IJABR Vol. 13(2): 51 - 61 (2022)

Original article

Impact of knowledge and usage of Long-Lasting Insecticidal Nets on malaria prevalence among Pregnant Women attending antenatal care, Dutse General Hospital, Jigawa State, Nigeria

Adeniyi, K. A[1*]., Ibeh E. O[2]., Usman Yamman, H[3]., Rufai, A. M[4]., Osodi, F. A [5]. and Muhammed, I. O[6]

[1]Department of Biological Sciences, Federal University Dutse, Ibrahim Aliyu By-Pass, P.M.B 7156 Dutse, Jigawa State, Nigeria
[2]Veritas University Abuja, Nigeria
[3]Department of Public Health Science, Newgate University Minna, Niger State, Nigeria,
[4]Department of Zoology, Faculty of Basic and Applied Sciences, Osun State University, P.M.B. 4494, Oke- Baale, Osogbo, Nigeria
[5]Bioresources Development Centre, National biotechnology development agency Abuja
[6]Kogi State Polytechnic, Lokoja, Nigeria

Submitted: November, 2022; Accepted: December, 2022; Published: December, 2022

ABSTRACT

Malaria in pregnancy is a major public health concern in Nigeria and is characterized with deleterious effects on both the mother and foetus. The current study elucidated the influence of knowledge and usage of long-lasting insecticidal net (LLINs) on malaria incidence among pregnant women attending antenatal care in Dutse General Hospital. A total of 150 blood samples was aseptically collected and subjected to malaria test using Giesma-microscopic procedure. Their demographic characteristic as well as their knowledge of mosquito net usage were assessed using well-structured questionnaire. Out of the 150 pregnant women enrolled in the study, 98 (65.33 %) were positive for malaria. The age group 26-35 years recorded the highest prevalence (69.33 %). The prevalence also varied with respect to the other demographic characteristics of the study participants. This study found that majority of respondents used Long-lasting Insecticidal Nets (LLINs) as a measure to prevent malaria during pregnancy. The knowledge and use of LLIN as a preventive measure against malaria was relatively high among the participants in this study, though still below national target. There is therefore a need to strengthen the policy of malaria prevention education as an integral component with distribution of free LLIN in health care setting to enhance its utilization

Keywords: Dutse General Hospital, Insecticidal Net, Malaria Prevalence, Pregnant Women

Corresponding author's email: adeniyi.k@fud.edu.ng

INTRODUCTION

Despite gains over the first 15 years of this millennium, malaria remains the chief health challenge in the tropical and sub-tropical Africa and its control has stagnated in the last several years, with resurgence and rising morbidity in several highly endemic countries. This scenario has been aggravated with the service disruptions arising from the COVID-19 pandemic. In 2020, malaria was estimated to have resulted in 627,000 deaths and 241 million cases, with 77% of deaths in children <5 years of age [1] Overall, 90% of malaria cases and deaths are reported in Africa, and six countries•Nigeria, DRC, Uganda, Mozambique, Angola, and Burkina Faso•account for 55% of all cases globally [2]. According to WHO report malaria deaths reduced steadily from 736,000 in 2000 to 409,000 in 2019 [3]. Of the 87 countries that were malaria endemic in 2019, 29 accounted for 95% of malaria globally. WHO African region recorded an estimated 215 million cases in 2019, accounting for about 94% of all cases [3]. Sub-Saharan Africa is the most affected by the disease, with nineteen countries accounting for almost 85% of the global malaria burden by 2019 [3].

Since the past two decades, Insecticide-treated nets (ITNs) usage, particularly LLINs, indoor residual spraying (IRS) and improved malaria case management have been attributed to the recorded global decline in malaria cases since 2000 [4]. An insecticide treated net (ITN) is a net (usually a bed net), designed to block mosquitoes physically, that has been treated with safe, residual insecticide for the purpose of killing and repelling mosquitoes [5]. A long-lasting insecticide-treated net (LLIN) is an ITN designed to remain effective for multiple years without retreatment. In Nigeria where maternal mortality ratio is 512 per 100,000 live births, under fie mortality rate is 132 per 1,000 live births and malaria is holo-endemic, the disease causes up to 11% of maternal mortality and is consistently recorded as one of the fie leading causes of mortality among children under five years [6]. In addition to the direct health impact of malaria, its severe socio-economic burdens on the country at large is estimated at an annual loss of about 132 billion naira in form of treatment cost, prevention, and loss of work time among others. The *Anopheles gambiae* complex, a very efficient group of mosquitoes, is responsible for transmission of malaria in Africa, and the predominant parasite species in Africa is *Plasmodium falciparum*. This species causes severe malaria and death, and the local weather conditions in Africa allow transmission to occur year round [7].

Protecting pregnant women is crucial in the fight against malaria, as malaria in pregnancy contributes significantly to deaths of mother and young children, estimated to amount each year to 10,000 women and up to 200,000 infants less than one year of age [5]. Malaria in pregnancy contributes significantly to perinatal morbidity and mortality. It is known to cause higher rates of miscarriage, intrauterine death, premature delivery, low birth-weight babies, and neonatal deaths [8]. The knowledge and use of preventive methods against malaria is considered a cost-effective intervention in the fight against malaria, especially in endemic areas. It is also associated with significant reduction in malaria morbidity and mortality, particularly among pregnant women and children less than 5 years [10, 11).

The impact of knowledge of long-lasting insecticidal nets on malaria prevalence among pregnant woman attending ante-natal care at Dutse general hospital has not been well documented. The current study proposed to determine the impact of knowledge and usage of LLNS on malaria prevalence among the pregnant woman attending ante-natal care in Dutse General Hospital. Been an endemic area if this is not determine more pregnant woman life will be in danger due to multiple side effect complication of the diseases [11] Updated data on the impact of usage and knowledge of LLINs on malaria prevalence will help in developing better control intervention and minimizing the complications from the disease [12].

MATERIALS AND METHODS

Description of the study Area

The study was conducted in Dutse General Hospital located in the capital city of Dutse, Dutse Local Government Area, Jigawa state. The hospital was established in 1972 as Dutse comprehensive health care; (CHC) by old Kano state. The CHC as on 8th August 1985 converted to Dutse general Hospital and commissioned by the military governor of Kano state Air commanded Hamza Abdullahi FSS, PSC. Dutse General Hospital covers an area of 500 to 800 m and is currently a 200 bed capacity secondary health facility, serving as referral centre for all PHCs in Dutse and Kiyawa local government areas. It is also provide for other neighboring settlement in Kano and Bauchi state; thus, the hospital Centre for the health access of some 58,581 total catchment population consisting of 2,343 under 1 year children, 11716 children less than 5 years 2,929 pregnant women and 12,888 women of child bearing. Human resources for health (HRH) of the general hospital is made up of 100 nurses, 10 JCHEW, 22 CHEW, 7 health information technicians, 15 doctors, 103 health attendant and 83 casual staffs including NYSC core members [13].

Research Design, Target Population and Sample size

A descriptive non experiment design was employed in the study. This design enables proper description of the subject close observation for easy documentation of the outcome. The target population of the study consisted of pregnant women attending ante-natal care at Dutse general Hospital, Jigawa state. Random sampling was used in the selection of respondents. This gives the entire pregnant woman in the study population equal opportunity to participate in the study. A total of 150 pregnant women between the age of 25 and 40 years above and attending ante-natal care in the hospital were enrolled for the study. A well-structured questionnaire was administered to each study participant for obtaining their demographic information and usage of long-lasting insecticidal nets [14].

Blood Sample collection

The method of sample collection is that of venipuncture technique. Soft tubing tourniquet was fastened to the upper arm of the patient to enable the index finger feel a suitable vein. The puncture site was then cleansed with methylated spirit (methanol) and venepuncture made with the aid of a 21g needle attached to a 5 ml syringe. Sufficient blood was collected, the tourniquet was released and the needle removed immediately while the blood was transferred into an EDTA bottle. Sample was collected with informed consent from each subject [15, 16].

Laboratory Analysis

Thin and thick blood smear for the diagnosis of malaria parasite , for each subject, were prepared on the same grease-free slide and stained with 10 % Giemsa at buffered at pH 7.2 for 45 minutes using 12 µL (for thick film) and 2 µL (for thin film) of blood taken with an adjustable micropipette (P20 Pipetman, Gilson) and spread over a diameter of 15mm. The slides were made in duplicates and labeled appropriately. The thin film end of the slide was fixed by dipping the prepared film in absolute methanol for one to two seconds, and both films were allowed to dry for 24‑48 hours and subsequently stained with 5% Giemsa at pH 7.2 for 45 minutes [17].

Statistical Analysis

Data collected from the study was converted to percentage and presented in tables, charts and figures. Prevalence data was subjected chi-square analysis. All analysis was assumed significant at $P < 0.05$. Analysis was done using Microsoft excel, 2010, and statistical packages for social sciences (SPSS) 20th version.

Ethical Clearance

The study was carried out following the approval from the ministry of health Jigawa state and General hospital Dutse. The information for inclusion into the study was obtained from the pregnant women using a standard informed consent format.

RESULTS

Prevalence of malaria in relation to social-demographic characteristics of the respondents

The result of prevalence of malaria in relation to social-demographic characteristics is presented in Table 1-3. Respondents in the age group 26-35 years (66.34 %) had the highest prevalence, followed by 36-45 years (63.88 %) and the least were recorded for respondents in the age group 18-25 years (60.00 %). With regard to marital status, single respondents recorded the highest prevalence of malaria infection (66.34%). Respondents with primary and secondary level of education had the highest prevalence (71.42%). Also, teachers recorded the highest prevalence (66.66%), followed by traders (58.33%) and the least malaria infection was recorded for house wife (28.98%).

Table 1: Prevalence of malaria in relation to age

Age group (years)	Number Examined (%)	Number Positive (%)	Number Negative (%)	χ2	P-Value
18-25	10 (6.66)	6 (60.00)	4 (40.00)	0.206	0.990
26-35	104 (69.33)	69 (66. 34)	35 (33.65)		
36-45	36 (24.00)	23 (63.88)	13 (36.11)		
Total	150 (100)	98 (65.33)	52 (34.66)		

Table 2: Prevalence of malaria in relation to marital status

Marital Status	Number Examined (%)	Number Positive (%)	Number Negative (%)	χ2 value	P-value
Married	143 (95.33)	93 (65.03)	50 (34.96)	0.122	0.980
Single	7 (4.66)	5 (71.42)	2 (28.57)		
Total	150 (100)	98 (65.33)	52 (34.66)		

Table 3: Prevalence of malaria in relation to educational level

Education	Number Examined (%)	Number Positive (%)	Number Negative (%)	P-value
Primary	7 (4.66)	5 (71.42)	2 (28.57)	0.980
Secondary	28 (18.66)	20 (71.42)	8 (28.57)	
Tertiary	115 (76.66)	73 (63.47)	42 (36.52)	
Informal	0 (0.00)	0 (0.00)	0 (0.00)	
Total	150 (100)	98 (65.33)	52 (34.66)	
χ 2	0.740			

Table 4: Prevalence of malaria in relation to occupation of the respondents

Occupation	Number Examined (%)	Number Positive (%)	Number Negative (%)	χ2	P-Value
Teaching	6 (4.00)	4 (66.66)	2 (33.33)	15.320	0.032
Traders	60 (40.00)	35 (58.33)	25 (41.66)		
House Wife	69 (46.00)	20 (28.98)	49 (71.01)		
Others	15 (10.00)	10 (66.66)	5 (33.33)		
Total	150 (100)	69 (46.00)	81 (54.00)		

Prevalence of Malaria infection in relation to trimester

The result of prevalence of malaria infection in relation to trimester is presented in Table 5. First trimester pregnant women had the highest prevalence (71.87%), followed by second trimester pregnant women (71.33%) and the least were pregnant women in their third trimester (36.36%).

Table 5 Prevalence of Malaria infection in relation to trimester of the study participant

Trimester	**Number Examined (%)**	**Number Positive (%)**	**Number Negative (%)**	**χ 2**	**P-value**
First	32 (21.33)	23 (71.87)	9 (28.92)	4.738	0.448
Second	170 (71.33)	71 (66.35)	36 (33.64)		
Third	11 (7.33)	4 (36.36)	7 (63.63)		
Total	150 (100)	98 (65.33)	52 (34.66)		

Prevalence of Malaria infection in relation to drainage system

The result of Malaria infection in relation to drainage system of study respondent is presented in Table 6. Respondents with open drainage system had the highest prevalence of malaria infection and respondents with close drainage system had malaria prevalence of (60%). There is no significant difference in the prevalence of malaria in realtion to drainage system used by the respondents.

Table 6: Prevalence of Malaria infection in relation to drainage system of the study participant

Drawing System	**Number Examined (%)**	**Number Positive (%)**	**Number Negative (%)**	**χ 2**	**P-Value**
Close	90 (60.00)	54 (60.00)	36 (40.00)	2.825	0.4193
Open	60 (40.00)	44 (73.33)	16 (26.66)		
Total	150 (100)	98 (65.33)	52 (34.66)		

Prevalence of Malaria infection in relation to side effects of the net, use of the net prior to interview, malaria in pregnancy, use of malaria drug in pregnancy, availability of net and source of the net

The result of the prevalence of malaria infection in relation to participant view on the side effects of the net, use of the net prior to interview, malaria in pregnancy, use of malaria drug in pregnancy, availability of net and source of the net is detailed in Table 7. Though none of the respondents experiencing any side effect of the net, yet 65.33% of those who were not experiencing side effect tested positive for malaria infection. Respondents that are used to net prior to interview, accounted for 65.87 % of prevalence; while respondent who use the net prior to the interview accounted the prevalence of (62.50 %) respectively. 64.89%) of the prevalence were recorded in the pregnant women. (65.33%) of the prevalence were recorded among the pregnant women that were using malaria drugs. With regard to availability of the net, (68.88%) of the prevalence were recorded in the respondents that have the availability of the net.

Table 7 Prevalence of Malaria infection in relation to side effects of the net, use of the net prior to interview, malaria in pregnancy, use of malaria drug in pregnancy, availability of net and source of the net

Parameters	Number Examined (%)	Number Positive (%)	Number Negative (%)	χ2	P-value
Yes	0 (0.00)	0 (0.00)	0 (0.00)	0	0
No	150 (100)	98 (65.33)	52 (34.66)		
Total	150 (100)	98 (65.33)	52 (34.66)		
UNPI					
Yes	126 (84.00)	83 (65.87)	43 (34.12)	0.803	0.992
No	24 (16.00)	15 (62.5)	9 (37.5)		
Total	150 (100)	98 (65.33)	52 (34.66)		
MIP					
Yes	94 (62.66)	61 (64.89)	33 (35.10)	0.013	0.993
No	56 (37.33)	37 (66.07)	19 (33.92)		
Total	150 (100)	98 (65.33)	52 (34.66)		
UMDIP					
Yes	150 (100)	98 (65.33)	52 (34.66)	0.00	0.00
No	0 (0.00)	0 (0.00)	0 (0.00)		
Total	150 (100)	98 (65.33)	52 (34.66)		
Availability of Net					
Yes	43 (30.00)	31 (68.88)	14 (31.11)	1.171	0.759
No	105 (70.00)	67 (63.80)	38 (36.19)		
Total	150 (100)	98 (65.33)	52 (34.66)		
Source of NET					
Market	25 (16.66)	14 (56.00)	11 (44.00)	2.122	0.831
Hospital	97 (64.66)	63 (64.94)	34 (35.00)		
Others	28 (18.66)	21 (75.00)	7 (25.00)		
Total	150 (100)	98 (65.33)	52 (34.66)		

Prevalence of Malaria infection in relation to knowledge of long lasting nets, water storage, closeness of the bush, and living close to the rivers

The result of prevalence of malaria infection in relation to knowledge of long lasting nets, water storage, closeness of the bush, and living close to the rivers is presented in Table 8. A prevalence of 63.30 % was recorded among the respondents have knowledge of long lasting insecticidal nets. Respondents that are using Bucket as water storage accounted 72.00 % prevalence, followed by respondents using tank (68.88 %) and the least prevalence was recorded among the respondents that were using drum as water storage (60.00 %). Respondents living close to the river had 67.4% malaria prevalence while the respondents that were not living close to the river had prevalence of 58.33%. With regard to prevalence base on the likeness of the net, (64.06%) of the prevalence were recorded among the respondents like the net while (72.72**%)** prevalence were among the respondent that unlike the net.

Table 8 Prevalence of Malaria infections in relation to knowledge of long lasting nets, water storage, closeness of the bush, and living close to the rivers

Parameters	Number Examined (%)	Number Positive (%)	Number Negative (%)	χ2	P-Value
Knowledge of usage of LLINs					
Yes	150 (100)	98 (65.33)	52 (34.66)	0.00	0.00
No	0 (0.00)	0 (0.00)	0 (0.00)		
Total	150 (100)	98 (65.33)	52 (34.66)		
Water storage container					
Tank	45 (30.00)	31 (68.88)	14 (31.11)	1.514	0.981
Drum	55 (36.66)	33 (60.00)	22 (40.00)		
Bucket	25 (16.66)	18 (72.00)	7 (28.00)		
Others	25 (16.66)	17 (68.00)	8 (32.00)		
Total	150 (100)	99 (66.00)	51 (34.00)		
Closeness to Bush					
Yes	15 (10.00)	7 (46.66)	8 (53.33)	21.27	0.001
No	135 (90.00)	91 (67.40)	44 (32.59)		
Total	150 (100)	98 (65.33)	52 (34.66)		
Household closeness to Rivers					
Yes	12 (8.00)	7 (58.33)	5 (41.66)	35.046	0.001
No	138 (92.00)	91 (65.94)	47 (34.05)		
Total	150 (100)	98 (65.33)	52 (34.66)		

DISCUSSION

The overall prevalence in this study was (65.33%). The high prevalence observed in the present study may be due to fact that the study site contained a favourable and productive breeding site in the town which facilitate the mosquito vectors proliferation. This is supported with the fact that surface water and pools facilitate breeding of the disease vector and subsequently spread the disease. This result is similar to the work of Wariso and Oboro [18], who reported 67.5% prevalence rate of *Plasmodium falcifarum* among blood donors at River state. The prevalence in this study is higher than the work of George *et al*. [19] who reported 55.4% prevalence among women who had not taken antimalarial drug at north central Nigeria. The result of this study is also higher the finding of Udomah *et al*. [20] who observed prevalence of malarial infection to be 55.2% among pregnant women attending Usman Danfodiyo University Teaching Hospital, Sokoto. This variation in prevalence may be as a result of differences in among geographical locations that have different in climatic and ecological condition such as rainfall, temperature and altitude, which favour survival and development of Mosquito vector. The finding of this study also indicate that the pregnant women has less immunity in the body as such is reason to have higher prevalence of malaria infection in the pregnant women.

Pregnant women in the age group of 26 to 35 years accounted the higher prevalence in this study, This is contrary to the finding of Abubakar *et al.* [21] who reported the age group 0 to 5 years were found to be affected more, followed by 0 to 15 years at Hadejia, Jigawa state. Married pregnant women recorded more prevalence and respondents with tertiary education accounted more prevalence were pregnant women with informal education have lower prevalence. This indicates the infection of malaria is irrespective of education level as reported by several authors**.**

Surprisely**,** in this study pregnant woman with knowledge of net, living far from the bush, and living not near the river were found to have higher prevalence of malaria infection. This is contrary to the finding of Awosolu *et al*. [22] at Ibadan and Dawaki *et al.* [23] at Kano reported. Higher prevalence was also found among the respondents whose houses were surrounded by bushes and stagnant water. The bushes and stagnant water have been found in previous studies to be reservoirs of breeding grounds for mosquitoes, thereby enhancing human‐vector contact [24]. These findings suggest that effective environmental sanitation, geared toward the clearing of bushes and gutters should be intensified. This intervention may reduce the spread of mosquitoes, thereby reducing the incidence of malaria in rural settings.

CONCLUSION

Evidence from the current study indicates that despite the high level of the knowledge and usage of LLIN as a preventive measure, malaria prevalence is relatively high among the participants in this study area. There is therefore strong need to intensify other control measure to break the circle of malaria transmission in the study area.

ACKNOWLEDGEMENTS

We express our profound gratitude to the laboratory technologist and management of the Federal University Dutse, for their interest and selfless contribution to the success of the study.

Conflict of Interest

Authors declare no conflict of interest.

REFERENCES

1. WHO. *World Malaria Report, 2021*. (World Health Organization, 2021).
2. World Health Organization. (2022). *World malaria report 2022*. World Health Organization.
3. World Health Organization. (2020). *World malaria report 2020*. World Health Organization.
4. Pryce, J., Medley, N., and Choi, L. (2022). Indoor residual spraying for preventing malaria in communities using insecticide-treated nets. *Cochrane Database of Systematic Reviews*, (1).?
5. Ng[illegible]ang[illegible]a, P. N., Aduogo, P., & Mutero, C. M. (2022). Long lasting insecticidal mosquito nets (LLINs) ownership, use and coverage following mass distribution campaign in Lake Victoria basin, Western Kenya. *BMC Public Health*, *21*(1), 1046.
6. Uhomoibhi, P., Okoronkwo, C., Ajayi, I. O., Mokuolu, O., Maikore, I., Fagbamigbe, A., ... & Ssekitooleko, J. (2022). Drivers of long-lasting insecticide-treated net utilisation and parasitaemia among under-five children in 13 States with high malaria burden in Nigeria. *Plos one*, *17*(5)?
7. Anikwe, C. C., Irechukwu, J. C., Okorochukwu, B. C., Ikeoha, C. C., Obuna, J. A., Ejikeme, B. N., & Anikwe, I. H. (2020). Long-lasting insecticide-treated nets: assessment of the awareness and utilization of them among antenatal clinic attendees in Abakaliki, Southeast Nigeria. *Journal of Tropical Medicine*, *2020*.
8. Schantz-Dunn, J., & Nour, N. M. (2009). Malaria and pregnancy: a global health perspective. *Reviews in obstetrics and gynecology*, *2*(3), 186.
9. World Health Organization. (2015). *Global technical strategy for malaria 2016-2030*. World Health Organization. Dawaki, S., Al-Mekhlafi, H. M., Ithoi, I., Ibrahim, J., Atroosh, W. M., Abdulsalam, A. M., ... & Lau, Y. L. (2016). Is Nigeria winning the battle against malaria? Prevalence, risk factors and KAP assessment among Hausa communities in Kano State. *Malaria journal*, *15*, 1-14.
10. Goshu, Y. A., & Yitayew, A. E. (2019). Malaria knowledge and its associated factors among pregnant women attending antenatal clinic of Adis Zemen Hospital, North-western Ethiopia, 2018. *PLoS One*, *14*(1)?
11. Short, R., Gurung, R., Rowcliffe, M., Hill, N., & Milner-Gulland, E. J. (2018). The use of mosquito nets in fisheries: A global perspective. *PloS one*, *13*(1), e0191519.
12. Dogara, M. M., & Ocheje, A. J. (2016). Prevalence of malaria and risk factors among patients attending Dutse General Hospital, Jigawa State, Nigeria. *Int J Pub Environ Health*, *11*, 270-7.

13. Uhomoibhi, P., Okoronkwo, C., Ajayi, I. O., Mokuolu, O., Maikore, I., Fagbamigbe, A. and Ssekitooleko, J. (2022). Drivers of long-lasting insecticide-treated net utilisation and parasitaemia among under-five children in 13 States with high malaria burden in Nigeria. *Plos one*, *17*(5), e0268185.

14. Lippi, G., Salvagno, G. L., Montagnana, M., Franchini, M., & Guidi, G. C. (2006). Phlebotomy issues and quality improvement in results of laboratory testing. *Clinical laboratory*, *52*(5-6), 217-230.

15. Sylvia, E. E., Ogid I. M., Nduka, F. O., & Nzeako, S. O. (2021). Malaria Prevalence and Its Demographic Determinants in Oyigbo Local Governement Area, Rivers State, South-South, Nigeria. *Asian Journal of Biology* 12(4): 26-33.

16. Mgbemena, I., Ezea, C., Ebe, T. E., Udensi, U. J., Nwachukwu, A. A., Nzenwa, D. C., & Nwannah, A. L. (2016). Asymptomatic malaria among students of Federal University of Technology, Owerri (FUTO), Imo State, Nigeria. *Issues in Biological Sciences and Pharmaceutical Research*, *4*(6), 50.

17. Wariso, K. T., & Oboro, I. I. (2015). Prevalence of *Plasmodium* parasitaemia among blood donors in Port Harcourt, Nigeria. Advances in Microbiology, 5(05), 351.

18. George, I. O., Chris, O. A., Stephen, A. A., Stephen, N., & Diane, A. O. (2015). Prevalence of Malaria Parasitaemia among asymptomatic women at booking visit in a tertiary hospital, North central Nigeria. J. *Reproductive Biol. Health, 3: 1*, *2*.

19. domah, F. P., Isaac, I. Z., Lukman, I., Nwobodo, D., Erhabor, O., Abdulrahaman, Y., & John, R. T. (2015). Plasmodium parasitaemia among pregnant women attending antenatal clinic in Sokoto, North Western Nigeria. *Journal of Nursing Sciences*, *1*(1), 9-14.

20. Abubakar, S., Yunusa, I., Ahmad, M. K., Abdullahi, M.K, Ibrahim, I. And Zakariya, M.(2016). Cross Sectional Study Of Malarial Parasite Among Patients Attending General Hospital, Hadejia, Jigawa State, NIGERIA.*Bayero Journal of Pure and Applied Sciences,* 9(2): 57-60

21. Awosolu, O. B., Yahaya, Z. S., Haziqah, M. T. F., Simon-Oke, I. A., & Fakunle, C. (2021). A cross-sectional study of the prevalence, density, and risk factors associated with malaria transmission in urban communities of Ibadan, Southwestern Nigeria. *Heliyon*, *7*(1), e05975.

22. Dawaki, S., Al-Mekhlafi, H. M., Ithoi, I., Ibrahim, J., Atroosh, W. M., Abdulsalam, A. M., ... & Lau, Y. L. (2016). Is Nigeria winning the battle against malaria? Prevalence, risk factors and KAP assessment among Hausa communities in Kano State. *Malaria journal*, *15*, 1-14

23. Osaro, E., Jamilu, M. H., Ahmed, H., & Ezimah, A. (2014). Effect of plasmodium Parasitaemia on some

haematological parameters in children living in Sokoto, North Western, Nigeria. *Int J Clin Med Res*, *1*(2), 57-64.Darbro, J. M., and Thomas, M. B. (2009). Spore persistence and likelihood of aeroallergenicity of entomopathogenic fungi used for mosquito control. *American Journal of Tropical Medicine and Hygien*e, 80, 992-997.

24. Liston, (1901). Persistent organic pollutants and adverse health effects in humans. *Journal of Toxicology and Environment*, Ishii, W., Adnan, M., Shabbir, A., Naveed, H., Abubakar, Y. S., Qasim, M., andAli, H. (2017). Insect-fungal-interactions: A detailed review on entomopathogenic fungi pathogenicity to combat insect pests. *Microbial Pathogenesis*, *159*, 105122.