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Differential Prevalence of Malaria Infection in Rural and Urban Out-Patient Clinics in Lagos State, Nigeria

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Introduction: Nigeria is a country with diverse weather conditions supporting the substantial breeding of mosquitoes resulting in high malaria transmission. Mapping of malaria prevalence in areas with ongoing transmission is critical for effective distribution of control interventions. In this study, a cross-sectional survey was carried out in two different (rural and urban setting) endemic communities within a hypo-endemic state (Lagos) of Nigeria.

Methodology: The study targeted patients visiting clinics in both Ijede and Gbagada General Hospital between September and November 2017. All patients visiting each of the two hospitals with febrile complaints were recruited into the survey. Blood samples collected were examined using the standard thick and thin films stained with Giemsa.

Results: A total of 342 participants were screened out of which 108 (31.6%) were positive for *P. falciparum* by microscopy in both centers (Ijede centre 90 [43.9%]; Gbagada 18 [13.1%]). Children aged 1-10 years had the highest prevalence (43.6%) in both locations and this rate was significantly higher (P=0.001) in Ijede (63%) than in Gbagada (17%). There was no significant difference (P>0.05) in infection rate between male (31.9 %) and female (31.3%) participants in both sites.

Conclusion: These findings give an overview of the "freedom of establishment" of malaria in an under-resourced area where all conditions serve as motivation for the breeding of malaria vectors. Distribution of control measures should strategically target rural areas where the burden of infection is high, and inhabitants of such areas have a disproportionate access to health care.

Keywords: Malaria, Prevalence, Hypo-endemic, Rural area, Urban area.

1.0 INTRODUCTION

Malaria, a very important infectious disease in Sub-Saharan Africa (SSA) with high morbidity and mortality rates, is caused by an obligate intracellular protozoan parasite, *Plasmodium* species. Approximately 435,000 deaths were associated with malaria in 2017, with 92 % of the estimated deaths reported from SSA [1]. The most vulnerable individuals at risk of mortality from the infection are those with low immunity especially pregnant women and children below age five [2]. Malaria infection in high transmission zones results in enormous spending equivalent to almost half of all public health expenditures involving 30-50% hospital admissions and up to 50% of all hospital visits [3].

Plasmodium infection has witnessed a remarkable decrease of about 37% since the turn of the millennium while mortality has reduced by 60% with many countries moving towards eliminating malaria, and "no case reported from the WHO European Region for the first time since record keeping began" [4]. This achievement was substantially driven by large scale research and implementation of new chemotherapy, insecticides and diagnostic methods in the past few years [5].

Nigeria bears the second highest burden of malaria infection in SSA after the Democratic Republic of Congo, where 97 % of the total population is at risk of infection, and accounted for 25% and 19% of global malaria case and mortality respectively in 2017 [1]. High death rates of up to approximately 11% and 30% have been documented among women of child bearing age and children under five years old respectively [6]. The high prevalence of malaria in certain regions are due to factors such as the behaviour of inhabitants, over-crowded human populations, aggressive urbanization, temperature, availability of conducive breeding environment for malaria vectors, relative humidity and intensity of rainfall [7]. All of these create a fertile environment for the continuous transmission of malaria.

Modest reduction in malaria transmission which has been achieved in much of SSA is jeopardized by increase in resistance to insecticides by the vectors [8] and by the detection of *Plasmodium* parasites that are resistant to artemisinin and its partner drugs in south-east Asian countries [9 -14] with a propensity to spread to Africa as observed with chloroquine [15,16] and sulphadoxine-pyrimethamine [17]. There is need for renewed efforts in other to reduce the prevalence of malaria in endemic regions. This can be achieved through effective deployment of the available preventive tools such as insecticide treated nets, antimalarial drugs and vector controls [18].

Geographic differences in rural and urban communities have been known to be a driver for observed variations in malaria transmission dynamics which ultimately determine the prevalence. For instance, urban areas characteristically display low malaria prevalence especially when targeting government based hospitals, not because of increased implementation of preventive and control measures but for lack of capturing the true epidemiological situation of malaria in such settings. A study reported that residents of such urban areas are inclined to visiting private and specialist hospitals [19]. Previous studies have reported substantial differences in malaria prevalence between rural and urban settlement [20-22]. These geographic differentiation seems to be inconsistent, justifying the need to constantly determine the prevalence of *P. falciparum*. Such disparities however need to be evaluated in various malaria transmission settings, in order to initiate region specific sustainable intervention measures. To this end, this study was conducted to evaluate the prevalence of malaria in two outpatient clinics located in an urban and rural area of Lagos.

2.0 METHODOLOGY

2.1 Study area and Ethical consideration

Lagos State is a metropolitan city with 20 Local Government Areas (LGAs), of which Ikorodu and Kosofe are two of the 20 LGAs. Ijede is located in Ikorodu LGA which by its location is rural, while Gbagada on the other hand is an urban located in Kosofe LGA. The rainfall pattern (1400-1800mm), climatic conditions (dry; November-March and rainy season; April-October), dominant vector species (*Anopheles gambiae* and *An. funestus*), all-round the year transmission and a hypo-endemic prevalence rate of 1.9% in children age 6-59 months are all similar in both study locations [23]. This study was part of a larger study with ethical clearance number IRB/16/347 from the institutional review board of the Nigerian Institute of Medical Research. All staff and patients concerned were duly notified and informed consent and/or assent where available were obtained.

2.2 Collection and preservation of blood samples

All patients visiting each of the two hospitals with febrile complaints were recruited into the survey. Blood samples collected in EDTA were utilized for sample processing, and diagnosis were made by clinical observations and microscopy.

2.3 Examination of blood film

Two drops of blood were added onto grease free slides, and a clean glass slide was used as a spreader to make thin films of blood. Still on the same slide, about 2cm slightly above the thin smear, three drops of blood were used to make the thick film. While only the thin films were fixed in 100% methanol, both films (thin and thick) were stained in 10% Giemsa for 10 minutes, then gently rinsed with distill water and air dried [22]. Good laboratory practices and other precautions were observed while preparing blood films [25]. The asexual trophozoite stage of the parasites were examined and was used to estimate parasite density by counting the total number of parasites per two hundred white blood cells.

2.4 Data analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive and inferential statistics were also used to further analyze the results obtained. In all analysis, P is considered significant if < 0.05.

3.0 RESULTS

A total of 108 (31.6%) participants were positive for *P. falciparum* in the two study areas. The prevalence in Ijede was 43.9%, while that of Gbagada showed a marked lower prevalence 13.1% and the difference was statistically significant (P=0.000). Overall infection rate was found to be slightly higher in males 31.9% than in females 31.3% in both study locations, although not stastically significant (P=0.9) (Table 1). However, females from Ijede had a slightly higher prevalence (60%) than males (40%) while in Gbagada, infection was higher in male subjects (55.6%). (Table 1).

Table 1. Prevalence of *P. falciparum* in an urban and rural locations of Lagos State, Nigeria

Variables		No Exam-ined	No Infected	Prevalence (%)	p -Values
Sex	Male	144	46	31.9	0.9
	Female	198	62	31.3	
Total		342	108	31.6	
Loca-tion	Ijede	205	90	43.9	0.000
	Gbaga da	137	18	13.1	
Total		342	108	31.6	

The age related prevalence distribution patterns in the study showed those within age group 1-10 years have the highest prevalence (43.6%) while the lowest prevalence (14.6%) was observed among the age group 31- 40 years (Table 2). Similarly, the highest prevalence of 63% was obtained in Ijede among children in age group 1–10 years while the lowest prevalence (15%) was observed among the oldest age group (above 50 years of age). Gbagada also recorded same pattern of prevalence (17%) among children 1–10 years of age, while no infection was recorded in the 41-50 year age group.

The parasite density obtained from the asexual blood stage was markedly different in both study area. Gbagada had a significantly higher parasite density in comparison to Ijede (p=0.04) (figure 1).

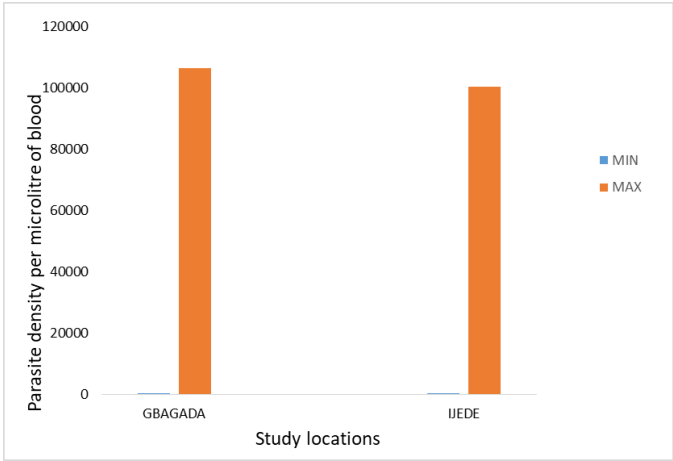

Figure 1. Parasite density per microitre of blood in the two study locations.

4.0 Discussion

Conducive environmental conditions enhances the continuous transmission of malaria infection. In this study a significantly higher prevalence of malaria was recorded in Ijede compared to Gbagada community of Lagos state Nigeria. Ijede represent a rural, underdeveloped area with poor drainages, unkempt dumping sites and uncompleted housing structure, which makes it a suitable breeding site for mosquitoes, the vectors of malaria parasites. All these factors increases the chances of exposure to the parasite vector which is a predisposing factor for increased infectious bite [26]. The observed high prevalence is in agreement with a similar study conducted in a neighbouring state where majority of the participants were also found lacking in malaria preventive measures [27]. Also, majority of the inhabitants

Table 2: Prevalence of *Plasmodium falciparum* by age in the rural and urban study areas of Lagos State, Nigeria

Age Group (Years)	Number Examined	Positive samples (%)	Ijede		Gbagada		
			Number examined	Number positive (%)	Number examined	Number positive (%)	p-values
1-10	140	61 (43.6)	81	51(63)	59	10(17)	0.001
11-20	40	16 (40)	28	15(53.6)	12	1(8.3)	0.000
21-30	47	14 (30)	27	11(40.7)	20	3(15)	0.192
31–40	48	7 (14.6)	30	6(20)	18	1(5.6)	0.398
41-50	27	4 (14.8)	19	4(21.1)	8	0	0.317
>50	40	6 (15)	20	3(15)	20	3(15)	
TOTAL	**342**	**108 (31)**	**205**	**90(43.9)**	**137**	**18(13.1)**	

of Ijede community are not well educated and are mostly traders with very little knowledge on malaria prevention strategies which may directly lead to increased susceptibility to the parasite.

Gbagada on the other hand, has well-constructed drainage for proper disposal of waste water thereby reducing the occurrence of stagnant water in the community. Wastes are properly disposed at designated and well-kept dumping sites, thus reducing the risks of malaria infections since there is a reduced exposure to the parasite vector. Needless to mention the high education status of majority of the inhabitants of Gbagada which equips them with the necessary knowledge for preventing the parasite infection [28]. This report is in line with the findings of Rasheed *et al* [29] that showed that rural populations fall ill more often than those in urban setting. Another possible explanation to the low prevalence observed in Gbagada could be due to the economic status of residents which permits them to visit private hospitals and even pharmaceutical drug stores more than the government owned hospitals [30]. Although the prevalence of malaria in Gbagada was low, but the parasite density in comparison to Ijede was visibly higher. The reason for this is not quite clear but it can be argued to be the result of increased immunity due to continuous exposure, however, this is applicable to both study areas as exposure is always ongoing.

Children age 10 years and below with the highest prevalence of infection as recorded in this study may not have developed enough protective immunity against malaria infection. It was also noted that majority of this children leave the comfort of their homes to play with peers in the neighborhood in the evenings which exposes them to bites of the *Anopheles* vector. The lower prevalence observed among 31- 50 year and above could be due to the fact that this age groups would have developed enough protective immunity as a result of repeated exposure [31, 13]. The slightly disproportionate prevalence observed in females and males could be connected to the different exposure period as males are known to spend more time outside the homes than females and to this end, they may be more exposed to the infection than females.

The sharp difference in the prevalence of malaria in the two locations could be attributed to the differences in their socioeconomic status, level of infrastructural development and sanitary level of the environment. Gbagada is a well-developed area with less breeding sites for malaria vectors with affluent inhabitants. This is expected to help reduce malaria exposure risk and malaria episodes reducing the possibility of regular hospital visits. On the other hand Ijede is the exact opposite of the affluent Gbagada and this could be argued for the observed higher prevalence of malaria parasite recorded in this community. Also, the period of the year when the study was carried out could be an additional factor responsible for the increased prevalence obtained in both sites since malaria vectors coexist longer during rainy seasons and this aids transmission [7].

Although this study is limited in the number of study sites, the findings however, indicates a public health concern in the studied locations particularly in Ijede area of Lagos State. Sensitization programs should be organized to enlighten the entire populace of the dangers that a dirty and unkempt environment poses to them. Drainage should be kept clean, stagnant water should be eradicated as they provide habitation for the disease vector which increases risks of transmission. Greater attention should be paid to the population living in rural areas, towns and villages. Control interventions in these regions should be given urgent priority especially during intense transmission seasons.

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Conflict of interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

TSO-J conceived and designed the study, wrote the first draft of the manuscript; **MAO** designed the study, contributed to writing the manuscript, revised darft, contributed to data analysis. **GOO** supervised data collection and data preparation for analysis; **IKF** Performed analysis, contrubuted to manscript writing; **UO** contributed to initial data analysis; **DDA** contrubuted to sample and data collection;

Declaration of conflict of interest

The Authors declare that there is no conflict of interest

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