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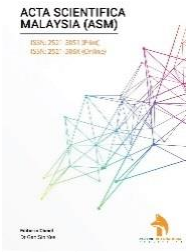

RESEARCH ARTICLE

GEOSPATIAL DISTRIBUTIONS OF MALARIA AND ITS VULNERABILITY IN MINJIBIR, KANO STATE

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ABSTRACT

Malaria is considered to be a deadly disease spread in almost all parts of Nigeria, especially in the Northern parts. This has to do with the climatic influence of the north-easterlies and the hot dry savannah couple with the attitude of health sanitation. This study captured the vulnerable areas where the malaria cases are severe and predominant using satellite images and data. The frequency of malaria prevalence was done on a daily, monthly and annual basis for the period of 3 years from 2017-2019. The outcome shows that people in Minjibir and 5 villages were sampled having high malaria prevalence in 2017 with 41.28%, 2018 has 35.19% and 2019 has 23.53%. The result indicates that malaria cases are dropping with a decrease from 2017 to 2019 by 17.75%.

KEYWORDS

Vulnerability, Geospatial, Malaria, Climate, Sanitation.

1. INTRODUCTION

The World Health Organization (WHO) has estimated that Nigeria has the greatest number of malaria cases, with about 51 million cases and over 200 000 deaths reported annually, which accounts for one-third of the total incidence of malaria in Africa WHO Malaria Report 2017 (Barber et al., 2017). Approximately 40% of the world's population lives in areas where malaria is transmitted. There are an estimated 300–500 million cases and up to 2.7 million deaths from malaria each year. The mortality levels are greatest in sub-Saharan Africa, where children under 5 years of age account for 90% of all deaths due to malaria1. Human malaria is caused by infection with intracellular parasites of the genus Plasmodium that is transmitted by Anopheles mosquitoes. Of the four species of Plasmodium that infect humans, Plasmodium falciparum is the most lethal. Malaria is one of the life-threatening diseases transmitted via the infected Anopheles mosquito.

The mosquito bites release Plasmodium vivax or Falciparum which is a parasite into the human bloodstream. The parasite in the human body will then be transported into the liver where after several days they mature. Consequently, the mature parasite will start infecting the red blood cells. The Malaria Atlas Project and its partners in the Sub-Directorate for Malaria Control in the Directorate of Vector-borne Diseases aim to assemble malaria parasite rate surveys across the Indonesian archipelago (Guerra et al., 2007). Environmental factors such as the presence of bushes and stagnant water around homes, rainfall, low altitude and high temperatures favor the breeding of malaria vectors, as well as parasite reproduction within them (Messina et al., 2011).
Tropical areas including Nigeria have the best combination of adequate rainfall, temperature and humidity allowing for breeding and survival of anopheles mosquitoes (Efe and Ojoh, 2013). An increase in rainfall and temperature enhances mosquito breeding and improved breeding sites leading to the incidence of malaria. Rainfall provides the breeding sites for mosquitoes and increases relative humidity necessary for mosquito survival, leading to an increase in the number of mosquitoes biting an individual per unit time (Lindsay and Martens, 1998). An adult mosquito`s chance of survivorship is determined by the ambient temperature, humidity and rainfall. Warmer ambient temperatures shorten the duration of the extrinsic cycle, thus increasing the chances of transmission. Malaria is thus been treated as one of the environmental diseases (Hay et al., 2000). A group of researchers has sampled 9 malaria vulnerability and prevalence in kano Dala, Fagge, Gwale, Kano Municipal, Nassarawa, Tarauni and Ungogo (Madobi, 2019).

The obtained result has confirmed a positive statistical analysis of malaria in the sampled areas. Prompt treatment of malaria cases with effective antimalarial medication and environmental management also reduces malaria morbidity and mortality; one study showed an odds ratio of 0.55 between 2003 and 2005 after the deployment of artemisinin-based combination therapy (ACT) and ITNs (Achan et al., 2011). Another study, a systematic review in West Africa involving seven studies found that intermittent preventive therapy in children (IPTC) prevented three-quarters of all clinical malaria episodes. According to the World Health Organization (WHO), in 2016 there were estimated cases of about 216 million people attacked by malaria in 91 countries. The United States Center for Disease Control and Prevention (CDC) reported 1700 cases of malaria annually. The disease spread mostly when people travel to countries where malaria prevails (Simon and Snow, 2006).

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Interventions against malaria can alter the natural transmission cycle of malaria from the vector to the human host and vice versa and be able to change and/or eliminate malaria transmission. A meta-analysis of 13 studies done in sub-Saharan Africa on indoor residual spraying (IRS) effectiveness indicated a relative risk in malaria prevalence by 0.38 %. The use of insecticide-treated nets (ITNs) is another effective strategy for reducing the malaria burden; one systematic review of over 10 studies in sub-Saharan Africa estimated an incident rate ratio of 0.49. in another systematic review which included 19 studies worldwide, ITNs were found to have a protective effect of 17% compared to no nets (Relative Rate 0.83) and to reduce the incidence of uncomplicated malaria episodes by 50% (Qin et al., 2017). Another systematic review attributed 79% of the reduction in malaria burden to vector control interventions (Bhatt et al., 2015). The countries' confirmed and suspected cases of Malaria incidence as of 2015, stood at 19,555,575 people (Goodarzi et al., 2020). Among vector-borne diseases, malaria is influenced by seasonal or spatial changes in the environment. Apart from following the seasonal pattern based on temperature and rainfall season, the malaria burden also follows regional trends (Messina et al., 2011).

2. Methodology

2.1 Study Area

The study area Minjibir is located at Lat 12°10'28.42"N, Long 8°39'31.28"E in Kano State Lat 12° 1'42.68"N, Long 8°35'17.45"E. Minjibir is one of the 44 Local Government areas in Kano State. Its location closer to the Wase Dam had modified its microclimate. The Dam harnesses the growth of the socio-economic and cultural heritage of fishing and irrigation agriculture. Temperature is hot 320c-360c, with a longer duration of the dry season of about 8 months; Humidity is high 75-80%. The transition period of Harmattan characterized by a dusty-haze that blows from the Sahara Desert commences from late November to early February every year (Sufiyan et al., 2020).

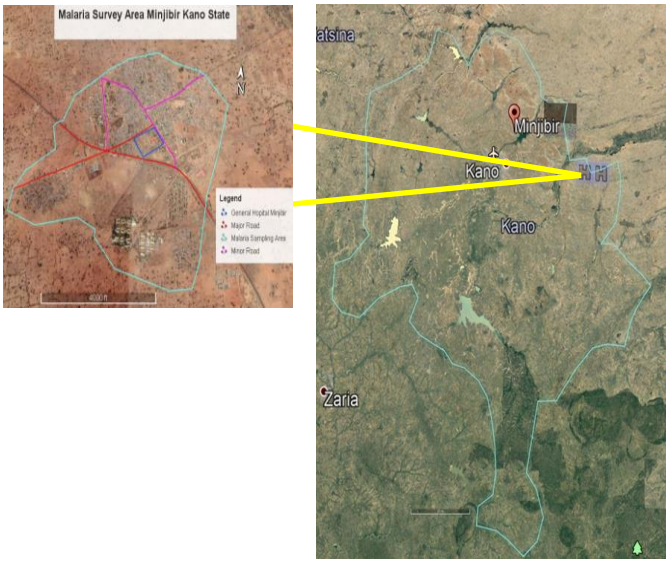

Figure 1: Map of the Malaria Affected area Minjibir, Kano State

2.2 Data sources

The data used in this study is from the general hospital Minjibir department of Kano State Contributory Healthcare Management Agency (KSCHMA), Malaria Health Product-Daily Consumption Register, Minjibir General Hospital (Federal Ministry of Health) and the samples survey conducted from the patients attending medical check daily in the hospital. One–way ANOVA was tested for the malaria positive testing versus the percentage obtained.

3. Result and Discussion

3.1 Daily Prevalence of Malaria in Minjibir Town 2019

People are tested positively infected by malaria in the General hospital Minjibir. The statistics have shown that most of these patients tested with malaria positive are found around Minjibir Gari and the nearby villages.

Table 1: Daily Average analysis of the prevalence of the Malaria endemic in Minjibir

Daily cases of Malaria	Malaria positive tested	percentage
Minjibir	10	29.41%
Chedi	5	14.70%
Tofa	6	17.64%
Dingin	7	20.58%
Galwanga	2	5.88%
Sakau	4	11.76%
Total	34	100%

The 6 selected areas of this study were computer showing the percentage of the results demonstrated in Table 1 and Figure 1. The highest percentage of a daily report on malaria in Minjibir with 29.41%, Dingin with 20.58%, 17.64%, Chedi 14.70%, 11.76% and Sakau 5.88%.

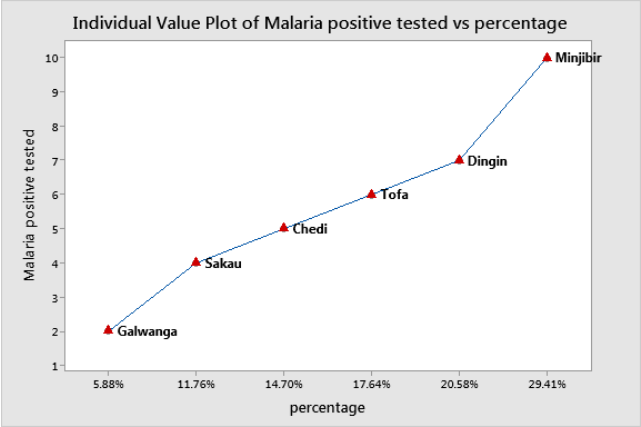

Figure 2: One-way ANOVA at 0.05 significant levels showing the highest cases of Malaria on daily basis in Minjibir General Hospital, Kano State

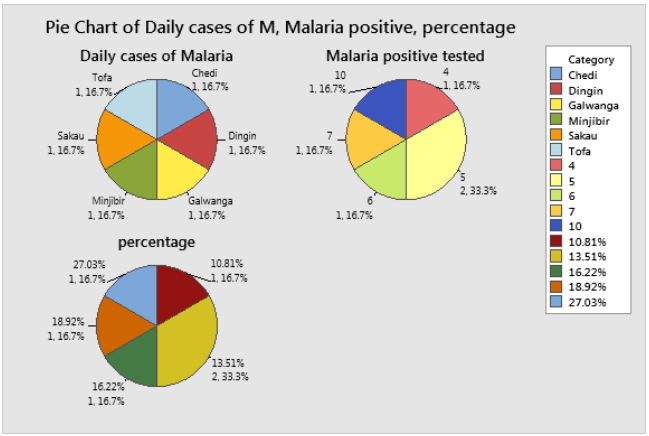

Figure 3: Illustrates the 3 graphical models in Pie form showing cases of Malaria

3.2 Monthly Average Analysis of Malaria prevalence (2017)

The next results are of three years of analysis of the malaria vulnerability in the study area Minjibir. Table 2 is the average monthly malaria cases that are tested positive in 2017

Table 2: Average Monthly analysis of the prevalence of the Malaria endemic in Minjibir 2017

Monthly cases of Malaria	Malaria positive tested	Percentage
Minjibir	142	26.19%
Chedi	75	13.83%
Tofa	95	17.52%
Dingin	90	16.60%
Galwanga	80	14.76%
Sakau	60	11.07%
Total	542	100%

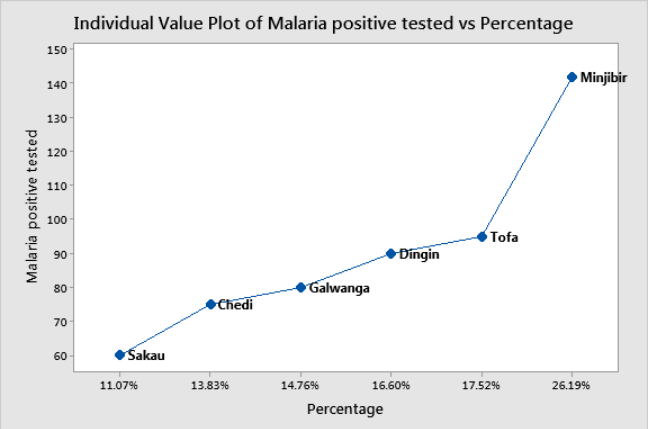

Figure 4: One-way ANOVA at 0.05 significant levels in 2017 MSE =0 and the degree of freedom for error =0

The same patterns have been applied to analyze the results in the monthly data of malaria prevalence in 2017. The patients who tested positive for malaria are fully presented in Table 4.20. The highest prevalence is found in Minjibir Gari with 26.19%, Tofa with 17.52%, Dingin with 16.60%, Galwanga with 14.76%, Chedi with 13.83% and lastly Sakau with 11.07%. Figure 4 is the time series that analyzed the data using a simple equation to test the model fit. The R^2 is significant with 0.57 with the trend line showing the highest Malaria prevalence in Minjibir town to the lowest in Sakau village.

3.3 Monthly Average Analysis of Malaria prevalence (2018)

Table 3 is the average monthly malaria cases that are tested positive in 2018

Table 3: Average Monthly analysis of the prevalence of the Malaria endemic in Minjibir 2018

Monthly cases of Malaria	Malaria positive tested	Percentage
Minjibir	120	25.97%
Chedi	71	15.36%
Tofa	82	17.74%
Dingin	75	16.23%
Galwanga	65	14.06%
Sakau	49	10.60%
Total	462	100%

In the year 2018, the malaria prevalence in Minjibir has reduced from 26.19% to 25.97%, Dingin from 16.60 to 16.23%, Galwanga from 14.76% to 14.06% Sakau from 11..07% to 10.60% while the rest have not reduced rather the malaria at that time has more or less effectively increases in Tofa 17.52% to 17.74% and Chedi from 13.83% .to 15.36%.

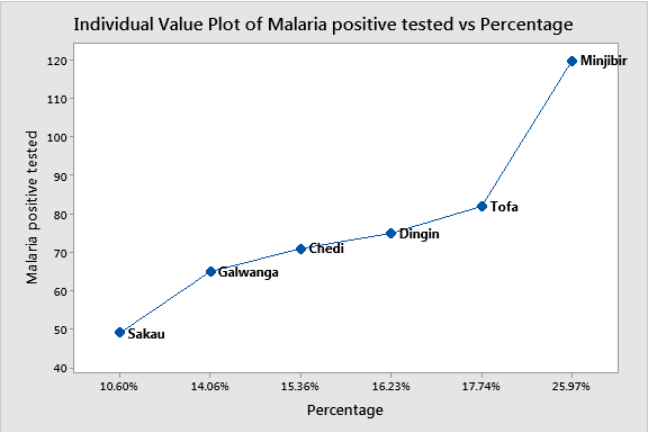

Figure 5: Figure 4 one-way ANOVA at 0.05 significant levels in 2018

The model has shown a significant correlation. While Figure 4.30 illustrates the highest proportion of area malaria prevalence that is Minjibir town with 26% and the lowest recorded data is found in Sakau with 11%.

3.4 Monthly Average Analysis of Malaria prevalence (2019)

Table 4 is the average monthly malaria cases that are tested positive in 2019

Table 4: Average Monthly analysis of the prevalence of the Malaria endemic in Minjibir 2019

Monthly cases of Malaria	Malaria positive tested	Percentage
Minjibir	101	33.00%
Chedi	51	16.50%
Tofa	46	14.88%
Dingin	48	15.53%
Galwanga	35	11.33%
Sakau	28	9.06%
Total	309	100%

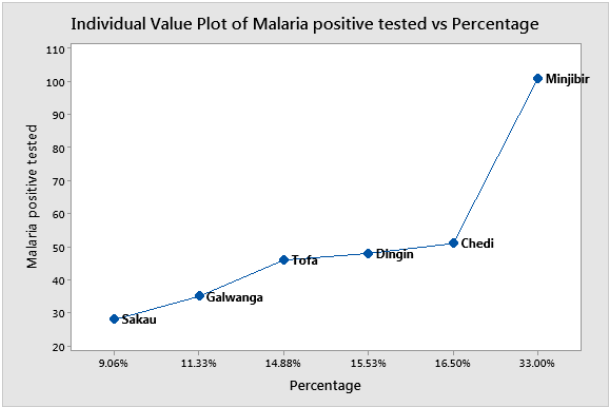

Figure 6: One-way ANOVA at 0.05 significant levels in 2019

In 2019, the prevalence of the malaria-endemic was analyzed with the focal area of the survey Minjibir having 33% of the malaria prevalence, followed by Tofa with 16.50%, Dingin with 15.53%, Chedi with 14.88%, Galwanga with 11.33% and lastly Sakau with 9.06%. This result indicates a drastic reduction in the spread of the disease. The menace of the malaria prevalence in the study area is declining with the improved health care facilities and changes in the people sanitation attitudes.

3.5 Three years Average of Malaria prevalence in Minjibir Town

The positive case of malaria prevalence in Minjibir town was summarized for three years. Table 5 has shown the analyzed results obtained from the study. The cases of malaria in Minjibir is reducing from 41.28% in 2017 to 35.19% in 2018 and then to 23.53% in 2019.

Table 5: Total Annual Average of the prevalence of Malaria in the study area

Sample Year	Positive cases of Malaria reported	percentage
2017	6504	41.28%
2018	5544	35.19%
2019	3708	23.53%
Total	15757	100%

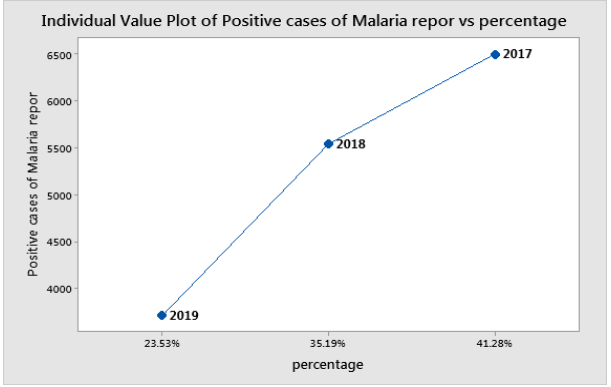

Figure 7: One-way ANOVA at 0.05 significant levels for 3 year

Figure 7 is the highest fitted model showing that by the year 2017 with a rate of malaria vulnerability. The prevalence also dropped in 2018. This indicates that there is progress in malaria reduction in Minjibir town in the last three years. Figure 8 is an illustration showing the highest numbers of malaria prevalence in the study area. In 2017 the total number of cases was 6504, 2018 was reduced to 5544 and in 2019 it also reduces to 3708.

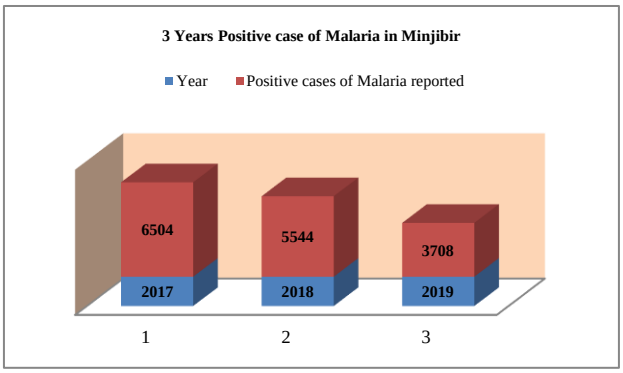

Figure 8: 3 years positive cases of Malaria in Minjibir town

4. Conclusion

The cases of Malaria prevalent are gradually decreased in Minjibir and its environs. There is more improvement in health facilities, environmental sanitation, coupled with the free distribution of malarial drugs from the Ministry of Health and also frees distribution of Insect Treated Nets (ITNs). Base on this study, in 2019 malaria epidemics had reduced 23.53% as compared to 2017 with 41.28%. However, massive campaigns and public enlightenment are required to educate people on the danger of malaria (cerebral Malaria) that kills both infants and adults. Kano State Government should intensify more effort to harness and employ more environmental health inspectors and other stakeholders for the total eradication of the disease. In the next proceeding years, there is an expectation Malaria reduction to the minimal level.

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