UJMR, Vol. 11 No. 1, June, 2026, pp. 135 – 143 *E-ISSN: 2814 – 1822; P-ISSN: 2616 – 0668*

https://doi.org/10.47430/ujmr.26111.014

Received: 12 February 2026 **Accepted:** 05 June 2026

Prevalence of Plasmodium Infections Among Internally Displaced Persons in Abuja, Nigeria

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Abstract

This study was carried out to determine the prevalence and risk factors associated with Plasmodium infection among internally displaced persons (IDPs) in camps in Abuja, Nigeria. The administration of structured questionnaires determined socio-demographic and risk factors predisposing the IDPs to Plasmodium infection. Blood samples were collected from four hundred (400) internally displaced persons living in camps in Abuja, Nigeria. Blood samples were examined for Plasmodium parasitemia using Giemsa-stained thick and thin films and the RDT method. Packed Cell Volume (PCV) was determined. The study reported an overall prevalence of 42.0% using microscopy: 98.8% Plasmodium falciparum, 1.2% Plasmodium malariae, and 30.5% Plasmodium infection using the rapid diagnostic test. Plasmodium infection among IDPs in camps in Abuja, Nigeria, was associated with stagnant water (P = 0.022, OR = 1.713). 14.3% of the study population was anaemic while 85.8% were normal. Those IDPs positive for Plasmodium infection had a Mean ± SEM PCV of 38.125 ± 0.400, and those IDPs without Plasmodium infection had a Mean ± SEM PCV of 38.28 ± 0.272. There was no statistically significant difference between Plasmodium-infected and non-infected IDPs (P = 0.747). This study reported 42.0% prevalence of Plasmodium infection using microscopy and 30.5% using RDT. Unsanitary living circumstances of the IDPs may have caused this, the majority of whom resided in tents in around camps, which serve as breeding grounds for mosquitoes, which are vectors for the transmission of Plasmodium. When diagnosing malaria, both the Rapid Diagnostic Method and Microscopy should be used. Community mobilization and health education on the importance of using Insecticide-treated nets to prevent mosquito bites should be considered.

Keywords: Socio-demographic, Plasmodium, Pack Cell Volume (PCV), Internally Displaced Persons (IDPs), Abuja

INTRODUCTION

Malaria is a life-threatening parasitic disease caused by the genus *Plasmodium*. Four species are known to infect humans, namely *P. falciparum*, *P. malariae*, *P. ovale*, and *P. vivax*, with *P. falciparum* being the most virulent and accounting for the majority of malaria deaths (Olupot-Olupot and Maitland, 2013; WHO, 2014). The bite of an infected female *Anopheles* mosquito transmits the disease. In malaria-endemic regions, individuals are constantly exposed to malaria parasites through bites from infected mosquitoes. The *Plasmodium* parasite life cycle involves two hosts: humans and female *Anopheles* mosquitoes. Human infection begins with the injection of sporozoites into the bloodstream by infected female *Anopheles* spp during a blood meal. Sporozoites infect liver cells and mature into schizonts, which rupture and release merozoites. *P. vivax* and *P. ovale* have a dormant stage (hypnozoites) that can persist in the liver and cause relapses by invading the bloodstream weeks or even years later. After this initial replication in the liver (exo-erythrocytic schizogony), the parasite undergoes asexual multiplication in the erythrocytes (erythrocytic schizogony), and merozoites infect red blood cells (CDC, 2013; Wampfler *et al.*, 2014).

Malaria is a deadly infectious disease and one of the main health problems facing developing countries in Sub-Saharan Africa (SSA) and Asia. In 2015, approximately 3.2 billion people, nearly half of the world's population, were at risk of malaria, and there were around one million deaths annually (Langhorne *et al.*, 2008; Casares and Richie, 2009; WHO, 2016). Although there has been a decline in the global prevalence of malaria (due to the increased number of funding bodies that have been contributing to the fight against the disease in the last decade, hundreds

of thousands of people still die from the disease every year (CDC, 2015). Information on the prevalence status and the accompanying risk factors that affect the transmission of *Plasmodium* infections in internally displaced persons (IDPs) is scarce.

A recent report by the Internally Displaced Monitoring Center (IDMC) revealed an increase in the number of Internally Displaced Persons (IDPs) in the first half of 2015 (GR, 2016). In the tropics, parasitic infections constitute a major public health problem, as these areas are often characterized by conditions that favor their transmission, including a humid climate, unsanitary environments, and poor socio-economic conditions typical of IDP camps (Zeukeng *et al.*, 2014). The result of this study should provide valuable information to health authorities to improve existing control strategies and also define the status of the disease among IDPs in camps in Nigeria. The present study aimed to determine the prevalence of *Plasmodium* infections among internally displaced persons living in camps in Abuja, Nigeria.

MATERIALS AND METHODS

The study area, Abuja, is Nigeria's capital city, located in the middle of the country. The Federal Capital Territory has an area of 7,315 sq kilometers. It is bounded on the North by Kaduna State, on the West by Niger State, on the East and Southeast by Plateau State, and on the Southwest by Kogi State. It falls within latitude 7° 25°N and 9° 20° North of the equator and longitude 5° 45° and 7° 39°. Abuja has two distinctive seasons: the rainy season, which runs from March to October, and the dry season, which runs from October to March (www.abujafacts.ng/about-abuja-geography). The Federal Capital Territory comprises six area councils: Abuja Municipal Area Council, Abaji Area Council, Bwari Area Council, Gwagwalada Area Council, Kuje Area Council, and Kwali Area Council. The camps for internally displaced persons are located in Lubge, Durumi (Area 1), New Kuchingoro, and Kuje, all in Abuja, Nigeria.

A cross-sectional study was conducted to determine the prevalence of Plasmodium infections among internally displaced persons in camps in Abuja, Nigeria. Two different camps were selected within the Abuja metropolis for sample collection. Ethical approval for the research was obtained from the Federal Capital Territory Health Research Ethics Committee, Abuja, Nigeria (Approval number: FHREC/2016/01/92/28-11-16). Inclusion criteria included those living in IDP camps who gave consent, exclusion criteria included those living in IDP camps who did not give Consent. For each person enrolled in this study, data on socio-demographic and risk factors were obtained and recorded using a structured questionnaire. Five (5) ml of blood was collected from each subject by venipuncture for preliminary screening into an ethylenediaminetetraacetic acid (EDTA) bottle. This was used for the preparation of thin and thick blood films for Microscopy, PCV, and for the detection of Histidine Rich Protein II (HRP II) antigen by rapid diagnostic test (RDT) at the Parasitology Research Laboratory, Department of Microbiology, Ahmadu Bello University, Zaria, Nigeria. Samples were analyzed using methods described by Cheesbrough (2006) and Cheesbrough 2009. Results were recorded and compared with the Atlas of Medical Helminthology and Protozoology (Chiodini *et al.*, 2001) and District Laboratory Practice in Tropical Countries (Cheesbrough, 2009).

Statistical analysis

Data collected were entered into an Excel spreadsheet and analyzed using IBM SPSS Statistics, version 21. The statistical tests performed included Pearson's Chi-square test for group comparisons; odds ratio for association; mean and standard error, t-test; and Analysis of variance (ANOVA). Statistical significance was set at $p < 0.05$.

RESULTS

The overall Prevalence of *Plasmodium* infection in the camps was 42.0%. Enrolled subjects in the New Kuchingoro camp had a prevalence of 40.0%, and enrolled subjects in Durumi Area 1 had the highest prevalence of 44.0%. The prevalence rate in both camps was not statistically significant ($P > 0.05$), P-value = 0.418, $x^2 = 0.657$ (Table 1). The prevalence of *Plasmodium* infection among IDPs using the Rapid diagnostic method was 30.5%, with enrolled subjects in the New Kuchingoro camp having 27.0% and enrolled subjects in Durumi, Area 1, having 34.0%. The prevalence rate in both camps was not statistically significant ($P > 0.05$), P-value = 0.128, $x^2 = 2.312$ (Table 1). The study found an overall prevalence of 42.0% *for* Plasmodium infection, with microscopy showing 72.0% sensitivity and 99.6% specificity, and the Rapid diagnostic method showing 30.5% prevalence, with 99.2% sensitivity and 83.1% specificity. The level of agreement between the tests is moderate (K = 0.744) (Table 2).

Table 1: Prevalence of *Plasmodium* infection among IDPs in camps in Abuja, Nigeria

IDPs Camps	No. Examined	No. Positive (%)	
		Microscopy	RDT
New Kuchingoro	200	80 (40.0)	54 (27.0)
Durumi, Area 1	200	88 (44.0)	68 (34.0)
Total	400	168 (42.0)	122 (30.5)

Microscopy: p – value = 0.418, x^2 = 0.657, RDT: p –value = 0.128, x^2 = 2.312

Table 2: Sensitivity and Specificity of Microscopy and RDT

Test	Prevalence %	Sensitivity	Specificity	K – level
Microscopy	168 (42.0)	72	99.6	0.744
RDT	122 (30.5)	99.2	83.1	

K = Kappa value

Table 3: Prevalence of *Plasmodium* infection and Mean parasite density in relation to age and sex among IDPs in camps in Abuja, Nigeria

Age (years)	**No. examined**	**No. Positive (%)**	**MPD (no. pµl^{-1}) ± SEM**	**P = value**	**df**	**F- value**
0 -10	135	46 (34.1)	689.78±68.12	0.921	6	0.33
20-Nov	101	42 (41.6)	735.35±61.88			
21 -30	78	42 (53.8)	628.48±66.44			
31 - 40	54	25 (46.3)	711.32±86.96			
41 - 50	18	7 (38.9)	721.71±169.96			
51 – 60	9	5(55.6)	614.20±123.09			
≥ 61	5	1(20.0)	962			
Total (%)	400	168(42.0)	690.02±32.79			
Sex						
Male	195	80(41.0)	726.85±50.47	0.145	1	2.14
Female	205	88(42.9)	656.13±42.49			
Total	400	168(42.0)	690.024±32.79			

MPD = Malaria parasite density, no. pµl^{-1} = Number of parasites per microliter of blood, SEM = Standard error of mean

Table 4: Association of Demographic Factors and *Plasmodium* Infection among IDPs in Camps in Abuja, Nigeria

Demographic factor	No. Examined (%)	No. positive (%)	Prevalence: N = 400 (%)	x^2	df	P - value
Age (years)						
0 - 10	135	46(34.1)	11.5	10.135	6	0.119
11 - 20	101	42(41.6)	10.5			
21 - 30	78	42(53.8)	10.5			
31 - 40	54	25(46.3)	6.25			
41 - 50	18	7(38.9)	1.75			
51 - 60	9	5(55.6)	1.25			
≥ 61	5	1(20.0)	0.25			
Total	400	168(42.0)	42.0			
Sex						
Male	195	80(41.0)	20.0	0.148	1	0.700
Female	205	88(42.9)	22.0			
Total (%)	400	168(42.0)	42.0			
Educational status						
Primary	162	66(40.7)	16.5	4.503	3	0.212
Secondary	85	44(51.8)	11.0			
Tertiary	10	4(40.0)	1.0			
Non formal	143	54(37.8)	13.5			
Total (%)	400	168(42.0)	42.0			

The majority of the positive cases (130, 77.4%) had low parasitemia (<1000 parasites/µl of blood), and 38 (22.6%) had moderate parasitemia (>1000 parasites/µl of blood). *Plasmodium* parasitemia in the collected samples ranged from 140 to 1950 parasites/µl of blood, with a mean of 694.1 parasites/µl of blood. Age group ≥61 years had the highest mean parasite density (962.00 parasites μl^{-1} of blood), and age group 51-60 years had the lowest mean parasite density (521.60 parasites μl^{-1} of blood). Mean parasite density of *Plasmodium* infection is not statistically significant with age (p =0.921, f = 0.330, df = 6). Males had the highest mean parasite density (726.85 parasites μl^{-1} of blood), and females had the lowest mean parasite density (656.13 parasites μl^{-1} of blood). Mean parasite density of *Plasmodium* infection is statistically significant with Sex (p = 0.145, f =2.140, df = 1) (Table 3).

The 51-60-year-old age group had the highest prevalence of *Plasmodium* infection, while the lowest prevalence of 20.0% was observed in the> 61 age group. Though there was no association between age and *Plasmodium* infection among IDPs in camps in Abuja, Nigeria (x^2 = 10.135, df = 6, and P- value = 0.119) (Table 4).

Overall prevalence of *Plasmodium* infection in male IDPs was 41.0% while that of female IDPs was 42.9% (x^2 = 0.148, df = 1, and P-value = 0.700). There was no association between *Plasmodium* infection and Sex among IDPs in camps in Abuja, Nigeria (P > 0.05) (Table 4).

Subjects with Secondary School education had the highest prevalence of 51.8%, while those with non-formal educational status had the lowest prevalence of 37.8% (x^2 = 4.503, df = 3, P-value = 0.212). There was no association between *Plasmodium* infection and the educational status of IDPs in camps in Abuja, Nigeria (x^2 = 4.503, df = 3, P-value = 0.212) (Table 4).

Those who responded positively to the use of insecticide-treated nets (ITNs) had a prevalence of 41.0%, and those who responded negatively had a prevalence of 43.7%. There was no association between *Plasmodium* infection and use of ITNs among IDPs in camps in Abuja, Nigeria (x^2 = 0.291, df = 1, P-value = 0.590, OR = 0.894, 95%CI = 0.594-1.345)

Those who responded positively to the use of repellant had a prevalence of 0.0%, and those who responded negatively had a prevalence of 42.2%. There was no association between *Plasmodium* infection and use of insect repellant among IDPs in camps in Abuja, Nigeria (df = 1 and P - value = 0.228, x^2 = 1.456, OR = 0.578, 95%CI = 0.531 - 1.345)

E-ISSN: 2814 – 1822; P-ISSN: 2616 – 0668

Table 5: Prevalence of *Plasmodium* infection and Risk factors among IDPs on Camps in Abuja, Nigeria

Risk factor	No. Examined (%)	No. Positive (%)	Prevalence: N = 400(%)	x^2	df	P-value	OR	95%CI
ITN Use								
Yes	249	102(41.0)	25.5	0.291	1	0.59	0.894	0.594-1.345
No	151	66(43.7)	16.5					
Total	400	168(42.0)	42					
Use of repellent								
Yes	2	0(0.0)	0	1.456	1	0.228	0.578	0.531-0.629
No	398	168(42.2)	42					
Total	400	168(42.0)	42					
Stagnant water present								
Yes	96	50(52.1)	12.5	5.272	1	0.022	1.713	1.079-2.720
No	304	118(38.8)	29.5					
Total	400	168(42.0)	42					
Sanitary condition of the camp								
Poor	365	157(43.0)	39.25	1.76	1	0.185	0.607	0.289-1.277
Good	35	11(31.4)	2.75					
Total	400	168(42.0)	42					

Table 6: Association of *Plasmodium* Infection and Anemia of enrolled IDPs on camps in Abuja, Nigeria

Anaemia Status	*Plasmodium* Infection		Total	p-value
	Negative (%)	Positive (%)		
Anaemic	29 (50.9)	28 (49.1)	57 (14.25)	
Normal	203 (59.2)	140 (40.8)	343 (85.75)	
Total	232 (58.0)	168 (42.0)	400	
Mean ± SEM	38.28 ± 0.272	38.125 ± 0.400		0.747

Those who responded positively to the presence of stagnant water in IDP camps had a prevalence of 52.1%, and those who responded negatively had a prevalence of 38.8%. There was an association between *Plasmodium* infection and the presence of stagnant water in camps in Abuja, Nigeria (x^2 = 5.272, df = 1, P- value = 0.022, OR = 1.713, 95% CI = 1.079 – 2.720) (Table 5).

Those who responded positively to the poor sanitary conditions of the camp had a prevalence of 43.0%, and those who responded negatively had a prevalence of 31.4%. There was no association between *Plasmodium* infection and sanitary condition of the camps (x^2 =1.760, p = 0.185, OR = 0.607, 95%CI = 0.289 -1.277) (Table 5).

DISCUSSION

This study, to the best of our knowledge, is the first to report the prevalence and risk factors for *Plasmodium* infection among internally displaced persons in camps in Abuja, Nigeria. The study was designed to use data on the intensity of *Plasmodium* infection. The study found an overall prevalence of 42.0% for *Plasmodium* infection and a Mean parasite density of 694.1/µl of blood in some IDP camps in Abuja, Nigeria. Our findings relate mainly to asymptomatic *Plasmodium* infections, as the majority of infected IDPs were without clinical symptoms.

This study reported 42.0% prevalence of *Plasmodium* infections among IDPs in camps in Abuja, Nigeria. This could be attributed to the living conditions of the IDPs, most of whom live in tents with poor hygiene and stagnant water present in and around the camps. These serve as breeding sites for mosquitoes, which transmit *Plasmodium*. Recent risk maps estimated that malaria prevalence in Nigeria varied from less than 20% in certain areas to over 70% in others (Onyiri, 2015). This variation can be attributed to different climatic conditions, less rainfall, and surface water that serve as mosquito breeding sites. Malaria is usually reported with the highest prevalence among children and pregnant women; our study revealed that adults had the highest prevalence of malaria and the highest malaria parasite density, which did not differ significantly among age groups. This is probably due to hypertransmission of the infection in these camps. Consistent with the present finding, previous findings reported prevalence rates of 39.2% of 360 antenatal patients who visited primary healthcare facilities in Kano State (Gajida *et al.*, 2010), 42.3% in Otukpo, Benue State, (41.6%) in pregnant women in a semi – urban community of Argungu, Kebbi State, (Fana *et al.*, 2015). Also, when compared to other Sub-Saharan African countries endemic for malaria, the prevalence reported in this study is consistent with the 48.2, 47.8, 49.3 and 42.9% reported in the Democratic Republic of Congo (DRC) (Mvumbi *et al.*, 2016), Mozambique (Temu *et al.*, 2012), Burkina Faso (Geiger *et al.*, 2013), and Sirerra Leone, respectively. These are considered the top six among countries affected by malaria (WHO, 2015). Similarly, a recent study found that 42.0% of 2346 school children living in a high-transmission area in Western Kenya were positive for *P. falciparum* (Kepha *et al.*, 2016). In contrast, other studies reported higher prevalence rates: 62.5% of patients attending two hospitals in Kano metropolis and 51.7% of pregnant women attending an antenatal clinic at a specialist hospital were malaria-positive (Oyeyi *et al.*, 2009). Also, higher prevalence findings were reported in previous studies among children in Kebbi, Awka, and Abuja, which reported prevalence rates of 64.0%, 59.6%, and 58.0%, respectively (Mbanugo and Ejims, 2000; Singh *et al.*, 2014; Nmadu *et al.*, 2015). These differences in prevalence may be due to differences in the study populations. Pregnant women and children have low immunity, which predisposes them to infections. This study was carried out among internally displaced persons of all ages living in camps in Abuja. Although transmission rates are low during the dry season, poor sanitary conditions and bushes surrounding the Camps serve as breeding sites for mosquitoes.

The present findings showed that the prevalence of *Plasmodium* infection among the IDPs was

significantly higher among adults than among children, although the difference was not statistically significant ($p > 0.05$). This difference could be explained by the fact that older individuals are expected to have a higher exposure to mosquito bites because they engage in more outdoor activities than younger children, particularly at night, and because ITN use is more common among children than adults. This finding is consistent with recent reports that rates of ITN use were significantly higher among the youngest children, particularly those less than 5 years old, and among heads of household, and this might be attributed to the inadequate number of ITNs per household (Ferrari *et al.*, 2016). This implies that the number of ITNs available to IDPs should be increased to achieve universal coverage in these camps. In contrast, a recent study among Kenyan schoolchildren found that the prevalence of malaria decreased with increasing age, from 5–10 to 11–15 years (Kepha *et al.*, 2016). Findings of the present study showed a similar prevalence rate among male and female subjects, although it is slightly higher in females than in their male counterparts. The high level of parasitemia is not dependent on sex, consistent with previous studies in Nigeria, Kenya, and Mozambique, suggesting that malaria risk is heterogeneous (Brooker *et al.*, 2004; Temu *et al.*, 2012; Noland *et al.*, 2014). However, males were at higher risk of *Plasmodium* infection due to exposure, and inherent and cultural determinants (Bates *et al.*, 2004; Al-Mekhlafi *et al.*, 2011; Winskill *et al.*, 2011; Loha *et al.*, 2012). Coinciding with this, greater and repeated exposure to *Plasmodium* infection among males may result in the development of partial immunity, rendering them at lower risk of clinical malaria than females (Smith et al., 1999), a situation reported in Western Kenya as well (Kepha *et al.*, 2016).

The present study demonstrated that stagnant water was a significant risk factor for Plasmodium transmission among IDPs ($P = 0.022$, OR = 1.713). In most cases, malaria is transmitted through the bites of female *Anopheles* mosquitoes, which breed in stagnant water. All the important vector species bite between dusk and dawn. *Anopheles* mosquitoes lay their eggs in water, which hatch into larvae that eventually emerge as adult mosquitoes. Female mosquitoes seek a blood meal to nourish their eggs (WHO, 2015). The mechanism by which Plasmodium infection causes anemia (Table 6) is multifactorial and includes direct destruction of infected red blood cells (RBCs), RBC rupture, hypersplenism, and reduced RBC production in the bone marrow (Menendez *et al.*, 2000; Akinosoglou *et al.*, 2012). Other factors, such as other infections, nutritional status, and socio-economic level, could be contributory. In developing countries, although mild anemia is common in the general population, moderately severe anemia is most frequently seen in areas where infections can cause or exacerbate it.

CONCLUSION

The study found an overall prevalence of 42.0% for *Plasmodium* infection, with microscopy showing 72.0% sensitivity and 99.6% specificity, and the Rapid diagnostic method showing 30.5% prevalence, with 99.2% sensitivity and 83.1% specificity. The level of agreement between the tests is moderate ($K = 0.744$). *Plasmodium* parasitemia in the samples collected ranged from 140–1950 parasites/µl of blood, with a mean of 694.1 parasites/µl of blood. *Plasmodium* infection among IDPs in camps in Abuja, Nigeria, was associated with stagnant water ($P = 0.022$, OR = 1.713). The 14.3% of the study population were anaemic while 85.8% were normal. Those IDPs positive for *Plasmodium* infection had a Mean ± SEM PCV of 38.125 ± 0.400, and those IDPs without *Plasmodium* infection had a Mean ± SEM PCV of 38.28 ± 0.272. There was no statistically significant difference between infected and non-infected IDPs ($P = 0.747$).

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