Sero-prevalence of *Plasmodium falciparum* Malaria in Rural Communities of Bassa, Plateau State, Nigeria.

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Abstract

Background: *Nigeria and Democratic Republic of Congo account for an estimated 40% of world malaria burden. Malaria parasite prevalence is one of the primary tools for estimating disease burden in a population.*

Aim: *To estimate rural sero-prevalence of Plasmodium falciparum malaria.*

Method: *This was a cross-sectional descriptive study of 564 children and adults; 312(55.3%) and 252(44.7%) from Kwall and Jengre communities respectively of Bassa Local Local Government Areas of Plateau State using a multistage sampling technique between 1ˢᵗ and 4ᵗʰ May, 2017. Clinical evaluation, laboratory diagnosis and case management for malaria were carried out. Stata 14.1 software was used for data analysis. Results were presented in table and bar chart.*

Result: *One hundred and five (34.6%), 289(51.2%), and 80(14.2%) were aged 0 – 5, 5 – 17 and 18 – 80 years respectively. Fever was the commonest presenting complaint in 34 (6%) while 472 (83.7%) had no symptoms. P. falciparum sero-prevalence rates were 24.2%, 41.4% and 34.3% among under-five children, 6 – 17 years and 18 – 80 years respectively.*

Conclusion. *Plasmodium falciparum malaria transmission continues to occur with high sero-prevalence in rural communities of Bassa Local Government Areas of Plateau State. A slight decline was however, noted. Research on innovative models such as malaria vaccines, mosquito bionomics and environmental sanitation to compliment malaria therapeutics may need be employed in our rural communities so as to achieve the global goal for malaria eradication.*

Key word: *Malaria, sero-prevalence, Rapid diagnostic test, disease burden.*

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BACKGROUND

In 2015, the World Health Organization (WHO) reported that annual global clinical malaria has dropped substantially from staggering figures of 500 million prior to the year 2000 to 212 million. In addition, malaria attributable mortality has equally fell to about 429,000 cases annually between 2010 and 2015.[1] These significant gains are thought to be due partly to deployment of both preventive, diagnostics and therapeutic interventions through the activities of Roll Back Malaria (RBM) program and other partners (President Malaria Initiatives, United Kingdom Agency for International Development (UKaid), Bill and Malinder Gates Foundation and PATH Malaria initiatives) in previously malaria endemic countries of the world.[2,3,4] However, coverage of malaria control activities varies between and within countries in Africa including Nigeria.[5,6,7]

To accurately estimate malaria burden, robust continuous active surveillance, monitoring and evaluation activities are key components. Malaria parasite prevalence is one of the primary tools for estimating disease burden in a population. This tool is used to determine the proportion of demonstrable peripheral blood parasitaemia from a given representative population estimates at a given

time. [8,9]

Sub-Saharan African is however, still bearing the highest burden of the disease with 90% of clinical malaria and 92% of these mortality in 2015 alone.Malaria, a preventable and treatable infection, is endemic in Nigeria. Nigeria and Democratic Republic of Congo account for an estimated 40% of world malaria burden.[10]The country wide Nigeria malaria sero-prevalence is 45.1% by rapid diagnostic test (RDT) and 27% by light microscopy.[11]These figures are disturbing in the lights of huge investments to curb this ancient scourge in our sub-region.

The WHO observes 25th April, every year as the world malaria day (WMD). This ambitious objective is intended to increase and sustain public awareness on the disease. "Malaria Prevention Works: Let's close the gap" is the theme for the year 2017.[12]This year, attention is focused on preventive strategies for the most vulnerable groups in Africa, vector control measures particularly mosquito resistance to insecticide (Long lasting insecticide treated nets and indoor residual spray) and needs for antimalarial medicines.

In this article, we seek to determine the rural sero-prevalence of *Plasmodium falciparum* malaria; a key component for disease burden estimation. Theoutcome of this study would be useful to policy makers and program implementers on the progress being made as we gear towards malaria eradication in Nigeria.

MATERIALS AND METHOD

Study locations and time of study – Kwall District and Jengre communities both in Bassa Local Government Areas of Plateau State, north-central Nigeria, situated at coordinates 9°56′00"N and 8°44′00"E. It has a landmass of 1,743 km^2 with an estimated population of 189,859 (2006 National Census).[13,14] It shares a woodland and tall grass savanna in which anopheline mosquito vector thrives substantially. The study was conducted between 1st and 4th May, 2017.

Study design – This was a cross-sectional study to allow us determine the sero-prevalence of *P.falciparum* malaria parasitaemia.

Study population This comprised of children and adults resident in these two rural communities

Sample size estimates Sample size was calculated to be 380 using the appropriate formula for a descriptive cross-sectional study.[15] where n≥ minimum sample size, Z≥ standard normal deviation and probability of 0.05 at 95% confidence interval, p≥0.05. p≥ prevalence (45% estimates from previous study),[11] d≥ tolerance limit, the minimum is 0.05 and q≥1-p.

ENROLMENT CRITERIA

Inclusion criteriaand exclusion criteria for the study Children and adults without age or gender consideration, resident in the two communities who visited the treatment facilities and were willing to participate in the study.

Sampling Technique A three stage cluster sampling technique was used in this study in which Bassa LGA was purposively. Following which Irigwe and Pengana Chiefdoms from the list of three chiefdoms in Bassa LGA were selected by simple balloting. Of the four administrative districts in these selected chiefdoms, two were further selected by simple balloting; Kwall and Jengre Districts respectively. In order that each subject would have an equal chance of being selected, one of every three was chosen for enrolment.

STUDY PROCEDURE

Community Mobilization – A collaborative meeting between the Roll Back Malaria Office, Plateau State Ministry of Health and the Malaria Drug Therapeutic Efficacy Testing and Surveillance Unit, North-Central Nigeria, was held in April, 2017 at the Jos University Teaching Hospital (JUTH) Paediatric Lounge to discuss the theme and activities to commemorate this year world malaria day (WMD). Highlights for the activities included a need to increase public awareness on malaria through the media houses, community screening, distribution of long lasting insecticide treated bed nets (LLITNs),malaria case management and advocacy visits to relevant stakeholders on the Plateau. Events also included live telephone questions and answers to the viewer/listener. It was deemed successful. In addition, other visits were made to the Bassa Local Government Council, community and opinion leaders.Public mobilization was done through letters to relevant groups inviting them to converge at the primary Healthcare centers (PHCs).

Study Procedure

Research team personnel comprising of Paediatricians, a community pharmacist and clinical medical students were grouped into four; a team for health education, on use and distribution of LLITNs, a team for initial clinical evaluation and

administration of semi-structured original questionnaires to study participants. Relevant medical information obtained included bio-data, history of symptoms, and recent use of antimalarial medications. Participants had general and systemic examinations including temperature, weight, respiratory rate, pulse rate, blood pressure. Relevant medical information obtained were entered into case report forms. The third team was responsible for malaria testing procedure.

Malaria testing

RDT kitts laboratory scientists used the SD Bioline Malaria Ag *P.f*(HRP-II) ™ RDT to determine whether children and adults had malaria; blood was obtained from the ball of the left thumb-prick samples. Those with positive RDT results were offered antimalarial treatment according to the Nigeria malaria treatment protocol which recommends the use of oral artemisinin-based combination therapy by weight bands for uncomplicated malaria or parenteral artesunate for severe malaria. The last team distributed LLITNs to participants.

Another team was concerned with dispensing of antimalarial medicines to those who tested positive to malaria.

Data collection

A semi-structured interviewer administered questionnaire was used to collect relevant medical information. Information obtained included; biodata, presenting complaints, anthropometric measurements, temperature and relevant systemic examination. Malaria test results were also documented on the case record form. Verbal informed consent and or assent was obtained from the parents or guardians as applicable to age limits.

Methods of Data analysis

Data obtained from study participants were processed and analyzed using Stata 14.1 copyright 1985-2015 StataCorp, 4905 Lakeway Drive, College Station, Texas 77845 USA. Serial N0:301406310375. Demographic characteristics and nominal variables of study subjects were expressed on frequency table and percentages. Dichotomous variables were displayed in a bar chart.

Result

The age and sex distributions of population studied is as shown in **Table 1** below:

Table 1: Age and sex distribution of study participants.

Demographic characteristics	Number(N)	Percent (%)
Age (years)		
0 – 5	195	34.6
5 – 17	289	51.2
18 - 80	80	14.2
Age total	564	100
Sex		
0 - 5		
Male	102	18.1
Female	93	16.5
6 – 17		
Male	131	23.2
Female	158	28.0
18 – 80		
Male	29	5.1
Female	51	9.1
Sex total	**564**	**100**

Fever was the presenting complaint in 34 (6%) of study participants. One participant presented with febrile convulsion. Majority, 472 (83.7%) had nosymptomatic, **Table 2.**

Table 2: Presenting symptoms of study subjects

Baseline presenting symptoms	Number (n)	Percentage (%)
Fever	34	6.0
Headaches	14	2.5
Body weakness	13	2.3
Vomiting	12	2.1
Reduced appetite	10	1.8
Abdominal pain	8	1.4
Convulsions	1	0.2
No complaints	472	83.7
Total	**564**	**100**

The overall *Plasmodium falciparum* sero-prevalence was 17.6%. Sero-prevalence among children aged $0-5$ years was 24.2% compared to 34.3% in the adult sub-population, Figure 1.
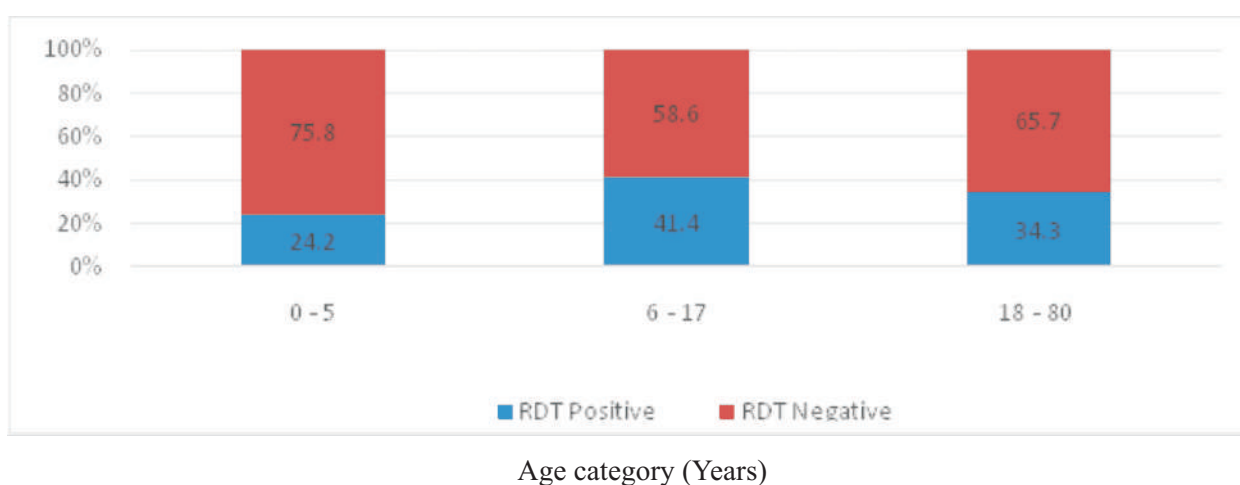
Age category (Years)

Figure 1: Percentage RDT test results by age category

Discussion

The *Plasmodium falciparum* malaria rural sero-prevalence of 24.2% among under-five children in the two communities studied was significantly lower than 45.1% sero-prevalence in Plateau State reported in 2010.[11] This figure is similarly lower than 46.8%, 56.0%, 35.6%, 53.8% and 60.5% in the region-wide north-east, north-west, south-east, south-south and south-western Nigeria respectively from the same study cited above. *Plasmodium falciparum* malaria was the predominant specie (95.1%)[11] in the population studied. In a similar rural community sero-prevalence study in Anambra State, south-east Nigeria, Onyido *et al* reported a figure of 58.2% in 2011.[16] The find in our study is however, higher than 10.1% reported by Adeoye *et al*[17] in 2011 among adult blood donors in Lagos, South-West Nigeria. The reason for the significantly lower prevalence rate in the current study may be because of the difference in two populations studied. Whereas, the study in Lagos was among apparently healthy adult blood donors in urban areas compared to the under-five children in a rural communities our study.

The rural sero-prevalence of 24.2% in our find is also significantly lower than 57.6% in Plateau State reported by the national malaria indicator survey (NMIS) 2015[11]. This current prevalence is comparable to 55.3% and 57.1% in neighboring rural communities of Benue and Nassarawa States, north-central Nigeria respectively and 54.4% in Osun State, south-south Nigeria[11]. Our find is however, significantly lower than 19.5%, 1.9%, 21.1% and 29.9% reported in 2015 from Rivers State, Lagos State, Abia State Yobe States respectively.[11] The variations in the community sero-prevalence rate may be due to the differences in

climatic andthus, mosquito bionomics including mosquito biting and inoculationrates, transmission intensity in the various geo-political zones of the country.Secondly, the large sample size from the NMIS report is way larger than the one in our study. Malaria transmission in Nigeria is intense and stable but sub-perennial in dry Savannah ecotypology where its transmission is significantly low during the dry season (November/December to April/March). The malaria stability is supported by the presence of efficient malaria vectors particularly *Anopheline gambiae, Anopheline. arabiesis* and *Anopheline. funestus.*Unique environmental factors such as temperature ($20^{o}C$ to $30^{o}C$), rainfall in excess of 10cm, relative humidity greater than 60% are also known to be important epidemiologic determinants which coincided with the period of our study. Perhaps, the prevalence rates may be higher in the raining seasons.[18]

Compared to NMIS reports of 2010 and 2015, the difference of 12.5% is troubling. This trends perhaps suggest that, public access, ownership and utilization of malaria preventive, diagnostic and therapeutic measures may have dwindled overtime in our rural communities. For example, the NMIS clearly showed a decline in the levels of knowledge among pregnant women on ways to avoid exposure to mosquitoes. Compared to 33% and 13% in 2010, only 17% and 10% respectively sleep under LLITN and or keep doors/windows closed in 2015. Similarly, the trends in LLITNs ownership has dropped from 78% to staggering figures of 61%. In addition, in Plateau State, 38.4% households' surveyed slept under insecticide treated net the previous night. Only an average of 0.8% had access and utilize indoor residual spray in north-central zones of the country.[11]One will not therefore, be surprised with significant increase in the malaria sero-prevalence from 45.1% in 2010 to 57.6% in 2015.

Compared to the adult sub-population, the malaria sero-prevalence among the school aged children was low in the current study. The reason for this unexpected find is not immediately clear. But we speculate that, larger proportion of the school aged population in the current study may have accounted for the higher prevalence figure we found otherwise, it would have been surprising since malaria disease burden has traditionally been found to be higher among the under-five sup-population of children.[19,20] This prevalence figure is however, nearly one-thirds lower than 63.3% and 69.0% reported using light

microscopy by other researchers from Angiama community of Bayelsa State, South-South Nigeria[21]and Aguleri, Anambra State South-East, Nigeria [22] respectively.

In sharp contrast to rising rural malarial sero-prevalence in north-centralNigeria from 45.1% in 2010 to 58.6% in 2015, Papua New Guinea reported a steady decline in her national prevalence rate in which, its reported 11.1% (95 CI 8.5 - 14.3), 5.1% (95% CI 3.6 - 7.4), and 0.9% (95%CI 0.6 - 1.5) in 2008-2009, 2010-2011 and 2013-2014 respectively.[23] Similarly, recent works from Haiti and Dominican Republic clearly show sustained gains in malaria control activities raising hopes on malaria elimination in those regions of the world.[24, 25] As Nigeria gears up towards malaria elimination, measurement of time sensitive malaria burden, active disease surveillance, expansion of research on vector bionomics and deployment of effective vaccines are crucial to curb this ancient scourge in our rural settings. These are ambitious calls of the government of Nigeria to make.

Conclusions

Plasmodium falciparum malaria transmission continues to occur in rural communities of Bassa Local Government Area of Plateau State.A slight decline in sero-prevalence was however noted. Research on innovative models that work such as malaria vaccines, mosquito bionomics and environmental sanitation to compliment the current malaria therapeutics may need be employed in our setting to achieve the global goal of malaria eradication.

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