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Malaria Prevalence and Treatment Seeking Behaviour of Young Nigerian Adults

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Abstract

Background: Malaria is a cause of poverty in Africa, therefore its appropriate treatment and prevention is a key strategy for control. This study was designed to determine the preferred treatment and control methods adopted by young adults in an urban setting, and the presence and levels of antimalaria antibodies as an indication of exposure.

Method: During a high transmission period in Ibadan, questionnaires on malaria management and treatment practices were administered to 307 undergraduate science majors. Follow up questionnaires were also administered to some of the students. Microscopy was done to determine parasitaemia, and antibodies to *Plasmodium falciparum* MSP 1 were measured by ELISA.

Results: In this population, malaria prevalence was 17 % (19/109) and parasite burden was generally low. Anti malaria antibodies present in 93.6% of the volunteers confirmed malaria exposure. Analysis of data from questionnaires administered to the volunteers revealed that self treatment at home was common; approximately 25% of the volunteers self treated the initial symptoms at home and this included the use of herbal remedies. The use of multiple drug types to treat a single episode of malaria was common practice and chloroquine® and maloxine® (Sulfadoxine-Pyrimethamine) were most often used in treatment. The study showed that 97.5% of the respondents had malaria at least once in the preceding three months. There was no significant difference in malaria prevalence and antibody levels between those living on the university campus and non-residents.

Conclusion: Most of the volunteers had been exposed to the malaria parasite during transmission, but did not translate into illness. This may be due to their knowledge of malaria transmission and prophylactic use of antimalarial medication. We show that many episodes of malaria are treated outside the formal health system.

Key words: Malaria, treatment seeking, behaviour, young adults

Résumé

Introduction: La malaria est une cause de la pauvreté en Afrique, donc son traitement approprié et prévention est une stratégie clé pour un contrôle. L'objet de cette étude est de décider le traitement préféré et une méthode de contrôle adoptée par des jeunes adultes dans un milieu urban, et la présence et les niveaux anticorps d'antimalaria comme un indication d'exposition au risques.

Méthodes: Au cours d'une période de transmission très élevée à Ibadan, questionnaires sur les pratiques de la prise en charge et le traitement ont été donnés aux 307 étudiants qui préparent la licence en science comme matière majeure. Des questionnaires de deuxième entretient ont été donnés aux quelques uns des étudiants. La microscopie a été effectuée afin de décider la parasitémie, et des anticorps au plasmodium falciparum MSPI étaient mesuré à travers ELISA.

Résultats: Dans cette population, la fréquence du palaudisme était 17% soit (19/109) et dans l'ensemble, la charge du parasite était peu élevé. Des anticorps d'antimalaria qui sont présent chez 93,6% des volontaires avaient confirmé l'exposition au palaudisme. L'analyse de données basée sur des questionnaires fournis par des volontaires avait indiqué qu'auto traitement dans la maison était ordinaire, approximativement 25% des volontaires autotraitement des symptômes de stade initial dans la maison et y compris l'utilisation de la médecine par les plantes. L'utilisation des drogues diverses afin de soigner un seul épisode du palaudisme était courant et chloroquine® et malaxine® (sulfadoxine-Pyrimethamine) étaient le plus souvent utilisé pour traitement. L'étude a montré que 97,5% des sondés étaient atteints du palaudisme une fois du moins au cours de trois mois précédents. Il n y avait aucune différence

importante dans la fréquence du palaudisme et niveau d'anticorps entre ceux qui vivent sur le compus et les externes.

Conclusion: La majorité des volontaires ont été exposés aux parasites du palaudisme pendant la transmission, mais n'avait pas conduit à une maladie. Ceci pourrait être attribuable à leur connaissance de la transmission du palaudisme et l'utilisation du médicament prophylactique d'antimalaria.
Nous tachons de montrer que beaucoup d'épisodes de la malaria sont traités en dehors d'un centre hôpitalier.

Mot clés: Palaudisme, en recherche du traitement, comportement des adultes jeunes

Introduction

Malaria is the commonest cause of outpatient consultation and a major cause of morbidity and mortality in Nigeria [1] it accounts for about 1 million episodes annually with mortality rate of 0.15%.[2] Falciparum malaria remains a leading cause of morbidity and mortality among Nigerian children. [3] About 95-99% of the adult population carries the malaria parasite with less than 30% of this number coming down with illness. [4] Sociocultural and economic factors such as education, income, housing patterns, social groups, water storage and treatment seeking behaviour play an important role in malaria transmission. [5] Economic and political policies determine availability and affordability of malaria drugs, and thus determine decisions about whether to self- treat or attend adequate health care centers. This may result in treatment with inappropriate drugs. [6] Nigeria spends about 6 billion Naira annually to treat malaria and about 46% of an average household's income is expended on malaria treatment, hence the disease is a major cause of poverty in Nigeria. [7]

Malaria is said to be more prevalent in rural areas due to favourable environmental conditions for parasite transmission, [8] however, there is significant risk of infection in urban areas. Uncontrolled urbanization leads to an increased number of slums simulating a rural environment and results in increased malaria transmission in some third world urban areas. The presence of swamps, gutters and thick vegetation in the cities enhances the breeding of vectors. Agricultural practices around dwellings also increase the risk of mosquito bites. In Nigeria, malaria risks exist throughout the year in the entire country including urban areas. [9] The problems of rural -urban migration, the persistence of poverty in the population, environmental degradation and seemingly intractable problems of providing decent housing, potable water, sanitation and transportation are common in many Nigerian cities. Available evidence indicates that urbanization is having a significant impact on malaria epidemiology. [10] Formal urban development can typically reduce anopheline mosquito vector densities, but the informal, peri-urban settlements found at the edge of many major urban centres in sub-Saharan African create conditions favourable to anopheline vector breeding. During the initial stages of their development, these sub-urban slum areas are frequently nothing more than expanded rural areas with mosquito breeding sites essentially unchanged..[10]

Malaria control in Nigeria is based almost exclusively on chemotherapy, mainly with chloroquine, the cheapest antimalaria drug. The control of falciparum malaria is becoming increasingly challenging in many endemic areas of the world including Nigeria; [11] not only because *Plasmodium falciparum* has developed resistance to commonly used anti-malaria drugs, but also due to individual and household drug use patterns. In West Africa including Nigeria, chloroquine resistance is firmly established. [12 - 15] Alternative drugs like amodiaquine and sulfadoxine-pyrimethamine were being used in other parts of Africa. [16] However many African countries are seeking evidence to change from even these alternatives to perhaps combination therapies. [17] Chloroquine was the official first line antimalarial drug in Nigeria until February 2005, when the Federal Ministry of Health announced the change to artemisinin (Cotexcin$^{R)}$ and artemisinin combination therapies.

This work aims to determine the prevalence of malaria in an urban setting, and how young people treat and manage malaria episodes. Antibody levels to *Plasmodium falciparum* merozoite surface protein 1, (MSP 1_{19}) will be used as a sero-epidemiological tool to monitor malaria prevalence and protection.

MSP 1 is synthesized as a 200KD glycophosphatidylinositol – anchored membrane protein precursor, which undergoes a two-stage proteolytic processing reaction. [18, 19] At the time of erythrocyte invasion, the 42KD C-terminal component (MSP 1_{42}) is further cleaved to produce a soluble 33KD fragment (MSP 1_{33}) and a 19KD fragment (MSP 1_{19}) that remains on the merozoite surface during invasion, [20] and elicits specific antibodies which protect against erythrocyte invasion by inhibiting the secondary processing of MSP 1_{42} to MSP 1_{19}.[21] Several studies have examined the efficacy of human antibodies in controlling malaria infection. [22 - 24]

Materials and Methods

Study area and volunteers

The study was carried out in the University of Ibadan campus. The University campus is well laid out, the roads are tarred and there is no clustering of houses. There is a lot of natural vegetation in and around the halls of residence and the Faculties. Most of the students who live off campus reside in Agbowo, which is a densely populated peri-urban area located

opposite the campus. Here the houses are clustered and there is water scarcity and water pollution due to lack of hygiene Potholes from bad roads and gutters lead to accumulation of stagnant water, a good breeding ground for mosquitoes. Malaria transmission in Ibadan is intense, [25] with a rainy season period that begins in April and lasts till October, and a dry season that starts from November and ends in March. The study was carried out between June and September, 2002. The volunteers were randomly selected male and female undergraduate science majors, aged 17-33 years.

Study design

A cross sectional study, questionnaires on malaria management and treatment practices were administered to 600 volunteers, to determine their history of malaria attack, the control methods adopted and treatment methods preferred. Only 307 returned the questionnaires. However, follow-up questionnaires were administered six weeks later to 38 students from the original sample population who had responded to the questionnaire. Blood samples (2ml) were obtained from 118 of the volunteers after informed consent: this was the number that voluntarily consented to give blood samples. Blood was drawn by venepuncture into tubes containing 0.5ml anticoagulant (0.12M trisodium citrate). The plasma was removed by centrifugation and stored at -20^0 C. Thick and thin blood films from the volunteers were examined after Giemsa staining. Malaria parasites were counted against leucocytes assuming a constant leukocyte content of 8000 / µl of blood. The packed cell volume (PCV) of each subject was measured immediately after collection of blood samples. The HB genotype of each subject was determined by cellulose acetate paper electrophoresis.

Ethical approval was obtained from the joint Ethical Committee of the University of Ibadan and the University College Hospital, Ibadan, Nigeria. In all cases consent was obtained from volunteers before enrollment into the study.

Antibody response to MSP1 $_{19}$

An enzyme linked immunosorbent assay (ELISA) was used to determine the levels of antibodies to MSP 1_{19} [24] 96-well polystyrene microtitre plates (Dynatech USA) were coated with $_{50\mu g}$/ml MSP $1_{19\ in}$ 0.1M carbonate coating buffer, pH 9.6 and incubated overnight at 4°C. Plates were then washed 3 times with washing buffer (0.05% Tween 20 in phosphate buffered saline)

The wells of the plate were filled with blocking buffer (1% PBS / 0.5% Tween 20/ 1% Bovine serum albumin, pH 7.4) and incubated for 1hour at 37°C. Plasma samples were diluted serially 1:50 – 1:6400 in blocking buffer (50µl/well) and incubated for 1hour at 37°C, after which plates were washed 3 times with washing buffer. Bound antibodies were subsequently detected with 1:2000 horseradish peroxidase conjugated to rabbit lgG (Kirkegaard and Perry Labs, USA) and the reaction developed with ABTS/hydrogen peroxide substrate solution. A microplate absorbance reader (Molecular Devices, USA) was used to read the plates at optical density of 650nm. The end point titre was the highest serum dilution that had an absorbance value above that of the negative control at 1:50 dilution. The MSP1_{19} antibody titre was expressed as the log reciprocal of the serum dilution.

Data analysis

Pearson's correlation coefficient test was used to correlate antibody responses, packed cell volume and parasitaemia. Demographic data were analyzed with Chi - square tests to evaluate differences in the malaria prevention behaviour of student's resident either on- or off campus. Clinical and parasitological data were evaluated with regression tests to evaluate the correlation between the various factors studied. Analyses were done at a 0.05 level of confidence using the Microsoft Excel 2000 and SPSS 11.0 software packages.

Results

Three hundred and seven questionnaires were retrieved after being administered to the students; of the 307 students, 155 (45%) were males and 152 (49.5%) females. Their age range was 17-33years, and 260 (84.6%) of the students were resident on campus while 47 (15.3%) lived off campus.

Symptoms experienced by the students

The symptoms experienced by the students during their malaria episodes included headaches, bitter taste, loss of appetite, joint pains, dizziness, vomiting and nausea and diarrhoea. The most common symptoms experienced by the students were headaches (80%), followed by bitter taste (53%), although most of the students experienced several of the symptoms during one malaria episode. This was also the pattern of symptoms experienced by 22 students (10.1%) who claimed to have malaria at the time of sampling (Table 1), although microscopy results showed only 19 of 22 volunteers to be parasitaemic.

Preventive methods employed by students

More than 50% of the respondents actively did nothing to prevent malaria attacks. Of 240 respondents, 103 (42.9%) took drugs such as Fansidar®, Metakelfin® and Daraprim®, 102 (42.5%) used mosquito nets and 92 (38.3) used insecticides as malaria prophylactics. One hundred and thirty eight (54.3%) respondents succumbed to malaria attacks at least once in 1-6months (Table 2).

Treatment of malaria in the population

The students treated themselves with anti-malaria drugs when they were sick. The most common drugs used among 250 students were maloxine® (43.2%), an SP formulation (38.8%) and chloroquine® 43% (Table 3). Many of the volunteers responded positively to self-medication with a single drug treatment 123 of 202 (61%) while 39% failed to respond.

Some students (71%) combined drugs in order to cure their malaria episodes. More severe cases, and cases which did not at first respond to self medication with single or combinations of drugs were further treated at the hospital. The treatment received at the hospital included injections of unspecified drugs; some received intravenous drips for energy boost and dehydration, which seemed to cure the disease. More students (98.2%) felt better after receiving treatment at the hospital. A handful (25%) of the students used native herbs (Agbo) to treat for malaria either alone or in combination with western drugs. More off-campus students used native herbs compared to on campus students.

Laboratory investigations

The results of the antibody assay, genotype and parasitaemia are shown below. The haematocrit (PCV) values of blood samples were obtained from the 109/307 (38.4%) of the respondents, (those who consented to have blood drawn), ranged from 30% - 53%. None of the students was anaemic at the time of sampling. Parasites were detected in 19 of 109 samples (17%) examined for malaria parasites in thick blood films. The highest occurrence of parasitaemia was within age group 21-22years. Overall parasite density ranged from 120 – 920parasites per µl of blood. The mean parasite density was 221parasites/µl of blood. Antibodies to MSP 1_{19} were detected in 109 (96.3%) samples assayed. However, four of the volunteers had no anti MSP 1 antibodies. Anti MSP 1_{19} responses in the study population were generally high, with a mean antibody titre of 2.6. There was no significant difference in antibody titres between those living within the campus and those living off campus. However residents in Agbowo had a higher parasitaemia. There was no correlation ($r = 0.074$, $P = 0.273$) between parasitaemia and titres of anti-$MSP1_{19}$ antibodies in the population.

Eighty one of 109 volunteers (74.3%) were of the AA genotype, 25 (22.9%) AS, 2 (1.83%) AC and 1 (0.92%) SS. The highest antibody titres were found in the volunteers with genotype AC. The AA genotype volunteers harboured higher parasite densities than the AS volunteers.

Follow-up questionnaires

Questionnaires were administered to 38 students six weeks after the sampling to check if they had fallen sick again since the initial survey. Results showed that 11 of 32 (34.3%) students had a new malaria attack after they traveled out of Ibadan for a few days (Table 4). Of this number, four had been sick two weeks before the first survey, and two had been sick at the time of the first survey.

Table 1: Malaria prevalence at the time of sampling (n = 218)

Place of residence	Parasitaemic + clinical malaria	Not parasitaemic, not ill	% of sick respondents at sampling
On campus	17	158	9.7
Off campus	5	38	11.6
Total	22	196	10.1

Table 2: Frequency of malaria attacks among the students (n = 254)

Frequency of malaria attacks	No.	%
Once in a month	15	5.9
Once in 2 months	25	9.8
Once in 3 months	36	14
Once in 6 months	62	24.3
Once in a year	96	37.6
Never	21	8.2

Table 3: Drug treatment of malaria and perceived efficacy (n = 250)

Name of drug	No. on medication (%)	Responded to treatment	% Efficacy
Maloxine®	108 (43.2)	97	89.8
Chloroquin®	97 (38.8))	90	92.7
Camoquin®	13 (5.2)	13	100
Halfan®	12 (4.8)	11	91.6
Native herbs	20 (8.0)	17	85

Table 4: Students who fell sick 6 weeks after sampling

Traveled since the last survey	Sick since the last survey		Total (%) n = 32
	Yes (%)	No (%)	
Yes	8 (36.4)	14 (63.6)	22 (100)
No	3 (30)	7 (70)	10 (100)
Total	11 (34.4)	21 (65.6)	32 (100)

Discussion

This work studied the effects of socioeconomic and epidemiological factors on malaria prevalence in an urban setting. University of Ibadan, a well laid out urban area was the major focus of the study. Comparisons were made of the effects of various factors being studied on both on- campus and off - campus students, who lived in Agbowo.

Malaria prevention among the students was chiefly through the use of preventive drugs such as fansidar®, metakelfin® and daraprim®, bed nets and insecticides. Basically, the preventive methods employed by on- and off- campus students were the same, however more off- campus students used insecticides than on- campus students. Off-campus students were probably exposed to more mosquitoes because of the characteristics of their environment such as clustered houses and stagnant water, which provide good breeding sites for mosquitoes. About a third of the volunteers suffered malaria attacks once a year, though a few claimed never to have malaria. They all had a good knowledge of the disease and had developed individual methods of self-management of their malaria attacks. The antimalarials they used had varying degrees of efficacy. Although resistance to these drugs has been reported, their success rate in treatment of malaria is still high. [26] Maloxine ® was most preferred by the students, because it was effective and affordable. A single dose treatment cost N50.00, a complete dose of chloroquine® cost ₦80.00 while camoquin®, although very effective, was not used often because a single dose cost ₦ 150.00. The more expensive anti malarial drugs such as halfan® (unit cost ₦ 850) were used by very few students. Clearly, the low price of the drugs enhanced the practice of self-medication in malaria treatment among students and influenced the drug of choice. This is similar to the findings of Brieger et al, [27] in a study on urban malaria treatment in Lagos. The average cost of a packet/dose of anti malarial drug was ₦ 106.00 and the median was ₦ 50.00. The study estimated that in one week $4,076 was spent on antimalarials in three shops in Lagos. In the present study, more severe malaria cases or cases which had not been cleared after self-medication was employed were treated in the hospital. Hospital treatment was more effective, with a high percentage of students feeling better after treatment in the hospital than those who felt better after self medication. It is interesting to note that more of the off- campus students received treatment at the hospital. This is probably because of the proximity of students living off-campus to the many small clinics in Agbowo. Although the drugs used were affordable and within reach of the students, some of the students used native herbs in treating malaria in addition. Again, more off- campus students used native herbs than on campus students. This may be due to its affordability and availability. Since Agbowo is semi rural, the neighbours of off-campus students in town probably used native herbs and may have influenced their choice of treatment. It will be interesting to see what effect the recent announcement of the change of first line drug to coteexin will be on peoples' treatment seeking beaviour, drug choice, and malaria drug resistance.

Results from follow-up questionnaires showed that some of the students who traveled outside Ibadan for about 3- 7 days after sampling, succumbed to fresh malaria attacks when they got back to the campus. Although multi-drug resistant *P. falciparum* malaria is a rapidly increasing problem in the world, particularly in regions of high endemicity such as Nigeria, [11, 15, 28] it has been observed that a knowledge of people's perception and socioeconomic implication of the disease will be of considerable value when control programmes are being planned and implemented. [29] In this study, good knowledge of the disease, prompt treatment upon infection with malaria- though self treated, and control measures taken by the students no doubt contributed to reducing the prevalence of malaria in the population.

None of the volunteers was anaemic at the time of sampling: the parasite prevalence (23.8%) and parasite density (120-960 parasites / µl of blood) were low. It has been said that at any time one could see parasites in the blood of a person living in a malaria endemic area. The results of this study do not confirm this observation. Dodoo et al [23] observed low parasitaemia in adults in a study in Ghana. This was thought to be due to the high levels of MSP 1 antibodies in these adults, which might have conferred some degree of immunity to them. Malaria is more prevalent in children, due to the low levels of their immunity. In a recent study with children in Igbo Ora, [24] it was found that parasitemia declined with age. The acquisition of immunity by age may be due either to a gradual build-up of immunological memory covering high and larger parts of the parasites antigenic repertoire, or to a physiological effect of age, which makes adults more effective in combating the disease. [30] Socioeconomic status i.e. spending power of the students may have played a role in the low parasite

rates observed in this study. This was reflected in their approach to malaria prevention. Socioeconomic status has been shown to have a relationship with the adaptability of mosquito avoidance measures and preventive behaviours.

There was more parasitaemia in AA than AS volunteers, although both groups of individuals had similar antibody titres. However the AC genotype individuals were not parasitaemic and had high antibody titres. Recent reports indicate that this blood group may have a role to play in the prevention of malaria infection. None of the blood group genes have been shown to confer a strong survival advantage against malaria except the sickle cell trait. [31] However ABO blood group genes have been known to be associated with malaria. [32]

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