**Prevalence of Malaria Infection among Inmates of Makurdi and Gboko Prisons, Benue State, Nigeria**

**ABSTRACT**

This study was carried out to determine the prevalence of malaria infection among prison inmates in Makurdi and Gboko, Nigeria. Using structurally designed questionnaires, Blood samples of 144 inmates within the age range of 21 years and 60 years plus, were screened for malaria. Blood samples were collected among inmates and were investigated for malaria infection using Malaria Rapid Test Kit (mRDT) kits, and thick and thin film methods. Out of 144 inmates screened, (93.06%) were males and (6.94%) were females and the overall prevalence of malaria infection obtained from the study was 15.28%. Malaria infection was higher among inmates within the age range of 21-30 years. The prevalence of the infection with respect to their months of stay in prison showed that inmates with short periods of stay were infected most with this disease. In relation to gender, males had a higher prevalence than the females. There was no statistical relationship between the prevalence of Malaria infection (P>0.05) with respect to age groups, occupation and duration of stay. On the other hand, there was a statistical relationship between the prevalence of Malaria infection (P<0.05) with respect to gender. The use of insecticide-treated nets and the incorporation of basic health education into the curricula of the inmates were recommended.

**Keywords:** Malaria, inmates, prevalence

1. **INTRODUCTION**

Prisoners carry much more burden of illness than other members of society, they harbour diseases that are determined both by the environment from which they come from and by the prison in which they live (Ishaku and Mamman 2014). Most health professionals find it difficult to work in a prison set-up, due to undernutrition, lack of concern, and inadequate facilities and expertise, which deteriorates the health of inmates. Observed that there are problems of severe drug abuse, alcoholism, trauma, homicide, suicide, malaria fever, tuberculosis (TB), HIV/AIDS, Sexually Transmitted Diseases (STDs), and skin and helminths infection among prisoners (Abah *et al*., 2018). Within the last decade, the world has experienced a reduction of the malaria burden [[1]](https://www.sciencedirect.com/science/article/pii/S2468227622001041" \l "bib0001). However, these achievements are disproportionate among the countries and regions of the world with increasing burdens in recent times (Bayode & Siegmund, 2022)..  Malaria is rife in tropical areas, particularly in sub-Saharan Africa, where almost all cases of severe malaria are attributable to the plasmodium falciparum species (Cisse et al. ,2023).

Malaria is a potentially deadly disease characterized by fever, muscle stiffness, shivering and sweating. They also stated that malaria is a parasitic infection transmitted to humans through the bites of an infected female *Anopheles* mosquito, (WHO, 2020). The name “malaria” is derived from the Italian words Mal (bad) and aria (air). It arose originally because the citizens of Rome thought that the disease was contracted by breathing the bad air of the Pontine Marshes (Hornby, 2007). He defined malaria (ague, marsh fever, periodic fever, and paludism) as an infectious disease due to the presence of parasitic protozoa of the genus *Plasmodium* (*P. falciparum, P. malariae, P. ovale* and *P. vivax*) within the red blood cells. The disease is confined to tropical and subtropical areas. Malaria is one of the most prevalent diseases of the tropical world. Current estimates predict over two hundred million cases annually.

About 90% of all malaria deaths in the world today occur in Africa, South of the Sahara. This is because the majority of infection is caused by *Plasmodium falciparum*, which is the most dangerous of all the four malaria parasite species. It is also because the most infective malaria vector, *Anopheles gambiae* is most widespread in Africa and most difficult to control. According to WHO (2020), severe malaria is not easily distinguishable from other severe diseases such as typhoid, pneumonia, and meningitis which require very different diagnoses and therapy.

Worldwide, great and varied efforts are being made to learn about this disease and to determine how to control it, this is a formidable task. The official malaria eradication programme, run by the world Health Organization (WHO), was cancelled in the late 1960s because of growing difficulty given that the complex and persistent nature of this disease became increasingly obvious. A management strategy today includes the development of vaccines and chemotherapeutic agents, vector control, insecticides, education, long-lasting insecticide-treated nets (LLIN). Resistance to drugs by both the mosquito and the parasite is a growing obstacle in the battle against malaria. Combination of therapy has been shown to increase the efficacy of combining drugs such as Artemisinin-based Combination therapy (ACT) which includes Artemeter\lumefantrine and Artemeter + Amodiaquine (WHO, 2009).

Malaria continues to be one of the most serious infectious diseases causing approximately about one million deaths (WHO, 2008). The malaria parasite, *Plasmodium falciparum* invades and grows within the host red blood cells (Miller *et al*., 2002). According to Snow *et al. (*2005) and WHO (2011) despite substantial advances in the treatment and prevention of malaria over the past decades, malaria still threatens the lives of millions in tropical countries. The symptoms of malaria are nonspecific and parasitological diagnosis of the disease is very difficult and not common among medical diagnostic laboratories. This study is an attempt to determine the malaria status of persons from a section of our society, who are condemned by the law, and are behind the high walls of two of the largest Nigerian Correctional service, maximum and minimum centres of our State, with the view to generating information that may spur or stimulate planning, management, prevention and control strategies for Nigerian correctional centres.

This present study was conducted to assess the prevalence of malaria infection and the contribution of active case finding for the malaria elimination program and control in Makurdi and Gboko Nigerian Correctional Service, both maximum and minimum security custodial centres in Benue State, Nigeria.

1. **MATERIALS AND METHODS**

**2.1 Study Area**

The study wascarriedout in Makurdi and Gbokometropolis both in Benue State, Nigeria. The State lies in the middle of the country (North Central Geo-Political Zone) and shares boundaries with Cameroon and five other states namely, Nasarawa to the north, Taraba to the east, Cross River and Enugu to the south, and Kogi to the west. Benue State derives its name from the River Benue, the second largest river in Nigeria. The most prominent geographical feature in the State is the river Benue. The State has a population of about 5 million, and an area of about 34, 059sq.kms. Benue state lies within hot humid zone with seasonal temperature variation throughout the year and experiences two distinct major seasons in the year. The seasons are dry and wet seasons. The wet season occurs between April to October, while the dry season usually occurs between November to March (Mngutyo and Ogwuche, 2013).

**2.2 Study Population**

The study population included the Makurdi and Gboko prisons in Benue State Nigeria. The population of inmates in Makurdi and Gboko prisons at the time of study were 452 inmates in Makurdi and 274 inmates in Gboko prisons respectively, with staff strength of 89 employees spread across different departments in Makurdi and Gboko.

**2.3 Sample size and parameters.**

A sample size of 90 inmates in Makurdi prison and 54 inmates in Gboko prison were collected as samples for the study. The sampling parameters adopted for this study were based on random sampling. It was assumed that none of the inmates were using long-lasting insecticide nets (LLIN). The total number of samples collected for the study were 144 blood samples (Niaing *et al.,* 2006).

**2.4 Ethical Consideration**

Ethical clearance was sought for and obtained from the Benue State Ministry of Health and Human Services; also permission was sought from the Benue State Comptroller of Prison and the Chief Warden of the two prisons. Informed consent was also obtained from all the subjects enrolled in the study.

**2.5 Sample collection**

Following official consent secured from the prison officers and the inmates with the assurance of confidentiality of the results, the 2ml of blood samples were obtained in the EDTA bottles by venipuncture using a syringe and needles. Thick and thin smears were prepared from the blood samples collected from the inmates. Demographic information such as age, sex and prison unit of each inmate was obtained.

**2.6 Preparation and Microscopic Examination of Parasites**

Thin and thick Giemsa’s-stained blood-smeared slides were prepared following standard microbiological methods for microscopic identification of malaria parasites as described by Cheesbrough (2002) and Arora and Arora (2005). Malaria Rapid Test Kit’ (mRDT) was also done by collectingfifty microlitres (50µl) of whole blood (sample) was collected using an automatic pipette and dropped into the test kit sample pot well. Two (2) drops of (care start malaria test kit) buffer were added into the test kit buffer well. The timer was immediately set after the buffer was added for 15 minutes. Results were read 15 minutes after the addition of buffer for each sample tested, (Incubation time) (Endeshaw *et al*., 2008, Bisoffi *et al*., 2009 Clinton and Jason, 2011 Obeagu *et al.,* 2018). The data obtained were analyzed using the chi-squares (χ2) test to compare the rate of infection. All malaria rapid test results were read after the incubation period of 15 minutes, also all results of malaria microscopy were read.

1. RESULTS

**3.1 Prevalence of malaria among inmates in relation to gender.**

One hundred and forty-four (144) inmates screened from Makurdi and Gboko Medium and Security Prisons for Malaria parasites. Males had a (15.7%) prevalence of malaria parasites while females (10%). The overall prevalence of malaria parasites obtained from this study (15.3%)

**Table 1: Prevalence of malaria among inmates in relation to gender.**

|  |  |  |  |
| --- | --- | --- | --- |
| Gender | No. Examined | No. Positive (%) | No. Negative (%) |
| Male | 134 | 21(15.7) | 113(84.3) |
| Female | 10 | 1(10) | 9(90) |
| Total | 144 | 22(15.3) | 122(84.7) |

**3.2 Prevalence of malaria among inmates in relation to age groups.**

The prevalence of malaria with respect to age groups showed 21-30years had the highest prevalence of (18.9) followed by 41 & above (16.7%) and 31-40years (11.3)

**Table 2: Malaria distribution in inmates with various age groups**

|  |  |  |  |
| --- | --- | --- | --- |
| Age | No. Examined | No. Positive (%) | No. Negative (%) |
| 21-30 | 58 | 11(18.9) | 47(81.0) |
| 31-40 | 62 | 7(11.3) | 55(88.7) |
| 41 & Above | 24 | 4(16.7) | 20(83.3) |
| Total | 144 | 22(15.3) | 122(84.7) |

**3.3 Prevalence of malaria among inmates in relation to occupation**

The Prevalence of malaria among inmates in relation to occupation revealed that farmers had the highest prevalence of (22.2%), Businessmen and women had (13.3%), and artisans had (13.3%) while civil servants had the least (10.3%)

**Table 3: Prevalence of malaria among inmates in relation to occupation.**

|  |  |  |  |
| --- | --- | --- | --- |
| Occupation | No. Examined | No. Positive (%) | No. Negative (%) |
| Civil Servants | 39 | 4(10.3) | 35(89.7) |
| Businessmen/women | 30 | 4(13.3) | 36(86.7) |
| Artisans | 30 | 4(13.3) | 36(86.7) |
| Farmers | 45 | 10(22.2) | 35(77.8) |
| Total | 144 | 22(15.3) | 122(84.7) |

* 1. **Prevalence of malaria among inmates in relation duration to of stay.**

Malaria with respect to the duration of stay in the prison showed inmates stay for 40months and above had the highest prevalence of (30.0%), followed by 6-12months had (20.5), 19- 24months had (16.0%), 13-18months had (10.0%) while the least is 25-37months at (3.3%).

**Table 4: Prevalence of malaria among inmates in relation to duration of stay.**

|  |  |  |  |
| --- | --- | --- | --- |
| Duration of Stay(Months) | No. Examined | No. Positive (%) | No. Negative (%) |
| 6-12 | 39 | 8(20.5) | 31(79.5) |
| 13-18 | 30 | 3(10.0) | 27(90.0) |
| 19-24 | 25 | 4(16.0) | 21(84.0) |
| 25-39 | 30 | 1(3.33) | 29(96.67) |
| 40 & Above | 20 | 6(30.0) | 14(70.0) |
| Total | 144 | 22(15.3) | 122(84.7) |

1. **DISCUSSION**

The malaria prevalence rate of 15.28% among inmates in Makurdi and Gboko prisons is not surprising for a number of reasons. Poor environmental sanitation, lack of Mosquito nets coupled with the fact that prisons are not regularly fumigated which encourages the breeding of mosquitoes. Presently, Makurdi and Gboko prisons are overcrowded.

The study indicated that the prevalence rate of 15.28% of Malaria parasites (MP) among prisoners in Makurdi and Gboko is lower than previous studies conducted in Jos by Mamman *et al.* (2014) which recorded a prevalence rate of 53.67%, in Port Harcourt with 55.2% by Adah *et al.* (2018) and in Abakiliki with 92.57% by Alao *et al.* (2015).The prevalence rate of the present study was lower than the study done on the prison in Delta State 35% by Erhabor *et al.* (2012) and in Otukpo, Benue State 36.1% by Jombo *et al.* (2010).

The prevalence rate of the present study was nearly comparable to the results of the study done by Adedotun *et al.* (2010) in Oshogbo who recorded 18.2%. The possible explanation of the similarity might be that whatever different methodologies they may have used; they may have implemented good comparable prevalence and diagnostic in their setting.

The Malaria infection in relation to Age group was higher among the age groups between 21-30 years as shown in Table 1 in Makurdi and Gboko prisons and among those that stayed within 6-12 months and 40 months and above in Table 4 has the high prevalence rate of Malaria infection in Makurdi and Gboko prisons. This could be due to several factors which may include constant exposure to vectors, inmate’s duration in the prisons and age as observed by Smith *et al*. (1995), and Trape and Rogier (1996) in Tanzania and Congo respectively that Malaria infection is inversely related to age group. Thus, some inmates suffer from a disproportionately high rate of infection while other inmates are at lower risk.

Male inmates were reported to have a higher prevalence rate of Malaria infection (29.99%) than their Female (1.11%) counterparts in Makurdi and Gboko prisons as reported in Table 2 This confirms the results of Umar (2006), in Port Harcourt by Adah *et al.* (2018) and in Jos by Mamman *et al.* (2014). However, studies have shown that females have better immunity to parasitic disease and this was attributed to genetic and hormonal factors (Kwabla *et al.,* 2015). This may be because the male inmates are freer than females and leisure hours are strictly controlled and restricted. Also, female inmates have better personal hygiene practices.

In relation to occupation, inmates in Makurdi and Gboko prisons as shown in Table 3, malaria infection was high among farmers (14.81%) and low among artisans and businessmen/women. This agrees with the results of Humphrey *et al.* (2010) in Tanzania and is in disagreement with that of Adedotun *et al*. (2014) in south-western Nigeria which has a higher prevalence rate of Malaria parasite infection among Civil servants.

1. **Conclusion**

The establishment of these parasites in these inmates may portend grave consequences on human health. There is therefore the need to introduce and intensify preventive and control measures for malaria infection, and basic health education should be incorporated into the curriculum of the inmates, adequate bed space with treated mosquito nets and other social and recreational facilities be provided to reduce vector-borne infections.

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1.

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**References**

Adah, A.E, Nduka F. O, Amadi Q, Ayacha O. C, and Nzeji P. (2018). Malaria infection among prison inmates of the Maximum Security prison Borokiri, Port Harcourt, River State, Nigeria. *Nigeria Journal of Parasitology* (2) 95-126.

Adedotun A.A. Adedotun, O. Morenikeji A. and Odaibo A.B. (2010). Knowledge, attitudes and practices about malaria in an urban community in south-western Nigeria. *Journal of Vector Borne Diseases* 47, 155–159

Alao, M N, Ugah, U I, Saidu, A Y, and Alhassan H M (2015). Microbial Status of Prison Inmates in Abakaliki Prison, Ebonyi State Southeastern Nigeria. *Global Journal of Medicine Researches and Studies*, 2(1) 7-11.

Arora, D.R. and Arora, B. (2005). Medical parasitology. 2nd Edition, CBS Publishers and distributors, New Delhi, Bangalore (India). Pp. 76- 77

Bisoffiz Z, Gobbi F, Anghehen A, and Van den ende J (2009). The role of rapid diagnostic test in managing malaria PLoS Medicine 6 (4).

Cheesbrough, M. (2002). Medical Laboratory Manual for Tropical Countries. 2nd Edition, Cambridge university press. Pp 605.

Endeshaw T, Gebre T, and Ngondi J (2008). Evaluation of light microscopy and rapid diagnostic test for the detection of malaria under operational field conditions a household survey in Ethiopia. *Malaria Journal of Medicine* 7: 118.

Erhabor O, Azuonwu O, and Frank-Peterside N. (2012) Malaria parasitaemia among long distance truck drivers in the Niger delta of Nigeria. *African Journal of Health Sciences.*12:98–103.

Humphrey D.M, Emmanuel O, Wilhellmus M, Paulina M M Z, Eliningaya J. K, Ladslaus L.M, and Jorg H (2010) Knowledge, Attitudes, and Practices about Malaria and Its Control in Rural Northwest Tanzania. *SAGE-Hindawi Access to Research Malaria Research and Treatment*3:126–132.

Ishaku G. R and Mamman, A. S. (2014). Malaria parasitaemia among long distance truck drivers in the Niger delta of Nigeria. *International Journal of Microbiology and Immunology Research* Vol. 3(3), pp. 042-045.

Jombo GTA, Mbaawuaga EM, Ayegba AS, Enenebeaku MNO, Okwori EE, Peters EJ (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*.1:235–241.

Kwabla M., Ameme D., and Nortey P., (2015) “Pulmonary Tuberculosis and Its Risk Factors among Inmates of a Ghanaian Prison,” *International Journal of Tropical Disease & Health*, 9 (3) 1–10.

Mamman, A.S., Gyar, S.D. and Reuben, C.R. (2014). Malaria Infection among Inmates of Jos Prison, Plateau State, Nigeria. *International Journal of Microbiology and Immunology Research* 3 (3) 042-045.

Miller, L.H. Baruch, D.I. Marsh, K., and Doumbo, O.K. (2002).The pathogenic basis of malaria. *Nature,* 415: 673–679.

Mngutyo, I. D and Ogwuche, J. (2013). “Comparative Analysis of Effects of Annual Flooding on the Maternal Health of Women Floodplain and Non Floodplain Dwellers in Makurdi Urban Area, Benue State, Nigeria”, *Wudpecker Journal of Geography and Regional Planning 1 (1)45-50.*

Naing L, Winn T and Rusli G (2006). Sample size calculator For Prevalence Studies Archives of Orofacial Sciences; 1: 9-14.

Obeagu E I, Chijioke U O, and Ekelozie I S (2018). Malaria Rapid Diagnostic Test (RDTS),Annual Clinical Laboratory Research (6) 275.

Oche A O, and Aminu M. (2012). The prevalence of malarial parasitaemia among blood donors in Ahmadu Bello University Teaching Hospital, Shika, Zaria, Nigeria. *Niger Journal of Medicine*. 21:445–449.

Smith, T., Hurt, N., Teuscher, T., Tanner, M. (1995). Is fever a good clinical sign of malaria in surveys of endemic communities *American Journal of Tropical Medicine and Hygiene*, 52(4):306-310.

Snow RW, Guerra CA, Noor AM, Myint HY,and Hay SI (2005). The global distribution of clinical episodes of Plasmodium falciparum malaria. *Nature* 434: 214–217.

Trape, J.F., Rogier, C. (1996). Combating Malaria Morbidity and mortality by reducing transmission. *Parasitol. Today*, 12: 236- 240.

Uko, E.K., A.O. Emeribe and G.C. Ejezie (2016). Malaria Infection of the placenta and Neo- Natal Low Birth Weight in Calabar. *Journal of Medical Laboratory Sciences.*, 7: 7-10.

Umar, M.M. (2006). NCE thesis on Prevalence of Malaria in Gombe Local Government Area. FCE, Gombe, Unpublished. 26.

WHO (2020). Global Tuberculosis Control. Surveillance, Planning and Financing

Wogu MN, Nduka FO, and Wogu MD (2013). Prevalence of malaria parasite infection among pregnant women attending antenatal clinics in Port Harcourt, Rivers State, Nigeria. *International Journal of Tropical Disease and Health.;*3:126–132.

World Health Organization (2020) Tuberculosis control in prisons: A manual for programme managers. Geneva;

World Health Organization (2008). World Malaria Report.Geneva.

World Health Organization (2009) “Methods for surveillance of antimalarials drug efficacy”, *World Health Organization*, Switzerland.

World Health Organization (WHO) (2007).*Tuberculosis Fact Sheet: Global and Regional Incidence*, Switzerland.

World Health Organization, 2011 (WHO/NMH/NHD/ MNM/11.1).

Cisse, V. M. P., Mbaye , K. D., Badiane , A. S., Diallo, M., Diop, M., Lakhe, N. A., Fall , N. M., Diouf, A., Massaly , A., Ka, D., Fortes , L., Diop , S. A., & Seydi , M. (2023). Severe Malaria and Risk Factors for Death in the Infectious Diseases Department of the University Hospital of Fann in Dakar, Senegal. *Asian Journal of Research in Infectious Diseases*, *14*(4), 86–93. <https://doi.org/10.9734/ajrid/2023/v14i4311>

Bayode, T., & Siegmund, A. (2022). Social determinants of malaria prevalence among children under five years: A cross-sectional analysis of Akure, Nigeria. *Scientific African*, *16*, e01196.