

EFFICACY OF MALARIA SYMPTOMS AS AN INDICATOR OF MALARIA INFECTION AMONG STUDENTS OF A TERTIARY INSTITUTION IN OGUN STATE NIGERIA

ABSTRACT

Malaria is a life-threatening disease caused by the parasite Plasmodium, which is transmitted through the bite of an infected female Anopheles mosquito. Asymptomatic Plasmodium falciparum parasitemia refers to the presence of the parasite in the absence of fever or malaria-related symptoms. In Ijebu-Igbo, Ogun State, Nigeria, a study was conducted to ascertain the frequency of asymptomatic malaria among students attending higher education institutions and determine the efficacy of malaria symptoms as an indicator of malaria infection. A total of 115 students who consented to participate in the study were enrolled, and only a total of 93 of the respondents were recruited for the study, having met the inclusion criteria. A structured questionnaire was used to obtain data on socio-demographic characteristics, signs and symptoms of malaria, and malaria prevention strategy using Insecticide Treated Nets (ITN). Blood samples were collected from the respondents and diagnosed for malaria using Rapid Diagnostic Tests (RDT) kit. Of the 93 respondents, 32 (34%) were males while 61 (66%) were females. Analysis of the result showed that 77% of the respondents had malaria parasites, 38.7% of the respondents indicated that they do feel feverish sometimes while 47.3% responded that they rarely feel feverish, those who rarely show symptoms were observed to be asymptomatic as the result of the RDT was positive for malaria. On the use of Insecticide Treated Net (ITN) for both categories of students, those who are not using the net had a higher prevalence (64.5%) of malaria infection. The result of this study shows that malaria symptoms is not a good diagnostic tool for determining treatment. Asymptomatic malaria was a risk factor among the students therefore measures to reduce the prevalence are advocated.

Key words: efficacy, malaria, asymptomatic, parasitaemia, questionnaire

Introduction

“One of the leading causes of life-threatening disease to man and which has remained a cause of concern to man is malaria transmitted by the bite of the vector, the female anopheles mosquito” (11). “*Plasmodium falciparum* infection has a wide range of manifestations that are classified into three clinical groups: asymptomatic, mild, and severe” (5). “In malaria-endemic areas, a large proportion of the populace harbour parasites without presenting signs of clinical malaria and are considered asymptomatic cases” (3).

“Asymptomatic *Plasmodium falciparum* parasitemia is the presence of a parasite in the absence of fever or malaria-related symptoms, it is also an extremely common and chronic condition among (semi) immune persons in malaria endemic areas with prevalence rates exceeding 50% in some areas” (6). “Asymptomatic carriers do not usually seek treatment for their infection and therefore constitute a reservoir of parasites available for transmission by female anopheles mosquitoes” (4).

“Until recently, four plasmodium species were considered infectious to humans; *Plasmodium falciparum*, *Plasmodium ovale*, *Plasmodium malariae*, and *Plasmodium vivax*. However, *Plasmodium knowlesi*, the natural host of which are the long and pig-tailed macaque monkeys, has now been suggested as the fifth human malaria parasites” (8). “Malaria caused nearly one million deaths; mostly among African children. Malaria is preventable and curable but can decrease gross domestic product by as much as 1.3% in countries with high disease rates” (10).

“Malaria infections are asymptomatic during the liver stage and clinical symptoms do not develop until rupture of the infected erythrocytes. The mechanisms associated with *Plasmodium falciparum* pathogenesis are still largely unknown. However, the parasite’s ability to sequester in the deep vascular system with a high multiplication rate is thought to be a key feature. The outcome and severity of the disease depend on age, genetic disposition, immune status, and general health of the person” (7). The clinical diagnosis of malaria is usually based on the patient’s symptoms, which include fever, chills, sweats, headaches, muscle pains, nausea, and vomiting, which are also associated with other diseases, this makes early diagnosis difficult, leading to delays in the commencement of treatment”. (9). This study aims to investigate the

efficacy of malaria symptoms in diagnosing malaria infection among students of a tertiary institution in Ogun State.

Materials and Method

Study Area

The study was carried out in Ijebu-North Local Government Area of Ijebu-Igbo, Ogun State. Students of Abraham Adesanya Polytechnic, which is one of the higher institutions located in the LGA were recruited for the study. The institution is a non-residential campus having its students take residence at different locations within the perimeters of Ijebu-Igbo.

Sample population and size

The study was carried out among students of Abraham Adesanya Polytechnic, which include students from different departments and levels in the polytechnic. A total of 115 questionnaires were distributed among the students, only 100 students returned the filled questionnaire while 93 students returned the questionnaire and consented to submitting blood samples for analysis.

Recruitment and Data collection

Inclusion criteria: students who gave their consent to participate in the study irrespective of having symptoms or no symptoms of malaria and the students who submitted blood samples for analysis were included in the study.

Exclusion criteria: students who declined consent and did not submit blood samples for analysis were excluded from the study.

Exclusion criteria: students who are on anti-malaria drugs or have taken any within two weeks before the study, also those who declined consent and did not submit blood samples for analysis were excluded from the study.

Sampling method

Questionnaire administration

Pretested and well-structured questionnaires were administered to participants to obtain demographic information as well as information regarding malaria symptoms, anti-malaria drug intake, knowledge, and control measures after an informed consent had been obtained.

Blood collection and processing

Blood samples were collected for *P. Falciparum* malaria parasite screening using CareStat rapid antigen diagnostic test kit. About 2 drops of blood were collected from each participant using a micropipette after pricking the thumb with a lancet needle. The blood sample collected was added into the 'S' well, 2 drops of assay buffer solution were added to the 'A' well and the timer was started. The result was read after 20 minutes according to the manufacturer's instructions.

Data analysis

The data obtained were analyzed using chi-square, frequency distribution, and percentages.

Results

Of the one hundred and fifteen (115) questionnaires distributed to respondents, 100 (i.e. 87%) were returned. Out of the 100 questionnaires returned 7 (7%) were void due to the non-compliance with the inclusion criteria in the study. The sex profile of the respondents shows that 61 (65%) were female while 32 (34%) were male (Table 1). The age of the respondents falls between 15 and 34 years with the majority (65.6%) in the 20-24 age range (Table 2).

From the analysis of the questionnaire, it was discovered that majority of the respondents were familiar with malaria as an infection caused by the protozoan parasite, *Plasmodium falciparum*. The questionnaire was used to evaluate the knowledge of the respondents about signs and symptoms of malaria. When asked the question "How often do you feel feverish"? 38.7% of the respondents indicated that they do feel feverish sometimes while 47.3% responded that they rarely feel feverish. 86.1% of the respondents that reported they do feel feverish sometimes were positive for malaria using the RDT kit while 70% of those who rarely feel feverish were also positive for malaria using the RDT kit (Table 3).

When asked the question "Do you feel tired easily" 52.7% (49) of the respondents responded in the negative, of those who responded in the negative, 77.6% (38) of the were positive for

Plasmodium falciparum (Table 3). Of the 93 respondents included in this study, 78 (83.9%) were not on any anti-malaria drug while 15 (16.1%) were on anti-malaria drugs as at the period of the study. Out of the 78 participants that were not on any anti-malaria drugs, 57 (73.1) were positive for malaria using the RDT kit (Table 3).

From Table 3, it can also be deduced that the majority of the participants do not make use of insecticide-treated bed net, and those that use it reported that do not use it often while 33.3% of the participants reported that they rarely use any preventive measures against the vector of the parasite.

Table 1: Sex profile of respondents

| Sex | Frequency | Percentage (%) |
|--------------|-----------|----------------|
| Male | 32 | 34.4 |
| Female | 61 | 65.6 |
| Total | 93 | 100 |

Table 2: Age profile of respondents

| Age group (years) | Frequency | Percentage |
|-------------------|-----------|-------------|
| 15-19 | 20 | 21.5 |
| 20-24 | 61 | 65.6 |
| 25-29 | 9 | 9.7 |
| 30-34 | 3 | 3.2 |
| 35 and above | Nil | 0.0 |
| Total | 93 | 100% |

Table 3: Students response to questions about signs and symptoms of malaria

| Questions | Response | | Percentage (%) | RDT +ve/(%) | RDT -ve/(%) |
|--------------------------------------|----------------|----|----------------|-------------|-------------|
| How often do you feel feverish? | Often | 13 | 13.98 | 10 (77) | 3 (23) |
| | Sometimes | 36 | 38.71 | 31 (86) | 5 (14) |
| | Rarely | 44 | 47.31 | 31 (70) | 13 (30) |
| How often do you feel headache? | Once in 3 days | 21 | 22.58 | 17 (81) | 4 (19) |
| | Sometimes | 44 | 47.31 | 36 (82) | 8 (18) |
| | Rarely | 28 | 30.11 | 19 (68) | 9 (32) |
| Do you feel tired easily lately? | Yes | 44 | 47.31 | 34 (77) | 10 (23) |
| | No | 49 | 52.69 | 38 (78) | 11(22) |
| How often do you lose your appetite? | Regularly | 4 | 4.30 | 4 (100) | 0 (0) |
| | Sometimes | 54 | 58.07 | 44 (81) | 10 (19) |

| | | | | | |
|--|-----------------|----|-------|---------|---------|
| | Rarely | 35 | 37.63 | 24 (69) | 11 (31) |
| Is your tongue or mouth feeling tasteless? | Yes | 34 | 36.56 | 28(82) | 6(18) |
| | No | 59 | 63.44 | 44 (75) | 15(25) |
| Any nausea feeling? | Yes | 16 | 17.20 | 14(88) | 2(12) |
| | No | 77 | 82.80 | 58 (75) | 19(25) |
| Are you on anti-malaria drugs? | Yes | 15 | 16.13 | 14(93) | 1(7) |
| | No | 78 | 83.87 | 57 (73) | 21(24) |
| Do you usually complete your medication? | Yes | 33 | 35.48 | 27(82) | 6(18) |
| | No | 31 | 33.34 | 24 (77) | 7(23) |
| | Rarely | 29 | 31.18 | 21 (72) | 8(28) |
| Do you come down with malaria often? | Yes | 39 | 41.94 | 30(77) | 9(23) |
| | No | 54 | 58.06 | 42 (78) | 12(22) |
| Is your urine presenting unusual colour? | Yes | 72 | 77.42 | 58(81) | 14(19) |
| | No | 21 | 22.58 | 14 (67) | 7(33) |
| Do you feel well in the day and sick in the evening? | Yes | 40 | 43.01 | 33(83) | 7(17) |
| | No | 53 | 56.99 | 39 (74) | 14(26) |
| Do you live in a mosquito infested area? | Yes | 26 | 27.96 | 19(73) | 7(27) |
| | No | 45 | 48.39 | 35 (78) | 10(22) |
| | Not sure | 22 | 23.65 | 18(82) | 4(18) |
| How often do you make use of insecticide? | Often | 20 | 21.51 | 20(100) | 0 (0) |
| | Not often | 42 | 45.16 | 31 (74) | 11(26) |
| | Rarely | 31 | 33.33 | 21(68) | 10(32) |
| Do you make use of insecticide treated mosquito net? | Yes | 26 | 27.96 | 24(92) | 2(8) |
| | No | 60 | 64.51 | 42 (70) | 18(30) |
| | Once in a while | 7 | 7.53 | 6 (86) | 1(14) |

Discussion

“The distribution and efficiency of the insect vectors, climatic and environmental factors, acquired immunity, and the behavior of the human population are some of the variables in malaria infection” [12]. A prevalence of about 67% of both asymptomatic and symptomatic malaria among the students was observed in this study. A similar study conducted among first-year students of a tertiary institution in South-Eastern Nigeria shows a prevalence of 80% (2) these findings further confirm the endemicity of this infection even among the student population. “Despite the advances in the understanding of the pathogenic and clinical aspects of malaria, it is not well known why some people tolerate malaria infection with few or no symptoms whereas others are severely affected” (1). In this study, about 75% of the study population who were tested had malaria parasites yet, they were asymptomatic using the

symptoms of feverish feeling, Nausea, and tastelessness as a yardstick for the whole symptoms of malaria. A high percentage of the respondents who reported rarely having feverish feeling were observed to be positive for malaria infection, this could be attributed to their acquired immunity as a result of repeated exposure to malaria parasite.

The use of Insecticide Treated Nets (ITNs) is expected to confer a level of protection against the parasite vector and minimize the infection in an individual. In this study majority of the respondents do not make use of ITNs so it is understandable when 70% of them tested positive to malaria. Most of the respondents who reported using ITN were also positive for malaria infections. Low, infrequent, and improper use of ITNs in a malaria-endemic community may have contributed to its lack of efficiency in this study as previously reported by (10). Detection of the parasite antigen in asymptomatic participants could be as a result of acquired immunity in the subjects due to repeated exposure to malaria parasite from mosquito bites, low parasitemia which makes the immune system manage the parasite numbers such that infection does not occur.

Conclusion/ Recommendation

The result of this study suggests that the lack of fever is not always indicative of the absence of malaria parasites and that subjects with asymptomatic infection must be regarded as a significant reservoir of transmissible malaria parasites within the study environment. It is important to note that for malaria control measures to be effective, both asymptomatic and symptomatic individuals must be included in the management strategies.

consent:

Consent to participate in the study was obtained orally from the respondents after the purpose of the study had been well explained to them.

Disclaimer (Artificial intelligence)

Author hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

References

1. Azeez O. M. and Raji Y. (2007). Prevalence of Malaria Parasitaemia and its Association with ABO Blood Group in Odoakpu Area of Onitsha South Local Government Area. Anambra State, Nigeria. *“Nigerian Annals of Natural Sciences 8”*: 1-8
2. Eptidi T. T., Nwani C. D., Ugorji N. P. (2008). Survey of asymptomatic malaria cases in low transmission settings of Iran under elimination programme. *Malaria Journal 11*”: 126-136
3. Fogang B., Lellouche L., Ceesay S, Drammeh S., Fatou K. Jaiteh, Marc-Antoine Guery, Jordi Landier, Cynthia P. Haanappe, JaneriFroberg, David Conway, Umberto D’Alessandro, TeunBousema and Antoine Claessens (2024). Asymptomatic Plasmodium falciparum carriage at the end of the dry season is associated with subsequent infection and clinical malaria in Eastern Gambia. *Malaria Journal 23*:22 <https://doi.org/10.1186/s12936-024-04836-y>
4. Kimbi, H. K., Keka, F. C., Nyabeyeu, H. N., Ajeegah, H. U., Tonga, C. F., Lum, E., Gah, A. H. and Lehman, L. G. (2012). An Update of Asymptomatic Falciparum Malaria in School Children in Muea, Southwest Cameroon *J BacteriolParasitol 3*:154. doi:10.4172/2155-9597.1000154
5. Kimenyi, K. M., Wamae, K., &Ochola-Oyier, L. I. (2019). Understanding *P. Falciparum* Asymptomatic Infections: A Proposition for a Transcriptomic Approach. *Frontiers in Immunology, 10*. <https://doi.org/10.3389/fimmu.2019.02398>
6. Mombo, L., Ntoumi, F., Bisseye, C., Ossari, S., Lu, C. Y., Nagel, R. L., & Krishnamoorthy, R. (2003). Human Genetic Polymorphisms and Asymptomatic *Plasmodium falciparum* malaria in Gabonese School Children. *The American Journal of Tropical Medicine and Hygiene Am J Trop Med Hyg, 68*(2), 186-190. <https://doi.org/10.4269/ajtmh.2003.68.186>
7. Shwman F, Aribdor H, Kachur S.P. (2009). Comparative Prevalence Level of Plasmodium in freshmen (First Year Students) of Nnamdi Azikiwe University in Akwa, South Eastern Nigeria. *“Malaysian Journal of Microbiology 5”*: 51-54
8. Singh, B., & Daneshvar, C. (2013). Human infections and detection of Plasmodium knowlesi. *Clinical microbiology reviews, 26*(2), 165–184. <https://doi.org/10.1128/CMR.00079-12>
9. Trampuz, A., Jereb, M., Muzlovic, I., & Prabhu, R. M. (2003). Clinical review: Severe malaria. *Critical care (London, England), 7*(4), 315–323. <https://doi.org/10.1186/cc2183>
10. World Health Organisation (2010). *Malaria. WHO Fact Sheet No. 94*, WHO Media Centre, Geneva.

11. World Health Organisation (2022). World Malaria Report, 2022

12. Adepeju IS Prevalence of Malaria Parasite among Asymptomatic symptomatic Students of Federal University of Technology, Akure, Ondo State 10.21767/2394-3718.100005

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