academicJournals

Vol. 6(8), pp. 117-123, August, 2014
DOI: 10.5897/JPVB2014.0156
Article Number: AEB5F7146610
ISSN 2141-2510

http://www.academicjournals.org/JPVB

Journal of Parasitology and Vector Biology

*Full Length Research Paper*

# Factors associated with ascariasis among pre-school aged children in Ile-Ife, Osun state, Nigeria

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Received 27 May, 2014; Accepted 29 July, 2014

**The risk factors predisposing children to ascariasis transmission in a peri-urban community of Osun state, Nigeria were investigated from November, 2012 to June, 2013. Preschool children aged 24 to 60 months were tested by faecal examination for *Ascaris lumbricoides* infection using Kato thick smears after information on personal biodata, access to water supply, sanitation, socio-economic status of their parents, hygiene and deworming history was collected using a questionnaire. Out of 416 children examined, 117(28.1%) were infected with an overall mean intensity of 1846.33±235.23 eggs per gram (epg). Infection patterns were gender comparable and age dependent with peak prevalence (33.1%) and mean intensity (2264.14±493.58 epg) occurring in children aged 48 to 59 months. Parental educational background, sanitation, washing hands with soap and water and deworming history were identified as the significant risk factors which correlated with *Ascaris* infection. These findings suggest that socio-economic risk factors which play a role in disease transmission need to be taken into account when formulating sustainable control strategies for ascariasis and other soil-transmitted helminths in Nigeria.**

**Key words:** Prevalence, ascariasis, risk factors, preschool aged children, Nigeria.

## INTRODUCTION

Faecal contamination is one of the most environmental health problems in poor countries, where an estimated three million children die of enteric diseases annually and even more suffer from debilitating diseases due to soil-transmitted helminths (STHs) (Carneiro et al., 2002). Ascariasis is one of the important soil-transmitted diseases with enormous health and social implications for pre-school and school aged children in impoverished and endemic communities of tropical Africa, Asia and South America. Children are infected after ingesting emryonated eggs from contaminated soil or food. Although, the infection is often asymptomatic, its effect may contribute substantially to child mortality when associated with malnutrition, pneumonia, enteric diseases and vitamin A deficiency (Montressor et al., 2003). In developing countries the burden of helminthic diseases had been reported to be influenced by socio-economic status, poor environmental sanitation, lack of personal hygiene and use of unsafe water (Soares Magalhaes et al., 2011). Although, recent control strategies of targeted

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chemotherapy (that is, periodic administration of antihelminthic drugs to vulnerable groups) have achieved significant reduction in morbidity, they have failed to significantly break transmission in areas where socio-environmental risk factors have continued to play vital roles in the daily life of vulnerable population. Crompton (1989) reported that there is a direct relationship between some risk factors (such as water supply, sanitation and poverty) and patterns of ascariasis transmission in most endemic communities.

Other studies have reported the likely role of the age of the child, father's occupation, dog ownership, (Kirwan et al., 2009), defecation practices and mother's occupation (Nmorsi et al., 2009). In spite of the health risks associated with soil-transmitted helminthiasis, there is still paucity of epidemiological data regarding the endemicity of soil-transmitted helminth infection among pre-school children who are also vulnerable. Therefore, the present study was aimed to investigate the effect of water, sanitation, hygiene and other socio-economic parameters on the prevalence of ascariasis in pre-school children aged 24 to 60 months of age in Ile-Ife, Osun state, Nigeria. It is hoped that our findings will contribute to sustainable ascariasis control in this and other endemic communities in Nigeria and other countries with similar environmental conditions.

## MATERIALS AND METHODS

### Study area and population

The study was conducted in peri-urban community, Ile-Ife in Ife Central Local Government area of Osun state, Nigeria located between latitudes 7°26´´N and 7°35´´N and longitudes 4°24´´E and 4°39´´E. The climate is typically tropical with well defined wet (April to October) and dry (November to March) seasons with mean annual precipitation of 1220mm and mean annual temperature of 27ºC (Ayoade, 1982). The estimated population of people in the peri-urban city according to 2006 census is 167,254. The inhabitants are a mixture of people from different ethnic groups in Nigeria, although the majority are the Yoruba speaking people of the South-west. They are mainly peasant farmers growing cocoa, vegetables, maize and cassava. Traders, civil servants, artisan workers and transport workers are also found in smaller numbers. The three major sources of water supply are tap water, shallow wells and streams. Toilet facilities included water closets, pit latrines or indiscriminate defecation in the bush.

### Study design

A cross-sectional study was conducted among randomly selected pre-school aged children from Ife Central Local Government Area (LGA) between November, 2012 and June, 2013. Nine nursery and primary schools comprising four government-owned and five privately-owned schools were selected randomly from a total of 62 schools in Ife Central LGA. Introductory meetings were held in each selected school with the school authority where the purpose of the study was explained. Thereafter, the school authority called a Parents Teachers Association (PTA) meeting where the parents/guardians of the pre-school children aged 2 to 5 years were informed on the purpose of the study and their co-operation sought for the success of the study. The parents/guardians were informed that only children whose parents returned the signed fingerprint consent forms will be allowed to participate in the study. Prior to the commencement of the study, permission was sought and obtained from the Local Educational Authority of the Ife Central Local Government Area. Ethical clearance for the study was given by the Ethical Committee of the Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Ile-Ife, Osun State, Nigeria. The inclusion criteria for the study were (1) children aged 24 to 60 months; (2) parents or guardians gave written informed consent; (3) children lived in the study area.

### Sample size determination and sampling techniques

The sample size for this study was calculated by using proportion formula at 95% confidence interval (CI) level (Z (1-½α) = 1.96), an expected prevalence of 10% study has been conducted before on this topic in the area of study and 5% marginal error. Then the sample size was calculated as n = (Z . 1- ½α) 2P (1 – P)/d² , where n = sample size, P = proportion problem in the study area, Z 1- ½α = CI of 95%, d = Marginal error to be tolerated by adding 10% of contingency. This led to a total sample size of 416 children included in our study. The sample size which was determined earlier was used to calculate the proportion of pupil to be selected from each school. Using registration list, simple random sampling was employed to select pupils from each school using a table of random numbers.

### Data and faecal sample collection

A pre-tested questionnaire was sent to the parents/guardian to be filled out to provide information on personal biodata (name, age, sex) of each child, socioeconomic status of parent (Educational background and Occupation) access to different facilities for water supply (boreholes, well and stream), sanitation (pit latrines, water closet, bush), hygiene (washing hands before eating and after using the toilet, washing hands with soap and water, washing hands with water only), deworming history (whether the child had taken anthelminthic medication within the last 12 months prior to faecal collection). A total of 416 children were randomly selected from a total of 1080 children in the list of the nine selected schools. Labelled plastic bottles (containing the name, age and sex of the selected children) with a clean wooden spatula for the collection of faeces were distributed to the children for a small portion of their early morning faeces. Faecal samples were collected from each selected child on the same day or within 24hrs of being passed and examined for presence and number of *A. lumbricoides* eggs.

### Parasitological procedures

Each faecal sample was collected in a clean 30mL universal plastic bottle and stored in the laboratory refrigerator at 4°C. The Kato thick smear method (WHO, 1994) was used for the analysis of the presence and number of *A. lumbricoides* egg. Samples found to be positive for the *A. lumbricoides* eggs underwent egg burden counts to determine eggs per gram (epg) of faeces using standard WHO protocol (WHO, 2006). Those pupils who were positive for *A. lumbricoides* eggs were treated accordingly by appropriate antihelminthic drugs. Table 1.

### Statistical analyses

SPSS version 17.0 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis. The differences in the prevalence of ascariasis

**Table 1.** Prevalence and Intensity of ascariasis in preschool-aged children in relation to age, Gender, parental characteristic, water supply, sanitation, hygiene and deworming history in Ile-Ife, Osun State, Nigeria.

| Variable | No. examined | No. infected | Prevalence (%) | Intensity (eggs per gram mean±SEM) |
|---|---|---|---|---|
| **Age (months)** | - | - | - | - |
| 23-35 | 56 | 10 | 17.9 | 1459.71±595.48 |
| 36-47 | 103 | 32 | 31.1 | 1362.17±264.79 |
| 48-59 | 118 | 39 | 33.1 | 2264.14±493.58 |
| ≥60 | 139 | 36 | 25.9 | 2006.16±473.66 |
| P-value | - | > 0.05 | 0.84 | - |
| **Gender** | - | - | - | - |
| Male | 219 | 64 | 29.2 | 2010.63±344.64 |
| Female | 197 | 53 | 26.9 | 1663.68±316.55 |
| P-value | - | >0.05 | 0.00 | - |
| **Mother's educational background** | - | - | - | - |
| No formal education | 63 | 31 | 49.2 | 3284.59±816.08 |
| Primary | 63 | 29 | 46.0 | 3561.51±834.67 |
| Secondary | 116 | 40 | 34.5 | 2158.35±455.86 |
| Tertiary | 174 | 17 | 9.8 | 496.55±164.41 |
| P-value | - | <0.05 | 0.00 | - |
| **Father's educational background** | - | - | - | - |
| No formal education | 45 | 23 | 51.1 | 3116.82±841.71 |
| Primary | 55 | 27 | 49.1 | 3248.71±927.53 |
| Secondary | 121 | 42 | 34.7 | 2663.60±522.26 |
| Tertiary | 195 | 25 | 12.8 | 650.46±170.02 |
| P-value | - | <0.05 | 0.00 | - |
| **Sanitation** | - | - | - | - |
| Bush | 43 | 30 | 69.8 | 4653.21±1107.66 |
| Latrine | 150 | 55 | 36.7 | 2528.96±466.39 |
| Water closet | 223 | 32 | 14.3 | 845.91±192.95 |
| P-value | - | <0.05 | 0.00 | - |
| **Water supply** | - | - | - | - |
| Borehole | 94 | 10 | 10.6 | 505.02±242.93 |
| Well | 309 | 95 | 30.7 | 2131.88±294.97 |
| Stream | 13 | 12 | 92.3 | 4747.54±1700.69 |
| P-value | - | <0.05 | 0.00 | - |
| **Hygiene** | - | - | - | - |
| Washing hands after toilet | - | - | - | - |
| Yes | 305 | 51 | 16.7 | 982.58±189.76 |
| No | 111 | 66 | 59.5 | 4219.68±662.60 |
| P-value | - | <0.05 | 0.00 | - |
| Washing hands with soap and water | - | - | - | - |
| Yes | 194 | 15 | 7.7 | 515.51±185.63 |
| No | 222 | 102 | 45.9 | 3009.30±394.06 |
| Washing hands with water only | | | | |
| Yes | 111 | 36 | 32.4 | 1798.91±397.83 |
| No | 305 | 81 | 26.6 | 1863.58±286.67 |
| P-value | - | >0.05 | 0.238 | - |

**Table 1.** Contd.

| | | | | |
|---|---|---|---|---|
| **Deworming history** | - | - | - | - |
| <3 months | 78 | 2 | 2.6 | 2.46±1.94 |
| 6 month | 26 | 1 | 3.8 | 76.62±76.62 |
| 1 year | 96 | 10 | 10.4 | 547.25±220.93 |
| Never dewormed | 216 | 104 | 48.1 | 3302.56±418.58 |
| P-value | - | <0.05 | 0.00 | - |

EPG: eggs per gram; SEM: standard error of mean.

between groups were determined using chi-squared ($\chi^2$) tests. Mann-Whitney U test was used to test for differences in the intensity of infection between dichotomous groups and Kruskal-Wallis tests for groups with more than two levels. Multivariate logistic regression was further applied to assess the predictive effect of the various variables measured on the prevalence of ascariasis in the schools. P- value less than 0.05 were taken as statistical significant association dependent and independent variables.

## RESULTS

### Overall infection patterns

The cross-sectional study showed that out of the 416 children examined, 117(28.1%) were positive for *A. lumbricoides* eggs at an overall mean intensity of 1846.33 ± 235.23 eggs per gram (epg). In terms of distribution of infection among sub-groups, the prevalence increased from youngest age group, 24 to 35 months (17.9%) to a peak (33.1%) in the 48 to 59 months age group, while the intensity increased from 1362.17 ± 264.79 epg in children aged 36 to 47 months until it peaked at 2264.14±493.58 epg in children aged 48 to 59 month.. Neither prevalence nor intensity was significantly gender-dependent though each was higher in males than females. Prevalence and intensity of *Ascaris* infection were significantly lower among children with both mother (9.8%; 496.55±164.41 epg) and father (12.8%; 650.46±170.02 epg) having tertiary education than mother (34.5 to 49.2%; 2158.35 to 3561.51 epg) and father (34.7 to 51.1%; 2663.60 to 3248.71 epg) having at least a primary education or no formal education. Prevalence and intensity were significantly lower among children with access to boreholes (10.6%; 505.02±242.93 epg) and water closets (14.3%; 845.91±192.95 epg) than their counterparts utilizing other sources of water supply (30.7 to 92.3%; 2131.88 to 4747.54 epg) and/or lacking access to any toilet facility (36.7 to 69.8%; 2528.96 to 4653.21 epg). Both prevalence and intensity were significantly lower among children who wash their hands after using the toilet or before eating (16.7%; 982.58±189.76) compared to those that do not wash their hands (59.5%; 4219.68±662.60). Considering hand washing with water only and hand washing with soap and water, it was found that both prevalence and intensity were significantly lower in children who reported washing hands with soap and water (7.7% 515.51±185.63) than those who reported negatively (45.9%; 3009.30±394.06), while infection pattern was independent on whether children reported washing hands with water only or not.

### Logistic regression analysis

Table 2 summarised the results of logistic analysis carried out to determine the relative effect of explanatory variables on the prevalence of ascariasis in the study area. After adjusting for the effect of individual variables, ascariasis can be explained by five variables which are considered to be the risk factors. These are parent's educational background, sanitation, hand washing with soap and water and deworming history. Risk of ascariasis decreases from children whose fathers had no formal education to a minimum among those whose fathers had secondary education. The odds of harbouring *Ascaris* for children whose mothers had a secondary education were 4.2 times than children whose mothers had a tertiary education. The risk of *Ascaris* infection is 1.7 times higher among children that used the bushes indiscriminately than those who had access to water closet. The risk of infection is lower among children that washed their hands with water and soap than those who did not. Children who had received anthelminthic treatment prior to faecal collections were less likely to be infected than those who had never received treatment.

## DISCUSSION

The present study has revealed that an overall prevalence of 28.1% for *A. lumbricoides* infection was obtained among the pre-school aged children investigated in Ile-Ife, Osun State, Nigeria. The prevalence value obtained is higher than the national average of 18.6% (Crompton, 1989). The prevalence of infection is higher than prevalence of 13.1% reported among the same age group in the same region over a decade ago (Asaolu et al., 2002). The possible reason for this might be due to re-infection resulting from unhygienic habit of this age

**Table 2.** Logistic Regression model of the risk factors for *Ascaris lumbricoides* among the preschool-aged children.

| Risk factor | Number examined | Prevalence (%) | Odds ratio (95% CI) | P-value |
|---|---|---|---|---|
| **Fathers' educational level** | - | - | - | 0.035* |
| No formal education | 45 | 51.1 | 16.687(1.733-160.682) | 0.015 |
| Primary | 55 | 49.1 | 6.136 (1.041-36.158) | 0.045 |
| Secondary | 121 | 34.7 | 0.941(0.311-2.845) | 0.914 |
| Tertiary[a] | 195 | 12.8 | - | - |
| **Mothers' educational level** | - | - | - | 0.003* |
| No formal education | 63 | 49.2 | 0.211(0.025-1.760) | 0.151 |
| Primary | 63 | 46.0 | 1.881(0.433-8.174) | 0.399 |
| Secondary | 116 | 34.5 | 4.270(1.339-13.614) | 0.014 |
| Tertiary | 174 | 9.8 | - | - |
| **Sanitation** | - | -- | - | 0.029* |
| Bush | 43 | 69.8 | 1.691 (0.374-7.658) | 0.495 |
| Latrine | 150 | 36.7 | 0.421 (0.151-1.174) | 0.495 |
| Water closet[a] | 223 | 14.3 | - | - |
| **Water supply** | - | - | - | 0.204 |
| Borehole | 94 | 10.6 | 0.077 (0.005-1.291) | 0.075 |
| Well | 309 | 30.7 | 0.112 (0.008-1.501) | 0.098 |
| Stream[a] | 13 | 92.3 | - | - |
| **Hand-washing with water only** | - | - | - | - |
| Yes | 111 | 32.4 | 0.449 (0.171-1.178) | 0.104 |
| No[a] | 305 | 26.6 | - | - |
| **Hand-washing with soap and water** | - | - | - | - |
| Yes | 194 | 7.7 | 0.107 (0.034-0.338) | 0.000* |
| No[a] | 222 | 45.9 | - | - |
| **Time since last anthelminthic treatment** | - | - | - | 0.000* |
| <3 months | 58 | 2.6 | 0.011 (0.002-0.068) | 0.000 |
| 6 months | 42 | 3.8 | 0.008 (0.001-0.123) | 0.001 |
| 1 year | 40 | 10.4 | 0.153 (0.061-0.383) | 0.000 |
| Never[a] | 172 | 48.1 | - | - |

[a]=Reference category
95% CL, 95% confidence limit

group playing with contaminated soil and irregular deworming exercise. The prevalence of *A. lumbricoides* infection recorded in this study is significantly lower than the prevalence of 85.7% reported from preschool aged children in Ibilo, Akoko-Edo LGA, Edo State, Nigeria (Nmorsi et al. 2009), and higher than prevalence of 12.5% reported from the same age group in three villages in Ife North LGA, Osun State (Kirwan et al., 2009). However, it is comparable to a prevalence of 30.9% reported among the same age group of children in selected Local Government units in the Philippines (Belizario et al., 2013). Both the prevalence and intensity of *A. lumbricoides* infection were higher in males than in females, although the gender of the children was not found to be significantly associated with infection. Since there was no gender significant difference in gender related prevalence pattern, the propensity to ingest contaminated soil is similar in the two sexes (Culha et al*.,* 2007, Faiza et al., 2009). Our findings also showed a direct relationship between patterns of infection and sanitation.

The risk of *A. lumbricoides* infection is 1.7 times higher among children that practise indiscriminate defecation in the bush than those that have access to water closet, while those who used latrines are 0.4 times less likely to be infected. Though these findings may be explained by the varying degrees of environmental contamination associated with the various facilities for sanitation, it is also conceivable that where access to improved facilities for sanitation is a direct indicator of socio-economic stratification, differences in socio-economic status will play vital roles in explaining observed patterns of infection. For instance, it was observed in this study that there is a link between access to improved facilities and improved educational background. Thus, though it is well established that facilities like bucket latrines and defecation in the bush spread faecal matter in the environment, it is inconceivable that people are infected just because they use such facilities. Explaining the observed infection patterns should therefore also take into consideration earlier reports suggesting that the effect of any facility to reduce environmental contamination and disease transmission depends not just on access but also on educational background, awareness and ability to use improved facilities well. This conclusion is strongly supported by our findings and that of Quihui et al. (2006) which found that though both prevalence and intensity decreased significantly in children with access to water closets, the infection pattern was progressively better as parents' educational background improved.

## Conclusion

This study also found a strong association between infection pattern in children and hand washing with soap and water. Children who washed their hands with water and soap were less likely to be infected than those who did not. Hand washing with soap might remove the parasite eggs, reduce the egg load and because of the adhesive nature of the eggs washing hands with water only may not totally remove the *A. lumbricoides* eggs. This finding corroborates the observation of Awasthi et al. (2008) who reported that the exclusive use of soap and water after defecation was protective against geohelminth infection. Mumtaz et al. (2009) also reported that majority of the infected pre-school aged children at the tertiary care hospital in Karachi did not wash their hands with soap and water regularly. Our study found a strong association between deworming history and the prevalence of *A. lumbricoides* infection. The prevalence of infection was lowest among children who dewormed three months before they were examined while the highest was recorded among children who had never received any antihelminthic treatment.

The multivariate analysis also showed that children who received antihelminthic treatment prior to the study were less likely to be infected than those who had never received any anthelminthic treatment. Similar result had been reported among primary school children in Ebenebe town, Anambra state, Nigeria that children who had never taken antihelminthic drugs in their life had high prevalence of geohelminth infection (Chukwuma et al., 2009). Damen et al. (2010) reported a lower prevalence of helminth infection among children who had received anthelminthic drugs prior to the time their faecal samples were collected while a high prevalence of infection was recorded among children who did not receive antihelminthic medication before their stools were collected for analysis. This study has been able to identify risk factors which facilitate the transmission of *Ascaris* infection and the findings from this study will help in planning a sustainable ascariasis control programme in the area of study. It is worthy of note that among children who had received antihelminthic treatment prior to the study, some were still infected with ascariasis. This could be attributed to the fact that the antihelminthic used might not be effective and could also be due to reinfection because of the contaminated environment.

## ACKNOWLEDGEMENTS

We thank the parents of the children examined at Ile-Ife for their assistance in the collection of faecal samples from their children.

## Conflict Interests

The authors declare that there is no conflict of interests regarding the publication of this article.

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