

Full Length Research Paper

# ***Plasmodium* and *Loa loa* infections among secondary school teachers and students, and ante-natal out-patients in Ijebu North area, Southwestern Nigeria**

Jonathan K. A. and Agbolade O. M.\*

Department of Plant Science and Applied Zoology, Parasitology and Medical Entomology Laboratory,  
Olabisi Onabanjo University, P.M.B. 2002, Ago-Iwoye, Nigeria.

Abstract

***Plasmodium* and *Loa loa* infections were studied among secondary schools students and teachers, and ante-natal patients of Ijebu-North area, southwestern Nigeria. Blood samples from 743 (323 males and 420 females) volunteers were collected between March 2007 and March 2008, and analyzed by thin and thick smears stained with Leishman and Giemsa stains, respectively. A structured questionnaire was used to obtain information including use of mosquito net, window and door nettings, and use of insecticides, from each volunteer. Out of the 743 subjects examined, 47.4% had *Plasmodium* infection and 15-19 years age group (67.4%) had statistically highest prevalence ( $\chi^2 = 40.736$ ,  $P < 0.05$ ). Out of the four *Plasmodium* species recorded, *P. falciparum* (62.8%) was statistically most prevalent among the study population ( $\chi^2 = 89.444$ ,  $P < 0.05$ ). 35/743 (4.7%) had *L. loa* infection. The intensity of *L. loa* microfilariae (mf) ranged from 1 to 3mf/50 $\mu$ L of blood. From the examined subjects 13.5% were window and/or door net users, 2.4% used treated net, and 19.9% used insecticides. The findings of this study underscore the need for policy makers and health authorities to do more towards sustainable control and eradication of *Plasmodium* and *L. loa* infections in Ijebu North area, southwestern Nigeria.**

**Keywords:** *Plasmodium*, *Loa loa*, school children, ante-natal patients, Nigeria.

## INTRODUCTION

Malaria due to *Plasmodium* infection causes high cases of mortality in young children and pregnant women in sub-Saharan Africa (Carme *et al.*, 1989; Baniecki *et al.*, 2007; WHO, 2008). Studies on human *Plasmodium* infection have received much attention from several workers world over including Nigeria (Ghosh *et al.*, 2000; Anumudu *et al.*, 2007; Nosten and White, 2007; Ntoumi *et al.*, 2007; Agbolade *et al.*, 2009a). Human *Loa loa* infection has been shown to be of significant public health importance (Boulestiex and Carme, 1986; Ottesen, 1990; Agbolade *et al.*, 2005), more so that it sometimes affects individuals during their prime of life (Fain, 1978). Therefore, literature is replete with information on the occurrence and epidemiology of *L. loa* in several parts of the tropical African rainforest belt including Nigeria

(Akogun, 1992; Agbolade and Akinboye, 2001; Takougang *et al.*, 2002; Anosike *et al.*, 2004).

The advent of artemisinin-based combination therapy and insecticide-treated bed net give the ray of hope for the effective control of human *Plasmodium* infection. The widespread continual destruction of forest due to normal development of rural areas is generally believed to substantially reduce transmission of *L. loa* among humans. Since these phenomena apply to the Ijebu North area of southwestern Nigeria, it becomes imperative to periodically assess the epidemiological status of each of the infections, particularly among school children and pregnant women who constitute vulnerable segments of community. Furthermore, there seems to be paucity of information on the current epidemiological picture of *Plasmodium* and *L. loa* infections in pregnant women from Ijebu North area, southwestern Nigeria.

In view of the foregoing, this paper reports the current epidemiological status of *Plasmodium* and *L. loa* infections in secondary school children and teachers, and

\*Corresponding Author E-mail: [agbolmos@yahoo.com](mailto:agbolmos@yahoo.com);  
Tel: +2348055475864

ante-natal patients (pregnant women) from Ijebu North area, southwestern Nigeria. The level of popularity of some simple human-mosquito contact preventive measures among the examined population is also elucidated.

## MATERIALS AND METHODS

### Study area and population

This consisted of Ago-Iwoye, Oru and Ijebu-Igbo in Ijebu North Local Government (INLG) area of Ogun State, southwestern Nigeria. The area lies in the rainforest belt, between latitudes 7° 00' and 6° 55' N, longitudes 3° 50' and 4° 00' E. Ago-Iwoye is the main seat of the Olabisi Onabanjo University, Oru is much smaller than Ago-Iwoye, while Ijebu-Igbo is the headquarter town of INLG area. The composition and characteristics of the study area have been described in an earlier paper (Agbolade et al., 2009b).

The study subjects consisted of volunteers who were secondary school teachers and students, and ante-natal out-patients.

### Pre-survey protocols

Prior to the commencement of the study, the health and education authorities of the INLG area were contacted for permission and ethical clearance which were granted. The volunteers were properly enlightened on the importance of the study. The heads of the schools, teachers and parents of the participants, and ante-natal out-patients were adequately briefed. Consents of the parents and each of the school children, and the ante-natal out-patients were obtained.

### Questionnaire administration

Each volunteer received a structured questionnaire to fill in to obtain information such as age, gender, use of mosquito net, type of net used, window and/or door nettings, use of insecticides. Adequate, but careful, guidance was given to each volunteer (including the children) on how to fill in the questionnaire.

### Blood sample collection, staining and examination

Blood sample collection was done between 8.00 and 10.00 hours from March, 2007 to April, 2008 by finger-prick method using disposable sterile lancet. A blood sample of 50µL was collected from each subject and spread into a thick smear. The thick smears were dehaemoglobinized in clean tap water and later stained

with buffered Giemsa stain. Each of the stained thick smears was later observed in the laboratory for microfilariae (WHO, 1987).

For each participant, 20µL of blood was spread into a thin smear which was air-dried for few minutes, stained with Leishman stain, and later observed microscopically for species of *Plasmodium* (Baker et al., 1998).

### Statistical analysis

Data generated from the study were analyzed using SPSS version 14 and the chi-square ( $\chi^2$ ) was used to compare prevalence where applicable. In each case,  $P < 0.05$  was considered to be significant.

## RESULTS

The size of the examined population was 743 (323 males and 420 females) and the age range was 10 years to 40+ years. Out of the 743 participants examined 352 (47.4%; 95% confidence interval (CI), 41.6 - 53.2) were positive for *Plasmodium* and 35 (4.7%; 95% CI, 3.3 - 6.1) were positive for *L. loa*. Forty-one ante-natal out-patients were included in the study out of which 27 (65.9%; 95% CI, 34.9 - 96.9) had either of the two recorded infections.

Table 1 shows the prevalence of *Plasmodium* and *L. loa* infections in relation to age and gender among the examined subjects in INLG area, Ogun State, Nigeria. There was no statistically significant difference in the prevalence of *Plasmodium* infection among the genders ( $\chi^2 = 0.702$ ,  $P > 0.05$ ). Among the total study population, 15-19 years age group (67.4%; 95% CI, 60.0 - 74.8) had statistically highest prevalence of *Plasmodium* infection ( $\chi^2 = 40.736$ ,  $P < 0.05$ ). Among males, age group 15-19 years had the statistically highest *Plasmodium* prevalence (86.4%; 95% CI, 72.8 - 100.0) ( $\chi^2 = 73.708$ ,  $P < 0.05$ ), while among females, age group 10-14 years (58.3%; 95% CI, 49.5 - 67.1) had statistically highest prevalence ( $\chi^2 = 30.475$ ,  $P < 0.05$ ).

The prevalence of *L. loa* among the genders (Table 1) was not significantly different ( $\chi^2 = 0.232$ ,  $P > 0.05$ ). Among males, 10-14 years age group had the highest prevalence with 15.4% (95% CI, 11.1 - 19.7) ( $\chi^2 = 13.448$ ,  $P < 0.05$ ). Among females, however, 25-29 years age group had the statistically highest prevalence (9.1%; 95% CI, 6.3 - 11.9) ( $\chi^2 = 13.880$ ,  $P < 0.05$ ). Among the total study population, the prevalences of *L. loa* of the age groups were statistically not significant ( $\chi^2 = 10.729$ ,  $P > 0.05$ ). The intensity of *L. loa* microfilariae (mf) ranged from 1 to 3mf/50µL of blood.

Table 2 shows the prevalence of *Plasmodium* species among the examined subjects in relation to age. The prevalence of *P. falciparum* (62.8%; 95% CI, 55.8 - 69.8) was statistically highest among the study population ( $\chi^2 = 89.444$ ,  $P < 0.05$ ). Table 3 shows the nets and

**Table 1.** Prevalence of *Plasmodium* and *L. loa* in relation to age and gender among examined subjects in INLG area, Ogun State, Nigeria

Age group (years)	No. examined	Male		No. examined	Female		No. examined	Total	
		No. infected (%) <i>Plasmodium</i>	<i>Loa</i>		No. infected (%) <i>Plasmodium</i>	<i>Loa</i>		No. infected (%) <i>Plasmodium</i>	<i>Loa</i>
10-14	13	6 (46.2)	2 (15.4)	12	7 (58.3)	1 (8.3)	25	13 (52.0)	3 (12.0)
15-19	118	102(86.4)	5 (4.2)	198	111 (56.1)	6 (3.0)	316	213 (67.4)	11 (3.5)
20-24	48	23 (47.9)	3 (6.3)	56	26 (46.4)	4 (7.2)	104	49 (47.1)	7 (6.7)
25-29	24	8 (33.3)	2 (8.3)	22	8 (36.4)	2 (9.1)	46	16 (34.8)	4 (8.7)
30-34	44	14 (31.8)	3 (6.8)	64	15 (23.4)	2 (3.1)	108	29 (26.9)	5 (4.6)
35-39	57	10 (17.5)	2 (3.5)	58	13 (22.4)	2 (3.4)	115	23(20.0)	4 (3.5)
40 +	19	5 (26.3)	1 (5.3)	10	4 (40.0)	0 (0.0)	29	9 (31.0)	1 (3.4)
<b>Total</b>	<b>323</b>	<b>168 (52.0)</b>	<b>18 (5.6)</b>	<b>420</b>	<b>184 (43.8)</b>	<b>17(4.1)</b>	<b>743</b>	<b>352 (47.4)</b>	<b>35 (4.7)</b>

**Table 2.** Prevalence of *Plasmodium* species in relation to age in INLG area, Ogun State, Nigeria

Age group (years)	No. positive	No. (%) infected with			
		<i>P. falciparum</i>	<i>P. vivax</i>	<i>P. malariae</i>	<i>P. ovale</i>
10-14	13	5(38.5)	4(30.8)	3(23.1)	1(7.7)
15-19	213	147(69.0)	48(22.5)	18(8.5)	0(0.0)
20-24	49	29(59.2)	17(34.7)	3(6.1)	0(0.0)
25-29	16	7(43.8)	6(37.5)	2(12.5)	1(6.2)
30-34	29	18(62.1)	7(24.1)	3(10.4)	1(3.4)
35-39	23	11(47.8)	8(34.8)	4(17.4)	0(0.0)
40+	9	4(44.5)	3(33.3)	1(11.1)	1(11.1)
<b>Total</b>	<b>352</b>	<b>221(62.8)</b>	<b>93(26.4)</b>	<b>34(9.7)</b>	<b>4(1.1)</b>

**Table 3.** Nets and insecticides usage in relation to age among the examined subjects in INLG area, Ogun State, Nigeria

Age group (years)	No. examined	Net users (%)	Treated bed net users (%)	Insecticides users (%)
10-14	25	5 (20.0)	1 (4.0)	4 (16.0)
15-19	316	20 (6.3)	3 (0.9)	40 (12.7)
20-24	104	18 (17.3)	8 (7.7)	21 (20.1)
25-29	46	7 (15.2)	3 (6.5)	6 (13.1)
30-34	108	17 (15.7)	1 (0.9)	11 (10.2)
35-39	115	30 (26.1)	2 (1.7)	60 (52.2)
40+	29	3 (10.3)	0 (0.0)	6 (20.7)
<b>Total</b>	<b>743</b>	<b>100 (13.5)</b>	<b>18 (2.4)</b>	<b>148 (19.9)</b>

insecticides usage in relation to age among the examined population in INLG area, Ogun State, Nigeria. Use of treated bed nets (2.4%; 95% CI, 1.3 - 3.5) was least common while insecticides usage (19.9%; 95% CI, 16.6 – 23.2) was commonest in the study population ( $\chi^2 = 13.140$ ,  $P < 0.05$ ).

## DISCUSSION

The detection of *Plasmodium* and *L. loa* among the

examined secondary school children and teachers, and ante-natal out-patients in this study indicates their continued public health importance in INLG area of Ogun State, as in some other parts of Nigeria (Akogun, 1992; Agbolade and Akinboye, 2001; Anosike et al., 2004; Ibadapo, 2005; Anumudu et al., 2007; Agbolade et al., 2009a). The high prevalence of *Plasmodium* infection in this study is a reminder that INLG area of Ogun State is in malaria endemic region of the world (Heyneman, 2004; Anumudu et al., 2007). Apart from the presence of

vegetation which houses *Anopheles* vectors of *Plasmodium*, it was observed that many potential breeding sites (including improperly-managed septic tanks) abound in the study area. The situation is made worse by the fact that *A. gambiae* is fast adapting to a wide range of water pollution (Awolola et al., 2007).

*Plasmodium* infection was not gender-dependent in this study indicating that both genders were equally exposed to the infection in the study area. However, the infection seems more prevalent in 15-19 years male and 10-14 years female children. Overall, the infection was most common among subjects in 15-19 years age group. Due to economic reasons, older children may not have the opportunity to sleep under mosquito net. In addition, older children are freer in the communities, and as previously suggested could be exposed to mosquito bites virtually anywhere including classrooms, cyber-café and taxi-cabs (Agbolade et al., 2008). Children in the 0-5 years age group, who are less immuned against *Plasmodium* and are usually most severely affected by the infection (Ukoli, 1991), were not included in this study. The most prevalent *Plasmodium* species in this study was *P. falciparum*. The reason could be the ability of the infection to develop resistance to drug particularly when the prescribed regimen is not completed or properly adhered to (Ukoli, 1991; Smyth, 1996). *Plasmodium* species is known to destroy the red blood cells (erythrocytes) with the release of toxins which lower the ability of the subject to fight against infections (Smyth, 1996).

The high prevalence of *Plasmodium* infections in women of child-bearing age (20 years and above) and even among ante-natal out-patients in this study calls for concern of policy makers. *Plasmodium* infection is known to be one of the major causes of childhood and maternal mortality (Heyneman, 2004; WHO, 2008). Improper diagnostic approaches used by health giver and low level of education of many of the ante-natal out-patients are probable reasons for the high prevalence among women of child-bearing age (Ibidapo, 2005; Keating et al., 2008).

The prevalence of *L. loa* in this study was low compared with some previous reports (Agbolade and Akinboye, 2001). Nevertheless, the presence of *L. loa* calls for concern because it suggests continual transmission of the human filarial infection in the area. Previous reports have shown that *L. loa* and *M. perstans* exist in the study area (Agbolade and Akinboye, 2001) and that the vegetation favors the breeding of the vectors (Agbolade et al., 2006). The vicinities of the visited schools characteristically favor the presence of *Chrysops* and *Culicoides* species which transmit *L. loa* and *M. perstans*, respectively (Ottesen, 1990). The designs of the school uniforms make the upper and lower limbs of the children unprotected leaving them at the mercy of the vectors. Many adults and children in the study area often frequent villages and farms for farming activities. Also, due to economic hardship, some inhabitants engage in

fetching of fire-wood both for sale and domestic use. These practices expose them to bites of *Chrysops* and *Culicoides* species which transmit the infections (Muirhead-Thomson, 1982). The similarity in the prevalences of *L. loa* among the genders indicates that both genders are equally exposed to the infection.

The relatively higher prevalence of *L. loa* recorded in the 10-14 years age group among the males may be due to the fact that such children often assist their parents on the farm in weeding. Many prefer doing weeding with minimal clothing, particularly because of heat; this further exposes the children to filarial worm vectors. Among females, the highest prevalence was recorded in the 25-29 years age group. These are wives some of whom naturally help their husbands in the farm and this might have strongly enhanced their exposure to vectors' bites. Low intensity of *L. loa* recorded in this study is similar to some previous records from the study area (Agbolade and Akinboye, 2001).

This study showed that relatively little proportion of the examined subjects used window and/or door netting (13.5%). Worse still, only 2.4% of the examined subjects used insecticide-treated net (ITN), while 19.9% were insecticide users. The use of ITN is believed to significantly reduce transmission of *Plasmodium* infection (WHO, 2008). The need to direct the health message towards the poorly educated mothers has been emphasized for this will empower them to accept and use ITN (Ibidapo, 2005). If all the electronic media jingles and print media paid advertisements are anything to go by, or measures towards acceptance of the ITN, one would believe that malaria will soon be rolled back worldwide, and not only in Nigeria. But it appears that many are yet to know about or accept the net. It seems that the few that are aware of the net have no access to it because it is either too expensive or not available (Osero et al., 2006).

Policy makers and health authorities need to realize that much still needs to be done to bring down the unacceptable level of *Plasmodium* and *L. loa* infections in INLG area of Ogun State. This includes ensuring that houses are properly screened against insect vectors, enactment and enforcement of appropriate environmental sanitation laws, provision of effective insect repellents (particularly to school children), targeted chemotherapy with DEC (for *L. loa* infection) and artemisinin-based combination drugs (for *Plasmodium* infection), and strategic education and enlightenment of the inhabitants of the study area. Periodic insecticidal spraying of immediate vicinities of schools may also be given a reasonable consideration.

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