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Malaria parasitaemia among residents attending selected secondary health facilities in Rivers State, Nigeria

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Abstract

Malaria is an urgent public health priority due to its high cause of morbidity and mortality. This study investigated the prevalence of malaria parasitaemia in Rivers State, Nigeria. Random sampling technique was used. A total of 1200 samples were collected; thick films (stained with Fields stain A&B) and thin films (stained with 3% Giemsa) were examined microscopically. Out of these samples, 530 (44.16 %) were infected, with total parasite density of 2107518/µl. *Plasmodium falciparum* was the only species found. The highest infection 61 (61%) was in General Hospital (GH) Abua with statewide infection, 61 (5.08%) and parasite density 248616/µl followed by GH Ahoada East, 59 (59%) with statewide infection of 59 (4.92%) and parasite density 203540/µl and the least was GH Isiokpo, 24 (24%) with statewide infection of 24 (2%) and parasite density, 137696/µl ($p<0.05$). Rivers West had the highest infection rate, 215 (53.75%) with statewide infection of 215 (17.92%) and parasite density, 802100/µl whereas the least was recorded in Rivers East 134 (33.5%) with parasite density 685600/µl and statewide infection of 134 (11.16%). Consistent statewide investigation and sustained awareness should be carried out to track progress and identify areas of data driven intervention needs for smart decisions to combat malaria.

Introduction

Malaria is a major public health problem and cause of suffering and premature death in tropical and sub-tropical countries (Nwaorgu and Orajaka 2011). It is caused by the parasite *Plasmodium* transmitted through the bite of infected female *Anopheles* mosquito (WHO 2018). Globally, there were 229 million, 244 million and 249 million cases in 2019, 2021 and 2022, respectively (Kassam *et al* 2021; WHO 2023).

Despite being preventable and treatable, Nigeria accounted for 25% of global malaria cases followed by Democratic Republic of Congo with 11% in 2017 (WHO 2018). The most vulnerable groups are children who accounted for 61% (266,000) global malaria deaths. Other vulnerable groups are pregnant women, travelers, people living with HIV/AIDs (WHO 2018). There are five *Plasmodium* species (*Plasmodium falciparum, P. ovale, P. vivax, P. malariae* and *P. knowlesi*) known to cause malaria in humans. The most deadly and prevalent on African continent is the *P. falciparum*. Symptoms of malaria include fever, chills, headache, fatigue, confusion, seizures and difficulty in breathing, dark bloody urine and jaundice (WHO 2018, 2023).

Although malaria programmes were disrupted by COVID-19 pandemic, it was estimated that 174 million and 184 million cases were averted in 2020 and 2021, respectively. Deaths averted were 886,000 in 2020 and 948,000 in 2021 (World Malaria Report, 2023). The quest for malaria free world encouraged this research to be carried out in the year 2020 to 2021 while adhering to COVID-19 precautionary measures.

Malaria can be prevented by sleeping under Long-Lasting Insecticidal mosquito Nets (LLINs), window and door screening, indoor spray of insecticide, wearing protective clothing and use of chemoprophylaxis. Elimination of vector breeding sites such as collections of water around human habitats can also help break transmission (WHO 2018).

Malaria vaccines RTS/SAS01 and R21/Matrix-M are recommended for prevention in young children. The best treatment for *P. falciparum* malaria is artemisinin-based combination therapy (WHO 2018, 2023).

There have been reports of high malaria prevalence in Rivers State 78.2% (Eze *et al* 2014), 43.1% (Wogu and Nduka 2018) and 56.28% (Egbom *et al* 2022). This study was necessitated by the need for more investigation on malaria infection (with parasite density inclusive) to provide information, which will influence policy development for data driven interventions in effort to control/eliminate malaria in Rivers State in particular and Nigeria in general.

Materials and methods

Study areas

Rivers State is located in the southern part of Nigeria with coordinates 4º45′N and 6º50′E. It is bounded by Anambra and Imo states in the North, Abia and Akwa Ibom states in the East, Bayelsa and Delta states in the

West and the Atlantic Ocean in the South. It is made up of 23 Local Government Areas and three zones according to districts. Figure 1 shows study locations in Rivers State. It has a land mass of 11077km² with projected population of 747,6800 in 2022. The total annual rainfall decreases from 4700mm on the coast to 1700mm in the extreme North. Port Harcourt the capital city has an annual mean temperature of 32°C.

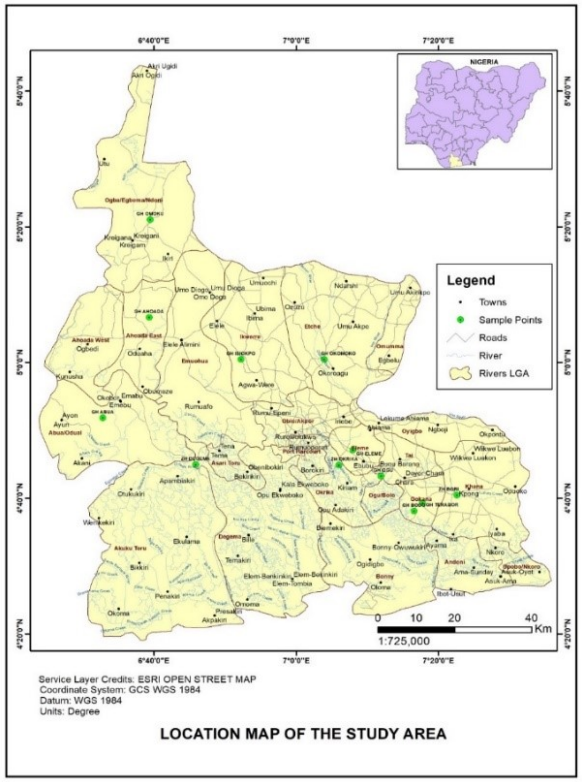

Figure 1. Map of Rivers State showing the sampling area with an in insert of map of Nigeria showing Rivers State.
Source: ESRI Open Street Map.

Study design
Random sampling technique was used. Twelve (12) secondary health facilities (100 samples from each) were randomly selected. Rivers State was stratified into 3 geographical zones; Rivers East, Rivers South-East and Rivers West for administrative conveniences. Rivers East consisted of General Hospital (GH) Okomoko, GH Ogu, ZH Okrika, and GH Isiokpo. Rivers South-East consists of GH Eleme, GH Terabor, GH Bodo, and ZH Bori. The health facilities selected in Rivers West are GH Abua, GH Ahoada, ZH Degema and GH Omoku.

Sample size was determined using Yamane's formula:

$n = N/1+N(e)^2$

where n = sample size, N = population size, e = level of precision (Glenn 2003). The total number of samples collected was 1200.

Sample collection
From each consented subject, 5ml of venous blood was collected with the assistance of licensed Medical Laboratory Scientists in the health facilities visited for laboratory in investigation.

Inclusion criteria
Only subjects that are permanent residents of the study area were included.

Exclusion criteria
Subjects that are were on malaria treatment and visitors (e.g. travelers) who report to the health facilities and thereafter will leave the study areas were excluded.

Ethical clearance
Clearance was obtained from University of Port Harcourt Research Ethics Committee and Rivers State Health Research Ethics Committee. Approval to conduct the research at the selected health facilities was obtained from Rivers State Hospital Management Board with Reference Number RSHMB/DMDS/4/Vol.9/228[A]. The subjects also gave written consent.

Laboratory procedure
From each subject, 5ml of venous blood was collected. Thick and thin blood films were prepared. Thick films were stained with Field stains A and B whereas thin films were stained with 3% Giemsa. Both films were observed by oil immersion microscopy. Thick films were for parasite detection and count while thin films were observed for species differentiation. Results obtained were kept confidential in record books. Parasite density was calculated using the formula:
Parasite count × 8000/Set range of white blood cells (WBC) = parasite density/µl (WHO 2016).

Data analysis
Analysis of variance, descriptive statistics and charts were used for comparison of malaria parasitaemia among subjects from different locations in the study area.

Results

Out of 1200 samples examined in Rivers State, 530 (44.16%) were infected with total parasite density 2107518/µl. *Plasmodium falciparum* was the only species found. Parasitaemia by location within Rivers State showed that subjects who reported to General Hospital (GH) Abua in Abua/Odual LGA had the highest infection 61(61%) with parasite density, 248616/µl and statewide infection of 61(5.08%) followed by subjects who reported to GH Ahoada in Ahoada East LGA with infection 59 (59%), 203540/µl parasite density and statewide infection of 59 (4.92%). The least infection was recorded among subjects who reported to GH Isiokpo in Ikwerre LGA with 24(24%), parasite density 137696/µl and statewide infection of 24(2%). The difference in prevalence rate and parasite density between the study locations were statistically significant ($p<0.05$, Table 1).

Infection rate in the 3 geographical zones (Rivers East, Rivers South-East and Rivers West), showed highest infection recorded in Rivers West 53.75% with statewide infection of 17.92% and parasite density of 802100/µl followed by Rivers South-East with 45.25% infection, statewide infection, 15.08% and parasite

density of 619818/µl. The least infection (33.5%) was recorded in Rivers East with statewide infection, 11.16% and parasite density of 685600/µl ($p<0.05$, Table 2 and Figure 2).

Table 1: Malaria parasitaemia in Rivers State in relation to locations.

S/N	**Location**	**No. examined**	**No. infected (%)**	**Statewide % infected**	**P.D./µl**	**p-value**
1	GH Okomoko Etche LGA	100	38(38)	3.16	227672	
2	GH Ogu Ogu/Bolo LGA	100	28(28)	2.33	126408	
3	ZH Okrika Okrika LGA	100	44(44)	3.67	193824	
4	GH Isiokpo Ikwerre LGA	100	24(24)	2.00	137696	
5	GH Eleme Eleme LGA	100	47(47)	3.92	164584	
6	GH Terabor Gokana LGA	100	54(54)	4.5	203331	
7	GH Bodo Gokana LGA	100	37(37)	3.08	85647	
8	ZH Bori Khana LGA	100	43(43)	3.58	166256	
9	GH Abua Abua/Odual LGA	100	61(61)	5.08	248616	
10	GH Ahoada Ahoada East LGA	100	59(59)	4.92	203540	
11	GH Omoku Ogba/Egbema/Ndoni LGA	100	39(39)	3.25	131280	
12	ZH Degema Degema LGA	100	56(56)	4.67	218664	
	Total	1200	530(44.16)	44.16	2107518	0.000

S/No= Serial number, %=Percentage, P.D.=Parasite density, µl= Microlitre, GH= General Hospital ZH=Zonal hospital, LGA= Local Government Area

Table 2: Malaria parasitaemia among selected residents of Rivers State by zones

S/N	Zone	No. examined	No. infected (%)	Statewide % infected	P-value
1	Rivers East	400	134(33.5)	11.16	0.000
2	Rivers South East	400	181(45.25)	15.08	
3	Rivers West	400	215(53.75)	17.92	
Total		1200	530(44.16)	44.16	

S/No=Serial number, % = percentage

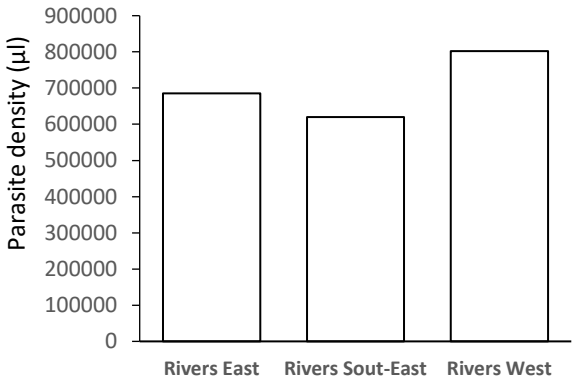

Figure 2. Parasite densities (µl) among residents of the three zones of Rivers State

Discussion

In this study, the overall prevalence of malaria in Rivers State, which was 44.16 % is relatively high. However, it is lower than 56.3% and 78.1% reported by Egbom *et al* (2022) and Gboeloh *et al* (2022), respectively, an indication that the infection is decreasing within the state. This finding concurs with the overall infection rate reported in the neighboring Akwa-Ibom State (Effah *et al* 2022). The high infection rate in Rivers State could be a reflection of a long wet season, abundant rivers and swamps and the practices of farming and fishing in the rural communities, which provide favourable mosquitoes breeding sites and consequent transmission of malaria parasite.

In relation to location, the results from GH Abua with 61% infection, parasite density, 203540/µl and

statewide infection of 5.08% differs from the 82.7% infection and state level infection of 10.17% reported in Primary Health Care Centre (PHC) Abua/Odual LGA by Egbom *et al* (2022). The second highest infection of 59% was observed in subjects who reported to GH Ahoada-East with statewide infection of 4.92% and parasite density, 203540/µl. This is at variance with 61.96% reported for Ahoada East by Egbom *et al* (2022), 53.3% in the neighbouring Emohua by Richard *et al* (2019) and 35.5% in Port Harcourt (Abah *et al* 2017). *Anopheles* mosquitoes could find it easy to thrive in Ahoada due to the reported ambient temperature (27ºC) and humidity (88%) in addition to consistent rainfall, consequently transmit malaria to the citizens who mostly practice farming and fishing as their major economic engagements

The least infection, 24% with statewide infection of 2% and parasite density of 137696/µl was recorded for subjects who reported to GH Isiokpo in Ikwerre LGA. This concurs with the 24% infection reported for Nando community of Anambra East, Nigeria (Uduji *et al* 2021), but higher than the 12.4% prevalence reported for Aluu community in Rivers State (Chijioke-Nwauche and Sam-Ozini 2017). It also differs from the 22.5% reported by Enoch *et al* (2020) in Doubeli PHC, Adamawa State, Northern Nigeria.

Infection by zones showed that Rivers West had the highest infection rate (53%) with statewide infection and total parasite density of 17.92% and of 802100/µl, respectively. This finding concurs with earlier reports of Gboeloh *et al* (2022).

Conclusion

Malaria remains a public health concern in Nigerian communities. Considering the high rate of malaria infection in Rivers State, more interventions are needed in areas of research, awareness and prevention. Data generated from this research can guide interest groups and governmental organisations in carrying out targeted intervention programmes.

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Conflict of Interest

The authors declare that there is no conflict of interest

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