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Epidemiology of Soil-Transmitted Helminthiasis Among Pre-School Children in Ijebu-Jesa, Southwest, Nigeria

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ABSTRACT: *A cross-sectional study was conducted between January 2012 and June 2013 among children aged 0-60 months attending monthly clinic organized by St. Andrew's Clinic for Children (STACC) with a view to determining the prevalence and intensity of soil-transmitted helminthiasis (STH) among pre-school children. The study also identified the associated risk factors for Ascaris lumbricoides infections. Fresh faecal sample were collected from 223 children randomly selected into the labeled sample bottle in addition to a pretested questionnaire to collect demographic information from parents of these children. The faecal samples were homogenized, processed in the laboratory by modified Kato-Katz technique and then examined for Soil-transmitted helminthes eggs using light microscope at a magnification of x100. The data collected were analysed using SPSS statistical software Version 17.0.Of the 223 children examined, 73 (32.7%) were positive for at least one helminth. The prevalences of the helminths eggs were 31.4% for Ascaris lumbricoides, 1.8% for T. trichiura, 0.9% for hookworm and 0.5% for Strongyloides stercoralis. The prevalence and intensity of soil-transmitted helminthes (STHs) increased with age; however, there was no significant difference (P>0.05) in the prevalence of infection between the two sexes. A co-infection of A. lumbricoides was the dominant infection. The lowest prevalence and intensity (15.6%; 31.27 ± 10.83), highest prevalence 58.3% and intensity (1943.33 ± 908.80) occurred in children aged 48-59 months. Multivariate logistic analysis revealed that the pattern of A. lumbricoides infection was strongly influenced by animal ownership.*

KEYWORDS: *Ascaris lumbricoides;* Kato-Katz technique; Pre-School Children; Nigeria; Soil-transmitted helminthiasis (STH)

INTRODUCTION

Soil-transmitted helminth (STH) infections are among the most common infections worldwide especially among human populations living in developing nations. They are major public health

problem in these countries (Hotez *et al.,* 2003; Ojha *et al.,* 2014). About two billion people are infected with STHs and 12,000 deaths are associated with this infection each year (WHO, 2002; 2012). Soil- transmitted helminths (STHs) are group of parasitic nematode worms that afflict humans through the ingestion of infective egg or contact with larvae (Neva and Brown, 1994; Nokes and Bundy, 1994). Parasitic nematodes have a widespread prevalence and distribution that results in hundreds of millions of humans infections, and these include large round worm *Ascaris lumbricoides*, whip worm *Trichuris trichiura*, and the hookworm *Ancylostoma duodenale* and *Necator americanus* (Hotez *et al.,* 2003).

STHs are estimated to affect more than 1.5 billion people worldwide and are associated with at least 12,000 deaths each year (WHO, 2017). The disease burden depends on the regional ecological conditions and also on local standard of living of the people (Ukpai and Ugwu, 2003). For all human soil-transmitted helminthes studied to date, worm burdens exhibit a highly over dispersed distribution so that most individuals harbor just a few worms in their intestines while a few hosts harbour just a few worm in their intestines while a few hosts habour disproportionately large worm burden (Hotez *et al.,* 2003). This over dispersion has many consequence, both with regard to the population biology of the helminths and public health consequence for the host, because heavily infected individuals are simultaneously at the risk of disease and the major source of environmental contamination (Hotez *et al.,* 2003).

Infection with STHs is subtle but has enervating effect on the body system; including growth and cognitive impairment, anaemia and decreased productivity (WHO, 2005; Hotez *et. al.,* 2009). Adult worms in the host feed on nutrients, proteins and blood especially for hookworms and can cause intestinal obstruction in case of *A. lumbricoides*. STHs contribute to malnutrition, iron deficiency anaemia and affect cognitive performance (Crompton, 2000). Morbidity is associated with the intensity of infection, which peaks in school-age children and reduced by lower exposure and increased immune response (Bundy, 1995).

The prevalence of STHs in Nigeria had been reported to be very high with variations in each region. In a study conducted in South-west Nigeria over two decades ago, it was reported that the prevalence of *A. lumbricoides* reached a peak level among children within age 11-14 years (Asaolu *et al*., 1992). School-aged children are particularly vulnerable to STHs infections and are known to harbor the heaviest burden of infections and therefore suffer most from associated morbidity. Morbidity and children of this age group have been the focus of intervention studies and age targeted strategies for chemotherapy (Asaolu *et al.,* 1991, 1992, Holland *et al.,* 1996). However, there has been lack of research and intervention targeted towards STH infection in pre-school children based on the assumption that prevalence and intensity are low and morbidity relatively insignificant. Recent studieshave confirmed that the pre-school children also suffer heavy burden of infection (Kirwan *et al.,* 2009; Sowemimo and Asaolu, 2011). Hence this study is planned to provide information on the endemicity of STH infection among pre-school age children in the area of study.

MATERIALS AND METHODS

Study Area

The study was conducted at Ijebu-jesa which is located in Oriade Local Government Area. The town is on $7^0 40' 49.96'' N 4^0 48' 29.47'' E$ in the north-eastern part of Osun State, Nigeria. It has an area of 465 km^2 and the town is situated eight kilometres north of Ilesa and about 128 kilometres east of Ibadaan. The annual mean temperature is 23^0C-28^0C. The annual mean rainfall is about 1500 mm . It lies approximately on latitude 7.45^0N within the rain forest belt which is favourable for farming on a large scale. It has population of 148.617 as at last population and housing census (National Bureau of Statistics, 2006 census).

The inhabitants are predominantly Yoruba speaking people of the Southwest with a mixture of people from different ethnic groups in Nigeria. Farming is the main occupation of the people but some are traders, transport workers, artisans and civil servants.

Study Population

The studied population was the pre-school children in Ijebu-Jesa and its environs brought to the clinic organized by St. Andrew's Clinic for Children for treatment of various parasitic and infectious diseases.

Study Design

Samples were randomly collected from the children after the informed conscent of their parents/guardians. Each child was given a wide-mouth screwed cap universal sample bottle bearing the serial number that was assigned to the children in the record book. It was explained to the parents/guardians the quatity of feaces to be put in the bottle.The differences in prevalence and intensity of infection were tested by Chi square (χ^2) and one-way analysis of variance (ANOVA) test respectively. Statistical difference was assign at P-0.05. Multiple logistic regression analysis was used to determine effects of independent variables on the prevalence of the soil transmitted infections using estimated adjusted odd ratio at 95% confidence intervals as basis of judgment.

Ethical Consideration

This study was approved by Institutional Review Boards at Obafemi Awolowo University, Ile-Ife, Nigeria. Prior to the commencement of the research, verbal consent was obtained from the government health authority. Written informed consent was obtained from the children's parent /guardian. All information obtained from the participants was treated with confidentiality, only willing parents/guardians were allowed to participate in the research.

Collection of personal data and faecal samples

A total of 223 of pre-school children aged 0-60 months were accessed between January, 2012 and June 2013. Labelled plastic bottles with a wooden spatula for the collection of faeces were distributed to parents/guardians of these children. A pre-tested questionnaire was given to the

parents/guardians to be filled out to assess parental education and occupation, hygiene habits (type of toilet), the use of anthelminthics and other factors related to intestinal parasites, particularly soil-transmitted helminths. Faecal samples submitted were examined for the eggs of helminth parasites.

Parasitological Procedures

Each faecal sample was collected in a clean 30ml universal plastic bottle, fixed in 10% aqueous formalin solution. In the laboratory, the samples were examined for *A. lumbricoides*, *T. trichiura* and hookworm eggs by the modified Kato-Katz technique (Forrester and Scot, 1990). This involved passing a subsample of each specimen through double-ply gauze to remove rough materials and washing with water, as necessary. The filtrate was then centrifuged at 2500 rpm for 5min, the supernatant fluid decanted, and the tube allowed to drain for 5 min. About 50 mg of the substrate was transferred on to a clean microscope slide, covered with a cover-slip soaked overnight in 50% glycerine-malachite green solution and carefully pressed to spread for even distribution. The slide was examined under a microscope at x 100. Eggs were identified by their characteristic features peculiar to them (WHO, 1994). Helminth eggs were counted for each species of STHs and multiplied by a factor of 24 in order to get the number of eggs per gram of stool (epg).

Data Processing and Analyses

Data was edited during and after the collection exercise. The data were entered using SPSS version 17.0.The differences in prevalence of helminth infection between age group, sex and school were tested by chi-squared (χ^2) tests. A Mann–Whitney U-test was used to test the difference in epg between sexes, while Kruskal–Wallis tests were used to test the difference in epg among age groups. Multivariate logistic regression was also applied to determine the predictive effect of the various variables investigated (source of water supply, type of latrine, mother's occupation and educational background, father's occupation and educational background, sex, age, personal hygiene of the child and the use of anthelminthics) on the prevalence of helminth parasites among pre- school children.

RESULT

Prevalence of Helminth Infections

The overall prevalence of soil-transmitted helminths (STH) infection recorded in this study was 32.7%. The occurrence of STH in relation to the faecal sample collected from pre-school children is presented in Fig.1. The overall prevalences of *A. lumbricoides*, *T. trichiura* and hookworms recorded were 31.4%, 1.8% and 0.9%, while 0.5% had infection with *Strongyloides stercoralis* (Fig.1.).

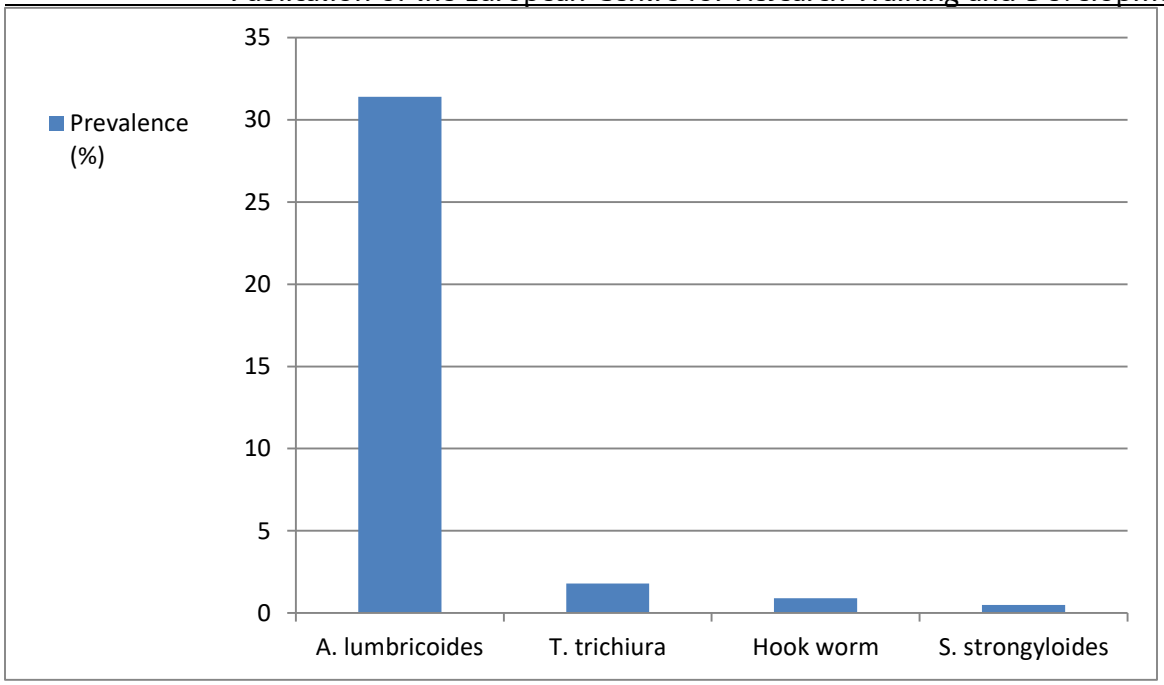

Fig 1: The Prevalence of Soil-Transmitted Helminth Infection

Prevalence of Soil-Transmitted Helminths in relation to Sex and Age of Children

The prevalence of STH infection among the children in relation to sex and age of children is shown in Table 1. In both sexes, the prevalence of infection increased sharply from 16.5% in children age 0-11 months to prevalence of 42.2% in children aged 12-23 months. The prevalence then fell to 38.5% in children aged 24-35 months and then the highest prevalence 58.6% was recorded in children aged 36-47.

In males, the prevalence of infection increased sharply from 18.9% in children aged 0-11 months to a prevalence of 44.0% in children aged 12-23 months and steadily increased until it reached the peak of 83.3% in children aged 48-59 months. In females, there was no definite pattern in the prevalence of infection; however the lowest prevalence of 14.3% was recorded in children aged 0-11 months while the highest of 71.4% was recorded in children aged 36-47 months.

The overall prevalence of STH infection was higher in males (34.3%) than in females (31.3%), however there was no significant difference in the prevalence of infection between the two sexes ($P>0.05$).

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Table 1: Prevalence and intensity of Soil-Transmitted Helminths by Age and Sex in 223 Pre-School Children from Ijebu-Jesa

Age group (Months)	Male			Female			Both Sexes		
	Number Examined	Number Infected	Prevalence (%)	Number Examined	Number Infected	Prevalence (%)	Number Examined	Number Infected	Prevalence (%)
0-11	**53**	**10**	**18.9**	**56**	**8**	**14.3**	**109**	**18**	**16.5**
12-23	**25**	**11**	**44.0**	**20**	**8**	**40.0**	**45**	**19**	**42.2**
24-35	**9**	**4**	**44.4**	**17**	**6**	**35.0**	**26**	**10**	**38.5**
36-47	**15**	**7**	**46.7**	**14**	**10**	**71.4**	**29**	**17**	**58.6**
48-59	**6**	**5**	**83.3**	**8**	**4**	**50.0**	**14**	**7**	**58.3**
Total	**108**	**37**	**34.3**	**115**	**36**	**31.3**	**223**	**73**	**32.7**

Prevalence of *Ascaris* infection in relation to sex and age of children

The prevalence of *Ascaris* infection among the children is shown in Table 2. The prevalence pattern observed in *Ascaris* infection was similar to that observed for STH infection. In both sexes, the prevalence of infection increased rapidly from 15.6% in children aged 0-11 months to prevalence of 40.0% in children aged 12-23 months. The highest prevalence 58.3% was observed in children aged 48-59.

In males, the prevalence of infection increased sharply from 17.0% in children aged 0-11 months to a prevalence of 40.0% in children aged 12-23 months and steadily increased until it reached the peak of 83.3% in children aged 48-59 months. In females, there was no definite pattern in the prevalence of infection; however the lowest prevalence of 14.3% was recorded in children aged 0-11 months while the highest 71.4% was recorded in children aged 36-47 months.The overall prevalence of STH infection was higher in males (31.5%) than in females (31.3%), however there was no significant difference in the prevalence of infection between the two sexes (χ^2=0.001, P=0.977).

Table 2: Prevalence of *Ascaris* infection in Relation to the Age and Sex of 223 Pre-School aged Children from Ijebu-Jesa

Age group (Months)	Male		Female		Both Sexes	
	Number Examined	% Infected	Number Examined	% Infected	Number Examined	%
0-11	53	17.0	56	14.3	109	15.6
12-23	25	40.0	20	40.0	45	40.0
24-35	9	44.4	17	35.3	26	38.5
36-47	15	40.0	14	71.4	29	55.2
48-59	6	83.3	8	50.0	14	58.3
Total	108	31.5	115	31.3	223	31.4

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Intensity of *Ascaris lumbricoides* in children by age and sex

The mean intensities of *Ascaris* infection in the children determined by egg per gram of faeces are shown in Table 3. In both sexes, the intensity of *Ascaris* infection rose sharply from 31.27±10.83 epg in children aged 0-11 months and gradually increased until it reached the peak in children aged 48-59 months.

In males, the intensity of infection increased sharply from 50.72±21.16 epg in children aged 0-11 months to intensity of 2858.67±3691.64 epg aged 48-59 months. In females, there was no definite pattern of infection; however the lowest infection of 12.56±5.96 epg was recorded in children aged 0-11 months while the highest was recorded in children aged 48-59 months.

Table 3: Intensity of *Ascaris lumbricoides* in children by age and sex of the pre-school children

Age group (Month)	Male		Female		Both Sexes	
	Number Examined	Mean ± SEM	Number Examined	Mean±SEM	Number Examined	Mean±SEM
0-11	53	50.72±21.26	56	12.56±5.96	109	31.27±10.83
12-23	25	337.92±706.91	20	804.00±501.23	45	545.07±235.57
24-35	9	1080.00±808.10	17	882.35±504.27	26	950.77±423.20
36-47	15	1659.73±930.67	14	1591.43±568.97	29	1626.76±544.61
48-59	6	2858.67±3691.64	8	17960.00±4289.67	14	1943.33±908.80
Total	108	582.44±180.74	115	818.37±253.17	223	704.11±157.04

Logistic Regression Analysis

The logistic regression analysis of data from pre-school children attending St. Andrew's Clinic for Children in Ijebu-Ijesa revealed after adjusting for other variables that only animal ownership (out of 13 variables entered into the model) played a significant role in the prevalence of ascariasis (Table 4) all other variables were not significant. All the last group in each variable was fixed to allow for non-linear interaction with other categories.

Types of animal reared were found to be significant in the infection of *A. lumbricoides*. Children whose families reared dogs were 4.3 times likely to be infected with *Ascaris* compared with children whose families reared other animals. Children whose families whose families reared cats

were 4.7 times more likely to be infected with *Ascaris* compared with children whose families reared other animals.

Table 4: **Result of Logistic Regression Analysis showing the Effect of Different Variables on the Prevalence of *Ascaris* infection in Ijebu-Jesa, Osun State**

Risk factors (Variables)	Number Examined	df	Significance	Odd ratio (Exp)	95% CL Lower class-Upper class
Type of animal		2	0.031		
Dog	45	1	0.01	4.3	1.416-13.238
Cat	2	1	0.437	4.7	0.096-227.878
Others[a]	119	____	____	____	____

95% Cl, 95% confidence limits. Variables are arranged in the order they were removed by the backward stepwise method (Wald). [a]Reference group.

DISCUSSION

The overall prevalence of soil-transmitted helminthiasis (STH) recorded among pre-school children examined ai Ijebu-Jesa was 32.7%. Previous studies in Nigeria have reported a prevalence range between 25.0-74.8% (Asaolu *et al*; 1992; Sur, 2005). The prevalence of STH obtained in this study was significantly lower than the prevalence of 94.3% from Ibilo, Akoko-Edo L.G.A. Edo State (Nmorsi *et al.,* 2009), 67.5% from three villages in Zaria (Adebote *et al.,* 2004). The prevalence value of STH obtained in this study was also comparable to 34.4% recorded in a study conducted at Ile-Ife (Sowemimo and Asaolu, 2011).

This study observed that *A. lumbricoides* was the most frequently encountered helminth with a prevalence of 31.4%. Previous studies in Nigeria and other parts of the world have reported *A.lumbricoides* to be the most common helminthes among the STHs (Akogun and Badaki, 1998; Asaolu *et al.,* 2002; Sowemimo and Asaolu, 2011). It has been discovered that the infective stages of *A. lumbricoides*, the embryonal eggs have enormous capacity for withstanding the environmental extremes of urban environments (Hotez *et al.,* 2003).

The high prevalence of *A. lumbricoides* (40.0%) in children aged 12-23 months found in this study supports the recommendation of WHO to enroll children aged 1-2 years to undergo deworming programmes for STHs. The prevalence of *Trichuris trichiura* obtained in this study was very low. This shows that few children harbor this parasite. Similar finding was reported in a study conducted among children aged 0-25 months in three selected villages in Ife North L.G.A. (Kirwan *et al.,* 2009). Previous studies have reported that *Ascaris lumbricoides* and *T. trichiura* infections are more important in younger children as opposed to hookworm which is found in older age groups (Asaolu *et al*., 2002). Similar result was obtained in this study where children age 0-11 months had the lowest prevalence. High prevalence observed in older age groups may be due to weaning

from breast milk to solid foods and better mobility of children greater than 1 year which expose them to risk of contact with contaminated materials that have helminth eggs.

The study observed that children were infected with *A. lumbricoides* early in life in the first half of their first year. The youngest child found infected was 6 months old, and thereafter prevalence increased significantly. This pattern of infection is typical among pre-school age children in many parts of the world where ascariasis is endemic (Elkins *et al.,* 1986; Brooker *et al.,* 1999). The early infection with ascariasis observed among pre-school children in this study could be associated with consumption of contaminated complementary food through use of utensils washed with well water, which was the common source for washing clothes, utensils and bathing of more than 50% of the families. Similarly, factors associated with normal development such as crawling from 5 months of age could be important risk behaviour.

Previous studies have recorded heaviest infections for *A. lumbricoides* among children (Giles,1996; Roy *et al*., 2011). This is similar to the finding in this study where infected children have more burden with *A. lumbricoides.* This pattern of infection is related to the fact that human ascariasis are spread through faecal pollution of soil, and so the intensity of infections depends on the degree of soil pollution (Giles, 1964). The study also observed that males were more infected with soil-transmitted helminths than females although there was no significant difference in prevalence of infection.

Animal ownership either dog or cat was significantly associated with the prevalence of *A. lumbricoides* and was retained as a significant risk factor in the logistic regression model. There was a positive association between families that keep dogs and cats and *Ascaris* infection. Traub and colleague have demonstrated that dogs were significant disseminators and environmental contaminators of *A. lumbricoides* in communities where promiscuous defecation by humans occurs (Traub *et al.,* 2002). This association suggests that there may be a significant health risk for young children in similar communities where dogs are present.

CONCLUSION AND RECOMMENDATION

The findings from this study suggest that many young children, who are at a critical stage of development, are infected with *Ascaris* and other STHs and that the rate of infection with these parasite increase with age. This study has demonstrated the need to incorporate pre-school children into deworming programmes in endemic regions and to explore innovative ways of delivering cost-effective deworming treatment to this high-risk age group.

It is recommended that deworming combined with efforts to bring about behavioural changes, improvement in sanitary facilities and use of purified water are important to reduce the burden of STH in young children in the area of study.

Ethical Statement

- Acknowledgements: We thank the all their staff of St. Andrew's Clinic for Children Ile-Ife for their support during the period of this research and the parents/ guardians that willingly participated in the study.
- Funding: This research work did not receive external funding.
- Financial or non-financial interests: Not applicable
- Ethical approval: This study was approved by Institutional Review Boards at Obafemi Awolowo University, Ile-Ife, Nigeria. Prior to the commencement of the research, verbal consent was obtained from the government health authority.
- Informed consent: Written informed consent was obtained from the children's parent /guardian. All information obtained from the participants was treated with confidentiality, only willing parents/guardians were allowed to participate in the research.
- Conflict of Interest: No conflict of interest.
- Authors' contribution: Femi Awotokun and Oluyomi Abayomi Sowemimo contributed to the research design and were involved in feld and laboratory work. Femi Awotokun carried out statistical analysis, interpreted the result of the study, and wrote the first draft of the manuscript.

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