GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL. 11, NO. 4, SEPTEMBER 2005: 471 - 476
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# LOAIASIS IN THE UPPER IMO RIVER BASIN, NIGERIA

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(Received 7 February, 2005; Revision accepted 29 April, 2005)

ABSTRACT

*Loa loa* is present in the Upper Imo River Basin with a prevalence of 2.7%. Microfilaraemia was highest among older people but comparable in males and females. Microfilarial intensity did not show any significant difference either between sexes or between age groups. On the overall, prevalence of clinical loaiasis was higher than prevalence of microfilaraemia. The relationship between microfilaraemia and clinical manifestations was discussed. The record of cases of calabar swelling and worm crossing the eye, which are related to *L. loa*, are common in the area. Calabar swelling was significantly higher in females than males and rose with increase in age. The characteristic swellings were observed mostly on the arms and in the facial regions. There was no significant difference in mf prevalence between those with a positive history of worm-crossing-the-eye and those without, but the difference in the mf GMI between the two groups were statistically significant. All cases of a positive history of calabar swelling were recorded in those aged 10 years and above. Endomyocardial fibrosis was not examined for in this study.

KEYWORDS: Loaiasis, epidemiology, Imo River, Calabar swelling, worm-crossing-the-eye

## INTRODUCTION

Loaiasis occurs only in Africa where transmission is confined to the rainforest and swampy areas of West and Central Africa. The estimated number of people living in endemic areas is put at 20-30 million. However, far more than this number could be at risk. Microfilaraemia is low in children, and tends to increase with age, although prevalence of microfilaraemia rarely exceeds 40% (Noireau *et al*, 1989).

Fain (1978) estimated that in hyperendemic zones inhabitants may receive one infective fly bite every five days. Goussard *et al* (1984) observed that 95% of inhabitants in a hyperendemic zone had antibodies reacting with *Loa loa* antigens by the age of two years. However, prevalence of microfilaraemia rarely exceeds 35%. This has consequently led to suggestion that acquired immunity may eliminate circulating microfilariae in some individuals (Van Hoegarden *et al*, 1987), a condition known as occult filariasis (DuPont *et al*., 1988). The frequency of occult loaiasis is reported to exceed that of microfilaraemia (DuPont *et al*, 1988; Fain, 1978), i.e. estimation shows that only one in three of those infected with *L. loa* shows microfilaraemia (Pinder, 1988). Furthermore, it has been observed that individuals with occult loaiasis did not differ from microfilaraemic subjects either in severity of symptoms or in eosinophil count (Duke, 1972). Therefore the occult state is not necessarily associated with increased pathology. Furthermore, some subjects with high levels of microfilariae-specific IgG antibodies were asymptomatic (Pinder, 1988). This contrasts the situation in *W. bancrofti* infections where occult filariasis is frequently symptomatic with enlargement of the lymph nodes and respiratory complaints. In addition, such patients show high levels of antibodies against microfilariae and marked eosinophilia (Ottesen, 1990).

Loaiasis shows a wide spectrum of symptoms, some of which are debilitating clinical signs (Pinder, 1988). The adults live mainly in the subcutaneous tissues where they provoke typical "Calabar swellings". Calabar swellings are localized areas of non-pitting oedema, usually 5-20 cm in diameter that lasts from a few hours to a few days. They occur predominantly on the wrists and ankles, and are considered to be an allergic reaction (Nutman, 1986), perhaps evoked by female worms releasing microfilariae.

Subconjunctival migration is pathognomonic of *L. loa* and the worm may pass under the conjunctiva in only a few minutes or stay for several days causing considerable discomfort (Pinder, 1988). Other symptoms include, generalized pruritis, which is often intense, arthralgia (pain in a joint) and fatigue. Central nervous system involvement may occur in untreated cases but is more frequent after treatment with DEC (Fain, 1978). Hypereosinophilia is common and may play a role in the etiology of endocardial fibrosis (Sasa, 1976). Also obstruction of the intestine or the testis can be caused by the adult worms or by the inflammatory or fibrotic reactions; and some case histories report nephropathy, cardiomyopathy, retinopathy, lymphoedema and lymphadenitis. It has also been associated with hypogonadism (a condition resulting from or characterized by abnormally decreased functional activity of the gonads, with retardation of growth and sexual development low serum testosterone and/or high levels of gonadotrophins (hormones having stimulating effect on the gonads) (Pinder, 1988). There can also be acute encephalitis (Negesse *et al*, 1985), and epileptic seizures (Adamolekun *et al*., 1993). More serious complications can occur when *L. loa* invade the central nervous system and other vital organs. For example, loaiasis has been associated with endomyocardial fibrosis and there is also the possibility that hypereosinophilia induced by the infection may lead to cardiac damage (Ive, *et al*, 1967). In the Upper Imo River Basin, loaiasis is endemic but has not been studied. This report is first from a comprehensive longitudinal study on the epidemiology of loaiasis in the basin.

## MATERIALS AND METHODS

### Study Area

The Imo River Basin (IRB) is located in the south-eastern region of Nigeria, lying between latitudes 4.4° and 5.8° North, and longitudes 7.0° and 7.8° East. It traverses three states of Imo, Abia, and Rivers states. From the derived savannah in the upper part it extents through the rainforest vegetation to the mangrove swamps at the Atlantic Ocean.

Studies in the Upper Imo River Basin were carried out in two neighbouring communities of Umuowaibu1and Ndiorji, which are located about 10 km northwest of Okigwe. The two communities are socio-culturally similar and are inhabited by the Igbo tribe. Familial settlement pattern was evident in the

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study communities with houses arranged in family clusters.

The area is hilly with characteristic undulating plains. There are 7 streams, and three rivers in the area in addition to the Imo River, and include Nkpoma Stream, Ngele Asaa Stream, Aluum Stream, Ngeleocha Stream, Kirika Stream, Mpiti Stream, and Ojomoko Stream, Ibu River, Ugbi River, and Nwangele River. There are also numerous pockets of natural, and man-made stagnant water pools at the banks of the rivers and streams, which are used by the villagers for processing cassava. They also serve as favourable breeding sites for mosquitoes. The villagers depend on the streams and rivers for most of their water needs. Activities normally carried out in the streams or rivers include fetching water for domestic uses, swimming, bathing and fishing. Fetched water is usually stored in drums or other plastic containers, clayey pots, and natural containers, which are normally kept under the rain tracks, most times without cover. Sanitary facilities are poor and grossly inadequate. Some families use nearby bushes for defecation but most have acquired pit latrines.

Farming is the main occupation. The soil consists predominantly of shale, which provides good agricultural land for intense farming activities for crops like yam, cassava, maize, groundnut, vegetables, cocoayam, three-leaf yam, banana, and pineapple. The chief economic tree crops include kolanut tree, rubber tree, palm tree, oil-bean tree, raffia palm tree, breadfruit tree, and local pear tree. Domestic animals include livestock such as goats, sheep, chicken, and ducks; and pets such as dogs and cats. Fishing and petty trading are also popular among men and women, respectively.

According to meteorological report from the Imo State Meteorological Service, the annual rainfall for the area averaged 2840 mm per annum, with most of the rainfall in the months of June through October.

**Parasitological survey**

Day blood samples for parasitological examination were taken from every consenting person of age one year and above. The day blood sampling took place between 0800 hours and 1600 hours, immediately after the clinical examination. A clean microscope slide was labelled with the personal number. Using a sterile lancet, 50□l of blood was taken from the left thumb, drawn into blood pipette and used to prepare thick smear on the microscope slides. The slides with day blood samples were left to dry overnight. They were then dehaemoglobinized by immersion to vertical positioning in clean tap water for two minutes. Thereafter, they were dried, and fixed in methanol for one minute. They were then stained with haematoxylin after Simonsen (1993). The stained slides were examined under microscope using x40-x100 magnification of the objective. Identification was according to the keys in Learning Bench Aid No.3 (Tropical Health Technology).

**Clinical survey**

The clinical surveys and the day blood sampling for parasitological examinations were carried out simultaneously. Individuals were interviewed about the history of occurrence of calabar swelling and the event of a worm crossing the eye, and specifically about the period that had elapsed since the last attack. For individuals who had suffered these manifestations more than once, only the time for the latest attack was noted. In the case of those who were too young, their parents or guardians were interviewed. Legends to stages of *L. loa*-related clinical manifestation are shown in Table 1. These examinations took place in utmost privacy. Children and infants who needed help were accompanied by their parents or guardians. Informed oral consent was obtained from all adults, and from parents or guardians of children aged ≤ 15 years, before any examination was carried out.

## RESULTS

Microfilaraemia in relation to age and sex.

The results for *L. loa* microfilaraemia are based on blood specimens collected during daytime only. The results are shown in Table 2. The mf Geometric Mean Intensity (GMI) in relation to age and sex is presented in Figure 1. The coverage was high (91.8%) for the whole population; 93.0% for males and 90.6% for females.

The prevalence of *L. loa* microfilaraemia was relatively low. Among those examined, the overall mf prevalence was 2.7% (2.6% for male, and 2.9% for females). There was no significant difference between the sexes ($\chi^2$-test; $p > 0.05$). Microfilaraemia was not found in young children. The youngest

Table1: The various clinical manifestations associated with loaiasis and their grading.

| Clinical sign/symptom | *Grading | Description |
|---|---|---|
| Worm crossing the eye | 0 | Normal |
| | 1 | < 3 months previously |
| | 2 | > 3 months but < 1 year previously |
| | 3 | > 1 year previously |
| Calabar swelling | 0 | Normal |
| | 1 | < 3 months previously |
| | 2 | > 3 months but < 1 year previously |
| | 3 | > 1 year previously |
| Others | 0 | None |
| | 1 | Signs of acute lymphatic filariasis (lymphangitis, funiculitis, orchitis) |
| | 2 | Signs of endomyocardial fibrosis |
| | 3 | Other (specified) |

(*It is only a grading for "worm crossing the eye", and calabar swelling. For skin manifestations and "others" it is only a code).

mf positive male was 18 years old and the youngest mf positive female was 11 years old. The mf prevalence increased with age to reach 11.1% in the oldest age group.

The overall mf GMI among mf positive individuals was 231

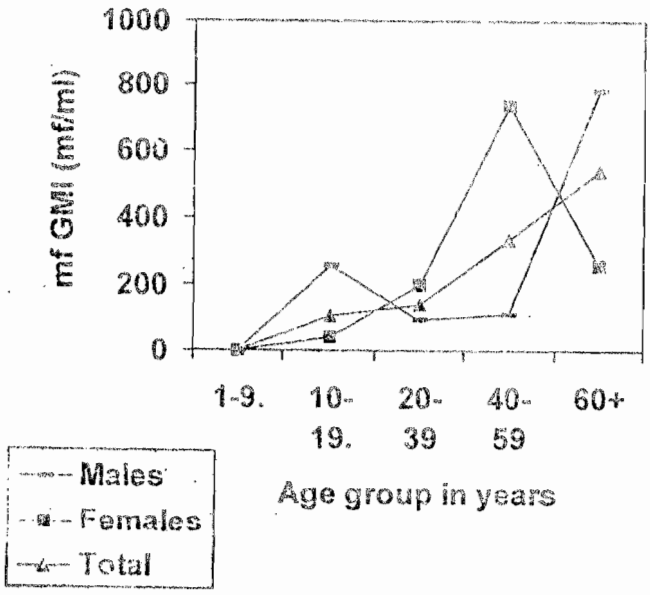


Figure 1 The *L. loa* mf GMI in relation to age and sex in the Upper Imo River Basin.

mf/ml of blood (151 mf/ml for males, and 336 mf/ml for females). The difference in mf GMI between males and females was not statistically significant (t-test; $p > 0.05$). There was an increase in the total mf GMI with age, which peaked at 543 mf/ml in the oldest age group. The highest individual mf intensity observed was 4840 mf/ml in a 45-year-old woman.

**Clinical manifestations**

The prevalence in relation to age group and time of last attack is presented in Figure 2. A history of calabar swelling was not reported for young children in the first ten years of age. The overall prevalence of calabar swelling was 17.2% (14.3% for males, and 20.0% for females). Females had significantly higher prevalence than males ($\chi^2$-test; $p < 0.05$), and the overall prevalence rose with increasing age to reach 40.7% in the oldest age group.

The prevalence of Calabar swelling experienced within the last three months was the least prevalent of the three periods being considered, with a total of 2.8% (2.0% in males and 3.7% in females). The characteristic swellings were observed mostly on the arms and in the facial regions.

The prevalence of positive history of worm-crossing-the-eye in relation to age and Time of last attack is presented in Figure 3. The overall prevalence was 14.6% (11.5% for males and 17.7% for females). A positive history of worm-crossing-the-eye was rare among those below 20 years old. Among those ≥ 20 years old, the prevalence in females was significantly higher than those of males (30.6% and 21.3%, respectively; $\chi^2$-test; $p < 0.01$).

Worm-crossing-the-eye experienced within the three months prior to the time of the survey was claimed by 1.7% of those examined (1.0% for males and 2.3% for females). Worm crossing the eye between three and 12 months prior to the study was claimed by 2.3% of those interviewed (1.8% for males and 2.9% for females). An episode of worm crossing the eye more than one year prior to the study was the most prevalent of the three, with an overall prevalence of 10.6% (8.7% for males and 12.5% for females).

Endomyocardial fibrosis was not examined for in the study because it involves very rigorous processes that were not convenient within the given framework.

**Relationship between microfilaraemia and clinical manifestations**

The relationship between *L. loa* microfilaraemia and positive histories of calabar swelling and worm crossing the eye was analysed and presented in Table 3. Of those who reported of a positive history of calabar swelling, 4.5% were positive for *L. loa* microfilaraemia with a total mf GMI of 258 mf/ml. For those without a positive history of calabar swelling, 2.4% were positive for *L. loa* microfilaraemia with a total mf GMI of 221 mf/ml. The difference in mf prevalence was not statistically significant ($\chi^2$-test; $p > 0.05$). However, there was a statistically significant difference in the mf GMI between those with and without a positive history (t-test; $p < 0.001$).

All cases of a positive history of calabar swelling were recorded in those aged 10 years and above. Among these, there was no statistically significant difference in the mf prevalence between the two groups ($\chi^2$-test; $p > 0.05$), but there was a statistically significant difference in the mf GMI between those with and without a positive history (t-test; $p < 0.001$).

The relationship between *L. loa* microfilaraemia and a positive history of worm crossing the eye is presented in Table 3. Of those who reported of a positive history of worm crossing the eye, 4.0% were positive for *L. loa* microfilaraemia with a mf Geometric Mean Intensity (GMI) of 281 mf/ml, whereas 2.5% of those without a positive history of worm crossing the eye were positive for *L. loa* microfilaraemia with a mf GMI of 219 mf/ml. The difference in mf prevalence was not statistically significant ($\chi^2$-test; $p > 0.05$), but the difference in mf GMI was statistically significant (t-test; $p < 0.05$). The majority of cases

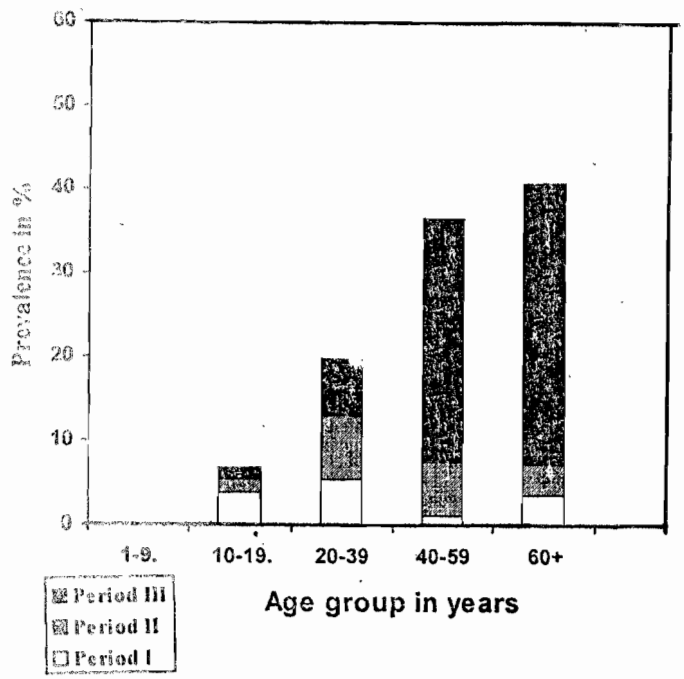


Figure 2: Prevalence of a reported history of calabar swelling according to age group and Time of last attack in the Upper Imo River Basin (Period I = < 3 months; Period II = 3 - 12 months; Period III = > 12 months).

Table 2: The *L. loa* microfilaraemia in relation to a reported positive history of calabar swelling in the Upper Imo River Basin study population

| Age group (years) | Positive history of Calabar swelling | | | Negative history of Calabar swelling | | |
|---|---|---|---|---|---|---|
| | No. | No. mf positive (% prevalence) | GMI (mf/ml) | No. | No. mf positive (% prevalence) | GMI (mf/ml) |
| 1-3 | 0 | 0 (0.0) | - | 209 | 0 (0.0) | - |
| 10+ | 176 | 8 (4.5) | 258 | 639 | 20 (3.1) | 221 |
| Total | 176 | 8 (4.5) | 258 | 848 | 20 (2.4) | 221 |

* Only indicated if there are ≥ 3 mf positive cases.

Table 3 *Loa loa* microfilaraemia in relation to a reported positive history of worm crossing the eye in the Upper Basin study population.

| Age group (years) | Positive history of worm crossing the eye | | | Negative history of worm crossing the eye | | |
|---|---|---|---|---|---|---|
| | No. | No. of mf positive cases (% prevalence) | GMI (mf/ml)* | No. | No. of mf positive Cases (% prevalence) | GMI (mf/ml) |
| 1-9 | 5 | 0 (0.0) | 0 | 463 | 2 (0.4) | - |
| 10+ | 145 | 6 (4.1) | 281 | 411 | 20 (4.9) | 236 |
| Total | 150 | 6 (4.0) | 281 | 874 | 22 (2.5) | 219 |

* Only indicated if there are ≥ 3 mf positive cases.

of a positive history of worm crossing the eye were among those aged 20 years and above. In this age group, there was no significant statistical difference between the mf prevalence in those with and without a positive history of worm crossing the eye ($\chi^2$-test; $p > 0.05$). However, there was a statistically significant difference in the mf GMI between these two groups (t-test; $p < 0.001$).

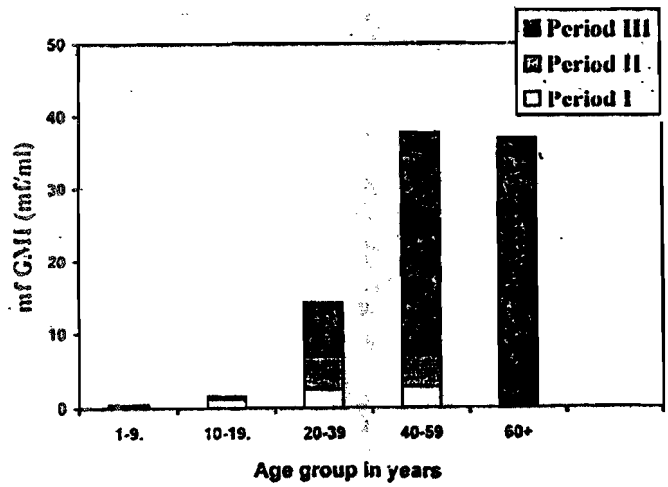


Figure 3 Prevalence of reported history of worm-crossing-the-eye in relation to age and time of last attack in the Upper Imo River Basin ((Period I means < 3 months previously; Period II means > 3 months but < 12 months previously; Period III means > 12 months previously).

## DISCUSSION

Prevalence of *L. loa* microfilaraemia was considerably lower (2.7%) in the Upper Imo River Basin, than in the neighbouring areas of Igwun River Basin or the Niger Delta areas (Udonsi, 1988a, 1986). This might be due to the ivermectin distribution in the area prior to the study. Ivermectin has a microfilaricidal effect on *L. loa* (Richard-Lenoble *et al*, 1988; Carme *et al*, 1991; Chippaux *et al*, 1992). Another reason could be an impact by other filarial infections, which are present in the area (Uttah, 1998), on loaiasis. Several studies elsewhere have thus indicated a low prevalence of loaiasis in areas endemic for multifilarial infections (Akogun, 1992; Anosike, 1994; Useh and Ejezie, 1995). There is need for further studies to confirm or refute this. Thirdly, amicrofilaraemic loaiasis is also common in Nigeria (Ogunba, 1971). This makes the diagnosis difficult and consequently, many infected individuals may not have been identified. A rise in prevalence of *L. loa* microfilaraemia from the savannah to the rainforest areas of Western Nigeria has earlier been noted by Ogunba (1972). He also noted high transmission in the mangrove areas.

There was no significant difference in prevalence of microfilaraemia between the males and females. This is consistent with the findings in Calabar of Useh and Ejezie (1995), but is contrary to the reports of Anosike (1994) in northern Nigeria where the population is predominantly Moslem. Marked differences between males and females, reflecting differences in exposure to the biting vectors was reported.

Microfilaraemia was rare among children. The prevalence rose with increasing age, but the microfilarial intensity did not show any clear-cut pattern with respect to age in either sex. Useh and Ejezie (1995) as well as Ogunba (1972) also observed a significantly higher prevalence among adults than among children in southeastern and southwestern Nigeria, respectively, and attributed it to exposure to the vector for longer periods of time, and also to more frequent exposure occasioned by their occupation. However, age-related patterns of *L. loa* microfilaraemia vary considerably even among places of close proximity. In the Igwun River Basin, prevalence of microfilaraemia was high (above 10%) in all age groups, even higher among children, and only individuals in the 30-39 years age group remained amicrofilaraemic (Udonsi, 1986) In Bauchi State, in the Savannah area, *L. loa* infections occurred early in life and were observed only in those less than 49 years of age (Anosike, 1994). In the Gongola State, also in the Savannah area, the middle-aged individuals were more affected than children (Akogun, 1992). The preponderance of microfilaraemia among the adults has also been reported widely elsewhere (Ogunba, 1977; Udonsi, 1986; Anosike and Onwuliri, 1994).

The significant difference in prevalence of loaiasis in these two areas may be related to the difference in the blood sampling method. In this study we used the finger pricking method, whereas Udonsi (1988) used the intravenous blood and a more sensitive concentration technique.

Calabar swelling was the commonest clinical manifestation associated with *L. loa* infection in the area. About 17.2% of the Upper basin study population recalled having had calabar swelling. The relatively higher rates of calabar swelling reported in the Upper Imo River Basin in spite of a low prevalence of *L. loa* microfilaraemia there indicates that *M. perstans* probably, may have played a contributory role in its pathogenesis as has been reported elsewhere in south-eastern Nigeria (Useh and Ejezie, 1995). Another reason may be that the prevalence of *L. loa* microfilaraemia had been reduced in response to the ivermectin treatment in the area. Calabar swelling was claimed more by females than males, with a significant difference. Since there was no significant sex-related differences in microfilaraemia, the higher prevalence of reported calabar swelling among females than among males may be due to gender differences in defining and recalling pathological swellings and not due to sex-related differences in immuno-pathogenesis and pathology. Furthermore, the prevalence of reported calabar swelling rose with increasing age. This was also the case with microfilaraemia. It reflects the fact that filarial pathology generally takes time to develop. A higher percentage of middle-aged individuals (10-39 years old) reported more calabar swelling within the last 12 months than the older ones, whereas the older ones reported more calabar swelling prior to the last 12 months than the younger ones. Observations based on clinical manifestation indicate that Calabar swelling is more common among the middle-aged group than in any other group.

Adult worms passing under the conjuctiva of the eye is characteristic of *L. loa* infections (McMahon and Simonsen, 1995). On the whole, 14.7% of the studied population recalled episodes of worm crossing their eyes. Prevalence was higher among females than among males, and prevalence rose with increasing age as reported for calabar swelling. The reasons adduced for calabar swelling may also go for worm-crossing-eye. Furthermore, it has been observed elsewhere that *M. perstans* microfilariae can also cross the conjuctiva (Ashton and Cook, 1979). Its involvement in the study population cannot be completely ruled out without verification.

There was higher prevalence of *L. loa* microfilaraemia among those who recalled having had calabar swelling than among those who did not recall having had it, although the difference was not significant. The role of *M. perstans* in causing swellings indistinguishable from calabar swellings is now widely reported (McMahon and Simonsen, 1995; Useh and Ejezie, 1995). The report of such swellings (Useh and Ejezie, 1995) from Calabar town, which is in the same geo-climatic zone of south-eastern Nigeria as the Imo River Basin, indicates perhaps that some of the swellings in the present study area may have been induced by factors pertaining to *M. perstans* infection. This needs to be investigated further.

The prevalence and intensity of *L. loa* microfilaraemia was also higher among those who recalled experiencing worm crossing the eye than among those who did not recall experiencing it. The difference was not significant unlike others reported by some studies (Nutman *et al*, 1986; Carme *et al*, 1989; Noireau *et al*,1990).

ACKNOWLEDGMENT

This work was sponsored by the Danish International Development Assistance (DANIDA) through Danish Bilharziasis Laboratory (DBL). We appreciate the efforts of the entire members of the DBL/ Uniport Joint Project on Filariasis.

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