International Journal of
Health Sciences
(IJHS)

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CARI Journals

International Journal of Health Sciences
ISSN: 2710-2564 (Online)
Vol. 5, Issue No. 2, pp 67 - 86, 2022
www.carijournals.org

Evaluation of the Current Status of Malaria Prevalence in the Three Senatorial Zones of Rivers State, Nigeria.

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Abstract

Purpose: The current status of malaria prevalence in three senatorial zones of rivers state was evaluated. There have been several intervention measures aimed at reducing the health menace of malaria in Rivers State by Government, international agencies and other stakeholders. This study was undertaken to assess the current status of malaria in the three senatorial zones of Rivers State with the view to maintaining the current intervention measures or otherwise.

Methodology: A randomized block experimental design was used for this study. The research was divided into two (2) parts. The first part involved the production and distribution of self-structured questionnaire to the respondents to collect demographic information. The second part was laboratory examination which involved the screening of thick and thin blood films from participants to find the presence of the malaria parasite and calculate the prevalence. A total of 352 participants (110, 120 and 122 from Rivers West, Rivers Southeast and Rivers East senatorial districts respectively) seeking treatment at the zonal hospitals were recruited for the study. Venous blood samples were collected from the 352 participants and screened for the presence of malaria parasite using standard procedure while 352 copies of self-structured questionnaire were distributed to participants to collect data on some demographic characteristics.

Findings: Out of the 352 participants examined, 275(78.1%) were positive for the presence of malaria parasites. Of the 275 infected persons, 94.6%, 77.5% and 63.7% were from Rivers West, Rivers East and Rivers Southeast senatorial district respectively. There was no significance difference (P<0.05) in the prevalence between males (78.4%) and females (77.9%). Participants within the age range of 21-30years and 31-40years had the highest and least prevalence of 84.5% and 65.9% respectively. There was no significance difference (P<0.05) in prevalence between singles (76.6%) and married (79.2%) participants. Level of education had no significance (P<0.05) impact on the prevalence of malaria among the participants. The prevalence of malaria in participants with no formal, primary, secondary and tertiary education was 74.1%, 82.4%, 74.1% and 82.7% respectively.

Unique Contribution to Theory, Policy and Practices: The study revealed that malaria is still endemic in the three senatorial districts and remains a public health concern. Deliberate efforts form government and other stakeholders is needed to improve on the present preventive measures put in place especially in the area of sanitation and health orientation.

Keywords: *Malaria, Prevalence, Senatorial districts, Rivers State*

INTRODUCTION

Malaria is a global parasitic disease. It is one of the most common parasitic infections especially among residents of tropical and subtropical areas [1,2]. Malaria infection is a significant public health concern in developing nations, particularly in Africa where environmental factors such as a warm, humid climate, unhygienic practices, poverty, and illiteracy are prevalent [3].

Protozoa belonging to the genus *Plasmodium* causes malaria and there are over 170 distinct species of *Plasmodium* that infect mammals, birds, and amphibians. Out of the aforementioned species, human malaria is known to be caused by five *Plasmodium* species, which are spread by about 50 species of *Anopheles* mosquitoes. *P. vivax, P. falciparum, P. knowlesi*, *P. ovale* and *P. malariae*. Records indicates that *P. falciparum* and *P. vivax* pose the most threat. *P. vivax* is the predominant species outside of sub-Saharan Africa, where *P. falciparum* is the most lethal and prevalent species [4,5]. These parasites are carried by adult female *Anopheles* mosquitoes, which bite at night often.

They consumed blood meals, provide protein for the eggs and transmit the parasites from person to person [1]. Malaria in humans has also been linked to *P. knowlesi,* which is known to infect long-tailed macaque monkeys in South East Asia, Thailand, Singapore, and certain regions of the Philippines [6-9].

In 2020, 241 million incidences of malaria and 627,000 deaths caused by malaria were reported globally [5]. An estimated two-thirds of the mortality were triggered by COVID-19 complications, while recent modification to WHO's malaria mortality methodology reported instigated the remaining one-third mortality rate [5]. African nations account for a significant portion of the world's malaria burden, with 228 million people accounting for 95% of all malaria cases worldwide and a 96 percent fatality rate, with children under 5 accounting for 80% of all fatalities in the area [5].

The burden of malaria was borne by 19 nations in sub-Saharan Africa and India, accounting for over 85% of the worldwide burden. In Africa, apart from Nigeria which contributed 25%, additional five African countries, namely Uganda, Niger Republic, Côte d'Ivoire, Mozambique and Democratic Republic of the Congo account for more than 50% of global malaria cases in the ratio of 5%, 4%,4%,4% and 12% respectively [10].

The majority of mosquitoes that transmit the virus in Nigeria are *Anopheles gambiae* s.s., which is responsible for 76 percent and 24 percent, respectively, of the people living in high and low transmission zones [10,11]. Despite notable geographic, rural-urban, and socioeconomic differences, the prevalence of malaria in young children that were below 5years was 23 percent in 2018, down from the 27 percent and 42 percent recorded in 2015 and 2010, according to microscopy results from the Nigeria Demographic and Health Survey (NDHS) [12].

Malaria is known to affect many people in impoverished countries of the world, placing a significant economic burden on these nations, creating a never-ending cycle of poverty and malaria. For instance, according to the 2021 Malaria World Report, a total of US$3.3 billion was spent globally in combating malaria in 2020, with 79% of that amount going to Africa, 7% to South East Asia, and 4% each to the Americas, Western Pacific Region, and Western Mediterranean [5]. This in turn affect global economy negatively.

The fatal and destructive illness reduces the nation's economic output, making African Countries to lose money. According to reports, families in Africa spent an average $250 on treating malaria in 2011 and $15 to $20 per month on preventing it [13]. In Nigeria, the typical family spends $12.5 for outpatient care and $23.20 for inpatient care, respectively, for each episode of malaria [14]. Due to the expansion of medical facilities, the expense of treatment, prevention, and other indirect costs places a significant financial burden on the afflicted person, their family, and the government.

With over 66 percent of clinic attendance being due to the condition, it has steadily been the most popular reason for out-patient visits across all age groups, adding to the already weak economy [15]. According to [16], malaria attacks in Nigeria result in an estimated 12 percent considerable loss of domestic product. Due to inadequate immunity, children below 5years, the elderly, and expecting mothers are particularly susceptible to malaria bouts. Additionally, first-time mothers and the fetuses are particularly susceptible to malaria attacks [17,18].

Malaria negatively affects the entire populace including children and expectant mothers [19,20]. The infection may also result in stillbirth, abortion, and premature delivery. The immaturity of young children's immune systems contributes to their susceptibility to malaria. Chills, pains in the muscles and joints, headaches, nausea, vomiting, coughing, and diarrhea are some of the symptoms observed in children [21]. The growing resistance of malaria to standard anti-malarial medications makes this issue worse.

The current status of malaria in Nigeria is an indication that the infection still remains a public health concern in spite of the deliberate effort by Government, Non-Profit Organizations and other stakeholders to reduce the prevalent rate. Hence, the evaluation of the current status of malaria prevalence in the three senatorial districts in Rivers State becomes necessary.

METHODOLOGY

Study Area

This research was done in Rivers State. The state is situated at 40 44' 59.06'N and 60 49' 39.58'E in the heart of the Niger Delta region. It shares borders with the states of Akwa-Ibom on the east, Imo, Abia, and Anambra on the north, the Atlantic Ocean on the south, and Bayelsa and Delta on the west. The projected population of the state in 2006 was 5,198,716 [22]. Rivers Southeast, Rivers Southwest, and Rivers East make up the state's three senatorial districts (Fig. 1.0).

The three general zonal hospitals built in each of the three senatorial districts were used to carry out the research**.** The southwest senatorial district is made up of Ahoada East, Ahoada West, Abua/Odua, Asari-Toru, Akuku-Toru, Degema, Ogba/Egbema, Ndoni, and Bonny Local

Governments Areas, Rivers South-East senatorial district is made up of Khana, Gokana, Tai, Andoni, Eleme, Opobo/Nkoro and Oyigbo Local Government Areas while Rivers East senatorial district encompasses of Obio/Akpor, Okrika, Ikwerre, Ogu-bolo, Emoaha, Omuma, Etche and Port Harcourt City Local Government Areas. The general hospitals in Rivers southeast, Rivers southwest and Rivers east senatorial districts are located in Bori, Ahoada East and Okirika respectively. These hospitals are called zonal general hospitals and were established and owned by the Rivers State Government.

The Bori zonal hospital was established in 1952 and is located on 4″ 6^{0} 7N latitude, 7″ 3^{0}6E longitude. It has 100 bed space and an estimated 95 employed workers. Ahoada zonal hospital was established in 1954 and is situated on 5′.07 N latitude, 6′. 6 ^{0}5 E longitudes. It is a ninety (90) bed capacity hospital. The Okrika Zonal Hospital was established in 1964 and it is situated on 4^{0}44 31” N latitude, 7^{0} 5” 1.25” E longitude. It has a ninety (90) bed capacity with a workforce of roughly seventy-three (73) permanent employees and thirty-six temporary employees.

The indigenes of the three senatorial districts are predominately farmers and fisher men while others are petty traders and Government workers.

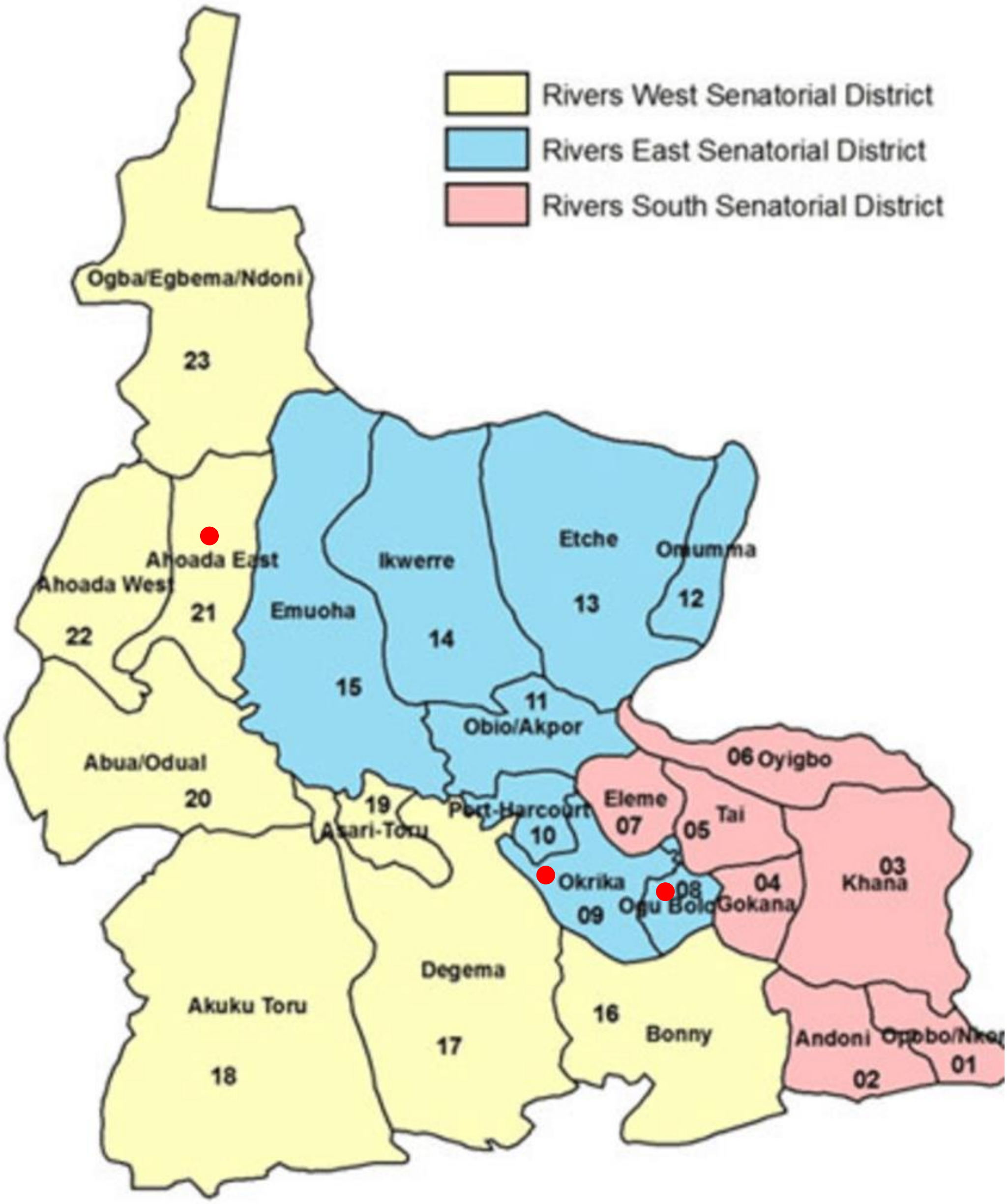

Fig. 1.0: Map the three senatorial districts in Rivers State

Source: Rivers State Ministry of Information

Experimental Designs

A randomized block experimental design was used for this study. The research was divided into two (2) parts. The first part involved the production and distribution of self-structured questionnaire to the respondents to collect demographic information. The second part was laboratory examination which involved the screening of thick and thin blood films from participants to find the presence of the malaria parasite and calculate the prevalence. The

International Journal of Health Sciences
ISSN: 2710-2564 (Online)
Vol. 5, Issue No. 2, pp 67 - 86, 2022 www.carijournals.org

participants were drawn from patients seeking treatment at the three zonal hospitals, each of which is located at the headquarters (Ahoada, Bori and Okrika) of the three senatorial districts.

Sampling size

The formula of [23] was used determine the sample size for each senatorial district:

$$n = \left(\frac{N}{1+N(0.05)^2}\right)$$

Where n = Sample size

N = Population size

0.05 = Marginal error

Rivers Southwest senatorial district (Ahoada zonal hospital):

N = 152; n = ?

$$n = \left(\frac{152}{1+152(0.0025)}\right)$$

$$n = \left(\frac{152}{1.38}\right)$$

n = 110.2

≈ 110

Rivers South-East senatorial district (Bori zonal hospital)**:**

N = 172; n = ?

$$n = \left(\frac{172}{1+172(0.0025)}\right)$$

$$n = \left(\frac{172}{1.43}\right)$$

n = 120.3

n ≈ 120

Rivers East senatorial district (Okrika zonal hospital):

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ISSN: 2710-2564 (Online)
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N = 176; n = ?

$$n = \left(\frac{176}{1+176(0.0025)}\right)$$

$$n = \left(\frac{176}{1.44}\right)$$

n = 122.2

n ≈ 122

A sample size used in this study were 110 for Rivers West, 120 for Rivers South East and 122 for Rivers East Senatorial zones.

Study Population

Only febrile outpatients who visited one of the three hospitals for medical care and had malarial symptoms were chosen for the research.

Ethical Clearance

The Ethical Committee of the Rivers State Hospital Management Board in Port Harcourt provided approval for this study's ethical conduct.

Questionnaire

A total of three hundred and sixty (360) copies of self-structured questionnaire were produced and distributed to the participants. The questionnaire was used to gather information on respondents' cultural views, degree of awareness about malaria, chosen preventative measures and socioeconomic characteristics of the patients.

Collection of Samples

The method of [24] was used in the collection of samples. Venous blood sample from each of the participants was carefully collected using sterile needle and syringe. The hospital staff helped in this process. The blood samples were collected from participants from all the senatorial zones based on the calculated sample size (Rivers south east:120, Rivers East:122 and Rivers West:110). The blood samples were preserved in well-labeled Ethylene Diamine-Tetra Acetic Acid (EDTA) bottles for laboratory analysis.

Laboratory Analysis

The laboratory analysis of the blood samples was done in the Research Laboratory, Department of Biology, Ignatius Ajuru University of Education in Port Harcourt. Thin and thick blood smears of each participant was prepared and examined under the microscope using the procedure of [25].

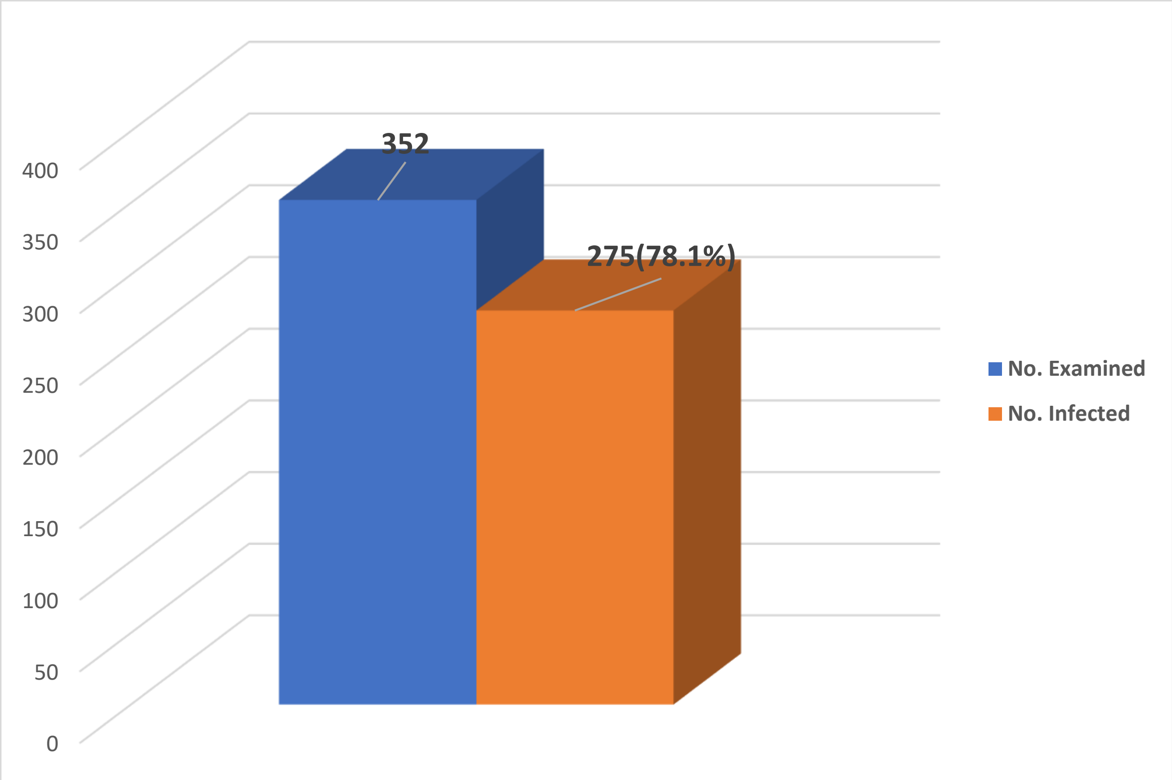
Data Analysis

Data analysis was done using SPSS version 20. Simple percentage calculations and chi-square were employed to determine demographic data and other results to identify differences between variables at 0.05 significant levels.

RESULTS

Malaria is generally prevalent throughout the three senatorial districts. Blood samples from the 352 participants were screened for the presence of malaria. Out of the 352 persons examined, 275(78.1%) were positive for malaria parasites (Fig. 1.0). The results indicated that out of the 110 persons examined in Rivers West senatorial district, 104(94.6%) were positive for malaria parasite, 93(77.5%) were positive for the parasite out of 120 persons examined in Rivers South East while, out of 122 persons examined in Rivers East, 78(63.3%) were infected with malaria parasites. A statistically significance difference(P>0.05) in malaria prevalence was observed in all the senatorial zones (Fig. 2.0).

Table 1: Overall prevalence of malaria in the Senatorial zones



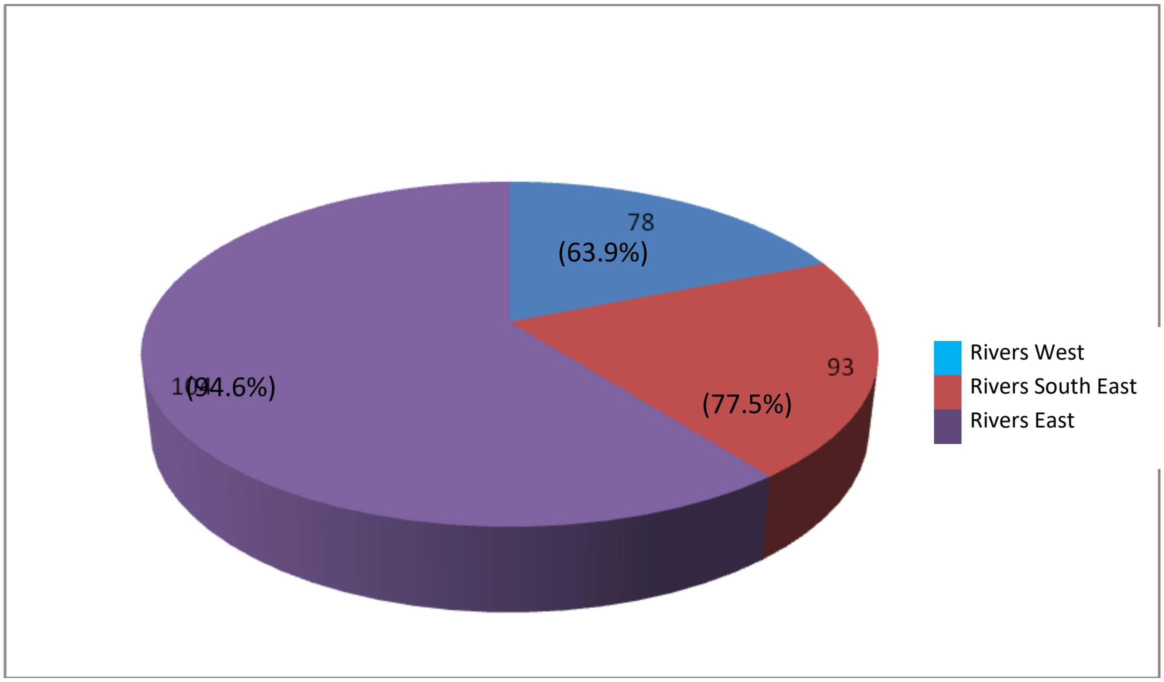


Fig. 2.0: Prevalence of malaria in each senatorial zone.

Prevalence of malaria based on gender

A total of 252 patients (139 males and 213 females) in all the three senatorial districts were positive for malaria parasite. Of the 139 males examined, 109(39.6%) had malaria while 166(60.7%) females were positive for the parasite out of the 213 examined. Of the 109 infected males, 46(42.2%), 41(37.6%) and 22(20.2%) were from Rivers west, Rivers Southeast and Rivers East senatorial districts respectively. Similarly, out of the 166 females infected, 58(35.0%), 52(31.3%) and 56(33.7%) were from Rivers west, Rivers Southeast and Rivers East senatorial zones respectively (Table 1.0). Statistically, the results indicate that gender has no significant ($p<0.05$) influence on the prevalence of malaria in the three senatorial districts.

International Journal of Health Sciences
ISSN: 2710-2564 (Online)
Vol. 5, Issue No. 2, pp 67 - 86, 2022
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Table 1.0: Prevalence of malaria in based on gender

Gender	Rivers West		Rivers South East		Rivers East			
	No. examined	No. infected (%)	No. examined	No. infected (%)	No. examined	No. infected (%)	Total no. examined	Total Infected (%)
Male	49	46 (42.2)	52	41(37.6)	38	22(20.2)	139	109(78.4)
Female	61	58(35.0)	68	52 (31.3)	84	56 (33.7)	213	166(79.9)
Total	**110**	**104(94.6)**	**120**	**93(77.5)**	**122**	**78(63.9)**	**352**	**275(78.1)**

$p<0.05$

Age-related prevalence of malaria in the senatorial districts

A total of 352 patients in the three senatorial districts were examined, out of which 86, 58, 71, 44, 35 and 58 patients were within the age group of 1-10yrs, 11-20yrs, 21-30yrs, 31-40yrs, 41-50yrs and >50yrs respectively. The results indicated that out of the 275 infected individuals, 72(26.2%), 44(16.0%), 60(21.8%), 29(10.5%), 24(8.7%) and 46(16.7%) were within the age range of 1-10yrs, 11-20yrs, 21-30yrs, 31-40yrs, 41-50yrs and >50yrs respectively (Table 3.0). Patients within the age range of 1-10yrs and 21-30yrs had a high prevent rate of 26.2% and 21.8% respectively. This was followed by >50years (16.7%), 11-20years (16.0%), 31-40years (10.5%) and 8.7years (8.7%) (Table 2.0). Statistically, age of patients has a significant ($p>0.05$) influence on malaria prevalence in the region.

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Table 2.0: Age-related prevalence of malaria in the senatorial zones

Age (yrs)	Rivers West		Rivers South East		Rivers East			Total infected (%)
	No. Examined	No. Infected (%)	No. Examined	No. Infected (%)	No. Examined	No. Infected (%)	Total	
1–10	32	31 (25.8)	29	25 (86.2)	25	16(64.0)	86	72 (83.7)
11 – 20	20	19 (95.0)	20	16 (80.0)	18	9(30.0)	58	44 (75.8)
21 – 30	25	23 (92.0)	22	19(86.3)	24	18(75)	71	60 (84.5)
31 – 40	13	12 (92.3)	13	5(38.4)	18	12(66.6)	44	29 (65.9)
41 – 50	5	5(100)	16	11(68.7)	14	8(57.1)	35	24 (68.5)
≥51	15	14(93.3)	20	17(85)	23	15(65.2)	58	46 (79.3)
Total	**110**	**104(94.5)**	**120**	**93(77.5)**	**122**	**78(63.9)**	**352**	**275(78.1)**

Prevalence of malaria in based on marital status of participants

Out of 352 participants from the three senatorial districts examined for the presence of malaria, 154(43.8%) were singles and children while 198(56.2%) were married. Of the 275 participants infected, 118(43.0%) were singles and children while 157(57.0%) were married. Although more married participants were infected. Statistically, no significance difference (P>0.05) was observed in the prevalence of the infection based on marital status (Table 3.0). The results also indicated that more married participants 65(95.5%) were infected in Rivers West, followed by 48(67.8%) in Rivers East and 44(74.5%) in Rivers South-East. The prevalence of malaria among the single participants in Rivers West, Rivers South-East and Rivers East were 39(92.8%), 49 (80.3%) and 30(58.8%) respectively.

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ISSN: 2710-2564 (Online)
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Table 3.0: Prevalence of malaria based on marital status of participants

Marital status	Rivers West		Rivers South East		Rivers East		Overall Prevalence	
	No. examined	**No. infected (%)**	**No. examined**	**No. infected (%)**	**No. examined**	**No. infected (%)**	**Total Examined**	**Total infected (%)**
Single	42	39 (92.8)	61	49(80.3)	51	30(58.8)	154	118(76.6)
Married	68	65(95.5)	59	44(74.5)	71	48(67.6)	198	157(79.2)
Total	**110**	**104(94.5)**	**120**	**93(77.5)**	**122**	**78(63.9)**	**352**	**275(78.1)**

Prevalence of malaria based on education level of participants

Of the 352 people investigated, 62 had no formal education, 108 were at elementary level while 22 and 58 were at the secondary and higher levels of education respectively (Table 4.0). Similar to this, out of the 275 infected individuals, 46 (16.7%), 89 (32.4%), 92 (33.4%), and 48 (17.5%) had non-formal education, basic education, secondary education, and higher education, respectively (Table 4.0). In the Rivers West Senatorial District, the incidence of malaria was highest among patients with higher education (95.4%) and non-formal education (95%) levels, followed by secondary education (94.2%) and basic education (93.9%) (Table 4.0). The result shows no statistical correlation between education level and malaria frequency in the Rivers West senatorial district. Contrary to this**,** in Rivers South East, individuals with basic education had the highest incidence (92.1%), followed by those with secondary education (77.8%). The group with the least prevalent rate (60%) was those that had non-formal education. Statistically, malaria prevalence in the Rivers South East senatorial district is significantly influenced by education level ($p>0.05$)**.**

Again, in Rivers East, individuals with higher education had the highest infection rate (73.4%), followed by those with no formal education 18(66.6%). Participants at the primary and secondary education levels had 23 (62.2%) and 26 (60.5%) respectively (Table 4.0). Education level of participants exact no statistical impact on malaria frequency in Rivers East senatorial area**.**

Table 4.0: Malaria prevalence base level of Education

	Rivers West		Rivers South East		Rivers East			
Educational level	**No. examined**	**No. infected (%)**	**No. examined**	**No. infected (%)**	**No. examined**	**No. infected (%)**	**Total no. examined**	**Total infected (%)**
Non-formal	20	19(95.0)	15	9(60.0)	27	18(66.6)	62	46(74.1)
Primary	33	31(93.9)	38	35(92.1)	37	23(62.2)	108	89(82.4)
Secondary	35	33 (94.2)	46	33(77.8)	43	26(60.5)	124	92(74.1)
Tertiary/ Higher	22	21(95.4)	21	16(76.2)	15	11(73.4)	58	48(82.7)
Total	**110**	**104()**	**120**	**93**	**122**	**78**	**352**	**275(78.1)**

DISCUSSION

The study investigated the prevalence of malaria in zonal hospitals in the three senatorial zones of Rivers State. The overall malaria prevalence in this study was 78.1% which agrees with the previous records of [26-29] who reported a prevalence of 73.1%, 71.1%, 68%, and 69.4% respectively. The results obtained in this study is also consistent with the reports of [30,31] who reported a prevalence of 80.4% and 60.6% respectively. The 78.1% recorded in our study is however lower than the 27%, 31.3% and 20% reported by [29,32] and [33] respectively. This high rate of malaria prevalence observed in this study may be a reflection of the poor socio-economic status of the people in the study areas. It could also be as a result of other factors, including the region's high rainfall, inadequate drainage and runoff water, proximity to water bodies, and local residents' behavioural tendencies, which encourage the breeding of the mosquito vector and subsequently increase susceptibility to mosquito bites. The prevalence of 78.1% in this research indicated a high susceptibility to malaria, probably due to low acquired immunity [27]. Despite efforts to reduce the threat of the illness, this high incidence highlights the reality that malaria is still a significant burden on the region. This is also attributable to the parasites' resistance to the majority of local medications that are often used. The poor drainage system as well as unselective dumping of refuge in drainages, waterways, and the surrounding area have all contributed to year-round favorable breeding conditions for mosquitoes that transmit *Plasmodium*.

The prevalence of malaria based on gender indicated no statistical difference (P>0.05) across the senatorial districts. However, the prevalence was slightly higher among males in Rivers West and South-east senatorial districts and lower in Rivers East senatorial districts. This shows that males were more likely to have the infection as observed in other studies by [27, 34-38]. Records indicate that resistance to malaria is relatively stronger in females than in males owing to hormonal and genetic disparity between the two genders [27,34]. According to [39], genetic variables play a significant role in giving females the immune-regulatory capacity to deal with the infection**.** Again, males are predisposed to mosquito bites more than females due to regular outdoor meetings, occupations and other social activities.

Age-related prevalence recorded a statistically significant difference in all age groups(p<0.05). Age groups 1-10yrs and 21-30yrs had high infection rate than other groups. This is in consonant with the report of [40]. This may be ascribed to low transferred immunity from mother to child and first-time pregnancy. Prevalence in other age groups in the study was also high. This also agrees with [41], who reported high prevalence in similar study in Jos, Plateau, Nigeria. This proved that malaria infection affects all ages.

The results obtained in this study base on marital status showed no significant correlation (p<0.05). This could be attributed to the general habit the people. The single and married dwell in the same environment and behaviorally are affected by the same climatic conditions.

Several measures have been adopted to curb the menace of malaria scourge in Nigeria but to no avail. Poor environmental management, stagnant water, swampy nature, poor drainage system, waste disposal system, hot climatic conditions, and behavioural patterns have been blamed for the non-performance of these measures. All these factors had enhanced the multiplication of the vector with serious negative impact on the health and socio-economic variables in the region [27].

[27,42] opined that reduction of poverty, improved sanitation and waste management system, good road network with drainages, and access to good health care system would ameliorate the burden of malaria in the region. Vector control in malarious regions is only a lips service due to political and administrative bottle neck.

Conclusion

Malaria prevalence in the study area is quite high and to reduce the health burden, deliberate and functional policies and practical measures are required. Measures such as specific legislations and policies that target health orientation on the epidemiology and transmission of malaria, behavioural changes in terms of waste disposal and management of the environment as well as malaria treatment procedures with the view to reduce emergence of drug resistant species of the parasite.

Recommendations

The study revealed that malaria is still endemic in the three senatorial districts and remains a public health concern. It is recommended that:

1. Deliberate efforts from government and other stakeholders are needed to improve on the present preventive measures put in place, especially in the area of sanitation and health orientation as well as health orientation for the local communities.
2. Prevention and control programmes should pay special attention to vulnerable groups such as infants and pregnant women.

Acknowledgements

The authors are grateful to Tertiary Education Trust Fund (TETFUND) for financing the study. We also appreciate the Rivers State Hospital Management Board for approving the study. We thank the staff especially the doctors and nurses in the three zonal hospitals and the laboratory technologists of research laboratory, Ignatius Ajuru University of Education, Port Harcourt.

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