation & conclusion: High prevalence of asymptomatic malaria detected in this study is a big challenge and can be a threat to the present malaria control programme. Thus, it should be considered in assessing and reorganising more effective malaria elimination strategies to achieve the desired goal of malaria control.

Key words Aliero; asymptomatic malaria; Kebbi state; Nigeria

INTRODUCTION

Despite global efforts, the malaria burden is increasing worldwide. About 3.3 billion people of the world's population are at risk of malaria and 216 million episodes of malaria from 106 malaria-endemic countries (81%, or 174 million cases in Africa), with nearly 655,000 deaths (91% in Africa, mostly children) were reported in 2010[1]. Malaria has remained a major public health problem in Nigeria and accounts for 30% childhood and 11% maternal mortality and >60% of outpatient visits[2].

The clinical presentation of *Plasmodium* infection varies from asymptomatic to uncomplicated, to severe malaria which can be fatal in high malaria transmission area[3]. Asymptomatic parasitaemia is the presence of malaria parasites in blood in the absence of symptoms. It is prevalent in endemic areas of Africa[4]. Since, asymptomatic carriers do not seek treatment for their infection and are not usually identified by clinical diagnosis, screening and treatment programmes by health care facilities, they may continue to serve as a source of *Plasmodium* infection for vector mosquitoes, hampering malaria elimination efforts[5].

In high transmission areas, continuous exposures to *Plasmodium* infections probably develop partial immunity in children[6] that suppress the symptoms, creating asymptomatic carriers with low parasitaemia[5]. It has been proposed that the development of partial immunity occurs in two stages: first, anti-disease immunity which develops protecting against symptomatic malaria, followed by antiparasite immunity responsible for reduction of parasite density[4]. Therefore, the immunity produced by asymptomatic carriage of *P. falciparum* may protect the children against new symptomatic or severe malaria[6], but sometimes young children fail to develop partial immunity, this condition may be a precursor in the progression to symptomatic malaria and they are at higher risk of developing symptomatic malaria within 30 days than children without parasitaemia[4, 7].

Asymptomatic malaria may protect children by keeping their immunity effective against malaria. Otherwise, it may give rise to severe disease, complicated by

coma, acidosis or severe anaemia[8], suppression of haematocrit levels[9], and thrombocytopaenia[10]. Also has a negative effect un the cognitive function and school achievement in children[11].

The prevalence of asymptomatic parasitaemia depends upon the high or low transmission area, period of residency in the endemic area, age, development of partial immunity by the previous repeated exposures to malaria, gender, use of bednets, and the genetic background[4–5]. Although, asymptomatic malaria is of epidemiological interest, Orogade *et al*[12] demonstrated that it is a valid, reliable and easily interpreted index for evaluating the utilization and implementation of malaria vector control programmes as well as monitoring their continued use.

The prevalence and clinical consequences of asymptomatic malaria may vary across different epidemiological settings. With the proposed roll-back malaria control programme in Nigeria, the presence of asymptomatic malaria will be a big challenge. No study on prevalence of malaria has been done till date in Aliero local government area. However, the national average malaria prevalence is 60%. Thus, the study of the prevalence of asymptomatic parasitaemias is important in assessing the level of reservoir of infection and reorganising any malaria control programme to be effective in Nigeria.

MATERIAL & METHODS

Study area

Aliero town is the headquater of Aliero local government area of Kebbi state, Nigeria. It is approximately located at latitudes 4° 23′ S & 12° 26′ 40″ N and longitudes 3° 6' W & 4° 27' 35" E. It was created in 1996, with a total land mass of 412.25 km^2 and has a total population of 67,078[13–14]. The study was carried out in the University Staff School, Aliero.

Study design and population

A cross-sectional prospective study was conducted from July to September 2012. The formula "$n = z^2pq/d^2$ was used to calculate the sample size of 198 subjects, where, n = the desired sample size (where the population is >10,000); z = the standard normal deviate, usually set at 1.96, which corresponds to the 95% confidence level; q=100–p; d = degree of accuracy desired for this study, it was set at 7%[15]; p = the prevalence of malaria = 60% (FY 2011). Every third apparently healthy child was randomly enrolled from the attendance register, class by class, until the total sample size was achieved.

The children without any signs and symptoms, suggestive of malaria and had given informed consent to participate were included in the study. The children presenting with clinical features of malaria or any other severe illness, and those refused to give consent for the study were excluded from the study.

Ethical approval

The study was approved by the Kebbi State University of Science and Technology, Aliero and permission was granted by the management of the school and the General Hospital, Aliero. Informed consent was obtained from the guardians of the children.

Data collection

All subjects were interviewed to obtain sociodemographic information using standardized questionnaire. Basic information regarding malaria prevention measures were also recorded for monitoring purposes. Blood was collected by using sterile disposable needle to prick disinfected thumb of the children. Blood film was made on the study site by the researcher and carried in a slide box to the General Hospital, Aliero for microscopy.

Malaria parasite test by microscopy

Thick smears were made for the diagnosis of asymptomatic malaria as described by Ochei and Kolhatkar[16]. Slides were stained with 3% Giemsa solution for 30 min and examined using an oil-immersion lens. Smears were considered negative if no parasites were seen in 100 × oil-immersion fields on a thick blood film. For positive smears, the number of parasites was counted against 200 white blood cells/µl.

Data analysis

Data were entered in Microsoft Office Excel Work sheet and analyzed using Epi-Info® (Version 3.5.3). Chi-square test was used for the analysis of association of asymptomatic malaria infection in relation to gender. The value of $p < 0.05$ was considered statistically significant.

RESULTS

Sociodemographic characteristics of the study population

A total of 198 schoolchildren were enrolled in a cross-sectional prospective study during July to September 2012 for the prevalence of asymptomatic malaria. Children's mean age was 9 yr (SD ± 3.73; range 3 to 15 yr). Females constituted 78 (39.4%) and males constituted 120 (60.6%) of the samples. A total of 41 (20.7%) children reported

Table 1. Baseline characteristics of the study subjects

Baseline characteristics	Frequency (%)
Number of subjects	198
Mean age in years ± SD (range)	9 ± 3.73 (3–15 yr)
No. of males	120 (60.6)
No. of females	78 (39.4)
Recent history of malaria within past four weeks	41 (20.7)
Used antimalarial medicine in preceding two weeks	27 (13.6)

recent history of malaria within past four weeks and 27 (13.6%) children had used antimalarial medicine in the preceding two weeks (Table 1).

Prevalence of asymptomatic malaria

A total of 118 (59.6%) children out of 198 apparently healthy children were found positive for asymptomatic malaria and 80 (40.4%) children were negative, as they had no hidden parasite in their body. Prevalence of asymptomatic malaria was higher in males 75 (63.6%) compared to females 43 (36.4%), but the difference is not statistically significant ($\chi^2 = 1.07$; $p = 0.30$; Table 2). Incidence of asymptomatic malaria was highest with 76.1% (54/71; Table 3) in the children aged 6–10 yr. There was a statistically significant association of the use of bednet on prevalence of asymptomatic malaria ($\chi^2 = 11.34$; $p = 0.001$; Table 4).

Table 2. Asymptomatic malaria infection in relation to gender

Gender	Malaria parasites		Total
	(+)ve	(–)ve	
Males	75	45	120
Females	43	35	78
Total	118	80	198

χ^2 =1.07; *p*-value = 0.30.

Table 3. Incidence of asymptomatic malaria infection by age

Age (yr)	No. studied	Malaria parasites	
		(+)ve	(–)ve
≥5	41	23 (56.1)	18 (43.9)
6–10	71	54 (76.1)	17 (23.9)
11–15	86	41 (47.7)	45 (52.3)
Total	198	118	80

Figures in parantheses indicate percentages.

Table 4. Effect of use of bednet on prevalence of asymptomatic malaria

Use of bednet	Malaria parasites		Total
	(+)ve	(–)ve	
Yes	11	22	33
No	107	58	165
Total	118	80	198

χ^2 =11.34; $p = 0.001$.

DISCUSSION

The high rate of asymptomatic parasitaemias in this study was concordant with the findings of Alves *et al*[17] (49.5%) and Baliraine *et al*[18] (52.4%). The high prevalence rate of asymptomatic malaria in males might have been due to the fact that boys spend more time playing outdoors and use exposed clothing than females in the study area. Therefore, males are more vulnerable to the bites of vector mosquitoes. This report is in concordant with the findings of Adeleke[19], who also reported that males were more infected than females. The prevalence of asymptomatic infection was higher in age groups between 6 and 10 yr among the study population. The children acquired immunity to malaria with increasing age and exposures to malaria infection that maintained asymptomatic infections. There was a statistically significant association of the use of bednet on prevalence of asymptomatic malaria because protection against mosquito bites by using bednets decreases transmission of both symptomatic and asymptomatic malaria.

High prevalence of asymptomatic malaria in apparently healthy children might be because of the acquired immunity to tolerate malaria parasites without having clinical symptoms. A newly born baby acquires immunity against malaria from maternal antibodies up to six months. They develop partial clinical immunity as they grow with repeated malaria infections over time to neutralize malaria infection and maintain low parasitaemia for long periods[20]. Thus, even with malaria parasite infection, the school-aged child looks healthy with asymptomatic malaria parasitaemia.

To reduce malaria morbidity and mortality, intermittent preventive treatment (IPT) for asymptomatic individuals with antimalarial has been proposed by Cisse *et al*[21]. Since, the transmission of malaria parasites from humans to mosquitoes requires the presence of transmissible sexual stage, i.e. gametocytes of the parasite in the human peripheral blood. Asymptomatic parasitaemia provides gametocyte reservoir in the community, capable of transmitting infections to the mosquitoes. Thus, any treatment used for asymptomatic carriers must be effective

against the transmissible gametocyte of the malaria parasite to interrupt the transmission. In comparison with non-artemisinin drugs, artemisinin derivatives have shown better effect to reduce gametocytes[22–23].

Although, National Antimalarial Treatment Guidelines of Nigeria recommend artemisinin-based combination therapy (ACT) for the management of symptomatic malaria but there is no recommendation for the treatment of asymptomatic carriers. So, without treatment they are serving as a source of continuous malaria transmission. In order to reduce malaria burden, there should be no waiting period for asymptomatic individuals to fall sick and then treat, rather there should be mass surveillance to identify and treat asymptomatic individuals. Therefore, health authorities should pay attention to make policy for identification and treatment of apparently healthy asymptomatic parasite carriers with antimalarials to reduce malaria at population level. Treatment of asymptomatic carriers can work in conjunction with existing control strategies, such as prompt and effective case management, IPT and vector control.

There might be sub microscopic parasitaemia in the asymptomatic malaria subjects that might have been missed by microscopy. Rapid diagnostic test could be another option but sub microscopic parasitaemia is also beyond its detection limit. Hence, polymerase chain reaction (PCR) could have been a better option for diagnosing asymptomatic malaria, in which case might show a higher prevalence than this study. Parasite density of subject could have been done to determine the 'cut-off threshold' to define asymptomatic malaria. Equally, we could also have determined the gametocyte level. Lack of manpower in our rural setting could not allow these estimations.

CONCLUSION

This study shows a high asymptomatic malaria infection in schoolchildren in the Aliero, Kebbi state. The high prevalence of asymptomatic parasitaemias is a major challenge and can be a threat to the present malaria control programme. This high rate will provide useful information in assessing and reorganising more effective elimination strategies to achieve the desired goal of malaria control. Continued follow-up, effective mass screening to identify asymptomatic carriers, treatment campaigns, improving environmental conditions, and control measures could have great potential, as part of a surveillance strategy towards asymptomatic malaria elimination. This could reduce the pool of parasites available for the malaria transmission by mosquitoes and ultimately reduce malaria burden.

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Correspondence to: Rupashree Singh, Department of Biological Sciences, Kebbi State University of Science and Technology, Aliero, Kebbi State, Nigeria.
E-mail: singhrupashree@yahoo.com

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