Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Epidemiological Studies of Malaria in Gboko Metropolis, Gboko Local Government Area of Benue State, Nigeria

Emmanuel Okwudili Ogbuefi (oe.ogbuefi@unizik.edu.ng)
Nnamdi Azikiwe University Awka
Dennis Nnanna Aribodor
Nnamdi Azikiwe University Awka
Ngozi Nneka Joe-Ikechebelu
University of Victoria, British Columbia
Ogechukwu Benedicta Aribodor
Nnamdi Azikiwe University Awka
Ifeoma Chizoba Okechukwu
Caritas University Enugu
Obinna Ndubueze Orjichukwu
APIN Public Health Initiatives Makurdi

Article

Keywords: Malaria, Epidemiology, P. falciparium, Gboko Community, Nigeria

Posted Date: April 25th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1405677/v2

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Abstract

We carried out an epidemiological study of malaria in Gboko metropolis in Gboko Local Government Area of Benue State, North - Central Nigeria to determine the malaria prevalence, risk factors and perception to malaria control among patients attending the hospital clinics between April and June, 2021. We used Rapid Diagnostic Test (RDT), thin blood and thick blood film microscopy to sample the blood of 415 patients to determine specie, prevalence and intensity of malaria parasites. Also, structured questionnaire was administered to 400 individuals to obtain information on malaria management practices of the people. Chi-square test $P < 0.05$ was used to check for relationships between prevalence of malaria and other parameters in the study. The prevalence rate was found to be (55.7%) 231/415 and all (100%) were infections of *Plasmodium falciparum*. There was significant difference ($p < 0.05$) in the prevalence by age with the age groups 20–29 years having the highest prevalence of 68.9% (51/74). General Hospital Gboko recorded the highest prevalence of 74.3% (92/124) while Royal Hospital Gboko recorded the lowest prevalence of 31.6% (12/38) with a significant difference. The intensity of malaria infection showed that 45.9% (106/231) had moderate infection with no significant difference. In the administration of questionnaire, the respondents in Gboko demonstrated a good knowledge of malaria, 93.2% (373/400) opined that they have heard about malaria before. Respondents who do not sleep under LLINs recorded that 32.6% (30/92) do not have the mosquito net recorded, 17.4% (16/92) had no money to buy mosquito net while 10.9% (10/92) averred that it's not comfortable sleeping under the net. Malaria public enlightenment efforts should be intensified to make malaria elimination not just possible but also achievable in Gboko Metropolis, Benue State.

Introduction

Malaria remains a significant public health problem. It is a parasitic disease of great importance in the world due to the morbidity and mortality associated with the disease (1). It has a high mortality which has caused nearly a half million deaths in Africa, most of which were in children under 5 years of age (2, 3). Malaria epidemiology is a diverse subject covering all aspects of malaria distribution and associated factors whose manipulation could influence the course of the disease. According to 2013 World Health Organization report, globally, an estimated 3.3 billion people are at risk of being infected with malaria and developing the disease (4). Also 1.2 billion people are at high risk in 109 countries and territories around the world, while Democratic Republic of Congo and Nigeria account for over 40% of the estimated total malaria deaths globally (4). World Health Organization reported that there were 214 million cases of malaria worldwide; and the African Region accounted for most global cases of malaria (88%), followed by South-East Asia Region (10%) and the Eastern Mediterranean Region (2%) (5). The burden of malaria is heaviest in the African Region and children under 5 years of age accounts for 78% of all deaths (6). Nigeria accounts for 25% of the world's malaria burden (5). Many species of *Plasmodium* exist, but four are well known to cause malaria disease in man namely: *Plasmodium falciparum, P. malariae, P. ovale, P. vivax. P. knowlesi* is recently established as the fifth *Plasmodium* species to cause malaria in humans in

forest areas of Southeast Asia (7). In malaria studies in Nigeria, some communities and towns like Gboko appear neglected, thus justifying the need for the research.

Material And Methods

Study Area

The study was carried out in Gboko metropolis. Gboko is a one town Local Government Area in Benue State, North-Central Nigeria.withgeographical coordinates of latitudes 7˚13'N - 7˚35'N, and longitudes 8˚30'E - 9˚03'E (8). Gboko is bordered to the north by Tarka and Buruku L. G. As., to the South by Konshisha L. G.A., to the West by Gwer L. G. A. and to the South – East by Ushongo L. G. A. Gboko has an estimated population of 280,600 (9). The people mostly belong to the Tiv ethnic group. Gboko comprises five districts namely: Mbatierev, Mbayion, Mbatiav, Yandev and Ipav. The climate in Gboko has two distinct seasons: dry season (October to March) and rainy season (April to September). Using hospital based outpatients, the study was carried out between April and June 2021 which corresponds to the wet season in Nigeria.

Sample Size Calculation

The sample population was made up of male and female of all age groups attending hospitals in Gboko. A sample size of 400 was determined using the formula n=N/1+N (e^2) according to (10). The number of participants sampled for malaria prevalence was 415 and 400 was used for the questionnaire.

Selection of Hospital and Sample Collection

Five hospitals were randomly selected for the study, one government owned hospital and four private owned hospitals. The rationale behind the selection was that these hospitals cut across the populations in Gboko metropolis. Venous blood samples were collected according to the method described by (11). Each participant’s hand was tied with a tourniquet, based on where most prominent vein was found. The site of collection of the blood sample was wiped with a cotton swab soaked in 70% methylated spirit to clean and sterilize the area. A 2milliliter disposable syringe with needle was used to collect 1ml of venous blood. The blood was transferred into a labeled EDTA bottle to prevent agglutination. Dry cotton was placed at the point of entrance of the needle into the vein and the needle gently removed, covered and disposed into a waste-bin provided for the purpose.

Investigation of Knowledge, Attitude and Practices

Investigation of local beliefs on malaria was determined using structured questionnaire administered to the participants. The questionnaire sought information about the knowledge, causation, prevention, treatment and beliefs on the possibility of malaria elimination. The questionnaire was administered along with local interpreters of Tiv speaking tribe to participants who could not understand English language.

Data Analysis

We obtained and summarized our data subjecting it to statistical analysis using (12). We also used Chi-square test of P<0.05 to check for relationships between prevalence of malaria and other parameters. The results were considered not significant, when the P–value was greater than 0.05 and significant, where P–value was less than 0.05 level of significance.

Results

The result showed that out of the 415 sample population, 231 representing 55.7% were positive for malaria infection and all (100%) were infections of *Plasmodium falciparum.*

The result on the prevalence of malaria infection in relation to age showed that age group 20–29 years had the highest prevalence of 68.9% (51/74), followed by age group 10–19 years 67.8% (82/121), 40–49 years had 64.3% (9/14), 30–39 years had 58.3% (35/60), 60–69 years had 50% (7/14), 0–9 years had 44.9% (31/69), 50–59 years had 27.1% (13/48) and > 70 years had the lowest prevalence of 20% (3/15) as shown in Fig. 1. Statistical analysis showed that there was a significant difference among the age groups ($P < 0.05$, $X^2 = 0.00$, $df = 14$).

The result also showed that females had more prevalence of malaria 55.9% (143/256) than males 55.3% (80/159) as shown in Fig. 2. Statistical analysis showed that there was no significance difference between the sexes ($P > 0.05$, $X^2 = 0.918$, $df = 1$).

The result also showed that the highest prevalence of malaria among hospitals was recorded by General hospital 74.2% (92/124), followed by Victory hospital 65.1% (41/63), Myom hospital had 52% (51/98), Lord is Saviour had 38% (35/92) while Royal hospital recorded the lowest prevalence of 31.6% (12/38) as shown in Fig. 3. There was a significant difference among the hospitals sampled ($P < 0.05$, $X^2 = 0.00$, $df = 8$).

The intensity of malaria infection as shown in Table 1 indicated that 45.9% (106/231) had moderate infection, 39.8% (92/231) had mild infection, while 14.3% (33/231) had severe infection. Age group 0–9 years had 48.4% (15/69) mild infection, 32.3% (10/69) moderate infection and 19.4% (6/69) severe infection while 10–19 age group had 47.6% (39/121) mild infection, 48.8% (40/121) moderate infection and 3.7% (3/121) severe infection. Age group 20–29 years had 27.5% (19/74) mild infection, 43.1% (22/74) moderate infection and 29.4% (15/74) severe infection. Age group 30–39 years had 25.7% (9/60) mild infection, 60.0% (21/60) moderate infection and 14.3% (5/60) severe infection. Age group 40–49 years had 22.2% (2/14) mild infection, 77.8% (7/14) moderate infection and 0% severe infection (0/14). The observed difference in the intensity of malaria in relation to age group was not significantly different ($P > 0.05$, $X^2 = 0.867$, $df = 1$).

Table 1
Intensity of malaria infection in relation to age in Gboko Metropolis, Benue State

Age Group (Yrs)	No. Examined	No. Positive (%)	Mild Infection (+) %	Moderate Severe Infection Infection (++) % (+++) %
0–9	69	31(44.9)	15 (48.4)	10 (32.3) 6 (19.4)
10–19	121	82 (67.8)	39 (47.6)	40 (48.8) 3 (3.7)
20–29	74	51 (68.9)	14 (27.5)	22 (43.1) 15 (29.4)
30–39	60	35 (58.3)	9 (25.7)	21 (60) 5 (14.3)
40–49	14	9 (64.3)	2 (22.2)	7 (77.8) 0 (0)
50–59	48	13 (27.1)	5 (38.5)	4 (30.8) 4 (30.8)
60–69	14	7 (50)	5 (71.4)	2 (28.6) 0 (0)
> 70	15	3 (20)	3 (100)	0 (0) 0 (0)
TOTAL	**415 (100.0)**	**231 (55.6)**	**92 (39.8)**	**106 (45.9) 33 (14.3)**

The result of the community's perception to malaria elimination in Gboko shows that out of the 400 respondents, 93.2% (373/400) averred that they have the basic knowledge about malaria while 6.8% (27/400) claimed that they have no knowledge about malaria as shown in Table 2. Statistical analysis showed no significant difference between the sexes on their knowledge about malaria ($P > 0.05$, $X^2 = 0.333$, $df = 1$).

Table 2
Respondent's knowledge about malaria in Gboko Metropolis, Benue State

Have you heard About malaria?	Male Respondents (%)	Female Respondents (%)	Total no. of Respondents (%)
No	11(5.5)	16 (8)	27 (6.8)
Yes	188 (94.5)	185 (92)	373 (93.2)
TOTAL	**199 (49.8)**	**201 (50.2)**	**400 (100.0)**

The result on Table 3 showed respondent's knowledge about the cause of malaria. 48.8% (195/400) attributed it to malaria parasite, 19.8% (79/400) attributed it to oily food, 13.3% (53/400) implicated demonic spirit, 12.3% (49/400) claimed that malaria is caused by overwork and 6.0% (24/400) implicated sunlight. Statistical analysis showed no significant difference ($P > 0.05$, $X^2 = 0.663$, $df = 1$).

Table 3
Respondent's knowledge about the cause of malaria in Gboko Metropolis, Benue State

Cause of Malaria	Male Respondents (%)	Female Respondents (%)	Total number of Respondents (%)
Sunlight	14 (7.4)	10 (4.7)	24 (6)
Overwork	19 (10.1)	30 (14.2)	49 (12.3)
Oily food	46 (24.3)	33 (8.3)	79 (19.8)
Malaria parasite	72 (38.1)	123 (58.3)	195 (48.8)
Demonic spirit	38 (20.1)	15 (7.1)	53 (13.3)
TOTAL	**189 (47.1)**	**211 (52.8)**	**400 (100.0)**

From the study, the reasons why respondents didn't sleep under LLINs are outlined on Table 4. Those that do not have the net had 32.6% (30/92), followed by 17.4% (16/92) and 10.9% (10/92) who averred that it was because there was no money to buy the net and that it's not comfortable sleeping under the net respectively. Other reasons were; 5.5% (5/92) didn't sleep at their house, 5.5 (5/92) forgot, 5.4% (5/92) don't like it, 3.3% (3/92) all averred that it was because it gives them itchy skin, the net got spoilt and that they hate it. It causes heat and no reason respectively had 2.2% (2/92), whereas 1.1% (1/92) opined that they were not use to the net.

Table 4
Response to why respondents don't sleep under LLINs in Gboko Metropolis, Benue State

Why didn't you sleep under LLINs?	Male Respondents (%)	Female Respondents (%)	Total number of Respondents (%)
Not comfortable	4 (4.3)	6 (6.5)	10 (10.9)
I don't have it	10 (10.9)	20 (21.7)	30 (32.6)
It gives me itchy skin	3 (3.3)	0 (0)	3 (3.3)
I don't like it	2 (2.2)	3 (3.3)	5 (5.4)
It causes heat	0 (0)	2 (2.2)	2 (2.2)
I hate it	1 (1.1)	2 (2.2)	3 (3.3)
Am not use to it	0 (0)	1 (1.1)	1 (1.1)
I didn't sleep at my home	3 (3.3)	2 (2.2)	5 (5.5)
No money to buy	7 (7.6)	9 (9.8)	16 (17.4)
Mine got spoilt	0 (0)	3 (3.3)	3 (3.3)
I forgot	3 (3.3)	2 (2.2)	5 (5.5)
Chemical on it is dangerous	0 (0)	2 (2.2)	2 (2.2)
Am afraid of it	1 (1.1)	4 (4.3)	5 (5.4)
No reason	0 (0)	2 (2.2)	2 (2.2)
TOTAL	**34 (37.0)**	**58 (63.0)**	**92 (100.0)**

Discussion

The result of the study showed an overall malaria prevalence of 55.7% among patients attending hospital at the five hospitals sampled in Gboko, Benue State. This high prevalence compared to pre-elimination stage prevalence of 5% could largely be attributed to gaps in malaria control interventions in the community. The result of prevalence was lower than the 76.9%, and 73.9% recorded by (13) in Gboko, and (14) in Abuja, respectively. Although, similar research done in Nigeria by (15) had reported lower figures of 42.4% in Otukpo, Benue State. The lower prevalence rate in these places could be due to the combination of factors like good environmental hygiene, literacy, and urban control efforts. The result also showed that *Plasmodium falciparium* was the only infection in the rural community of Gboko. This agrees with the observations of a related study carried out in Awka (16) where only *P. falciparium* infections were reported. It, however, differs from the related studies in Udi, Enugu State were infections of *P. falciparium* and *P. malariae* were reported (17). From the result on prevalence of malaria by age where 20–29 years

age group recorded the highest prevalence of 68.9%, followed by the 10–19 years age group where a prevalence of 67.8% was obtained, whereas 40–49 years old recorded 64.3% prevalence. The least prevalence was recorded among the > 70 years age group with 20%. Statistically, there was a significant difference among the different age groups. The highest prevalence found among the age group 20–29 years could be attributed to the vulnerability of that age group to malaria disease. Malaria infection in relation to age in this work shows also that the infection rate likely decreases as age increases as can be seen from the 20–29 years age group which had the highest infection rate of 68.9% and > 70 years age group which had the lowest infection rate of 20%. This could be possibly due to immunity gotten from previous exposure. The result is in line with similar study reported by (18) and (14), where 10–19 years age group and 20–29 years age group had the highest prevalence rate of 71.1% and 63.7% respectively. Work done by (19) in Onitsha recorded a high prevalence rate of malaria among pregnant women of age between 21–25 years, and a low prevalence rate among pregnant women of age 41 years and above. This could be because the immunity has been altered; hence with malaria 70% – 80% of pregnant women in endemic area are vulnerable (20). In the prevalence in relation to sex, our work showed that the infection rate was highest amongst the female sex group with prevalence of 55.9% while the male sex group had the lowest prevalence of 55.3% even though there was no significant difference between the sexes. Observed malaria infection prevalence rate among the males and females showed that out of five hundred male children examined in their study, 296 (59.20%) of males were positive for malaria while out of five hundred female children examined, 286 (57.20%) were positive for malaria. It appeared that malaria is more prevalent among male children, but at 5% level of significance the difference is not statistically significant. This also agrees with the findings of (16) who reported that sex did not affect the prevalence among the population. The result is also consistent with a similar work done to determine the prevalence of malaria parasites in adults and its determinants in malaria endemic area of Kisumu Country, Kenya by (21), where it was observed that the female had a 50.0% higher risk of having malaria compared to males in the univariate analysis. The result on the malaria prevalence in relation to hospital agrees with a survey done by (22), who diagnosed (213) blood samples obtained from pregnant women who registered for antenatal care at different hospitals, but Federal Medical Centre Vietnam, which is a government owned hospital, rated the highest prevalence of 56.3%. The result on intensity of malaria infection demonstrated that out of the 231 (55.6%) infected patients, 92 (39.8%) had mild infection, 106 (45.9%) had moderate infection while 33 (14.3%) had severe infection. From a study done by (23), it was observed that pregnant women in 20–29 years age group have a high intensity (67.7%) of moderate infection with malaria while they have a low intensity (7.2%) of severe infection. However, age was not significantly associated with intensity of malaria in this study. The structured questionnaire we distributed to determine the community's perception to malaria elimination showed that the respondent's knowledge about malaria was high. From the result, 93.2% averred that they have the basic knowledge about malaria whereas 6.8% claimed that they have no knowledge about malaria even though there was no significant significance. Respondents in Gboko also have demonstrated a good understanding of malaria causes. Result from the study showed that 48.8% attributed malaria cause to malaria parasite, 19.8% attributed it to oily food, 13.3% implicated demonic spirit, 12.3% claimed that malaria is caused by overwork and 6.0% implicated sunlight. Statistical analysis showed no significant difference in the cause

of malaria. Similar prevalence was observed in other reports from Bangledesh, Swaziland, Ghana and Sudan (24, 25, 26, and 27) where respondents demonstrated a high knowledge about the cause of malaria. This finding also agrees with the report of (28) and in consistent with the reports of (29) and (30). Good knowledge of the behavior of people, as well as that of epidemiology of malaria enhances correct prioritization of control strategies (31). Knowledge, Attitude and Practice (KAP) studies are therefore necessary to develop community-based interventions programme (32) as decided and agreed upon by community members with other stakeholders. The awareness in the present study is much higher than those reported for Central Ethiopia and Kenya by (33) and (34), respectively. By strengthening the knowledge of malaria, people may be convinced of the need to procure and use insecticide treated bednets and that ditches, pits and earthen pots around houses which are potential sources for support of mosquito breeding be eliminated. Various reasons have been identified as barriers to the practice of malaria prevention in various communities. From this study done in Gboko metropolis of Benue State, Nigeria, out of the 23% respondents in Gboko who didn't sleep under LLINs the previous night had the following reasons: 32.6% claimed that it was because they do not have the bed net while 17.4% averred that it was because they do not have money to buy one. 10.9% claimed that they feel uncomfortable sleeping under LLINs. The result agrees with (35) who had the same report. The respondents in a study done by (36) believed that nets are used to keep dead bodies. Various studies have identified barriers to practice of malaria prevention to include high cost, harmful effect of ITN to mother and fetus, low level of awareness and poor knowledge of IPT by the pregnant women and their belief that it can harm their unborn babies (37, 38). However, provision of bed nets alone may not be sufficient given the socio-cultural perceptions and behavioral patterns of the community.

Recommendations And Conclusion

Malaria prevalence at 55.7% among patients attending hospitals in Gboko metropolis was alarming especially when compared with World Health Organization pre-elimination phase prevalence of 5%. The study therefore emphasizes the importance of the promotion of LLINs acquisition, effective utilization, health education, advocacy and awareness creation of the inhabitants of Gboko to be involved in the Roll back malaria programme. Further participatory action research with the community members of Gboko, academy and affected stakeholders to explore and understand evidence based equitable interventions and knowledge to inform community practices and policies for improved individual and community health outcomes. Malaria public enlightenment efforts should be intensified to make malaria elimination not just possible but also achievable in Gboko, Benue State.

Declarations

Acknowledgements

We are acknowledge and appreciate the medical directors and staff of the five hospitals for giving us access to their laboratory.

Conflict of Interest: The authors hereby declare no conflict of interests.

Ethical approval and consent

A letter of introduction for the study was obtained from the Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka and presented to the Chief Medical Directors (CMDs) of the selected hospitals. Explanation of the project intent and its methodology was made, and ethical approval obtained from the Benue State Hospital Management Board, General Hospital Gboko Ethical Committe with Administrative number: HMB/GHG/S/210/VOL.II and signed by the Chairman Mr. Odagboyi Godwin before the commencement of the study. The participants were mobilized by a sensitization rally during which the objective of the study was explained. Participation was voluntary and participants had the liberty to withdraw from the study. Informed consent of the participants for the study was also obtained during the survey and the identity of the participants was anonymous. We also confirm that all methods used in the study were performed in accordance with the relevant guidelines and regulations as approved by the ethical committee.

References

1. World Health Organization. (2012). *World malaria report*. Geneva: World Health Organization; (Accessed. December, 2020).
2. World Health Organization. (2017). Guidelines for the treatment of malaria. 4th edition: *World malaria report*. Geneva: World Health Organization; (Accessed. April, 2021).
3. UNICEF (2016). Ethiopia. In *UNICEF Humanitarian Action Report* 2016. New York.
4. World Health Organization (2013). Guideline: Daily iron and folic acid supplementation in pregnant women. Geneva: accessed July 15, 2020.
5. World Health Organization (2015). Global malaria programme, avenue Appia CH – 1211. Geneva 27. Web: www.who.int/malaria. (Accessed. April 2021).
6. World Health Organization. (2014). A strategic framework for malaria prevention and control during pregnancy in the Africa region. Brazzaville: *World malaria report*. Geneva: World Health Organization Regional Office for Africa; 16:21. (Accessed January, 2021).
7. Cox–singh, J. A. (2010). *Knowlesi* malaria: Newly emergent and of public health importance. *Trends in parasitology*. 24:406 – 10.
8. Microsoft Encarta College Dictionary and Encyclopedia (2001). New York: St. Martin's Press, 2001. P. 276. Accessed 23 March, 2019.
9. National Population Commission, (NPC) (2015). National malaria control programme (NMP) and ICP International, Nigeria Malaria Indicator Survey 2015: *Final Report*. 2015.
10. Rao, J. N. K. and Scott, A. J. (1992). A simple method for the analysis of clustered binary data. *Biometrics*. 1992; 15: 385–397.

11. Cheesbrough, M. (2005). District Laboratory Practice in Tropical Countries. Polymerase Chain Reaction (PCV) and red cell indicies. *Cambridge University press Edinburgh*, United Kingdom. 191:310–313.
12. Statistical Package for Social Scientists (2007). SPSS 16.0 for Windows. .
13. Houmsou, C. A., Hay, S.I., Lucioparedes, L. S., Gikandi, P. W., Tatem, A. J., Noor, A. M. and Snow, R. W. (2009). Assembling a global database of malaria parasite prevalence for the Malaria Atlas Project. Malaria Journal 6 (1):17.
14. Bassey, F. and Manderson, L. (2007). Treatment seeking for malaria in Morong, Bataan, the Philippines. Social Science Medical. 50:1309–1316.
15. Jombo, G. T. A., Mbaawuaga, E. M. and Ayegba, A. S. (2010). How far have we rolled back malaria on the African continent nine years down? The burden of malaria among pregnant women in a semi-urban community of northern Nigeria. Journal of Medical Sciences. 1:235–41.
16. Mbanugo, J. I. and Ejims, D. O. (2000). *Plasmodium* infections in children aged 0–5 years in Awka metropolis, Anambra State Nigeria. The Nigeria Journal of Parasitology. 21: 55–59
17. Eneanya, C. I., (1998). Seasonal variation in malaria episodes among residents in Udi, a semi-urban community in southeast Nigeria. The Nigerian Journal of Parasitology. *19*: 39–43
18. Chimere, A. F. and Adongo, J. (2008). The cellular and molecular basis for malaria parasite invasion of the human red blood cell. Journal of Cell Biology 198 (6): 961–71.
19. Iwueze, M. O., Ezugbo-Nwobi, I. K., Umeanaeto, P. U., Egbuche, C. M. and Anaso, C. I. (2014). Knowledge, Attitude and Management Practices on Malaria: A Case Study of Amansea, Awka North Local Government Area of Anambra State, Nigeria. The Bioscientist. Vol. 1(1): 32–38.
20. Nwagha, U.I., Ugwu, V.O., Nwagha T.U. and Anyaehie, B.U. (2011). Asymptomatic *Plasmodium* parasitaemia in pregnant women: almost a decade after Roll Back Malaria. Transactions of the Royal Society for Tropical Medicine and Hygiene. 103(1): 16–20.
21. Jenkins, S., Deressa, E., Mukhtar, A., Maes, P., De Smet, M., Baker, S. and Maikere, J. (2015). Long-lasting insecticide-treated net usage in eastern Sierra Leone - the success of free distribution. Tropical Medical International Health. 15:480–488.
22. Pelters, B. and Alnwick, D. (2013). The use of insecticide-treated bed net in a semi-urban community in south-south, Nigeria. Nigeria Journal of Medicine. 16:223–226.
23. Lander, H. D., Mahande, A. M. and Seni, J. (2002). Co-infections with *Plasmodium falciparum*, *Schistosoma mansoni* and intestinal helminths among school children in endemic areas of northwestern Tanzania. *Parasite Vectors*. 2010; 3:44.
24. Anya, S.E. (2004). Seasonal variation in the risk and causes of maternal deaths in the Gambia: malaria appears to be an important factor. American Journal of Tropical Medicine and Hygiene. 70(5): 510–513.
25. Hlongwana, K. W., Mabaso, M. L. H., Kunene, S., Govender, D. and Mharay, R. (2009). Community knowledge, attitudes and practices on malaria in Swaziland: a country earmarked for malaria elimination. Malaria Journal 8:29

26. Cruz, N., Crookston, B. and Dearden, K. (2006). Who sleeps under bednets in Ghana? A doer / non-doer analysis of malaria prevention behaviors. Emergency of Medicine Practice. 16: 5.
27. Adam, C. K., Dunyo, S. K., Afari, E. A., Koram, K. A. (2008). Malaria-related beliefs and behavior in Southern Ghana: implications for treatment, prevention and control. Tropical Medicine and International Health. 2: 488–499.
28. Panda, H., Schellenberg, J. A., Mukasa, O., Nathan, R., Abdulla, S., Mponda, H., Tanner, M., Lengeler, C. and Obrist B. (2000). Introducing insecticide-treated nets in the Kilombero Valley, Tanzania: the relevance of local knowledge and practice for an information, education and communication (IEC) campaign. Tropical Medicine of International Health. 6:614–623.
29. Deressa, E., Basu, S. and Hanson, K. (2002). Is malaria a disease of poverty? A review of the literature. Tropical Health and Medicine 10 (10): 1047–1059.
30. Klein, A., Lines, J. and Hanson, K. (1995). Which family members use the best nets? An analysis of the condition of mosquito nets and their distribution within households in Tanzania. Malaria Journal. 9:211.
31. Salako, B. M., Bradley, A. K., Greenwood, A. M., Byass, P., Jammeh, K., Marsh, K., Tulloch, S., Oldfield, F. S. and Hayes, R. (2009). Mortality and morbidity from malaria among children in a rural area of The Gambia, West Africa. Malaria Journal of Hygiene. 81: 478–486.
32. Ukpong, D. and Zimmermann, C. (2005). Malaria: Disease Impacts and Long-Run Income Differences (Report). *Institute for the Study of Science.* Pp. 51
33. Yaneneh N, Dida G. O, Sonye G. O, Futami K. and Kaneko S. (1993). Unforeseen misuses of bed nets in fishing villages along Lake Victoria. Malaria Journal. 7:165.
34. Ongore, E. L., Miller, J., Cibulskis, R. E., Kabir Cham, M., Alnwick, D., Dye, C. (1999). Monitoring mosquito net coverage for malaria control in Africa: possession verse use by children under 5 years. Tropical Medical International Health. 8:693–703.
35. Ashis, L. M., Kyi, M. S., Chiodini, P. L., Warhurst, D. C. (2013). Accuracy of routine laboratory diagnosis of malaria in the United Kingdom. Journal of Clinical Pathology. 47: 740–742.
36. Iyaniwura, C.A., Ariba, A. and Runsewe-Abiodun, T. (2018). Knowledge, use and promotion of insecticide treated nets by health workers in a suburban town in south western Nigeria. Nigeria Journal of Clinical Pathology.11:149–154.
37. Akinleye, S.O. and Ajayi, I.O. (2017). Knowledge of malaria and preventive measures among pregnant women attending antennal clinics in a rural government area in southwest Nigeria. World Health and Population. 12(3): 12–13.
38. Beare, N. A., Lewallen, S., Taylor, T. E. and Molyneux, M. E. (2011). Redefining cerebral malaria refinopathy. Future Microbiology. 6 (3):349–355.

Figures

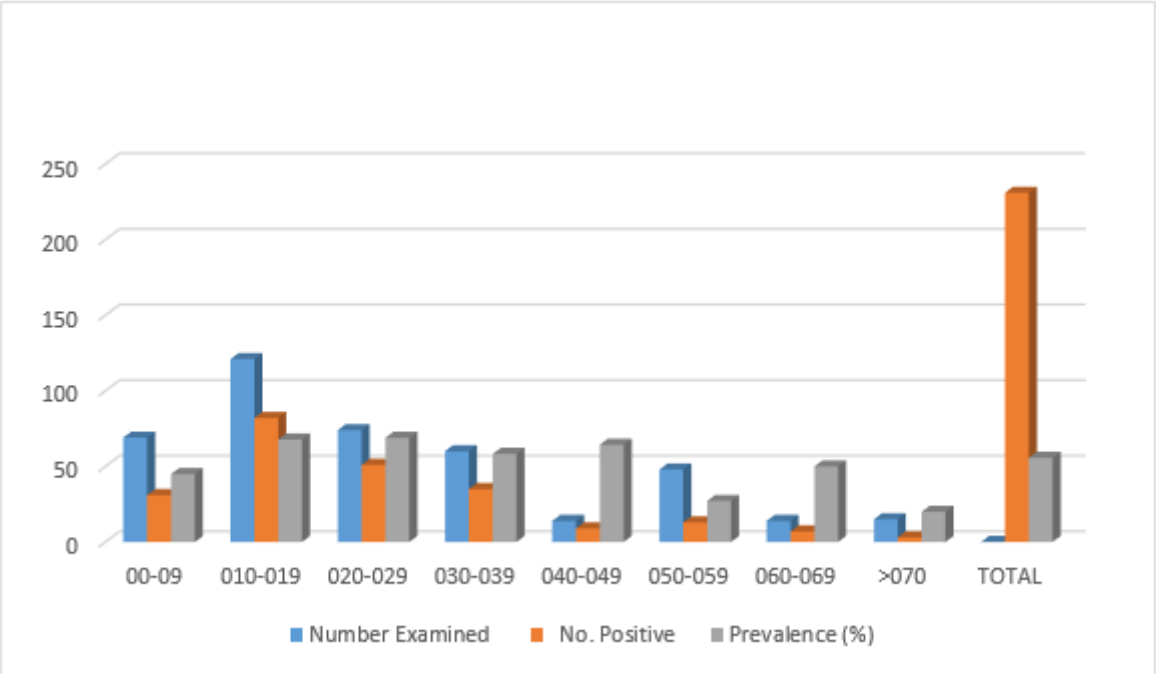

Figure 1

Prevalence of Malaria Infection in Different Age Groups in Gboko Metropolis, Benue State

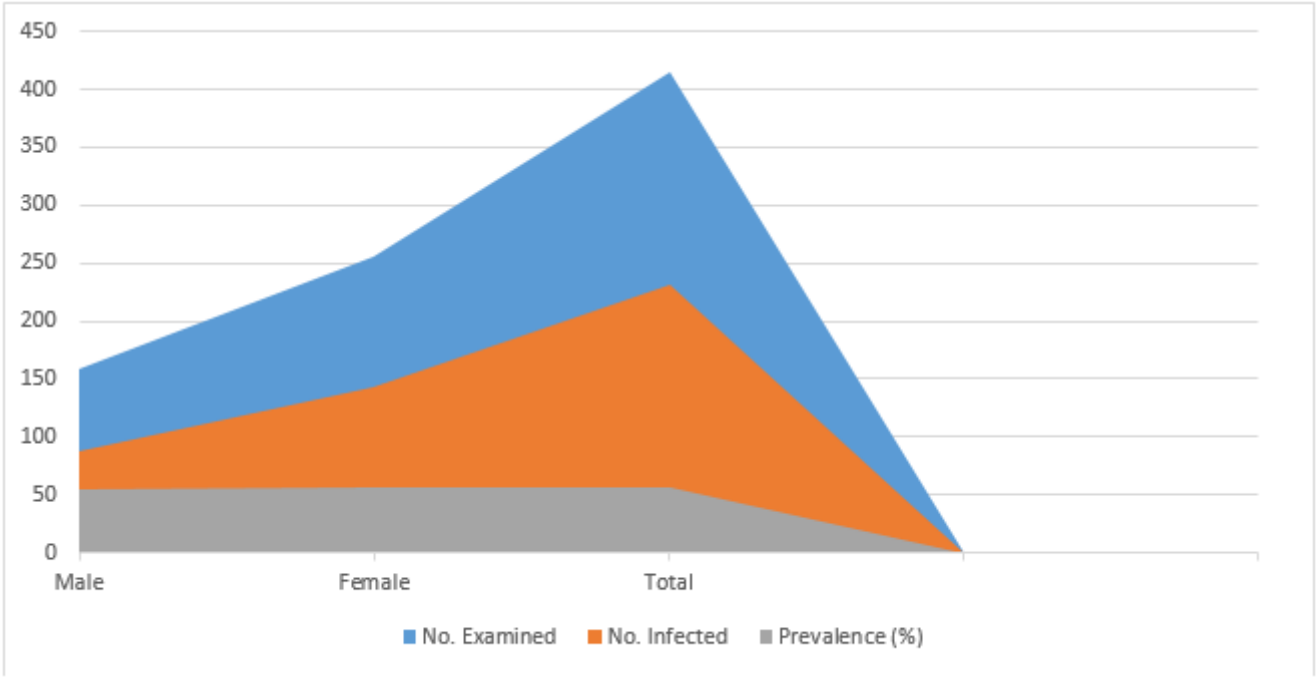

Figure 2

Prevalence of Malaria Infection in Relation to Sex in Gboko Metropolis, Benue State

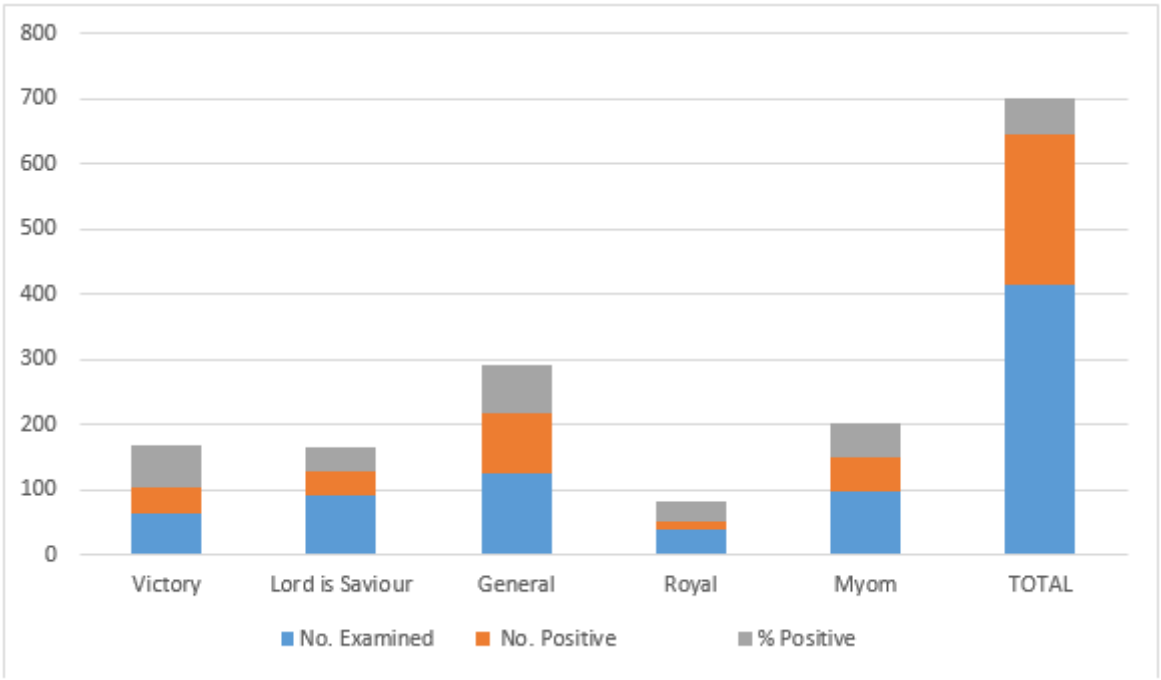

Figure 3

Prevalence of Malaria Infection in Relation to the Selected Hospitals in Gboko Metropolis, Benue State