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Point prevalence mapping of malaria infection in Rivers State, Nigeria

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Abstract
Background: Variations in the risk of malaria across locations exist but are poorly understood though identifying hotspots of malaria transmission will create opportunities for targeted interventions. Point prevalence of malaria in Rivers State was studied using Primary Healthcare Centres (PHCs) as survey points.
Methods: The PHCs in Rivers State were geo-referenced using a handheld Global Positioning System (GPS) and 74 were selected across 21 local government areas using systematic grid point sampling. Blood samples were obtained from 2340 persons who consented and questionnaires were administered to obtain their demographic data. Malaria parasites in blood films were detected using the Giemsa staining technique. Data generated were analysed using SPSS 22.0 and presented using descriptive statistics. The level of relationship amongst the parameters was obtained using Chi-square. Co-ordinates of PHCs sampled and their prevalence data for malaria were entered into Microsoft Excel 2007 spreadsheet and transmitted to ArcGIS 10.8. This platform was then used to produce point prevalence infection maps of the State using geographic information systems (GIS). Survey points with malaria point prevalence values of 75% and above and cumulative prevalence of 1.97% and above were categorised as malaria transmission hot spots in the various LGAs.
Results: The study recorded an overall prevalence of 56.3%, with *P.falciparum* as the only identified malaria parasite. Data revealed that Oyoro Model Primary Health Centre (MPHC), Arukwo Primary Health Centre, Ele Health Post (HP) and Emago HP recorded very high prevalence of 96.7%, 96%, 95.2% and 94.4% respectively, whereas MPHC Iriebe had the least prevalence. Twelve hotspots with point prevalence above 75% were identified and eight hotspots likewise with cumulative prevalence above 1.97%.
Conclusion: Malaria infection remains endemic in Rivers State. This study provides malaria point prevalence maps of Rivers State which will serve as a reference to policymakers for strategic interventions in the State.

Keywords: Malaria point prevalence, Geographic Information Systems, malaria map

Introduction:

Malaria continues to be a menace to public health, especially in the world's poorest countries like Nigeria (Onah *et al*., 2017). It is responsible for most deaths and illnesses in children and adults in tropical settings (Dougnon *et al*., 2015, Anene-Okeke *et al*., 2018). It leads to significant deaths in sub-Saharan Africa and other malaria-endemic areas (Bassey and Izah, 2017). Malaria is caused by single-celled obligate protozoan parasites of the genus *Plasmodium* (Kunihya *et al*., 2016; Udoh *et al.,* 2016). Infected female *Anopheles* mosquitoes naturally transmit the parasites to men during taking their blood meal (Onyido *et al*., 2014, Bassey and Izah, 2017). The WHO African Region accounts for 95% of cases and 96% of deaths due to malaria globally (WHO, 2021). The WHO African Region accounts for about 90% of malaria cases and deaths worldwide.

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Malaria is transmitted throughout Nigeria, with 97% of the population at risk (PMI, 2022). 76% and 24% of the population live in high-transmission and low-transmission areas, respectively. Several public health interventions have been implemented for malaria control in the country, yet, high morbidity and mortality rates are still attributed to the disease (Ajayi *et al*., 2017). More cases and deaths due to malaria are recorded in Nigeria than in other parts of the world (Okonta *et al*., 2013, Dawaki *et al*., 2016, WHO, 2017). In 2020, Nigeria accounted for 26.8% and 31.9% of global malaria cases and deaths, far above all other countries (WHO, 2021).

The first level of health service that provides basic healthcare to the Nigerian populace is Primary Health Care (PHC) (Ladi-Akinyemi *et al*., 2018). It is aimed at providing healthcare to the grassroots and, as such, is referred to as the entry point into the Nigerian Healthcare sector. This level of healthcare has full participation from the community. The community healthcare givers have access to the PHCs. They are expected to report all cases of sicknesses that failed to respond positively to management at home and every case with danger signs that they cannot manage at home (FMOH, 2008).To advance the approaches currently used in the fight against malaria and define more strategies targeting specific locations, it is pertinent to carry out surveys at local scales to obtain actual pictures of malaria situations within a larger geographical region. Therefore, this study assessed malaria prevalence in primary health care centres in Rivers State, Nigeria using a point-prevalence approach. The study also set out to determine age and sex-specific malaria prevalence, determine hotspots of malaria transmission and produce point prevalence maps of malaria distribution in Rivers State of Nigeria.

Materials and Methods

Study Area

Rivers State is one of the 36 States of Nigeria, located within latitude 4° 18^1 58.294˝ N - 5°43^{1}51.652 ”N and longitude 6° 24’7.88 3” E - 7° 35’58.6 83” E in the south-southern part of Nigeria. From the 2006 National Population Commission figure, the State has a population of 5,522,575 (RSMOH 2010). Port Harcourt, the largest city in the State, is the State capital and remains the centre of the oil industry in Nigeria. Rivers State occupies an area of about 10,363.98km^2 with more than one-third occupied by water. The southern part of the State consists of a network of creeks which extend through Opobo, Bonny etc into the Atlantic Ocean. The shores form part of the coastline of West Africa (RSMOH, 2010).

Selection of PHCs

A comprehensive list of PHCs was obtained from the Rivers State Primary Health Care Management Board, which had 383 PHCs. Of this number, 351 were geo-referenced and categorised. A systematic grid-point sampling method was used to select the PHCs (Oluwole *et al*., 2018). This was done by placing a 10 km by 10 km fishnet on the map of PHCs in Rivers State, and the grids' centres were geo-referenced. The closest PHC to the centroid of each grid was selected. A total of 87 PHCs were selected for the study. However, blood samples for the study were obtained from 74 PHCs, as seen in figure 1.

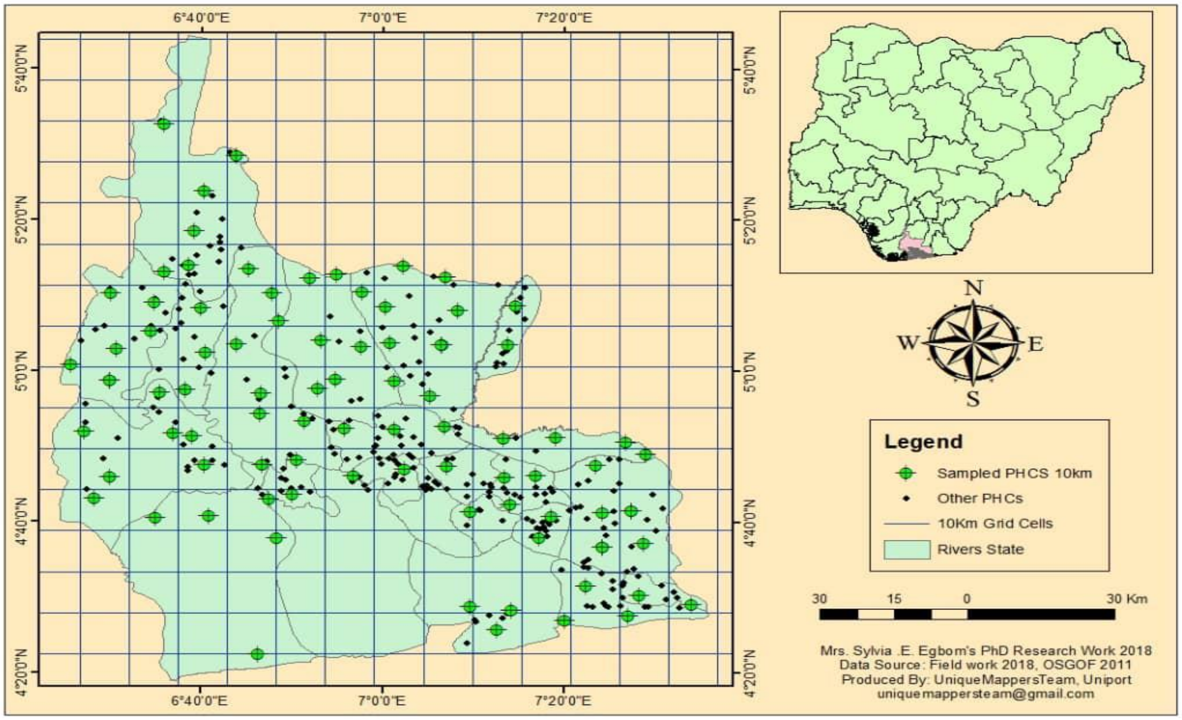

Figure 1: Study points selected using systematic grid point sampling

Blood Sample Collection and Laboratory Analysis

The cross-sectional study was carried out between March 2018 and February 2020. A minimum sample size of 441 was determined according to Leslie-Kish, 1965. Blood samples were obtained from 2340 persons from 74 PHCs comprising 920 males and 1420 females. The age of the respondents was grouped into seven classes which include 0-10, 11-20, 21-30, 31-40, 41-50, 51-60 and 60+. Trained laboratory personnel obtained intravenous blood samples from the study participants which were stored in ethylene diamine tetra acetate (EDTA) bottles. Thick and thin blood films were made and analysed using standard parasitological techniques.

Determination of Malaria Hotspots

Survey points with malaria point prevalence values of 75% and above and cumulative prevalence of 1.97% and above were categorised as malaria transmission hot spots in the various LGAs.

Ethical issues:

Ethical clearance to undertake this research was obtained from the University of Port Harcourt Health Research Ethics committee (UPH/CEREMAD/REC/MM77/020) and Rivers State Ministry of Health (MH/PRS/391/VOL.2/438). Verbal consent was obtained from the subjects who enrolled on the study.

Data Analysis

Statistical Analysis

Data sets were cleaned and analysed using Statistical Package for Social Sciences (SPSS) version 22. Prevalence by sex, age group and health facility were computed using descriptive statistics. The relationship between malaria prevalence and the facility was evaluated using the complex samples crosstabs procedure of the Chi-square test.

Spatial Analysis
A geodatabase was created using the generated data sets and imported into ArcGIS 10.8 for thematic analysis. Using the sampled PHCs as survey points, a point-prevalence map of malaria distribution in Rivers State was produced. The prevalence of malaria infection at the various PHCs in Rivers State was then displayed.

Results

Age and Sex-Specific prevalence of malaria in Rivers State during the study period

Table 1 shows the Age and Sex-Specific prevalence of malaria in Rivers State during the study period. A total of 2340 persons participated in the study, out of which 1317 were infected, giving an overall prevalence of 56.3%. Only *P. falciparum* was recorded. Of the 920 (39.3%) males examined, 518 (56.3%) were infected and 1420 (60.7%) females were examined with 799 (56.27%) infected. Amongst the males, the age group 31-40 recorded the highest prevalence of 62.8%, whereas the age group 11-20 recorded the least prevalence of 51.3%. Amongst the females, the age group 21-30 recorded the highest prevalence of 59.4%, whereas the age group 60+ recorded the least prevalence of 45.7%. Irrespective of sex, the prevalence was highest among the age group 31-40 (59.09%). However, there was no significant statistical relationship between age and malaria (p=0.376) nor sex and malaria prevalence (p=0.986).

Table 1: Age and Sex-Specific prevalence of malaria in Rivers State during the study period

AGE	TOTAL		MALE		FEMALE	
	No examined	No infected (%)	No examined	No infected (%)	No examined	No infected (%)
0-10	285	163 (57.19)	132	76 (57.6%)	153	87 (56.9%)
11-20	366	192 (52.45)	156	80 (51.3%)	210	112 (53.3%)
21-30	530	304 (57.36)	158	83 (52.5%)	372	221 (59.4%)
31-40	572	338 (59.09)	207	130 (62.8%)	365	208 (57%)
41-50	361	201 (55.68)	165	95 (57.6%)	196	106 (54.1%)
51-60	138	76 (55.07)	60	32 (53.3%)	78	44 (56.4%)
60+	88	43 (48.86)	42	22 (52.4)	46	21 (45.7%)
TOTAL	**2340**	**1317 (56.28)**	**920**	**518 (56.3)**	**1420**	**799 (56.27)**

Based on age ($\varkappa^2$=6.458; df=6; p=0.376)
Based on sex ($\varkappa^2$=0.0003; df=1; p=0.986)

Point prevalence map of malaria at the various facilities

The point prevalence and location of the 74 survey points are shown in Figure 2. The overall prevalence of *P. falciparum* is 56.3%. This varied significantly ($p<0.05$) across the 74 PHCs, from 21.43% in MPHC Iriebe to 96.67% in Oyoro MPHC.Oyoro MPHC, Arukwo PHC, Ele HP and Emago HP were among the PHCs with the highest prevalence (96.7%, 96%, 95.2% and 94.4%, respectively). Five of such facilities with very high prevalence were located in Abua-Odual LGA, two in Omuma LGA, two in Ikwerre LGA, and one in Ogu-Bolo, Emohua and Ahoada East LGAs. The facilities with the least prevalence were located in Ahoada West (MPHC Odawu), Etche (Abara HC and Chokota HC) and Obio-Akpor (MPHC Iriebe) LGAs (figure 2). The variations in prevalence of malaria across the survey points were found to be statistically significant ($p<0.05$)

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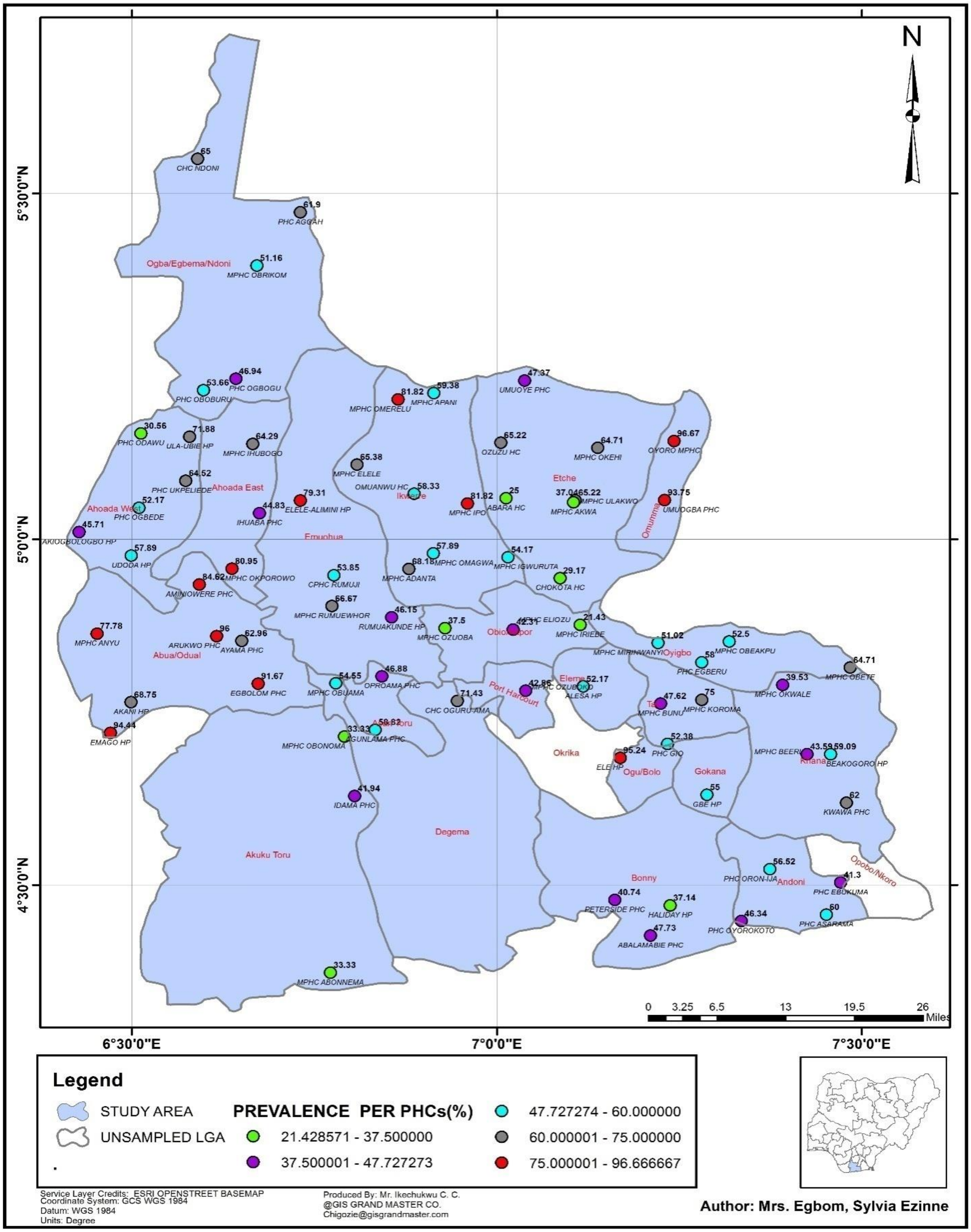

Figure 2: Point prevalence map of malaria in Rivers State during the study period

Cumulative prevalence map of malaria in Rivers State during the study period

Cumulatively, Egbolom PHC in Abua-Odual LGA and MPHC Obete in Oyigbo LGA had the highest malaria prevalence of 2.51% (figure 3), followed by Umuogba PHC, Oyoro MPHC, PHC Egberu, MPHC Ihubogo, MPHC Omerelu and Beakogoro HP. The least cumulative prevalence was recorded in Abara HC in Etche LGA. Chokota HC in Etche LGA and MPHC Iriebe in Obio-Akpor LGA also recorded very low cumulative prevalence. The differences in malaria prevalence across the facilities were statistically significant (p=0.000).

Malaria Hotspots identified in Rivers State during the study period

Twelve survey points with a point prevalence of 75% and above were identified (Fig 2). Five were identified in Abua-Odual LGA and are located in Arukwo, Emago, Egbolom, Aminiowere and Anyu communities. In Ahoada East LGA, one hotspot was identified in the Okporowo community. Others include Elele-Alimini in Emohua LGA and Ipo and Omerelu communities in Ikwerre LGAs. Ele was identified in Ogu-Bolo LGA, whereas Oyoro and Umuogba were identified in Omuma LGA. Eight hotspots with a cumulative prevalence of 1.97% and above were identified in Egbolom, Ihubogo, Omerelu, Kwawa, Oyoro, Umuogba, Obete and Egberu communities.

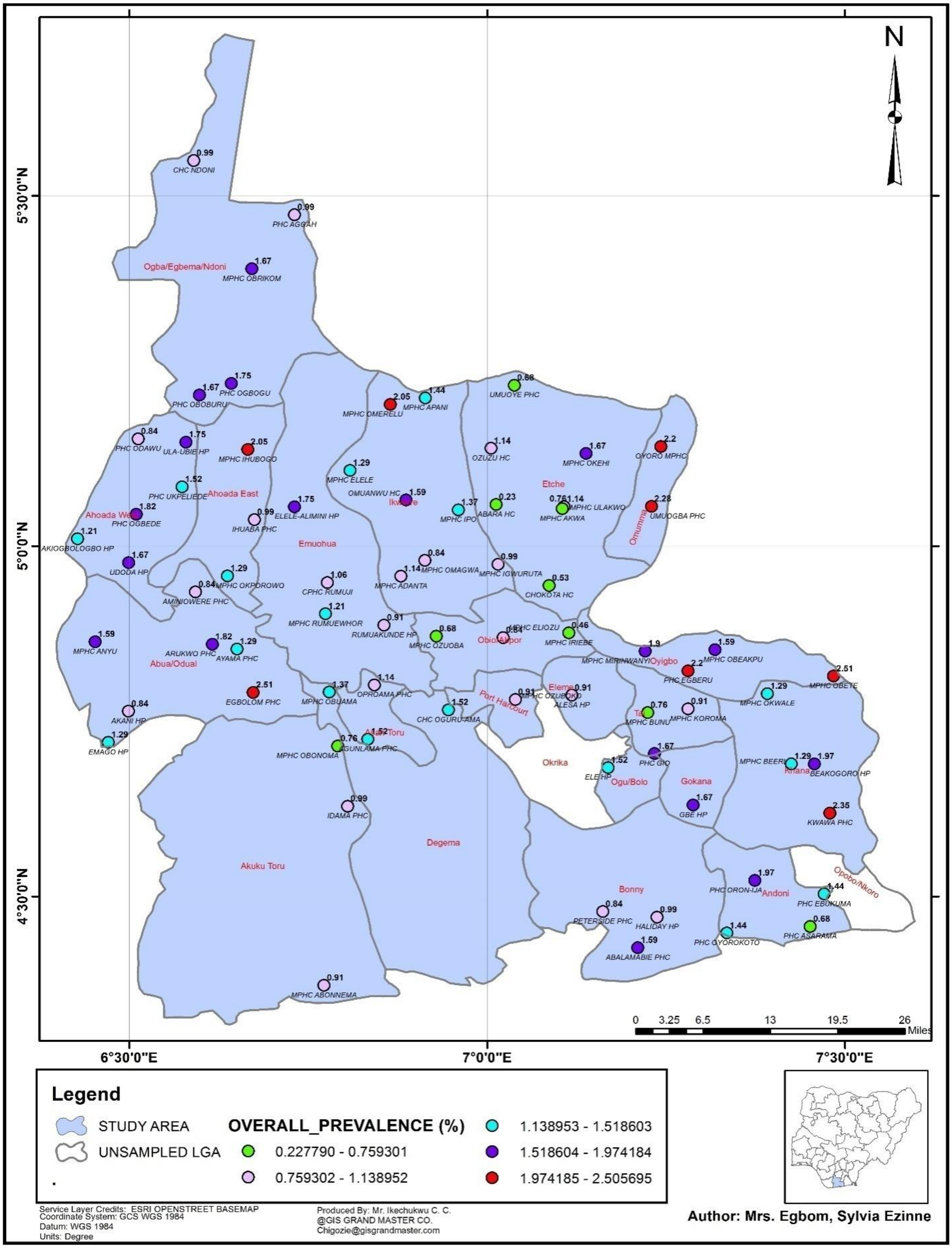

Figure 3: Cumulative prevalence map of malaria in Rivers State during the study period

Discussion

The study revealed an overall malaria prevalence of 56.3% in the various PHCs sampled in the study area. The result is in line with the accounts of Egbom and Nzeako (2017) and Egbom *et al*., (2021), who recorded the prevalence of 52.5% and 57.4%, respectively in Rivers State. The reason for the relatively high prevalence could be connected to the existing environmental conditions that may have enabled stable malaria transmission or the common day-to-day practices of the inhabitants that could continuously make them susceptible to the bites of the vectors. This result was, however, higher than the reports of Wogu *et al.* (2017) and Wogu and Nduka (2016), who reported a prevalence of 41.% and 32% in their study but lower than 78% and 87% reported by Augustine D'Israel and Abah 2018) and Wokem *et al*. (2017) respectively in the State.

Gender-related prevalence showed that both genders were affected equally, with males and females recording 56.3% and 56.27%, respectively. This is in contrast with the findings of Amadi *et al*. (2011), Chijioke-Nwauche and Sam-Ozini (2017), Egbom and Nzeako (2017), Egbom *et al*. 2021 and Okonko *et al.* (2021) who recorded higher prevalence among the females and the reports of Abah *et al*. (2017) and Wokem *et al*. (2020) who reported higher prevalence among the males. This could be because most of the participants in this study live in rural communities where they were equally exposed to the bites of mosquitoes due to their habits. Males in these communities are predominantly farmers and as such, are always predisposed to the bites of mosquitoes. The prevalence observed among females could be attributed to the continuous exposure of women due to the roles they perform in their households. Such roles include but are not limited to waking up before sunrise to prepare breakfast for their families, preparing them for the day's activities and preparing evening meals. These activities are usually done outdoors, thereby exposing them to the bites of malaria vectors. Gender norms and values have been shown to influence the distribution of household responsibilities, resting and sleeping patterns. This invariably leads to variations in the patterns in which males and females are exposed to mosquitoes (WHO, 2007). Household chores performed by women as they wake up at dawn make them more vulnerable to bites from malaria vectors (Vlassoff and Manderson, 1998). However, this difference was not significant statistically ($p>0.05$).

Study subjects aged 31-40 had the highest prevalence of 62.8%.This is in contrast with the findings of Aribodor *et al*. (2003); Kalu *et al*., (2012); Eze *et al.,* (2014), Mac *et al.,* (2019) and Egbom *et al*. (2021), who reported a higher prevalence among other age groups. The higher prevalence observed in the age group 31-40 could be due to greater exposure to the bites of malaria vectors. The observed difference was however not significant statistically ($p>0.05$).

The study revealed variation in malaria prevalence across the various survey points which were found to be statistically significant ($p<0.05$). The observed variations in prevalence could be due to prevailing environmental conditions in the various communities. Malaria has been referred to as an environmental disease (Raso *et al*., 2012). The local environment mediates the interactions of the vector and human hosts and ultimately determines malaria prevalence (Dalrymple *et al*., 2015). This, therefore, leads to geographical differences in malaria transmission patterns (Dalrymple *et al*., 2015). The identification of hotspots of malaria transmission in this study is in line with the findings of Bousema *et al.* (2010); Kangoye *et al.* (2016), who identified malaria hotspots in Tanzania and Kenya, respectively. These hotspots represent areas where malaria transmission intensity is significantly higher than the surrounding areas. They constitute significant reservoirs for residual malaria transmission, with higher malaria prevalence than the neighbouring areas (Debebe *et al*., 2020). This presents an opportunity for more targeted control interventions expected to be cost-effective and yield more results than blanket interventions in the State.

Conclusion:

This study provides baseline data on spatial patterns of malaria. It contributes to developing malaria point prevalence maps for Rivers State, Nigeria to aid efficient allocation of resources. PHCs represent the entry point to the Nigerian Healthcare sector; therefore, developing malaria control approaches using genuine data obtained at such local scales will be strategic and cost-effective.

Consent for publication: Not applicable.

Availability of data and materials: All data sets generated and analysed in this study are available upon request from the corresponding author.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: All authors contributed throughout the entire research, read through and approved for submission and publication of this manuscript.

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References

Abah, A.E., Awi-Waadu, G.D.B., Nduka, F.O. and Richard, A. (2017). Malaria infection and socioeconomic status of some residents of Port Harcourt metropolis, Rivers State, Nigeria. *Journal of Applied Sciences and Environmental Management*.; 21 (2): 299-304.

Ajayi, I.O., Ughasoro, M.D., Ogunwale, A., Odeyinka, O., Babalola, O. and Sharafadeen, S. (2017).A A qualitative exploration of malaria operational research situation in Nigeria. *PLoSONE*, 12(11): e0188128.

Amadi, E.C.; Sunday, H.J. and Usip, L.P.E. (2011). Prevalence of Malaria Parasites in Hospitals of Port Harcourt Metropolis, Rivers State, Nigeria. *Nigerian Journal of Parasitology*, 32(2): 215-219.

Anene-Okeke, C.G., Isah, A., Aluh, D.O. and Ezeme, A.L. (2018). Knowledge and practice of malaria prevention and management among non-medical students of the University of Nigeria, Nsukka. *International Journal of Community Medicine and Public Health,* 5:461-5.

Aribodor D.N., Njoku, O.O., Eneanya, C.I. and Onyido, A.E.(2003). Studies on the prevalence of malaria and management practices of the Azia community in Ihiala L.G.A, Anambra State.*Nigerian Journal of Parasitology*, 24: 33-38.

Bassey, S.E. and Izah, S.C. (2017).Some determinant factors of malaria prevalence in Nigeria.*Journal of Mosquito Research,* 7(7): 48-58.

Bousema, T., Drakely, C., Gesase, S., Hashim, R., Magesa, S., Mosha, F. *et al.* (2010).Identification of hotspots of malaria transmission for targeted malaria control.*The Journal of Infectious Diseases*, 201 (11): 1764-74

Chijioke-Nwauche, I.N. and Sam-Ozini, P. (2017). Malaria prevalence and health-seeking behaviour in two Niger Delta communities. *Scholars Academic Journal of Pharmacy*, 6 (5): 191-196.

Dalrymple, U., Mappin, B. and Gething, P.W. (2015). Malaria mapping: understanding the global endemicity of falciparum and vivax malaria. *BMC Medicine*, 13 (1): 140 DOI 10.1186/s12916-015-0372-x

Dawaki, S., Al-Mekhlafi, H.M, Ithoi, I., Ibrahim, J., Atroosh, W.M., Abdulsalam, A.M., Sady, H., Elyana, F.N., Adamu, A.U., Yelwa, S.I., Ahmed, A., Al-Areeqi, M.A., Subramaniam, S.R., Nasr, N.A., and Lau, Y. (2016).Is Nigeria winning the battle against malaria? Prevalence, risk factors and KAP assessment among Hausa communities in Kano State. *Malaria Journal*, 15:351.

Debebe, Y., Hill, S.R., Tekie, H., Dugassa, S., Hopkins, R.J., Ignell, R. (2020). Malaria hotspots are explained from the perspective of the ecological theory underlying insect forging. *Scientific Reports*, 10: 21449

Dougnon, T.V., Bankole H.S., Hounmanou Y.M.G., Echebiri S., AtchadeP. and Mohammed J. (2015). Comparative Study of Malaria Prevalence among Travelers in Nigeria (West Africa) Using Slide Microscopy and a Rapid Diagnosis Test. *Journal of Parasitology Research,* Article ID 108707, 4PP.doi:10.1155/2015/108707.

Egbom, S.E. and Nzeako, S.O. (2017). Malaria parasitaemia amongst military personnel households in a military formation in Port Harcourt, Nigeria.*International Journal of Scientific Research in Environmental Sciences*; 5 (1):0010-0016.

Egbom, S.E., Ogidi, M., Nduka, F.O. and Nzeako, S.O (2021). Malaria prevalence and its demographic determinants in Oyigbo LGA, Rivers State, South Nigeria. *Asian Journal of Biology*, 12 (4): 26-33.

Eze, N.C., Nzeako, S.O. and Nduka, F.O. (2014). Patterns of *Plasmodium falciparum* among selected Fulani pastoralists in Rivers State, Nigeria. *International Journal of Tropical Diseases,*4(3):295-305.

FMOH (2008).Federal Ministry of Health.*National Antimalarial Treatment Policy 2008*.Federal Ministry of Health, National Malaria and Vector Control Division.Abuja: Federal Republic of Nigeria; 2008

Kalu, K.M., Obasi, N.A., Nduka, F.O. and Oko, M.O. (2012). Prevalence of Malaria Parasitaemia in Umuchieze and Uturu Communities of Abia State, Nigeria. *Asian Journal of Epidemiology*; 5: 95-102.

Kangoye, D.T., Noor, A., Midega, J.,Mwongeli, T., Mkabili, D., Mogeni, P. *et al.* (2016). Malaria hotspots are defined by clinical malaria asymptomatic carriage, PCR and vector numbers in a low transmission area on the Kenyan Coast. *Malaria Journa*l, 15:213

Kunihya, I.Z., Samaila, A. B., Pukuma, M.S. and Qadeer, M.A. (2016). Prevalence of Malaria Infection and Malaria Anaemia among Children Attending Federal Medical Centre Yola, Adamawa State, Nigeria.*The International Journal of Engineering and Science*, 5(7): 8-14.

Ladi-Akinyemi, T.W., Amoran, O.E., Ogunyemi, A.O., Kanma-Okafor, O.J. and Onajole, A.T. (2018). Knowledge and implementation of the National Malaria Control Programme among healthcare workers in primary healthcare centers in Ogun State, Nigeria. *Journal of Clinical Sciences,*15:48-54.

Mac, P.A., Asheadzi, H.F., Gideon, A., Thaker, P. and Airiohuodion, P. (2019).Prevalence of Plasmodium Falciparum among Nigerians in Abuja and the Central States: A Comparative Analysis of Sensitivity and Specificity Using Rapid Diagnostic Test and Microscopy as Tools in Management of Malaria. *International Journal of Tropical Diseases*, 1:014.doi.org/10.23937/ijtd-2017/1710014

Okonko, I.O., Onwubuche, K., Cookey, T.I., Agbagwa, O.E. and Chijioke-Nwauche, I.N. (2021). Dual Infection of HIV and Malaria among HIV-Infected Individuals in Port Harcourt, Nigeria. *South Asian Journal of Parasitology,* 5 (1): 26-31.

Okonta, M.J., Nduka, S.O., Ilodigwe, E.E. andAnetoh, M.U. (2013). Comparative assessment of two Artemisinin-based combination therapies in the treatment of uncomplicated malaria among University students in Nigeria.*International Journal of Drug Development and Research*, 5(2):211–21.

Oluwole, A.S., Adeniran, A.A., Mogaji, H.O., Olabinke, D.B., Abe, E.M., Bankole, S.O., Sam-Wobo, S.O.

and Ekpo, U.F. (2018). Prevalence, intensity and spatial co-distribution of schistosomiasis and soil-transmitted helminths infections in Ogun state, Nigeria.*Parasitology Open,*4(e8): 1–9.

Onah, I.E., Adesina F.P., Uweh P.O. and, Anumba J.U. (2017). Challenges of malaria elimination in Nigeria; A review. *International Journal of Infectious Diseases and Therapy*, 2(4):79-85.

Onyido, A.E., Ugha, C.N., Eneanya, O.A., Umeanaeto, P.U., Egbuche, C.M, Obiechina, I.O., Ezugbo-Nwobi, I.K and Nwangwu, U.C. (2014). Malaria vector bionomics in Abagana community of Anambra State, Southeastern Nigeria. *Journal of American Science*, 10(2):157-162.

PMI (2022). U.S. President's Malaria Initiative Nigeria Malaria Operational Plan FY 2022.Retrieved from www.pmi.gov

Raso, G., Schur, N., Utzinger, J., Koudou, G., Tchicaya, E.S., Rohner, F., N'Goran, E.K., Silue, K.D., Matthys, B., Assi, S. and Tanner, M. (2012). Mapping malaria risk among children in Cote d'Ivoire using Bayesian geo-statistical models. *Malaria Journal,* 11:160.

RSMOH (2010) Rivers State Ministry of Health.*Rivers State Government Strategic Health Development Plan 2010-2015,* p10.

Udoh, S.B., Hamidu, I.M., and Saleh, A.H. (2016). Seasonal prevalence of malaria parasites infection in Maiduguri, Borno State, North East, Nigeria.*Scholarly Journal of Biological Science*, 5(1): 52-55.

Vlassoff, C. and Manderson, L. (1998). Incorporating gender in the anthropology of infectious diseases. *Tropical Medicine and International Health*, 3 (12): 1011-1019.

WHO (2007).World Health Organisation.*Malaria elimination - A field manual for low and moderate endemic countries, Geneva*

WHO (2017).World Health Organisation.*World Malaria Report, 2017, 196pp*

WHO (2021).World Health Organisation.*World Malaria Report 2021, 322pp*

Wokem G.N., Erasmus, A.M. and Wokem, V.C. (2020).Malaria Status about Risk Factors among Attendees of Two Health Facilities in Port Harcourt, Rivers State, Nigeria.*Journal of Advances in Medicine and Medical Research*, 32 (23): 222-230.