

Asymptomatic *Plasmodium falciparum* malaria infection in University undergraduate students.

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Abstract

Background: Malaria infection still remains a notable health problem in resource-limited countries due to difficulties in the implementation of control measures.

This was a prospective study designed to assess the prevalence of asymptomatic *P. falciparum* malaria infection in premedical undergraduate students at Nnamdi Azikiwe University Nnewi, Nigeria.

Methods: A total of 180 consenting apparently healthy subjects (male=90), female=90) aged 18-30 years were randomly recruited for this study. One millimeters of blood sample was collected from each of these participants and dispensed into EDTA bottle for *P.falciparum* malaria parasite screening using thick and thin film Giemsa staining technique and HRP2Pf rapid antigen diagnostic test kit (Access Bio Inc., USA).

Results: Ninety nine (99) of these participants tested positive for asymptomatic *P. falciparum* malaria giving a prevalent rate of 55% while 81 subjects were uninfected and served as control The prevalence was higher in males (54.5%), underweight (46.5%) ($P<0.0001$) and among students aged 18-21 years (48.5%) followed by overweight (30.3%) students ($P=0.039$). Only (33.9%) of all the students used insecticide treated net (ITNs) ($P=0.008$).

Conclusions: The present study showed high prevalence rate of asymptomatic *P. falciparum* malaria infection among university students who continuously served as reservoir for transmission to the uninfected ones which might progress to disease severity if left untreated.

Keywords: Asymptomatic malaria, *Plasmodium falciparum*, Body mass index, undergraduate students

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Introduction

Increased burden of *Plasmodium falciparum* malaria infection and the overwhelming economic impact has become devastating to human health in endemic regions, Nigeria inclusive. Several researchers have shown that incidence of asymptomatic malaria is high in endemic areas [1-5]. These asymptomatic individuals can thrive for days or months without falling ill for malaria, thereby posing potential reservoirs for *plasmodium* transmission to the uninfected ones [6]. This has been attributed to development of clinical immunity to *plasmodium* which enables the individual to reduce the parasite load and inflammation thus becoming symptomless. Special interventions that will target drugs to the asymptomatic parasite reservoirs have been strongly advocated in area of high transmission irrespective of their infection or symptom status. These include: routine screening of the population, routine administration of preventive malaria drugs and routine treatment of those infected with malaria parasite

[7,8]. Use of insecticide treated bed nets (ITNs) is also recommended to reduce the constant exposures to mosquito bites [9]. This may go a long way in complete reduction and eradication of malaria transmission to curb down the increasing burden and most of the mortality and morbidity seen in endemic regions. The present study therefore, seeks to investigate the prevalence rate of asymptomatic *P. falciparum* malaria infection among premedical undergraduate students at Nnamdi Azikiwe University, Nnewi Campus, Nigeria.

Study design

This was a prospective study designed to assess the prevalence of asymptomatic *P. falciparum* malaria in premedical undergraduate students of Nnamdi Azikiwe University, Nnewi Campus, Nigeria. A total of 180 participants (90 males and 90 female students) within the age range 18-30 years were recruited conveniently and subjected to malaria parasite (MP) screening. 99 of these subjects presented with asymptomatic *P.*

falciparum malaria parasitaemia while the remaining 81 served as control. Questionnaires were administered to obtain the bio-data of the entire subjects.

Inclusion and exclusion criteria

This comprised of apparently healthy male and female subjects aged between 18-30 years, who were asymptomatic to *P. falciparum* malaria infection and were not on any anti-malaria drugs prior to the time of sample collection. Subjects who were negative to *P. falciparum* after screening were used as control subjects. Pregnant women and lactating mothers were excluded. Subjects on antimalarial drugs and those with other debilitating diseases such as diabetes, typhoid and HIV infections, sickle cell anaemia were excluded from the study. Subjects outside the age range of 18-35 years were also excluded.

Specimen collection

Two milliliter (1) of whole blood was collected by standard venipuncture technique and dispensed into EDTA bottle for *P. falciparum* malaria parasite screening using thick and thin film Giemsa staining technique and HRP2Pf rapid antigen diagnostic test kit (Access Bio Inc., USA).

Laboratory Analysis

Statistical analysis

The GraphPad Prism version 7.04 Statistical package was employed in the analysis of the result and the data obtained for different parameters were analyzed using percentage frequency and test of statistical significant differences using Chi-square (X_2). Level of significance was set at $P < 0.05$.

Results

Demographic characteristics

Out of 180 students that participated in the present study, 99 (55%) were asymptomatic for *P. falciparum* malaria parasitaemia. 75(41.7%) out of 180 participants were between the age range of 18-21 years and 48(48.5%) were asymptomatic for *P. falciparum*, 73(40.6%) were between the age range of 22-25 years and 39(39.4%) were asymptomatic for *P. falciparum* malaria. Those between age the range of 26-30 years were 32(17.7%) and 12 (12.1%) were positive for *P. falciparum* malaria.

Based on BMI, 54 (30.0%) were ≤ 18.5 kg/m² (underweight) with 46(46.5%) asymptomatic malaria parasite infection. 30 (16.7%) of the participants were between 18.5-24.5 kg/gm² (normal) and 13(13.1%) tested positive compared with 17(21%) of control counterpart. 72 (40.0%) were between 25.0-29.9 kg/m² (overweight) and 30(30.3%) tested positive while 42(51.9%) were negative. Among the remaining 24 (13.3%) participants with BMI of ≥ 30 kg/m² (Obese), 10 (10.1%) were positive for *P. falciparum* malaria parasitaemia.

In the present study, 90 (50%) of the participants were males and 54 (54.5%) tested positive to malaria, while 90(50%) were female and 45(45.5%) were positive to *P. falciparum* malaria parasitaemia.

Furthermore, 61(33.9%) of the overall participants uses insecticide treated bed nets (ITNs) while 119(66.1%) does not. Among the males, only 25(27.8%) out of 90 male participants uses ITN, while 65(72.2%) does not. 36(40.0%) out of 90 female participants uses ITN while 54(60%) does not. 8(8.08%) of asymptomatic malaria infected male participants uses ITN compared with 17(21%) of control participants. Also, 16(16.2%) of female participants uses ITN compared with their 16(19.8%) control counterpart (Table 1).

Table 1. Age range distribution of asymptomatic malaria infection.

Age range (years)	Frequency(N)(%)180(100)	Asym mp pos n(%) 99(55)	control mp neg n (%) 81(45)	p-value
18-21	75(41.7)	48(48.5)	27(33.3)	
22-25	73(40.6)	39(39.4)	34(42.0)	
25-30	32(17.7)	12(12.1)	20(24.7)	0.039

$X_2=6.487$, $df=2$. Level of significance was set at $P < 0.05$. Key: Asym mp pos=Asymptomatic malaria parasite positive, mp neg=malaria parasite negative.

Table 2. Gender distribution of prevalence of asymptomatic malaria infection.

Gender	Frequency(N)(%) 180(100)	Asym mp pos n (%) 99(55)	Control mp neg n (%) 81(45)	p-value
Males	90(50)	54(54.5)	36(44.4)	
Females	90(50)	45(45.5)	45(55.6)	0.231

Level of significance was set at $P < 0.05$. Key: Asym mp pos=Asymptomatic malaria parasite positive, mp neg=malaria parasite negative (Table 2).

Table 3. Prevalence of Asymptomatic malaria infection in association body mass index (Kg/m²).

BMI (Kg/m ²)	Frequency(N)(%) 180 (100)	Asym mp pos n (%) 99(55)	Control mp neg n (%) 81(45)	p-value
≤ 18.5 (underweight)	54(30.0)	46(46.5)	8(9.9)	
18.5-24.9 (Normal)	30(16.7)	13(13.1)	17(21.0)	
25-29.9 (overweight)	72(40.0)	30(30.3)	42(51.9)	

≥30 (obese)	24(13.3)	10(10.1)	14(17.3)	<0.0001
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X=32.63, df=6. Level of significance was set at P<0.05. Key: BMI=Body mass index, Asym mp pos=Asymptomatic malaria parasite positive, mp neg=malaria parasite negative (Table 3).

Table 4. Prevalence asymptomatic malaria infection according to ITNs use.

ITNs Use	Frequency (N)(%)	Asym mp pos n (%)	Control mp neg n (%)	p-value
	180 (100)	99(55)	81(45)	
Males	25(13.9)	8(8.08)	17(21.0)	
Females	36(20.0)	16(16.2)	16(19.8)	
Non ITNs Use				
Males	65(36.1)	44(44.4)	21(25.9)	
Females	54(30.0)	36(36.4)	18(22.2)	0.008

X=11.96, df=3. Level of significance was set at P<0.05. Key: ITNs=insecticide treated bed nets, Asym mp pos=Asymptomatic malaria parasite positive, mp neg=malaria parasite negative (Table 4).

Discussion

The present study was designed to assess the prevalence of asymptomatic *P. falciparum* malaria parasitaemia in premedical undergraduate students using some indicators: In the present study, it was observed that 55% of the study population had asymptomatic malaria parasitaemia. This has been attributed to development of clinical immunity which allows the individuals to control infection and become symptomless. High prevalence of asymptomatic *P. falciparum* malaria infection has been reported in endemic areas including Africa and other countries [4,10-12]. Significantly higher prevalence of asymptomatic malaria parasitaemia was observed among the age range 18-21 years followed by age range 22-25 years and least among age range 26-30 years. This suggests that *plasmodium* malaria parasite density decreases with increasing age meaning that the older ones develop immunity more than the younger individuals. It is also an indication that age is a risk factor in asymptomatic malaria infection. The present study is compatible with previous reports [11-14]. The observed increase in the prevalence of asymptomatic *plasmodium* malaria parasite infection in males when compared with females shows the effect of *P. falciparum* infection on gender. Previous findings have reported high prevalence of asymptomatic malaria in male than in females [11,15-17]. Further study by Andrade and Barrel-Netto, [18] also noted that gender is among the determinant factors of clinical outcomes in malaria infection.

Furthermore, prevalence of asymptomatic malaria parasitaemia was significantly higher in underweight participants followed by overweight and least in obese participants. This suggests a reduced clearance rate of the parasite load hence development of more clinical immunity than in the overweight and obese

individuals. Excess body weight has been associated with reduced immune function including malaria infection [19] and time of residence in the endemic area and number of previous malaria episodes [20]. After many years of repeated infections, the host develops clinical immunity against *Plasmodium*. In these cases, the onset of symptoms is prevented by limiting parasite burden and controlling inflammation. This might be attributed to the duration of stay of these students in the study environment.

Furthermore, the result showed that only 39.9% of the students used insecticide treated mosquito nets. The low usage of ITN contributed to the high prevalence rate of asymptomatic *P. falciparum* malaria among the students population. The usage of ITN was more in females than in male students and this might contribute to the high prevalence rate of asymptomatic malaria parasite infection in males than in females. High prevalence of asymptomatic malaria in endemic areas has been associated with magnitude of parasite and vector exposure [21], time of residence in the endemic area, and number of previous malaria episodes [20]. These students might have come from different environments and at different times with low concentrations of circulating parasites thereby becoming a reservoir for increased parasite transmission to the uninfected ones.

Conclusion

In conclusion, the present study observed high prevalence of asymptomatic *P. falciparum* malaria parasitaemia among premedical undergraduate students. Drastic measures should be instituted for control of malaria in our University environment to ameliorate the risk, severity and fatal progression of asymptomatic to complicated malaria. Incentives on routine preventive therapy and free ITN should be introduced in tertiary institutions in endemic areas to curb the future menace of progression from asymptomatic infection to disease severity such as cerebral malaria and other neurological diseases in the study environment.

Declarations

Ethics approval and consent to participate

The ethical approval for this research was obtained from ethics committee of Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria in accordance with the Helsinki declaration by the World Medical Association (WMA) on the ethics principles for medical research involving human subjects [22]. Informed consent was obtained from the subjects prior to sample collection.

Authors' Contributions

"NRU conceptualized the study design; NRU, SNU, EIO and AOK analyzed and interpreted the student's data. NRU wrote the original manuscript. All authors read and approved the final manuscript.

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