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Validity of Presumptive Diagnosis of Malaria among Outpatients in a Tertiary Healthcare facility in Rivers State, Nigeria

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ABSTRACT

Malaria infection is responsible for high mortality rates in sub – Saharan Africa and this is partly caused by poor infrastructure especially for diagnosis in rural areas thereby making complying with the World Health Organization policy on proper malaria tests before treatment difficult. A cross – sectional study was conducted to evaluate the validity of presumptive diagnosis in malaria infections by comparing with microscopy and CareStart™ malaria HRP_2/pLDH *Pf* Test kit (RDT). 1000 consenting study subjects in the Outpatient Department of Braithwaite Memorial Specialist Hospital (BMSH), Rivers State, Nigeria were sampled for malaria parasites from January 2014 to June 2016. Blood samples were gotten through venous procedure and analyzed for the presence of *Plasmodium* using Giemsa – microscopy and RDT kits while presumptive diagnosis (presence of fever) was determined by a Physician. All results were statistically analyzed and Giemsa – microscopy was used as the "Gold standard" for malaria diagnosis. Malaria prevalence rates of 32%, 32% and 15% were recorded for presumptive diagnosis, microscopy and RDT respectively ($P<0.05$). Fever had sensitivity, specificity and diagnostic accuracy values of 99%, 100% and 99.7% respectively while RDT had sensitivity, specificity and diagnostic accuracy values of 46%, 100% and 83% respectively when compared to Giemsa – microscopy. This study showed that RDT was not as sensitive as fever and microscopy in the detection of malaria but it can be used when microscopy is not available due to its high specificity and diagnostic accuracy. Although more research is needed in the validity of presumptive diagnosis as a reliable diagnostic technique, suspected cases of malaria infection based on presumptive diagnosis (presence of fever) by highly experienced physicians can be considered for malaria treatment especially in emergency situations and in malaria – endemic rural areas lacking well – equipped malaria diagnostic centres for laboratory diagnosis but all suspected malaria cases should be confirmed with proper laboratory diagnosis (if possible) to avoid malaria mis – diagnosis and parasite drug resistance by wrong administration of antimalarial.

Keywords: Fever, Microscopy, RDT, Malaria, Prevalence, BMSH

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INTRODUCTION

Malaria infection is a serious public health problem especially in sub – Saharan Africa [1]. In Nigeria, 97% of the total population are at risk of contracting malaria while the remaining 3% are dwellers of highlands which are malaria – free zones [2]. To achieve effective malaria management, prompt and highly accurate diagnosis is needed. Malaria diagnosis is done by identifying the presence of malaria parasites or antigens in the blood of a patient. The worrisome global burden of malaria has led to the development of effective strategies for diagnosis in developing countries where malaria is highly predominant as well as in developed countries that lack proper malaria diagnostic expertise [3]. The World Health Organization recommended parasite based diagnosis before treatment is given in all malaria – suspected cases [4]. Routine microscopy still remains the "gold standard" for malaria diagnosis but it is time consuming, requires high expertise and is unavailable in rural areas that lack electricity and efficient laboratory equipment [5]. The use of Rapid Diagnostic Test (RDT) which is fast and requires little expertise for diagnosing malaria has been advocated to compliment the diagnosis by microscopy [6]. However, presumptive diagnosis (presence of fever) combined with a malaria – diagnostic method which is prompt, cheap and requires little expertise is appealing for an effective diagnosis of malaria in both urban and rural areas [7]. Therefore, this study was conducted to evaluate the validity of presumptive diagnosis as a reliable and efficient malaria diagnostic technique when compared with microscopy and RDTs among Outpatients in a Tertiary Healthcare facility in Rivers State, Nigeria.

MATERIALS AND METHOD

Study area and population

The study was carried out in Port Harcourt, Rivers State. Port Harcourt is the capital of Rivers State, lies along the Bonny river in the Niger Delta region and is geographically located at latitude 4.75°N and longitude 7.00°E 8. A total of 1000 consenting participants (irrespective of age and sex) attending the Outpatient Department of Braithwaite Memorial Specialist Hospital (BMSH), Port Harcourt, Rivers State from January 2014 to June 2016, were recruited for the study. Ethical clearance was obtained from the Rivers State Ministry of Health and other relevant health authorities before the commencement of this study.

Data Collection

Presumptive diagnosis (detection of fever) was carried out by a Physician. Blood samples were taken through venous procedure and stored in Ethylene Diamine Tetra Acetic – acid (EDTA) collecting tubes to avoid coagulation. Thick and thin blood films were prepared from the collected blood samples and allowed to air – dry. The thick films were stained with 3% Giemsa stains for 20 minutes while the thin films were stained with 10% Giemsa – stains [9].

All stained blood films (thick and thin) were microscopically examined using oil immersion at x100 objective lens [9]. The RDT kit used in this study was CareStart™ malaria HRP_2/pLDH *Pf* Test kit (Access Bio Inc, USA). The RDT kits were used according to the manufacturer's instructions.

Data analysis

The results collected from presumptive diagnosis were compared with those of RDT kits and microscopic examination to evaluate its sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy. Giemsa – microscopy was used as the "gold standard" for diagnosis in this study. All data collected were statistically analyzed by statistical package for social sciences (SPSS) version 17.0 using two – way analysis of variance (ANOVA) and Chi – square test for both paired and unpaired comparisons. A 95% confidence interval was used and a p – value less than 0.05 was considered significant.

RESULTS AND DISCUSSION

The only species of *Plasmodium* identified in this study was *P. falciparum.* Malaria infection prevalence rates of 32%, 32% and 15% were recorded for presumptive diagnosis, microscopy and RDT respectively Table 1. Presumptive diagnosis had sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 99%, 100%, 100%, 99.5% and 99.7% respectively when compared to microscopy Table 2. RDT had sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 46%, 100%, 100%, 80% and 83% respectively when compared to microscopy Table 2.

Table 1: Malaria prevalence in study subjects

Diagnostic Technique	NE	NI (%)
Presumptive Diagnosis	1000	319 (32)
Microscopy	1000	322 (32)
RDT	1000	148 (15)

NE = Number Examined; NI = Number Infected

Table 2: Malaria diagnostic techniques and their diagnostic performance

Diagnostic Technique	Diagnostic Parameters (%)				
	Sn	Sp	PPV	NPV	DA
Presumptive Diagnosis	99	100	100	99.5	99.7
Microscopy	100	100	100	100	100
RDT	46	100	100	80	83

Sn = Sensitivity; Sp = Specificity; PPV = Positive Predictive Value; NPV = Negative Predictive Value; DA = Diagnostic Accuracy

DISCUSSION

The only malaria parasite identified in this study was *Plasmodium falciparum* and this finding agrees with some other similar research conducted [10, 11] as well as buttress the WHO report that *P. falciparum* is the most common malaria parasite in sub – Saharan Africa [12].

Malaria prevalence rates of 32%, 32% and 15% reported in this study for presumptive diagnosis, microscopy and RDT respectively is lower than 100%, 49.8% and 38.2% reported for presumptive diagnosis, microscopy and RDT respectively in Osogbo [13] but it is comparable to some research which reported malaria prevalence rates less than 40% in Nigeria [14, 15, 16]. The spatial distribution and variation in malaria prevalence rates in different regions in Nigeria can be due to climatic and environmental factors as well as the use of malaria control strategies and personal habits which exposes humans to mosquito bites, favours the breeding and competence levels of mosquito vectors. Also, diagnostic techniques (presumptive diagnosis, microscopy and RDT) play a key role in identifying malaria parasites and giving credible prevalence rates when used effectively, to avoid malaria mis – diagnosis. The sensitivity and specificity rates of 46% and 100% respectively for RDT when compared to microscopy, are comparable to results reported in some other research conducted [17, 15, 18]. The low sensitivity rate for RDT in this study could be attributed to low parasitemia, wrong usage and storage, which resulted in the few false negative cases reported. RDTs were not as sensitive as presumptive diagnosis and microscopy in this study but had high diagnostic accuracy rates and can be used when microscopy is unavailable. Also, all RDT results (especially negative results) should be confirmed with microscopy to avoid malaria mis – diagnosis. Accuracy of presumptive diagnosis varies with the level of endemicity, malaria season and age group, thus no single presumptive algorithm can be regarded as a Universal predictor [19]. The ability to rule out malaria can aid in efficient diagnosis and treatment of other causes of fever such as acute respiratory infection, typhoid fever, meningitis and also avoid exposing individuals without malaria to chemotherapy as well as restrict antimalarial usage to test – positive individuals. Presumptive diagnosis by physicians is more effective when local epidemiological data on malaria and other febrile diseases are available.

CONCLUSION

Although findings from this study showed that presumptive diagnosis by experienced physicians can be considered before malaria treatment (especially in emergency situations or malaria – endemic rural areas lacking microscopy and RDTs), more research is needed in evaluating the validity of presumptive diagnosis as a reliable diagnostic technique. The World Health Organization advocates for proper malaria tests before treatment. Therefore, all malaria presumptive diagnosis should be accompanied by proper malaria laboratory tests before administration of antimalarial to avoid mis – diagnosis of malaria and parasite resistance to drugs when antimalarial are repeatedly administered to un – infected individuals.

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