ZIBELINE INTERNATIONAL™ PUBLISHING

ISSN: 2616-5961 (Online)
CODEN: IMCSBZ

Information Management and Computer Science (IMCS)

DOI: http://doi.org/10.26480/imcs.01.2021.06.09

RESEARCH ARTICLE

THE USE OF GEOGRAPHIC INFORMATION SYSTEM TO ANALYSE PREVALENCE OF MALARIA PARASITE IN MINJIBIR, KANO STATE NIGERIA

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ARTICLE DETAILS

Article History:

Received 10 January 2021
Accepted 14 February 2021
Available online 16 March 2021

ABSTRACT

Malaria is one of the tropical diseases popularly known all over Africa. It is caused by the female Anopheles mosquitoes which transmit Plasmodium falciparum into human blood and result in high fever or sudden death. Based on this study, people from the less developed region have poor hygiene and sanitation that contributed to the spread of the vector causing malaria. In this study, geospatial techniques were applied to collect the samples, about 125 samples were collected. The GPS capture was employed using the satellite image to georeference the area study. The data obtained are of four types; the National Health Management Information System (NHMIS, National Malaria Elimination Programme; Malaria Health Product-Daily Consumption Register, Minjibir General Hospital (Federal Ministry of Health), Sample Field Survey (Questionnaire) and Kano State Contributory Healthcare Management Agency (KSCHMA). The results indicated that over 26.4% of children are vulnerable to malaria, 24.8% of infants and 24% of adults. The overall analysis of the 5 villages including minjibir Gari surveyed have 84% of people tested positive with plasmodium falciparum in their blood and a few over 16% were tested with a negative reaction.

KEYWORDS

Prevalence, GIS, Malaria, Healthcare, vulnerability.

1. INTRODUCTION

Malaria is an endemic and pandemic caused by the female anopheles' mosquito which transmits plasmodium falciparum. In Africa`s malaria-endemic countries, an average of 30% of all outpatient clinic visits is for malaria (Malaria, 2008). In these same countries, between 20% and 50% of all hospital admissions are a consequence of malaria (Secretariat, 2013). There are about 460 recognized species of the anopheles mosquito. Among them, only 30-40 can transmit parasites of the genus Plasmodium which cause malaria to the human endemic region or area (Eichler, 1973).

The well-known species in Africa include;

1. Anopheles funestus
2. Anopheles subpictus
3. Anopheles culicifacies
4. Anopheles crucians
5. Anopheles dirus
6. Anopheles punctipennis
7. Anopheles beriberi
8. Anopheles wakeri
9. Anopheles introlalus
10. Anopheles latens
11. Anopheles earlei
12. Anopheles gambiae

Malaria is a disease caused by protozoan parasites of the genus Plasmodium, which has five different species: falciparum, Plasmodium vivax, Plasmodium malaria, Plasmodium ovale and Plasmodium (Shapiro) infection, with different Plasmodium species producing various clinical outcomes in patients (Jia et al., 2018). The most viral and lethal species of malaria worldwide is P. falciparum, although other Plasmodium species can also cause serious illness in humans (Kasetsirikul et al., 2016). In light of extensive worldwide efforts, the global burden of malaria has declined dramatically since 2000. The incidence rate has dropped by 37% and the mortality rate by 60% (Eperon et al., 2017). This decrease, which is evident worldwide, is chiefly the outcome of interventions such as the control of malaria-carrying mosquitoes (the use of insecticides, spraying indoor spaces), treatment of patients and improved diagnosis (rapid diagnostic tests) (Bhatt et al., 2015).

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

Quick Response Code	Access this article online	
	Website: www.theimcs.org	DOI: 10.26480/imcs.01.2021.06.09

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. Resistance to anti-malarial drugs and insecticides, the decay of public health infrastructure, population movements, political unrest, and environmental changes are contributing to the spread of malaria.

In countries with endemic malaria, the annual economic growth rates over 25 years were 1.5% lower than in other countries. This implies that the cumulative effect of the lower annual economic output in a malaria-endemic country was a 50% reduction in the per capita GDP compared to a non-malarious country. Recent studies suggest that the number of malaria cases may double in 20 years if new methods of control are not devised and implemented. Despite numerous challenges in our hospitals in Kano State, Minjibir Hospital have a short fault in the collation of daily, weekly, monthly and annual data of patients sufferings from the malaria parasite. This study criss-cross the peripheral of 5 villages nearby including the main Minjibir town to ascertain the actual percentage of people who vulnerable to Plasmodium Falciparum.

2. METHODOLOGY

2.1 Study Area

Minjibir Local Government area of Kano State is among the 44 local governments presently existing as the political division of the state in Nigeria. It consists of different villages and hamlets. For this study, the main Minjibir town including 5 nearby villages was sampled. The existing malaria records in the hospital can be compared with the obtainable data in the field to checkmate and evaluate the data using correlation.

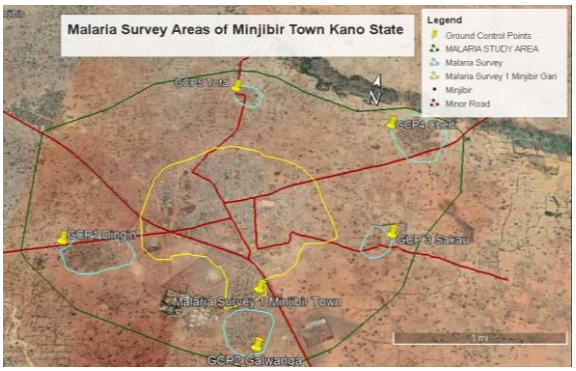

Figure 1: Map of the Study area Minjibir Town (Gari) and 5 other sampled villages

2.2 Location

The demarcation of the area surveyed was conducted on 07 June 2020 couple with the plotting of the coordinates using GPS. The Ground Control Points were digitized and analyzed using the software Google Earth Pro. The following are the existing points were the malaria survey was conducted:

Minjibir Town = Lat 12°10'15.24"N Long 8°39'16.69" E
Dingin = Lat 12°10'9.96"N Long 8°38'41.90"E
Galwanga = Lat 12° 9'52.44"N Long 8°39'51.24"E
Sakau = Lat 12°10'38.14"N Long 8°40'25.01"E
Chedi = Lat 12°11'18.10"N Long 8°40'18.25"E
Tofa = Lat 12°11'19.33"N Long 8°39'21.75"E

2.3 Geographical Setting of the Study Area

The climate of the study area is the same as found in most parts of Northern Nigeria. Areas located in Sudan and Sahel Savannah zones are characterized by the wet and dry seasons (Thomson, 2010). The wet season is between May to early September. The mean annual temperature usually is between 29oc to 32oc. Mean annual rainfall is between 1500mm to 2000mm and the amount of humidity is only higher during the rainy or wet season 15%-20% in the dry period and 50%-60% during the wet periods (Sufiyan et al., 2020).

2.4 Method Data collection and Presentation

The data are of two categories; those obtained from the General Hospital Minjibir and the field data administered in the form of a questionnaire. About 140 samples of questionnaires were distributed but the target objective is to analyze 125 samples in case if others will be missing. The data presentation is in a tabular format for easy statistical computation. The study obtained two different data from the General hospital Minjibir.

2.4.1 Data Sources

There are about four sources of the database on the study; the sources of the data include;

1. National Health Management Information System (NHMIS) Monthly summary for Health facilities Kano Unit (Federal Ministry of Health)
2. National Malaria Elimination Programme; Malaria Health Product-Daily Consumption Register, Minjibir General Hospital (Federal Ministry of Health)
3. Sample Field Survey (Questionnaire)
4. Kano State Contributory Healthcare Management Agency (KSCHMA)

2.4.2 Techniques of Data Analysis

The surveillance system in Kano State follows that of the other states in the federation and consists of stakeholders at the state and LGA levels involved with information collection, collation and planning for the effective operation of the system. The actors include the malaria program managers at state and LGA levels who offer technical assistance and the monitoring and evaluation (M&E) officers who do the actual data entry into district health information system version 2 (DHIS2), the web-based platform for NHMIS. Data flow from the Operation of the malaria surveillance system in Kano State, Nigeria. The data can be analyzed using standard time series including daily to the annual evaluation of the data and routine application of appropriate statistics such as the correlation and regression analysis.

3. RESULT AND DISCUSSION

3.1 Environmental Sanitation

Table 1: Attitudes of people on Sanitation in the study area

Sanitation attitudes	Respondents	Percentage
Daily cleaning	25	20%
Weekly cleaning	45	36%
Monthly cleaning	36	28.8%
Annual cleaning	19	15.2%
Total	125	100%

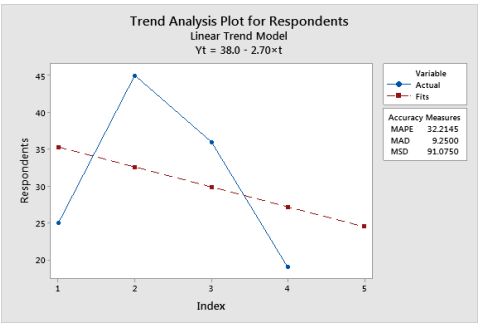

Figure 1. Trend analysis showing the model fit base on accuracy measures

People in Minjibir engaged in weekly sanitation more than other days 36%, monthly with 28.8%, daily 20% with few people did their sanitation annually as indicated in Table1.

3.2 Waste Disposal and Generation

Waste as unwanted materials needs to be discarded in our environment. The types of refuse disposal can trigger the development of mosquitoes hence; increase the rate of its breeding. This study was able to calculate the rate at which people in the study area spread their waste. Table 2 present the percentages for the type of waste generated. Most of the waste is disposed of in the open dumps (40%), some waste is also disposed of in the streets (28%), about 20% are disposing of refuse or wastes in open burning in front of their houses. While over 12% are taking their waste to the sanitary landfill. This can be another contributory factor that attracts mosquitoes breed places in Minjibir.

Table 2: Waste disposal types in the Study area		
Types of Waste Disposal	**Respondents**	**Percentage**
Open burning	25	20%
Open dumps	50	40%
Street litter	35	28%
Sanitary landfill	15	12%
Total	125	100

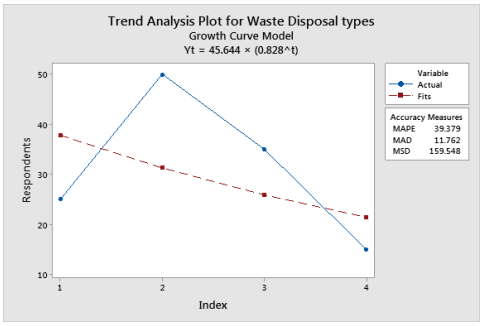

Figure 2: High index waste disposal methods in the Study Area

3.3 Malaria cases in the individual family

Table 3: Do you have malaria cases in your family?		
Malaria cases	**Respondents**	**Percentage**
Positive Cases	105	84%
Negative Cases	20	16%
Total	125	100%

Most family in the study has confirmed that they are attached by malaria parasites. About 84% of the respondents have contracted the disease. Only 16% of the families are free from malaria cases, refer to Table 3.

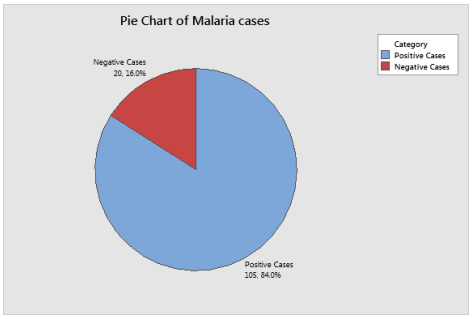

Figure 3: Number of the family vulnerable to malaria in Minjibir

3.4 Malaria parasites control

Table 4: What type of malaria control do you practice?		
Malaria control measure	**Respondents**	**Percentages**
Use of insecticides	35	28%
Insect treated Net	45	36%
Electric devices	5	4%
Mosquito coil	25	20%
Other specify	15	12%
Total	125	100%

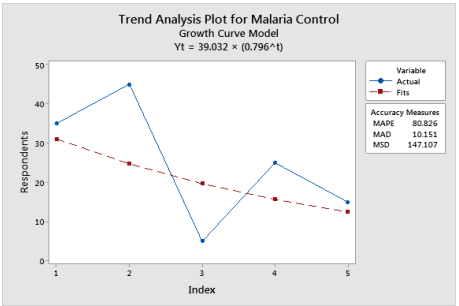

Figure 4: Explains the significance of the use of insecticides with the indication of model fit with Insect Treated Nets (ITNs)

There are many types of malaria control some of which are listed in Table 4. Nowadays, mosquitoes the carrier of the parasite (plasmodium falciparum) are resisting insecticides. Most people rely on insect treated nets (ITNs) for their reliability and durability. About 36% of the responses obtained so far have been using the mosquito nets. Some insecticides are also effective not for a very long time but a short period.

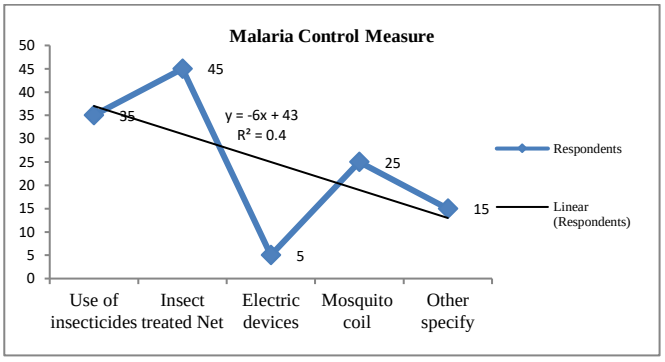

Figure 5: Linear graph showing (R^2) value of 0.4, significant model fit

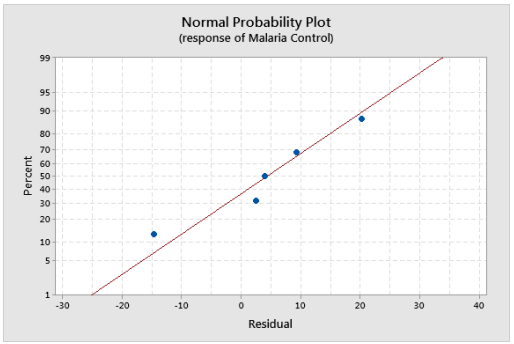

Figure 6: Residual value showing a normal linear relationship of Malaria control in Minjibir

3.5 Frequency of Malaria Occurrences

Table 5: Frequency of patients diagnosed with malaria Parasite in the Hospital		
Frequency of malaria occurrences	**Respondents**	**Percentage**
Daily cases	24	19.2%
Weekly cases	36	28.8
Monthly case	48	38.4
Annual cases	17	13.6%
Total	125	100%

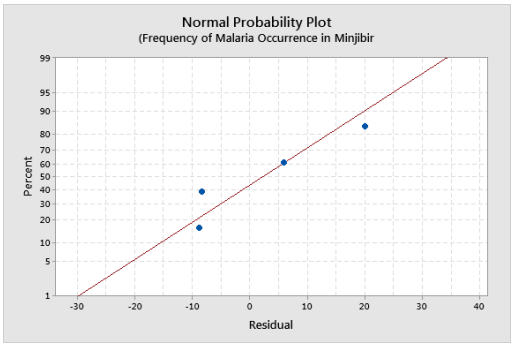

Figure 7: Indicate that Malaria occurs in almost all the respondents in the study area

The frequency of malaria occurrences in Minjibir is daily. But the statistics indicated that those coming to the General hospital monthly are higher. This is due to the cumulative reports summarized in the monthly Malaria register. The field investigation conducted practical shows the same result in Table 5. More the 38.4% are infected by malaria parasites monthly. While 28.8% are recorded weekly. 19.2% are recorded daily and 13.6% were annually recorded. Figure 7 and figure 8 shows the actual models of the result obtained.

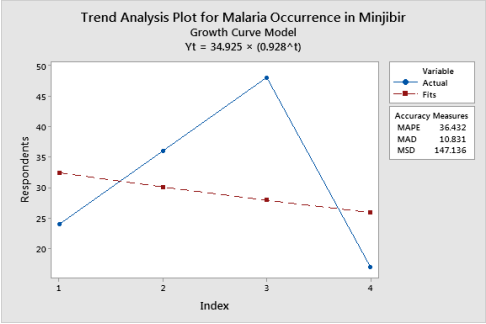

Figure 8: Frequency of Malaria cases in the Study Area

3.6 Malaria vulnerability in Minjibir Town

Table 6: Who do you think is more vulnerable to malaria-endemic?

Malaria vulnerability	Respondents	Percentage
Infants	31	24.8%
Children	33	26.4%
Adolescent	30	24%
Adult	31	24.8%
Total	125	100%

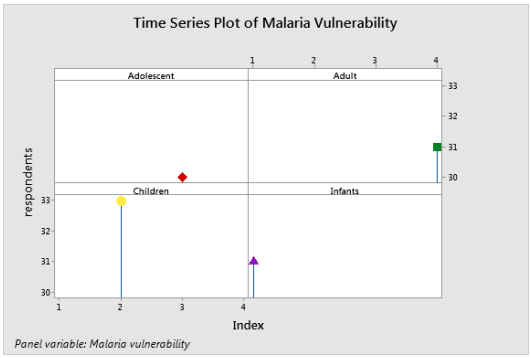

Figure 9: Categories of people vulnerable to Malaria in Minjibir

As indicated in Table 6 and Figure 9, most victims of malaria are children aged less than or greater than 5-13 years old. The mortality rate is higher within the same age range. According to this study, 26% of children are affected by malaria. Infant and adult share almost the same ranges 24.8%, adolescence that is vulnerable to malaria was about 24%.

4. Conclusion

The malaria parasite is proven to be vulnerable to human death by the Anopheles mosquito that carries Plasmodium falciparum into humans' bloodstream. However, because of poor hygiene and sanitation in the developing country such as Nigeria, the mosquitoes breed in stagnant dirty water and green grasses. There is little improvement of malaria control in Minjibir, Kano State, Nigeria with the health of the Federal and State Ministry of Health. This has been helpful through free distribution on Insects Treated Nets (ITNs). Furthermore, there is a limited supply of insecticides which can be spread in the stagnant water and total absence of fumigation to reduce or eliminate the breeding ground of the mosquito.

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