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Journal of Public Health and Diseases
Volume 2(1), pages 1-6, April 2019
Article Number: FFB184781
https://doi.org/10.31248/JPHD2019.022
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Full Length Research

Prevalence of malaria infection among persons seeking treatment from private drug retailers in North Central Nigeria

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Received 23rd January, 2019; Accepted 11th March, 2019

ABSTRACT: Malaria is a fatal insect-borne tropical disease that continues to pose public health challenges in Nigeria. This study was carried out to assess the prevalence of malaria infection among persons seeking treatment from private sector drug outlets and Proprietary and Patent Medicine Vendors (PVMs). Rapid diagnostic tests and microscopy were carried out to examine the blood samples collected from the study subjects. A total of 1,300 subjects of varying ages that came to seek for malaria treatment were randomly selected for the study after their free consent had been obtained. Finger prick and venous methods were used to collect blood for the rapid diagnostic test and microscopy. The results of this study revealed that of the total of 700 blood samples analyzed for Males, 402 (57.43%) were positive for microscopy and 396 (56.57%) were positive for RDT. While for females, the result showed that of the 600 blood samples screened, 304 (50.67%) were positive for microscopy and 288 (48.0%) were positive for RDT. In respect to age, for microscopy, the age group 15 to 24 years had the highest prevalence of 155 (86.11%) followed by 25 to 34 years with 150 (51.72%), while the least prevalence of 122 (42.36%) occurred within the 55 to 64 age group. For RDT, the age group 15 to 24 years had the highest prevalence of 161 (84.74%) followed by 25 to 34 years with 153 (54.64%), while least prevalence of 108 (38.30%) occurred within the 55 to 64 age group. Statistical analysis indicated that there is a significant difference in infection rate among the age group at $p<0.05$. The findings of this study further portray the need for confirmatory tests of suspected malaria cases before treatment.

Keywords: Malaria parasite, microscopy, *plasmodium*, rapid diagnostic tests, treatment.

INTRODUCTION

Recent studies report an increasing incidence of resistance of the malaria parasite to currently used antimalarial drugs (Dondorp et al., 2009; Ajayi and Ukwaja, 2013; Miotto et al., 2013). The massive reductions in malaria-related morbidity and mortality in regions of high endemicity in the last decade have been in part due to the effectiveness of the Artemisinin Combination Therapies (ACTs) regimen (Singer and Teklahaimanot, 2003). However, these successes are threatened by the emergence of artemisinin-resistant strains of *Plasmodium falciparum* (Dondorp et al., 2009; Miotto et al., 2013) from the Thai-Cambodian border (Miotto et al., 2013) and Thai-Myanmar border (Dondorp et al., 2009). Indeed, artemisinin resistance is a major threat to global health, particularly in low- and middle-income countries (LMICs), in which the disease burden is highest, substandard or

counterfeit ACT compounds are widely available, and systems for the monitoring and surveillance to identify and contain artemisinin resistance are inadequate (WHO, 2012; Braz et al., 2012; Campos et al., 2012).

Developing countries have for many years relied on clinical signs and symptoms to guide the diagnosis of the majority of malaria cases. Microscopic examination of blood smears requires trained personnel and relatively expensive laboratory equipment which are not readily available in sub-Saharan Africa. As a result, patients are often diagnosed and treated based only on clinical signs and symptoms. This result is significant over-diagnosis of malaria and subsequent over-prescription of antimalarial drugs, which may promote antimalarial drug resistance (Reyburn et al., 2004; WHO, 2015). One of the measures being put in place to reduce the resistance of the *Plasmodium* parasite to antimalarial drugs is the World Health Organization's recommendation for parasitological confirmation for suspected malaria cases before treatment (WHO, 2006). The WHO guidelines recommend parasitological confirmation (microscopy or RDT) before treatment, with the only exceptions for children under 5 years of age in areas of high transmission, where treatment in this group should be based on clinical diagnosis and for suspected severe malaria if parasitological confirmation is not immediately possible (WHO, 2010).

Artemisinin Combination Therapies (ACTs) are recommended for all cases of uncomplicated *falciparum* malaria except in the first trimester of pregnancy, during which ACTs should be given only if no other effective alternative antimalarial medication is available. The following ACTs are recommended as first line treatment of malaria: (i) artemether-lumefantrine; (ii) artesunate + amodiaquine; (iii) artesunate + mefloquine; (iv)artesunate + sulfadoxine-pyrimethamine. None of the artemisinin derivatives (oral, rectal, or parenteral formulations) should be used as monotherapy for treatment of uncomplicated malaria. For second-line treatment, the following options are recommended: (i) alternative ACT or (ii) quinine in combination with either tetracycline or doxycycline or clindamycin (WHO, 2006; 2010).

Despite these recent guidelines for malaria management in endemic countries by the World Health Organization, many suspected malaria cases are still to a large extent presumptively diagnosed and treated (WHO, 2006; 2010). In Nigeria for instance, many suspected cases of malaria are treated without confirmation, and in most cases with antimalarial drugs purchased from private drug shops and patent medicine vendors. This habit usually leads to over-administration of antimalarial drugs which is one of the key factors that increase malarial drugs resistance (Okeke et al., 2006; Uzochukwu et al., 2010).

In Nigeria, private drugs shops and patent medicine vendors play important roles in drugs dispensing, as they are in most cases the first place visited for drug purchase. Thus, it is important to use them as avenues of educating the public on the importance of diagnosing suspected malaria cases before treatment.

Rapid diagnostic tests can provide such diagnosis before treatment especially where microscopic diagnosis is not readily available (Moody, 2002; Masanja et al., 2010) and thus should be introduced to drug shops and PMVs in Nigeria. Therefore, this study investigated the malaria care-seeking behavior and prevalence of malaria parasite infection among persons seeking treatment from private drug retailers in North Central Nigeria using RDT and confirmation by microscopy.

MATERIALS AND METHODS

Study area

The study was conducted between January and April 2016 in selected towns in Niger and Nasarawa States and the Federal Capital Territory in North Central Nigeria. The towns include Madalla in Niger State, Mararaba in Nasarawa State and Kubwa in the Federal Capital Territory, Abuja. A total of 1,300 adult subjects of varying ages that came to seek for malaria treatment were randomly selected for the study after their free consent had been obtained.

Ethical clearance

Ethical clearance was also obtained from the Public Health Research Department of the Local Government and Area Councils in the towns where the study was conducted.

Use of questionnaires

Structured questionnaires were administered to the study subjects in order to obtain information about the malaria treatment behaviour of the subjects. The questionnaires contained questions on age, sex of the subjects and whether the subjects carried out confirmatory tests before taking antimalarial drugs or not.

Collection and examination of blood samples by RDT and microscopy

The finger prick and venous methods were used to collect blood samples from 1,300 adult subjects of varying ages that gave their consent for inclusion in the study. All the samples collected were first tested with the rapid diagnostic tests and then the same samples were used to make thin blood film for microscopic examination in the Laboratory (Cheesbrough, 2005).

Rapid diagnostic test

The CTK brand of Rapid Diagnostic Test (RDT) made by

Table 1. Prevalence of malaria parasite infection with respect to gender for Microscopy.

Sex	No. Examined	No. Positive	Prevalence (%)
Male	700	402	57.43
Female	600	304	50.67
Total	1300	706	54.31

X^2cal = 5.9553; X^2 critical = 3.841; df = 1 @ P < 0.05.

Table 2. Prevalence of malaria parasite infection with respect to gender for RDT.

Sex	No. Examined	No. Positive	Prevalence (%)
Male	700	396	56.57
Female	600	288	48.0
Total	1300	684	52.62

Table 3. Prevalence of *P. falciparum* infection with respect to age for Microscopy.

Age	No. Examined	No. Positive	Prevalence (%)
15 – 24	180	155	86.11
25 – 34	290	150	51.72
35 – 44	280	148	52.86
45 – 54	262	131	50.0
55 – 64	288	122	42.36
Total	1300	706	54.31

Biotech Inc. San Diego, United State of America, was used for the test and it is able to detect both *Plasmodium falciparum* (PfHRP-2) and *Plasmodium vivax* (PvLDH) infections. The test was carried out according to the instructtions in the manufacturer's manual. The PfHRP-2 band detects *Plasmodium falciparum* while the PvLDH specific band detects *Plasmodium vivax* and mixed infections.

Light microscopy

The Giemsa staining technique was used for the microscopy. The smears were processed by fixing the thin film in absolute methanol. They were then heat fixed and stained with 10% Giemsa solution in buffered water of pH 7.2 for 10 to 15 minutes. After the staining process, the smears were rinsed with water and allow to air dried for 30 minutes to 1 hour. The dried smears were then examined by light microscopy under X100 oil immersion for Plasmodium species of malaria parasites (Cheesbrough, 2005).

Data analysis

The data generated were subjected to descriptive statistical analysis using percentages and charts (SPSS version 20.0) and Chi – square analysis was used in determining the prevalence rates in the gender, age and the different types of small ruminants studied. $p<0.05$ was considered indicative of a statistically significant difference.

RESULTS

Out of the 1300 subjects that were tested, 700 were males while 600 were females. The number of infected male subjects for microscopy was 402 (57.43%) while the number of infected females was 304 (50.67%). Statistical analysis indicated a significant difference between the sexes at $p<0.05$ (Table 1).

The sex specific prevalence for RDT showed that males had the highest infection rate of 396 (56.57%) while females had 288 (48.0%) (Table 2). Statistical analysis indicated a significant difference between the sexes at $p<0.05$.

For microscopy, statistical analysis indicated the infection to be age specific at $p<0.05$. The age group 15 to 24 years had the highest prevalence of 155 (86.11%) followed by 25 to 34 years with 150 (51.72%), while the least prevalence of 122 (42.36%) occurred within the 55 to 64 age group (Table 3).

For RDT, statistical analysis also indicated the infection to be the age specific at $p<0.05$. The age group 15 to 24 years had the highest prevalence of 161 (84.74%) followed by 25 to 34 years with 153 (54.64%), while least

Table 4. Prevalence of *P. falciparum* infection with respect to age for RDT.

Age	No. Examined	No. Positive	Prevalence (%)
15 – 24	190	161	84.74
25 – 34	280	153	54.64
35 – 44	260	138	53.08
45 – 54	288	124	43.06
55 – 64	282	108	38.30
Total	1300	684	52.52

prevalence of 108 (38.30%) occurred within the 55 to 64 age group (Table 4).

DISCUSSION

One of the control strategies for malaria is effective management that requires only diagnosis and prompt treatment with recommended antimalarial drugs. Presently, the current management of malaria requires prior parasitelogical confirmation of all suspected cases of malaria before treatment by either microscopy or RDTs kits.

The overall prevalence of 54.3% obtained in this study shows that malaria still remains an important public health problem despite several control measures and intervention programmes being put in place by the federal government and other NGOs. The prevalence observed in this study is higher than 27.7, 29.5 and 37.65% reported by Ikeh et al. (2008) in Plateau State; Elechi et al. (2015) in Borno State and Millicent and Gabriel (2015) in Kaduna State respectively but consistent with the findings of Okoli and Solomon (2014), James et al. (2013) and NMSI (2010) in Plateau state.

The disparity in the prevalence of malaria between this study and those of the aforementioned studies may be due to multiple factors such as geographical location, sampling and processing protocols, targeted population, seasonal variation, environmental conditions as well as the rate of use of malaria intervention tools (WHO, 2013). This wide range of differences may also be attributed to differences in behavioural patterns of people in the area which promote mosquito breeding and susceptibility of the people to vector bites. The overall prevalence of malaria infection recorded in this study was substantially higher than other similar studies reported in other parts of Nigeria (Onyido et al., 2011). Anumudu et al. (2006) reported 17% in Ibadan and Attah (2000) reported 21.1% in Iwo community, Oyo State. The prevalence was lower than the prevalence reported by Okonko et al. (2000) which revealed an overall prevalence of 85.1% in Abeokuta. Also, Aribodor et al. (2003) reported a prevalence of 76% in Azia, Anambra state while Ukpai and Ajoku (2001) and Kalu et al. (2012) reported a prevalence of 80.25% and 80.4% in Okigwe and Owerri and in some parts of Abia state respectively.

Prevalence rate of 54.31% in this study represents a substantial level of illness, especially when one considers that the severity of the disease is likely high given the low level of acquired immunity among this population (Klinkenberg et al., 2005). This high prevalence underscores the fact that, malaria is still a heavy burden on the continent, despite all that has been done. The prevalence of *Plasmodium* is attributed to its ability to resist attack of most drugs that are commonly in use in the study area. The stagnant drainage systems in its environs created favourable environmental conditions all year round for the breeding of mosquitoes that act as vectors of malaria parasites and so this enhances the proliferation of the *Plasmodium* species.

Malaria prevalence among the sexes was not statistically significant ($p<0.05$), malaria prevalence was slightly higher among the males than their females' counterparts. This agrees with the result obtained by Mendel and White (1994), Pelletier et al. (1995), Malcom (2001) and Ukpai and Ajoku (2001). Studies have shown that females have better immunity to malaria and varieties of other parasitic diseases and this was attributed to hormonal and genetic factors (Mendel and White, 1994). Portilo and Sullivan (1997) suggested that genetic factors could play a role by endowing females with immuno-regulatory potentials to cope better with some disease infections. This may equally be attributed to the fact that males expose themselves to the bites of mosquitoes and other vectors more than females, especially when the weather is hot and during farm work. Exception is found during pregnancy and reproductive ages, when females are more vulnerable to malaria attacks due to immune suppression (Aribodor et al., 2003).

The prevalence of malaria was statistically significant among the various age groups ($p<0.05$). The children were more affected and this was also reported by Syafruddin et al. (2009). This may be attributed to low – transferred maternal immunity or infection acquired through the mother. Prevalence of malaria in other age groups was also high which was in agreement with Uneke et al. (2005), who recorded higher prevalence among the older age groups in a similar study in Jos, Nigeria. During hot weathers, adults are mostly seen sleeping outdoors, sometimes for the whole night exposing themselves to the risk of rate of exposure to mosquito bites. Although several efforts have been made to effectively control the high incidence of malaria in Nigeria, as long as there are

stagnant gutters and swamps in our environment where mosquitoes breed in millions, there shall be no respite to the malaria scourge and its attendant effect on the health and socio-economic life of Nigerians and by extension Africans (Yusuf, 2007). Atif et al. (2009) reported that reducing poverty and improving sanitation and access to health care in malaria endemic regions would go a long way to reduce the malaria burden in Africa. For those living in malaria endemic countries, limited resources frequently make malaria prevention very difficult to implement. Vector control (reducing the breeding grounds by spraying or destruction of habitat) has only had very limited success.

More successful strategies could include (WHO, 2005): Use of insecticide-treated bed nets (ITNs), indoor residual spraying, and targeted chemoprophylaxis for those most at risk for pregnant women and travelers (Atif et al., 2009).

In light of the current progress of malaria control efforts in Nigeria, where most states are not malaria free and the total number of cases has been steadily increasing, Nigeria is not yet on its way to achieving those original eradication goals. A key aspect of future research in Nigeria should therefore focus on understanding treatment-seeking behaviour, barriers to accessing health services among febrile persons, and quantifying patterns of malaria transmission (Klinkenberg et al., 2005). Future malaria intervention and preventive measures for the future hopes in the development of fatal malaria should include reducing poverty and improving access to health care in malaria endemic regions in Africa.

This study investigated the malaria treatment behaviour and prevalence of malaria parasite infection among those seeking treatment at private sector drug outlets and proprietary and patent. Medicine vendor which in most cases are the first call in suspected malaria cases in Nigeria and also the feasibility of introducing and creating awareness on the use of Rapid Diagnostic Test (RDTs) in these two important Primary Health Care providers in Nigeria.

Conclusion and recommendations

Although the prevalence of malaria from the results was high, a good percentage tested negative. The finding in this study further portray the need for confirmatory tests of suspected malaria cases before treatment and the need to create awareness on the importance of RDTs as accessible malaria diagnostic tools. This will help combat the incidences of malaria parasite resistance to currently used antimalarial drugs which has started hindering the fight to control and possibly eliminate malaria in endemic countries.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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