



Prevalence of Malaria Parasitaemia in Three Selected Local Government Areas of Niger State, North Central, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors HAE and IDE designed the study. Author HAE did the sample collection and carried out the laboratory analyses. Author GOD managed the literature and the manuscript. Author COE provided support of the work. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Malaria- a parasitic protozoan infection, caused by Plasmodium species- is a major public health challenge in Africa. Aside hundreds of thousands of annual deaths attributable to malaria, lots of valuable man-hours- that could otherwise be put to some productive endeavours- are wasted in hospital visits and waiting time in clinics. An estimated 81% of all annual global malaria cases, as well as 91% of all global deaths that are due to malaria, occur in Africa. Therefore, the monitoring of prevalence of malaria parasitaemia is an integral part of any preventive and control measure put in place to curb the spread of malaria.

Materials and Methods: This study was designed to determine the prevalence of malaria parasitaemia in three selected local government areas (LGA) of Niger State, north central, Nigeria. A total of 930 subjects were sampled from Borgu, Mashegu and Magama LGAs of Niger State. Out of these, 504(54.2%) were males, while 426(45.8%) were females. Twenty-two percent, 27.1%,

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22%, 5.3%, 4.7%, 6.3%, 4.5% 3.7% and 4.4% were within the 1-5 years, 6-10, 11-15, 16-20, 21-25, 26-30, 31-35, 36-40 and >40 years age-groups respectively. The subjects were requested to complete questionnaires (self-administered for the literate ones but interviewer-administered for those who could not read and write. Also 0.5mL of capillary blood samples was collected from each of them. Thick and thin blood films of the samples were stained with Giemsa and the stained slides were microscopically examined for the presence or absence of the asexual stages of *Plasmodium* spp.

Results: The study recorded an overall prevalence of 51.9%. The females had a higher prevalence (53.3%) than the males (50.8%). Among the various age-groups, 1-5 years, 6-10, 11-15, 16-20, 21-25, 26-30, 31-35, 36-40 and >40 years age-groups, the following prevalences respectively were recorded; 74.6%, 48.4%, 46.8%, 46.9%, 45.5%, 44.8%, 45.2%, 41.2% and 24.4%. No statistically significant ($p>0.05$) differences in prevalence were found among the various occupational groups of the subjects; students (47.9), farmers (57.7%), fishermen (64.9%), cattle-rearers (57.3%) and dependants/ full-time house-wives (60%). However, a statistically significant difference in prevalence ($p<0.05$) was discovered between subjects who lived in thatched-roof houses and those who lived in houses with corrugated iron roofing sheets. Prevalence was also significantly higher ($p<0.05$) among subjects who had no formal education. From the findings of the study, one out of every two subjects had malaria parasitaemia. If this is extrapolated to the entire communities of Borgu, Mashegu and Magama LGAs, it means greater than half (51.9%) of the general populace are infected with malaria.

Conclusion and Suggestions: It is therefore recommended that the government of Niger State and the chairmen of these three LGAs should immediately put measures in place to curb and curtail the spread of malaria in these rural communities.

Keywords: Malaria; parasitaemia; Niger State; prevalence; Nigeria.

1. INTRODUCTION

Malaria is a major public health challenge in Africa, where it causes millions of death annually [1]. Pregnant women, infants, children under five years and visitors to malaria-prone areas are particularly vulnerable to malaria, among whom morbidity and mortality are most severe and highest [2-5]. In the tropics, up to 80% of childhood fever could be due to malaria and an approximate 30-35% of hospital visits results from malaria or malaria-related issues [6].

The long-term consequences of malaria in endemic areas like sub-Sahara Africa among children under five years is equally disturbing, as these could manifest as cognitive impairment or stunted growth [4,5,7-10]. It takes heavy tolls on pregnant women, in form of pre-term birth, intra uterine foetal death, miscarriages, maternal hypoglycaemia, cerebral oedema and maternal death [11-15]. Prevalence of direct or indirect maternal death traceable to malaria in Nigeria has been reported as 10% in Calabar, Enugu 8%, 7.8% in Lagos and 8.2% in Kano [15,16].

Certain estimates claim that between 80-90% of global cases of malaria occur in sub-Sahara Africa [11,17,18] Out of a total number of 216 million cases estimated to have to occurred in

2010, 81% were in Africa, 13% in southeast Asia and 5% in Eastern Mediterranean region. Same year, 2010, 655, 000 deaths were estimated to be due to or related to malaria and out of these, 91% were in Africa, 6% in Southeast Asia and 3% in Eastern Mediterranean region [19].

Malaria- a protozoan infection- is caused essentially in Africa by *Plasmodium falciparum*. *Plasmodium* species are transmitted to humans by the bites of adult haematophagous anthropophilic female Anopheles mosquitoes [20]. In Asia, *Plasmodium vivax* accounts for about 70% of malaria infections, while in other parts of the world, *Plasmodium falciparum* accounts for about 33% of all malaria infections [20,21]. In Nigeria, the Federal Government has initiated different prevention and control programmes, such as Roll Back Malaria. The effectiveness of this and other measures depends to a large extent on studies like this, which will help guide government as where and how interventions programmes are needed and should be implemented. This study aimed at determining the prevalence of malaria parasitaemia in three selected local government areas of Niger State, North central, Nigeria. It equally aimed at evaluating the prevalence with regards to the age, gender and local government areas of the subjects.

2. MATERIALS AND METHODS

2.1 Study Sites and Study Design

This descriptive cross sectional study was conducted in three local Government Areas of Niger State, North-Central region of Nigeria. The state is located in the North Central geopolitical zone and Middle Belt of Nigeria and covers a land mass of 76,363 square kilometres. It lies between Latitude 8°.00-11°.30'N and Longitude 4°.00-8.00'E; it shares international boundary with the Republic of Benin to the west and 6 interstate boundaries in Nigeria namely; Kebbi and Zamfara States to the north, Kwara and Kogi States to the South and Kaduna and Federal Capital Territory to the East [22] (Fig. 1).

The climate of Niger State is that of tropical continental region which is characterized by relatively wide annual temperature range and a restricted rainfall. It is also marked by two distinct seasons, namely, rainy and dry. The rainy season starts in April and lasts till October, with

June and August as the months of peak rainfall. The dry season, extending from November to March is completely devoid of rains and characterized by harmattan with dust-laden cold winds swept-in by the Northeast Trade wind. The departure of harmattan for the rains is ushered-in by the arrival of moist tropical maritime air mass of the southwest trade wind. This period is usually marked by hot sunny days with temperature range of 34-40°C, the highest of which occur in March [23].

The vegetation of the North central Nigeria reflects that of Guinea Savannah zone, characterized by predominance of tall grasses interspersed with few trees [24].

2.2 Ethical Consideration

Ethical clearance was sought and obtained from University of Ilorin ethical review committee and Niger state ministry of health.

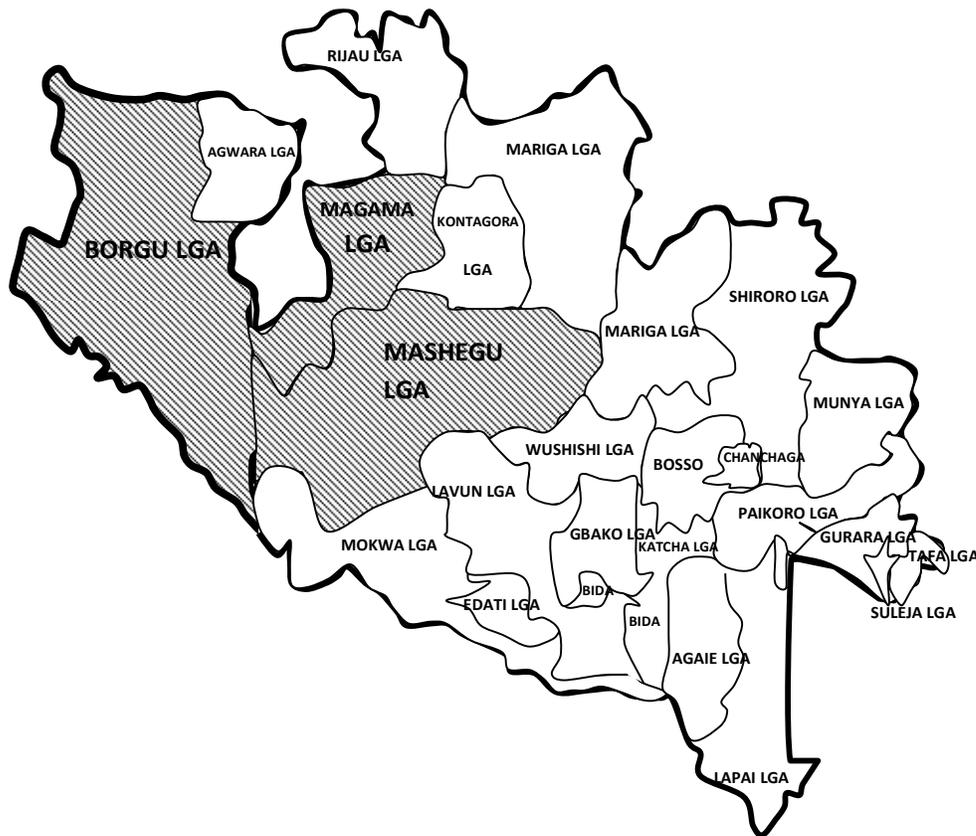


Fig. 1. Sketch Map of Niger State showing the 25 local government areas. The shaded areas are the three local government areas where the study took place

2.3 Sample Collection

Blood samples were collected aseptically by finger prick to make thick and thin blood smears on clean grease-free microscope slides. The slides were properly labelled and allowed to air dry before they were packed into slide boxes.

2.4 Microscopic Examination

Giemsa stain was prepared and diluted (3%) in buffered distilled water (pH 7.2). Thin films were first fixed with methanol and allowed to air dry after which both thick and thin smears were stained with filtered and diluted Giemsa stain for 30 minutes and then examined under compound microscope for the presence of asexual stage of *P. falciparum* as earlier described by Cheesbrough [25]. Parasite density was recorded as number of parasite/ul of blood, assuming an average leucocyte count of 8,000/ul of blood.

3. RESULTS

The study recorded an overall malaria parasitaemia prevalence of 51.9%. The subjects comprised of 504 males (54.2%) and 426 females (45.8%). Two hundred and five (22%) of the subjects fell within the 1-5 years age-group, while 252 (27.1%), 205 (22%), 49 (5.3%), 44 (4.7%), 58 (6.3%), 42 (4.5%), 34 (3.7%) and 41 (4.4%) fell within the following age-groups respectively; 6-10, 11-15, 16-20, 21-25, 26-30, 31-35, 36-40 and >40 (Table 1).

Table 1. Subjects' distribution by gender and age-groups

Age-groups	Male	Female	Total
1-5	114	91	205
6-10	144	108	252
11-15	113	92	205
16-20	22	27	49
21-25	28	16	44
26-30	21	37	58
31-35	20	22	42
36-40	18	16	34
>40	24	17	41
Total	504	426	930

The male subjects had a prevalence of 51.9% while females had 48.1% prevalence (Table 2).

Table 2. Prevalence among the genders

Gender	Positive	Negative	Total
Male	256	248	504
Female	227	199	426
Total	483	447	930

Malaria parasitaemia prevalence among the various age-groups were found to be 74.6%, 48.4%, 46.8%, 46.9%, 45.5%, 44.8%, 45.2%, 41.2% and 24.4% respectively among the 1-5 years, 6-10, 11-15, 16-20, 21-25, 26-30, 31-35, 36-40 and >40 age-groups (Table 3).

Table 3. Distribution of prevalence rates among the age-groups

Age-groups	Positive	Negative	Total
1-5	153	52	205
6-10	122	130	252
11-15	96	109	205
16-20	23	26	49
21-25	20	24	44
26-30	26	32	58
31-35	19	23	42
36-40	14	20	34
>40	10	31	41
Total	483	447	930

Fig. 2 shows that prevalence decreases as age increases and this further reinforces the fact that infants and children under five years are vulnerable to malaria infection.

Occupationally, prevalence among the subjects were found to be; fishermen 64.9%; dependants 60%; cattle-rearers 57.3%; farmers 51.7% and students 47.9%. The differences were not statistically significant ($p > 0.05$, *chi*-value: 0.1254) (Table 4).

Housing-wise, the subjects essentially lived in three types of housing structures; mud houses with thatched roof; mud houses with corrugated iron roofing sheets and concrete houses with corrugated iron roofing sheets. The study found that subjects living in thatched-roof houses were statistically significantly more infected than those living in houses with corrugated iron roofing sheets ($p < 0.05$) (Table 5).

Furthermore, prevalence was discovered to be significantly higher among subjects with non-formal education (64.1%) ($p < 0.05$ *chi*-value: 0.00231), followed by those with primary education (52.4%) and Quaranic education (50%). Those with post-secondary education had the least prevalence (27%) (Table 6).

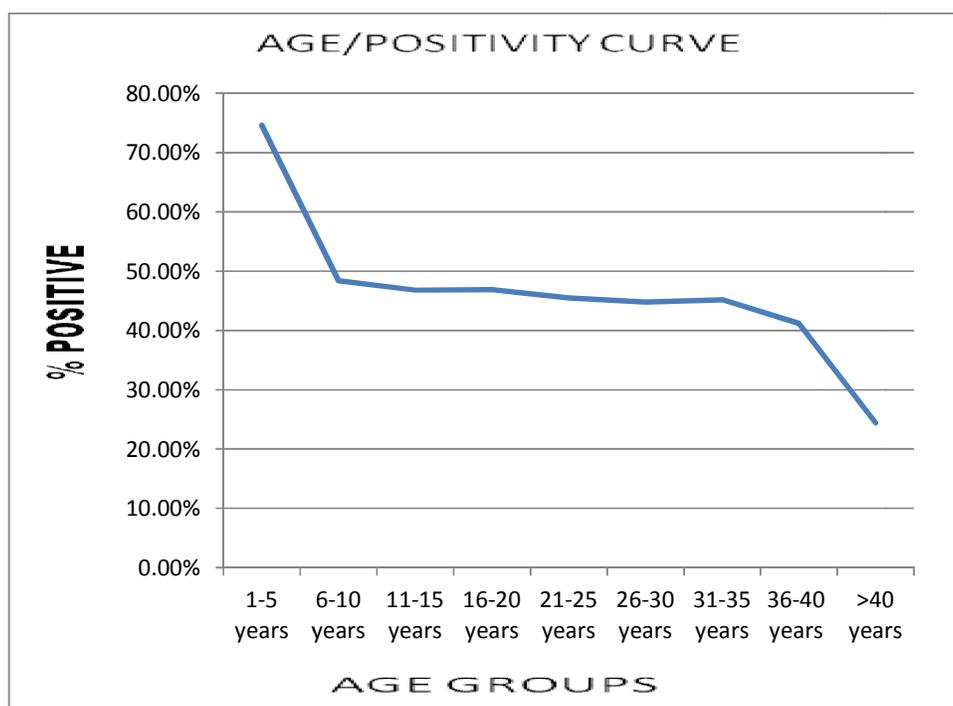


Fig. 2. Age/positivity curve

Table 4. Distribution of prevalence according to subjects' occupations

Occupations	Positive	Negative	Total
Students	227	247	474
Farming	121	113	234
Fishing	50	27	77
Cattle-rearing	43	32	75
Dependants/Full time housewives	42	28	70

Four hundred and sixty-nine (50.4%) of the subjects were from Borgu LGA (local government area), while 220 (23.7%) and 241 (25.9%) were from Mashegu and Magama LGAs respectively. Of the three LGAs, Borgu had the highest prevalence (59.9%), while Mashegu and Magama LGAs had 43.2% and 44.4% respectively.

Table 5. Distribution of prevalence according to housing types

Housing type	Positive	Negative	Total
A	338	228	566
B	72	124	196
C	73	95	168
Total	483	447	930

Legend: A: thatched-roof mud houses; B: mud houses with corrugated iron roofing sheets; C: concrete houses with corrugated iron roofing sheets

4. DISCUSSION

Prevalence of malaria parasitaemia is usually high in rural areas where mosquito-breeding and transmission are intense. The overall prevalence of 51.9% obtained in this study shows that malaria remains an important public health problem despite several control measures in Niger State and Nigeria as a whole. The observed prevalence in this study is higher than 27.7%, 29.5% and 37.7% reported by Ikeh et al. [8] in Plateau State; Elechi et al. [26] in Borno State and Millicent and Gabriel, [27] in Kaduna State respectively but consistent with the findings of Okoli and Solomon, [28], James et al. [29] and NMSI, [30] in Plateau State.

Disparity in prevalence of malaria parasitaemia between this study and those afore mentioned studies may be due to multiple factors such as

Table 6. Distribution of prevalence according to level of education

Level of education	Positive	Negative	Total
Pre-primary	227	247	474(51%)
Non-formal	177	99	276%
Quaranic	30	30	60(6.5%)
Primary	22	20	42(4.4%)
Secondary	17	24	41(4.4%)
Post-secondary	10	27	37(4%)

geographical location, sampling and processing protocols, targeted population, seasonal variation, environmental condition as well as rate of use of malaria intervention tools [31]. The high prevalence (51.9%) obtained in this study is attributable to socio economic status of the study population such as the housing structure, deplorable level of education, ignorance, poverty, neglect and socio cultural life style of the subjects.

Prevalence of malaria parasitaemia in relation to age showed a decreasing trend towards an increasing age. This may be attributed to the gradual acquisition of immunity to malaria which comes with cumulative exposure and is directly related to age in an endemic area [32]. The highest prevalence of infection within the age range 1-5 years strongly suggests that the residual maternal immunity acquired by the children had waned off and their immune systems are not yet fully developed. Consequently, they were not able to develop effective resistance to infections. Malnutrition is another reason that may be adduced to the high prevalence of malaria parasitaemia among this age group. Observations showed that many of these children are severely malnourished and this has been found to induce down-regulation of the overall anti-falciparum IgG antibody response [26]. Previous studies from various African regions have also reported highest prevalence in younger age groups [32-36].

Similarity in the overall prevalence of malaria between male and female observed in this study is largely due to uniformity in the degree of exposure of both sexes to mosquito bites. The higher prevalence (62.2%) seen among females than males (35.7%) in the age group 21-25 years may be due to pregnancy which is associated with immune-suppression specifically among primigravidae and secondgravidae. This finding is consistent with previous studies which reported higher prevalence among females in the same age group [37-39]. However, a predominance of malaria infection in males has also been documented [40].

Several studies have linked socio-economic status with malaria parasitaemia [41-45]. In agreement with previous studies, this current study illustrated that housing structures and level of education have significant impact on the prevalence of malaria parasitaemia. Houses made of thatched roof have an increased risk of mosquito bites indoors because such houses create cooler and darker environment which favours resting mosquitoes. Moreover, mud walls and thatched roofs often have crevices through which infected mosquitoes can gain access to the inside of the house thereby leading to increased mosquito population and resulting in higher risk of malaria transmission.

On the other hand, education holds the key to a sustainable response to malaria prevention and awareness of malaria services while low level of education is associated with ignorance and increased vulnerability to malaria [46].

However, this study did show positive association between occupation and malaria parasitaemia. The study revealed that malaria prevalence was higher in Borgu local government area than Mashegu and Magama local government areas. This may be largely due to lack of access to health care facilities and social amenities in Borgu local government area. Also, Borgu shares international boundary with republic of Benin (which is also endemic for malaria) and the possibility of cross border movement may be responsible for the observed higher parasitaemia [47]. The drainage of river Niger and its tributaries and presence of Yankari game reserve may be contributory factors.

5. CONCLUSION AND RECOMMENDATION

From the findings of this study it can be concluded that greater than half (51.9%) of the entire communities of Borgu, Mashegu and Magama LGAs of Niger State are infected with malaria. The attendant effects of this high rate plasmodiasis in an agrarian rural community are

enormous. This could either suggest a high level of ignorance among the locals on how to prevent malaria infection or absence of basic health facilities. It is therefore recommended that the government of Niger State and the chairmen of these three LGAs should immediately put measures in place to curb and curtail the spread of malaria in these rural communities.

CONSENT

As per international standard or university standard, patients' consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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