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Malaria prevalence in north-eastern Nigeria: A cross-sectional study

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ABSTRACT

Objective: To assess the prevalence of malaria parasitemia in north-east Nigeria and to evaluate the measures for the prevention of malaria. **Methods:** A village in north-eastern Nigeria was selected for the cross sectional study at the height of the rainy season in October 2011. A total of 550 inhabitants of a hamlet were recruited for this study. After obtaining the consent individuals received a structured interview and were tested for malaria parasites in their blood films. Recruits testing positive for malaria were given a course of artemesinin-based combination therapy (ACT). **Results:** A total of 497 inhabitants representing approximately 90 percent of the population participated: a quarter of the study group carried malaria parasites-exclusively *Plasmodium falciparum (P. falciparum)*-representing a *P. falciparum* parasite rate (PfPR) of 24.5%. Besides, 53/138 in the age group of 2 to < 10 years old children tested positive for *P. falciparum* representing a $PfPR_{2-10}$ value of 38.4%. Malaria control measures were used in just under a third (157/497) of this cohort. Despite these measures 28/157 (17.8%) still tested positive for *P. falciparum*. **Conclusions:** The malaria burden is overestimated for this region in north-east Nigeria. The findings support an intermediate pattern of malaria endemicity. The 30% bed nets coverage for malaria control is well below the WHO estimates for 2011.

1. Introduction

Nigeria is considered a holo-endemic country for malaria according to WHO data and groups studying the epidemiology of malaria[1-3]. The country accounts together with five other sub-Saharan countries for 60% of the malaria deaths[4].

This study is a result of a pilot project undertaken to establish the malaria infection rate amongst visitors and workers at the Specialist Hospital in Jimeta-Yola. During the second and third week of May 2011 (end of the dry season), a total of 167 volunteers had a malaria test; only four-representing <2.5%-were identified as being positive for *Plasmodium falciparum (P. falciparum)*. In other words the *P. falciparum* parasite rate (PfPR) would be just < 2.5% (unpublished data). This finding prompted a systematic study in a village setting in a north-eastern province of Nigeria at the height of the rainy season. In addition the level of malaria control measures were evaluated.

2. Materials and methods

The climate in the north-eastern states of Nigeria is dominated by a dry season (November to May) and a rainy season (May/June to October). A hamlet at Holmare with approximately 550 inhabitants according to records supplied by the local authority was selected for the cross-sectional survey. The little village is situated close to a tributary of the Bengue river in the north-eastern direction from Jimeta-Yola, the capital of Adamawa state (Nigeria).

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The malaria study received approval from the Ethics Committee of the Ministry of Health in Adamawa state and the local Ethics Committee of the Specialist Hospital in Jimeta-Yola.

The survey was carried out over three days at the beginning of October 2011 at the height of the rainy season.

A field survey was undertaken in the village and the surrounding marshes prior to the study. All participants were given a structured interview by the nursing staff. The questionnaire ranged from demographics (sex, age, pregnancy status) to malaria status (previous malaria exposure, measures of malaria protection at home) and personal health (recent illness, chronic diseases).

A written consent was required for participation in the study; an English and Hausa language version of the consent were made available. The consent was obtained on the understanding any participants testing positive for malaria receives a course of an artemesinin-based combination therapy (ACT) free of charge. In children, the parents or the legal guardian gave their consent to the evaluation.

Participants with a positive test result for malaria received a three day course of ACT (artemether & lumefantrine). Adults and adolescents older than 14 years received the full dosage of the regime; they were prescribed Artemef® (Artemether 80 mg & Lumefantrine 480 mg) by Bharat Parenterals Ltd, Gujarat, India. Children received a dose adjusted regime of ACTM® (Artemether 20 mg & Lumefantrine 120 mg) by Ipca Laboratories Ltd, Mumbai, India.

Blood samples were taken via heel pricks from babies up to the age of six months and by finger prick from all other individuals. A standard thick and thin blood film was prepared, fixed with methanol and stained with 3% Giemsa stain at pH 7.2[5].

Microscopic analysis was done with magnification (×100) in oil immersion; the number of parasites were recorded per 100 white blood cells (WBCs) or 1 000 red blood cells (RBCs) respectively; the parasite density was estimated assuming an average WBC count of 8 000/μL or RBC count of 4.5 Mio/μL respectively. The PfPR is being calculated to allow for comparison with results by other investigators[6,7].

The initial result in the field was later crosschecked for its accuracy via a second microscopy by one of the authors (HF). In case of discrepancy the latter result was incorporated in the overall study and affected individuals were informed and supplied with their medication as required. The individual data sets were transferred to a database (FileMaker Pro11®) for detailed analysis.

3. Results

The field survey revealed a distinct lack of evidence for malaria control measures, *e.g.* free of charge distribution of insecticide-treated bed nets (ITNs) or indoor residual spraying (IRS) campaigns initiated by international agencies or government bodies. However a health post exists for treatment of patients.

A total of 497 individuals (230 females) with a median age of 13 years (range 1 month to 74 years) participated in the study, 122 of the subjects (52 females) representing 24.5% of the group carried malaria parasites (Table 1).

Within the age group from 3 to less than 10 years, 38.4% (53/138) showed positive blood films, and those aged between 15-74 years old, 11.9% (29/244) were positive (Table 1).

176 (81 females) individuals (176/497, 35.4%) complained at the interview of having experienced symptoms of possible malaria infection in the preceding 28 days. These symptoms were mostly of a general nature ranging from joint discomfort to fatigue and from back-& headaches to flu-like symptoms. Only 58/176 (32.9%) individuals took during this episode of illness a course of chloroquine. Notwithstanding the region is considered harbouring chloroquine-resistant *P. falciparum*[8]. 41/176 (23.3%) individuals within this group tested positive for malaria, in effect the same rate as the overall result. Interestingly, nobody tested positive who had taken a course of chloroquine during the period of malaise.

Only six volunteers-aged 5 to 44 years-presented with symptoms and a temperature (>37.5 ℃) at the time of the

Table 1

Malaria distribution in Holmare, *Plasmodium falciparum* parasite rate (PfPR).

Age (yrs)		Total	Males	Females	Malaria parasitemia
0 – 2		39	19	20	7 (18.9)
2 – 9		138	67	71	53 (38.4)
10 – 14		76	38	38	33 (43.4)
Adults(Female, 143; Male, 101)	15 – 24	85	50	35	17 (20.0)
	25 – 34	64	32	32	6 (9.3)
	35 – 54	63	38	25	3 (4.7)
	55 – 74	32	23	9	3 (9.3)
Total		497	267	230	122 (24.5)

study, but nobody had a positive malaria test result.

Malaria control at home was established praxis for 157 individuals (31.6%), of which almost all used nets. The remaining six individuals used-not necessarily regularly - insecticide-containing mosquito coils at home. Despite the use of bed nets 28 (18%) tested positive for malaria.

Forty within this group of bed net users were under five year olds; they represent just 48% of the total number of under five years old children surveyed. Again, despite the precaution 6/40 (15%) showed parasitemia.

4. Discussion

Based on global estimates and WHO data Nigeria is a high transmission zone for malaria[1-3].

Local research on the transmission rate for malaria in the north-eastern region of Nigeria is limited to few articles[9,10]. One of the studies available examined 300 symptomatic volunteers form three different locations in Adamawa state (Nigeria) without stipulating what time of the year (dry or rainy season?) the evaluation was undertaken[9]. The PfPR for the under five year olds was 76.4% and the adult population maintained a PfPR of 36% for the age group 46-50 years.

In a similar study women aged 16-40 years from an urban area were examined during the rainy season form May to October; the PfPR was 42% for this adult population[10].

The results of the current study are significantly lower for both-children and adult-groups. For children the $PfPR_{2-10}$ is just 38.4% and for the adult population the overall PfPR result is 11.9%; dropping from a PfPR of 20% for the 15-24 year olds to a PfPR of < 5% for the age group 35-54 years.

Spatial and temporal differences could account for these inconsistencies. However, one would expect a higher prevalence of malaria in a village setting close to a river with surrounding marshes at the height of the rainy season as opposed to an evaluation done in an urban setting covering the whole of the rainy season or without specifying the season the research was conducted[9,10].

The aforementioned studies were untaken at least four years earlier, but it is difficult to conclude a somewhat significant reduction in the overall malaria burden as identified by O'Meara *et al* in other parts of West Africa, *e.g.* The Gambia[11]. In particular as the field survey was unable to identify any appreciable level of malaria control (distribution of ITNs or IRS campaigns) by government agencies or international bodies to support this notion.

Furthermore the ubiquitous use of chloroquine as the first line medication by individuals in this area is proof of the poor educational impact on disease management by responsible agencies.

Poor equipment, insufficient training and limited supervision of laboratory technicians may lead to an overestimation of blood films positive for malaria. Fear on the part of the technician to overlook a genuine case of malaria in an endemic region might be a contributing factor in overrating the prevalence.

The latest Nigeria Malaria Indicator Survey (MIS) claims bed nets are available in 67% of the households in the North East[12]. Our report cannot confirm this assertion. It appears just 30% of individuals in a rural setting have access to bed nets of some description. The findings in this study are more in line with the result of the Nigeria Demographic and Health Survey 2008 that concludes mosquito nets are available in 27.8% of the households in North East Zone of Nigeria[13]. Our findings are also supported by the World Malaria Report 2011, although at the lower end of the 30%-50% mosquito net coverage expected for Nigeria in this publication[14].

In our interviews no difference was made whether ITN or conventional nets were in use, but most likely untreated nets were purchased, as they are much cheaper. An ITN costs US $ 3.8 with the average monthly household expenditure for health running at US $ 0.4 in 2005[15].

The usage of nets in children under five is seen in 40/84 representing just 48% well below the target set by the WHO Report for 2003. This report envisaged 60% net cover for sub-Saharan Africa back in 2005[16].

It is also well below the findings of the latest Malaria Indicator Survey which claims a 57% to 74% usage of ITN's in under fives for the north-eastern provinces of Nigeria[12]. In total (28/157) 18% of the bed net users tested positive for Malaria comparable to the overall figure. However looking at the subset of under five year olds (6/40) 15% were found to suffer with malaria which is well below the PfPR of their peers without the support of a bed net.

Clearly this study was conducted in a small geographical area, nonetheless it should be noted the setting of the village in close proximity to the marches of a river at the height of the rainy season should guarantee a high transmission rate for malaria. The core finding of this study identifies an intermediate endemicity for malaria in this region in contradiction to prevailing assumptions[2,9,10].

It is hoped our study is a contribution to the epidemiological data for malaria in this region, after all mathematical modelling of disease burden relies on robust baseline data[17]. Furthermore, it appears national and international bodies overestimate the degree of implementation of even basic (*e.g.* ITNs) malaria control

measures[12,14].

Conflict of interest statement

The authors declare that they have no conflict of interest.

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References

[1] Anonymous. Impact of malaria control (Chapter 7). In: *World malaria report*. 2011. Geneva: WHO; 2011, p. 51-79.

[2] Anonymous. Profiles. In: *World malaria report 2011*. Geneva: WHO; 2011, p. 149.

[3] Gething PW, Patil AP, Smith DL, Guerra CA, Elyazar IRF, Johnston GL, et al. A new world malaria map: *Plasmodium falciparum* endemicity in 2010. *Malaria J* 2011; **10**: 378-393.

[4] Anonymous. Summary and key points. In: *World malaria report 2011*. Geneva: WHO; 2011, p. ix - xiii.

[5] Storey J. *Basic malaria microscopy*. 2nd ed. Geneva: WHO Press; 2010.

[6] Metselaar D, van Thiel PH. Classification of malaria. *Trop Geog Med* 1959; **11**: 157-161.

[7] Smith DL, Guerra CA, Snow RW, Hay SI. Standardizing estimates of the *Plasmodium falciparum* parasite rate. *Malaria J* 2007; **6**:131-140.

[8] Gbotosho GO, Folarin OA, Bustamante C, Pereira da Silva LH, Mesquita E, Sowunmi A, et al. Short report: different patterns of pfcrt and pfmdr1 polymorphisms in *P. falciparum* isolates from Nigeria and Brazil: the potential role of antimalarial drug selection pressure. *Am J Trop Med Hyg* 2012; **86**: 211-213.

[9] Tidi SK, Akogun OB. Effectiveness of the rapid test technique (RTT) in malaria diagnosis and chloroquine treatment failures in Yola, Nigeria. *Nig J Parasit* 2005; **26**: 49-54.

[10] Tidi SK, Danburam A, Gundirio M, Jumai AT, Livingstone R. Malaria parasitaemia and anaemia in pregnant women, in Yola, Nigeria. *J Med Lab Sci* 2009; **18**: 44-51.

[11] O'Meara WP, Mangeni JN, Steketee R, Greenwood B. Changes in the burden of malaria in sub-Saharan Africa. *Lancet Infect Dis* 2010; **10**: 545-555.

[12] Anonymous. Malaria prevention (Chapter 5). In: *Nigeria malaria indicator survey 2010*. Abuja: National Population Commission (NPC), National Malaria Control Programme (NMCP), and ICF International; 2012, p. 43-58.

[13] Anonymous. Malaria (Chapter 12). In: *Nigeria demographic and health survey 2008*. Abuja: National Population Commission (NPC) and ICF Macro; 2009, p. 187-196.

[14] Anonymous. Vector control (Chapter 4). In: *World malaria report 2011*. Geneva:WHO; 2011, p. 27- 34.

[15] Onwujekwe O, Uzochukwu B, Ezumah N, Shu E. Increasing coverage of insecticide-treated nets in rural Nigeria: implications of consumer knowledge, preferences and expenditures for malaria prevention. *Malaria J* 2005; **4**: 29-34.

[16] Anonymous. Insecticide-treated nets (Chapter 2). In: *The Africa malaria report 2003*. Geneva: WHO/Unicef; 2003, p. 24-29.

[17] Snow RW, Guerra CA, Noor AM, Myint HY, Hay SI. The global distribution of clinical episodes of *Plasmodium falciparum malaria*. *Nature* 2005; **434**: 215-217.