

## Community Directed Screening to Identify Asymptomatic Malaria Reservoir of Plasmodium Falciparum in Nasarawa State, Nigeria

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### Abstract

*Asymptomatic malaria is prevalent in highly endemic areas of Africa, with only a small percentage of individuals exhibiting clinical symptoms. The clinical consequence of asymptomatic malaria is not fully understood. Some researchers believe that asymptomatic parasitaemia is involved in developing partial immunity and may protect against clinical disease from new infections. This study therefore determined the prevalence of asymptomatic reservoir of plasmodium falciparum and the level of knowledge of malaria among the populace in Nasarawa state. A community-based cross-sectional study was conducted among selected local government areas of the state. The local government areas were observed to have reported the highest positivity rate of malaria between 2017 to 2022. The study was conducted from August 2022 to April 2023. A semi-structured questionnaire was employed to collect socio-demographic data and other associated risk factors by trained health professionals. Body temperature and different clinical manifestations were examined to identify the asymptomatic individuals. This examination was carried out after the selection of individuals from households before mRDT was conducted. Data entry and analysis were carried out using (SPSS, 20). The study indicates that the prevalence of asymptomatic malaria parasitaemia among adults in Nasarawa state is 23.8%. It is evidenced that malaria is endemic in Nasarawa state. This study, therefore, recommends continuous awareness of malaria, control measures, and environmental sanitation to control further transmission of malaria in the state.*

**Keywords:** Artemisinin Combined Therapy, Asymptomatic, Long Lasting Insecticide Net, Malaria Rapid Diagnostic Test, Plasmodium Falciparum, Screening.

### Background

Asymptomatic malaria is the presence of malaria parasites in the blood in the absence of symptoms. However, the clinical symptoms may vary across different epidemiological settings and are fully understood. It is also generally assumed that in endemic areas asymptomatic parasitaemia is involved in developing partial immunity and may protect against clinical disease from new infections [1]. On the other hand, asymptomatic parasitaemia provides a reservoir for transmission and may be the precursor in the progression to symptomatic disease [1]. Although experts

have emphasized the role of asymptomatic carriers in various studies, but the interesting point is the absence of a unified definition of asymptomatic malaria [2].

Asymptomatic malaria is prevalent in highly endemic areas of Africa, with only a small percentage of individuals exhibiting clinical symptoms [3]. The clinical consequence of asymptomatic malaria is not fully understood [1]. Some researchers are of the view that asymptomatic parasitaemia is involved in the development of partial immunity and may protect against clinical disease from new infections.

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Based on the latest data from the World Malaria Report, the year 2020 saw a total of 241 million reported cases of malaria worldwide, marking an increase from the 227 million cases recorded in 2019. Tragically, the estimated count of malaria-related deaths reached 627,000 in 2020, representing a rise of 69,000 fatalities compared to the previous year [4].

The burden of malaria remains significantly concentrated in the WHO African Region. In the year 2020, this region accounted for an overwhelming 95% of all reported malaria cases and a striking 96% of the total reported deaths due to malaria. Distressingly, around 80% of all malaria-related deaths in this region were among children under the age of 5 [4].

The global malaria landscape was notably influenced by four African countries, which collectively contributed to slightly over half of the total global malaria deaths. These countries are Nigeria (31.9%), the Democratic Republic of the Congo (13.2%), the United Republic of Tanzania (4.1%), and Mozambique (3.8%). According to the World Malaria Report 2021, Nigeria accounts for a major portion of the global malaria burden, in terms of both global estimated malaria cases and deaths, 27 percent and 32 percent, respectively [5].

Furthermore, malaria is a major public health risk in Nigeria where children and pregnant women are most vulnerable. In Nigeria, this infectious disease continues to be the primary source of both illness and death among children. Malaria accounts for about 60% of all clinic attendance in Nigeria [6].

The burden of malarial infections cannot be underestimated; it is widely agreed that malaria is a disease of the poor [7]. Malaria is transmitted throughout Nigeria, with 97% of the population at risk of malaria. The duration of the transmission season ranges from year-round transmission in the south to three months or less in the north [8]. According to the 2021 World Malaria Report, Nigeria had the highest number of global malaria cases (27

% of global malaria cases) and the highest number of deaths (32 % of global malaria deaths) in 2020 [9]. The country accounted for an estimated 55.2% of malaria cases in West Africa in 2020 [10]. Case numbers increased by 5.3% between 2017 and 2020, from 298 to 314 per 1000 of the population at risk. Deaths increased by 4.7%, from 0.92 to 0.97 per 1000 of the population at risk during that same period [10].

The prevalence of malaria amongst children 6 – 59 months was 27% with a slight decline to 23% in 2018 [11, 12]. Many studies have shown that the malaria burden is generally higher in rural compared to urban areas [3]. The prevalence of malaria is higher in the Northern part of the country.

According to NDHS 2018, Nigeria prevalence rate was at 22.6% while Nasarawa state reported 13.6% prevalence rate [12]. Nasarawa state is one of the states in the northcentral that is supported with different interventions by various developmental partners/non-governmental organizations in malaria. The donors provide supports to the state malaria elimination program on case management, surveillance monitoring and evaluation, drug-based prevention and treatment approaches (intermittent preventive treatment in pregnancy and seasonal malaria chemoprevention) which are more directed to those under five years and pregnant women, health system strengthening (planning management and program monitoring), distribution of long-lasting insecticide nets (LLIN), malaria commodities (drugs, malaria test kits). Therefore, this study aims to assess asymptomatic malaria plasmodium among adults in Nasarawa state.

## **Materials and Methods**

### **Study Area and Period**

The study was conducted in the three geopolitical zones of Nasarawa state. Three local government areas were selected based on the high positivity rate in the last 5 years. The

selected local government areas (LGAs) include Keana, Nasarawa and Wamba. The study was carried out from August 2022 to April 2023.

### **Study Design**

A cross-sectional survey was done between August 2022 and April 2023, which is a period of high malaria transmission intensity to capture peak transmission. The number of months suitable for malaria transmission in Nasarawa state is six and half months (May, June, July, August, September, and October) in the following states: Oyo, Ogun, Kogi, Benue, Nasarawa, the southern part of Taraba, Abuja and Kwara [13]. A community-based cross-sectional study was conducted among the selected local government areas (Keana, Nasarawa and Wamba) in Nasarawa state. The local government areas had a relatively higher malaria positivity rate in the past 5 years according to the District Health Information Software 2 (DHIS2) report from 2017 to 2022. To achieve the set goals for this study, three (3) health facilities were identified in the senatorial zones. The study considered some selected settlements in the catchment areas that are within a 5 km radius of the health facilities.

### **Study Population and Sample**

The sample population was drawn from persons aged 18 years and above, preferably household heads in Nasarawa state using a stratified sampling method. Within the stratum, the LGAs with the highest malaria positivity rate were selected. The sample population included willing participants based on age, gender, occupational status, marital status, educational background, and household size. Consequently, a mixed population of 1200 individuals were screened, and the survey was conducted between August 2022 to April 2023.

The sample size for this research was determined using Taro's formula.

The statistical formula devised by Taro is as follows:

$$n = \frac{N}{1 + Ne^2}$$

In the formula above.

n is the required sample size

N is the whole population

e is the precision or sampling error which is taken to be 0.05

Therefore, a sample size of 400 respondents each across the three local governments of the three geopolitical zones in Nasarawa state out of the entire population of 154,977,64,700 and 59,509 respectively will be considered. The respondents would therefore be the lowest acceptable number of responses to maintain a 95% confidence level.

There has never been any study conducted on this topic in the state. However, since there was no study of such conducted in the area, 13.6% prevalence in Nasarawa state was taken from the NDHS 2018 [12]. The margin error at 5%, and a sample size of 400 was obtained from the population of Nasarawa, Keana and Wamba LGA respectively.

### **Inclusion Criteria**

The study comprised individuals (aged 18 and above) within the community, particularly those with no history of fever before the survey, axillary body temperature ranging from 35.9°C to 36.7°C, and exhibited no additional indications or symptoms linked to malaria (such as headache, vomiting, abdominal pain, nausea, or diarrhoea). Participation was voluntary, contingent on the completion and signature of a consent form by everyone. Furthermore, the study exclusively enrolled individuals currently residing in Nasarawa State during the survey period.

### **Exclusion Criteria**

Persons with fever, those currently taking anti-malaria and those who took anti-malaria or have been on the therapy within the past 2 weeks were excluded. Additionally, individuals with life-threatening illnesses

(other than malaria) were also excluded. However, all participants showing clinical malaria signs present at the time of the study were tested and treated if their malaria parasite presence was confirmed.

### **Data Collection**

This study defined asymptomatic parasitaemia as a positive malaria Rapid Diagnostic Test (RDT) test without any reported history of fever before the research while exhibiting an axillary body temperature ranging from 35.9 °C to 36.7°C, and the absence of other malaria-related symptoms (such as headache, vomiting, abdominal pain, nausea, or diarrhoea). The selected communities' study population underwent testing using one of the Malaria RDTs. Based on WHO recommendations for product selection and procurement, the team procured one of the prequalified RDT for this study [14]. Specifically, the SD Bioline Malaria Ag standard diagnostics kit from the Republic of Korea was employed for this purpose. This RDT aids in detecting histidine-rich protein II antigens (HRP-II Ag) of malaria plasmodium falciparum in human whole blood.

For participants who tested positive for malaria parasites, the majority were treated using Artemisinin Combined Therapy (ACT) in line with malaria treatment guidelines. Artemether-Lumefantrine (AL) and alternatives: Artemether-Lumefantrine is the primary ACT deployed programmatically in Nigeria, with Artesunate-Amodiaquine as an alternative. To ensure adherence to the treatment regimen and to document any adverse effects, the initial dose was administered under direct supervision. Subsequently, participants were monitored for treatment adherence on days 1, 2, and 3 [15]. Each participant's retention of the drug was observed for 5 minutes after the treatment was administered.

### **Data Management and Analysis**

In this study, an open data kit (ODK) was used to collect data for this research. Hence, data was exported to Excel for cleaning. While SPSS (IBM SPSS Statistics 20, United States) was employed for the analysis of the data. Meanwhile, the household was considered as the unit of enrolment. The proportion of participants confirmed with malaria parasite during screening was used to report malaria prevalence. These proportions were categorized based on demographic variables such as age, gender, educational status, occupational status, marital status, and senatorial zones. The aim was to ascertain the extent of malaria prevalence related to asymptomatic parasitaemia among adults in Nasarawa state. Descriptive statistics, including tables and bar charts, were utilized for this purpose.

### **Results**

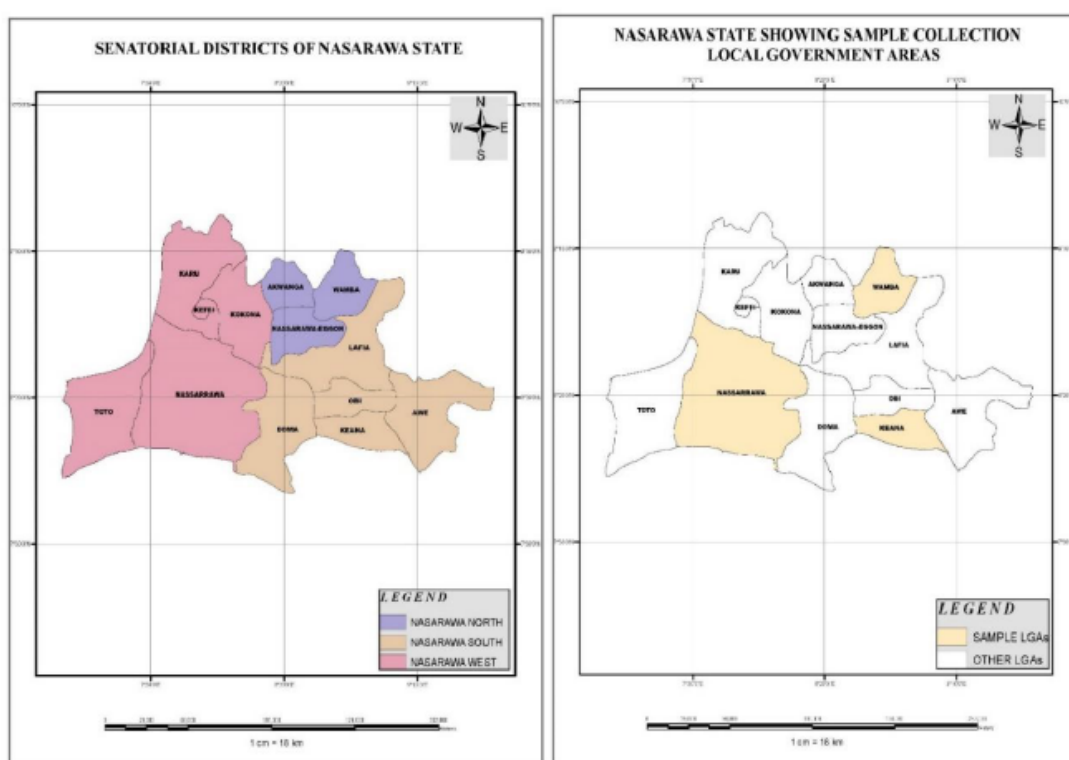
#### **Sociodemographic Characteristics of the Study Participants**

The study was conducted from August 2022 to April 2023. Out of 200 participants targeted across the three senatorial zones, the prevalence rate ranged from 19.3% (77/400) to 26.8% (111/400) (Table 1). The female participants made up 47.1% while the male counterparts made up 52.9% of the total participants. Considering the three different locations across the study. Asymptomatic malaria parasite carriage was found to be at 19.3% in Keana, 24.3% in Nasarawa and 26.8% in Wamba LGAs respectively. These observations reflect the seasonality of malaria in the zones across the state. It was also observed that some of the participant's attitude was a major factor that contributed to the high malaria positivity rate (Table 1).

A high number of the participants were within the age range of 25 – 29 years (73.4%), and nearly one-third of the population earned a monthly income within ₦30,000 – ₦80,000

(33.8%). The average household reported in the study was 3 – 5 household size. From the results in Table 1, Malaria knowledge among the participants was very good, 91.9% understand that a patient with a fever should be tested, and they will prefer to go to the hospital to see a health worker rather than do a self-medication as shown in table 1. Regarding LLIN coverage and usage, 94.2% of the participants have LLIN, out of which 47.8% have more than two LLINs. Most of the LLIN were obtained during the mass campaign, and

87.6% slept in the LLIN last night before the data collection. The majority of those who slept inside the LLIN were children under 5 years (64.4%). Of the 1200 participants, 471 (39%) were negative while 729 (61%) of the participants tested positive for malaria. Out of the total participants tested in the three senatorial zones, Nasarawa (24.3%) and Wamba (26.8%) reported the highest positivity rate in Nasarawa state. Malarial infection varied significantly according to the zones.



**Figure 1.** Map of Nasarawa State Showing the Study Areas.

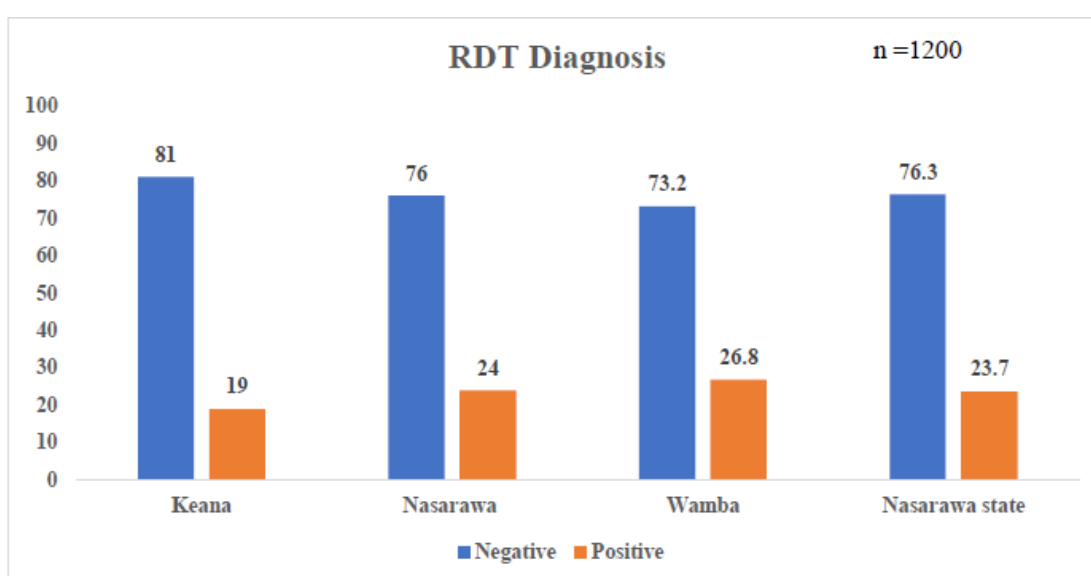
**Table 1.** Sociodemographic Characteristics and Households of the Study Participants and the Key Descriptive Results in the Selected LGAs of Nasarawa State

Characteristics/Variables	Category	Frequency (n=1200)	Percentage (%)	$\chi^2(P$ – Value)
<b>Demographic information</b>				
Age	18 – 24 years	232	19.3	0.164
	25 – 59 years	881	73.4	
	>60 years	88	7.3	
Sex	Male	635	52.9	0.7
	Female	565	47.1	
Educational status	Graduate	149	12.4	0.517

	Postgraduate	640	53.3	
	Secondary	230	19.2	
	Primary	18	1.5	
	None	163	13.6	
Occupational status	Business	388	32.3	0.826
	Civil service	122	10.2	
	Currently unemployed	14	1.2	
	Farmer	166	13.8	
	Housewife	328	27.3	
	Retired	60	5	
	Student	122	10.2	
Monthly income	<30,000	696	58	0.469
	30,000 – 80,000	406	33.8	
	>80,000	98	8.2	
Household size	1 – 2	166	13.8	0.00*
	3 – 5	530	44.2	
	6 – 9	335	27.9	
	>10	169	14.1	
<b>Knowledge and awareness</b>				
What's the sign of malaria	Fever	1103	91.9	0.695
	Chills	24	2	
	Vomiting	43	3.6	
	Diarrhea	12	1	
	I don't know	18	1.5	
Who decides you have malaria	Health worker	1097	91.4	0.355
	Self	92	7.7	
	Others	11	0.9	
What do when you suspect malaria	Self-medication	66	5.5	0.715
	Go to the lab	17	1.4	
	Go to the hospital	1112	92.7	
	Others	5	0.4	
<b>Control measures</b>				
LLIN availability	Yes	1130	94.2	0.71
	No	70	5.8	
LLIN usage	Yes	1051	87.6	0.007*
	No	149	12.4	
Stagnant water present in compound	Yes	337	28.1	0.339
	No	863	71.9	
Presence of water vessels	Yes	407	33.9	0.86

in the compound	No	793	66.1	
Presence of overgrown vegetation (within 5 metres) of the house	Yes	656	54.7	0.00*
	No	544	45.3	
<b>Prevalence of asymptomatic malaria</b>				
Keana – south senatorial zone		77/400	19.3	
Nasarawa – west senatorial zone		97/400	24.3	
Wamba – North senatorial zone		111/400	26.8	
<i>Nasarawa state</i>		<i>285/1200</i>	<i>23.8</i>	

**Note:** The p-value asterisk above are significant.



**Figure 2.** The Chart Above, Shows the Reporting on the Proportion of the Asymptomatic Population with Malaria Parasitemia as Diagnosed by mRDT Across the 3 Senatorial Zones in Nasarawa State.

## Discussion

Asymptomatic malaria is far more prevalent than previously thought, plays a significant role in onward transmission and is probably not completely asymptomatic. However, many important questions remain unanswered, with the key issues discussed in this review article. Asymptomatic, low-density infections are a significant component of the malaria reservoir, which also appear to contribute to the infectious reservoir [16]. However, the study revealed high prevalence rates of asymptomatic malaria parasitaemia in the three geopolitical zones of Nasarawa State.

A good proportion of asymptomatic carriers of parasites with no evident symptoms of malaria might be responsible for perpetuating transmission of malaria parasite in the presence of susceptible mosquitoes in the study areas as described previously [17]. Therefore, in the course of ongoing malaria elimination efforts in the country, there is a need to take into consideration routine surveillance, awareness creation during routine immunization sessions (either fixed or outreach), antenatal care sessions and encourage treatment of asymptomatic carriers of malaria to minimize infection rates.

The result from this study is similar to a study carried out in Nasarawa Eggon, Nasarawa state. The factors associated with asymptomatic malaria parasitaemia among women attending antenatal clinic in general hospital NasarawaEggon, Nasarawa state. The study indicates that the prevalence of asymptomatic malaria parasitaemia among pregnant women is 22.7% using microscopy [18].

This study is similar to a study conducted in Iwo, Ibadan, the impact of asymptomatic malaria on some hematological parameters in the Iwo community in southwestern, Nigeria. The prevalence of asymptomatic malaria patients found a prevalence of 21.1% using microscopic (Gold Standard) for examining malaria parasitaemia [19].

It is also comparable to a study done in Tanzania on the prevalence of asymptomatic malaria infections in selected military camps in Tanzania, where asymptomatic infection cases were likely to be detected more by microscopy 20.3% compared to 19.4% using RDT [17].

A good proportion of asymptomatic carriers of parasites with no evident symptoms of malaria might be responsible for perpetuating transmission of malaria parasites in the presence of susceptible mosquitoes in the study areas as described previously [20]. Therefore, in the course of ongoing malaria

### **Ethics Approval and Consent for the Study**

The protocol for this study was reviewed and approved by the Nasarawa State Ministry of Health Ethics Review Committee (NHREC Protocol Number:18/06/2017). Meanwhile,

### **References**

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elimination efforts in the country, there is a need to take into consideration routine surveillance, awareness creation during routine immunization sessions (either fixed or outreach)in addition to the current facility-based consultations that focuses on symptomatic patients in areas identified to have high malaria positivity rate, antenatal care sessions and encouragetreatment of asymptomatic carriers of malaria to minimize infection rates.

### **Conclusions**

It is evidenced that malaria is endemic in Nasarawa state. This study, therefore, recommends continuous awareness of malaria, control measures, and environmental sanitation to control further transmission of malaria in the state.

### **Acknowledgements**

We are grateful to all those who volunteered to participate in this study. We thank the Ministry of Health Nasarawafor the ethical approval. We would particularly like to thank the field investigators and health facilities in charge for their valuable contributions.

### **Conflict of Interests**

The authors declared no conflict of interest.

participants signed an informed consent form before participating in the study. An entry meeting was conducted with community chiefs and elders to seek their approval while household consent was given by the household heads.

Available at [https://www.academia.edu/52627888/Impact\\_of\\_Asymptomatic\\_Malaria\\_on\\_Some\\_Hematological\\_Parameters\\_in\\_the\\_Iwo\\_Community\\_in\\_Southwestern\\_Nigeria](https://www.academia.edu/52627888/Impact_of_Asymptomatic_Malaria_on_Some_Hematological_Parameters_in_the_Iwo_Community_in_Southwestern_Nigeria)

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