



## **RISK FACTORS OF HOOKWORM INFECTION IN A TOURIST DESTINATION IN CROSS RIVER STATE, NIGERIA**

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### **ABSTRACT**

The study aimed at elucidating the prevalence and risk factors of hookworm infection in a tourist destination in Cross River State, Nigeria, was carried out among children from two clusters of Primary schools in Obudu. The two clusters, the high fee paying (HFP) schools and the low fee paying (LFP) schools, comprised pupils of one to nine years old. A well-structured questionnaire was used to obtain data on the socio demographic and risk factors of hookworm. Stool samples were collected and processed using the brine method for presence of hookworm eggs. In all, 387 children were examined, 197 from LFP schools, and 190 from HFP schools. Overall prevalence from both clusters pooled together was 33.6%; and was significantly higher (38.1%) among children from LFP schools than those from HFP schools (28.9%) (  $\chi^2$ -test,  $p > 0.05$ ). Prevalence decreased with age and was significantly higher among younger (5- and 6-year olds) than the older children (7-9 years old) (  $\chi^2$ -test,  $p > 0.05$ ). The risk of getting infected with hookworm was reduced by 34% by being in HFP schools as against LFP schools. Washing vegetables before eating them reduced the risk of infection by 95%. Washing of hands before eating also reduced the risk of getting infected by 94%. Geophagy increased the risk by 85%. The chances of getting infected varied significantly depending on mother's level of education; children whose mothers had no formal education were far more likely to be infected than children whose mothers had tertiary level education (Odds ratio: 54.4). The chances of the children getting infected reduced considerably as their mothers' level of education improved. A comparative analysis of the performances of the HFP and LFP schools in the risk factors assessment indicated significant differences between the two clusters of schools (  $\chi^2$ -test;  $p < 0.05$  for all tests). Hookworm is endemic in Obudu. Urgent mitigation measures advised.

**KEY WORDS:** Hookworm, risk factors, poverty, tourism, Nigeria.

### **INTRODUCTION**

Parasitic diseases immensely undermine the health status of people thereby jeopardizing the economic development of nations in the tropics (Ukoli, 1999; Adeyeba and Tizani, 2002). One of such important parasitic infections is hookworm infection. Hookworm infection is an important cause of anemia in endemic areas (Magalhaes and Clements, 2011), and is regarded as the most common disease of the poor after malaria (Hotez *et al.*, 2006). About 2.376 billion persons are at risk of infection worldwide (WHO, 2005). The number of persons actually infected is 576 million, and most of these are found in sub Saharan Africa, Southeast Asia, India and the Americas (Bethony *et al.*, 2006). Two genera of hookworm have worldwide distribution. These are *Necator* and *Ancylostoma* but *Necator* is more prevalent in Africa. Hookworm infection occurs mostly among school-aged children, pregnant women, and their newborns (Ukoli, 1999). It occurs in areas of extreme poverty, areas without good toilet facilities where defecation is consequently littered around the environment, and lack access to essential medicines (Hotez *et al.*, 2006), areas where non-composted human faeces from infected persons are used as manure for fertilizing crops such as cabbages, onions, carrots, potato among others, thereby depositing hookworm eggs on the soil. This is why hookworm larvae are found in raw and unwashed vegetables. The state of health in Obudu is related to its social, economic and

environmental variables such as social status, income, occupation, quality of water drainage, proper housing and health awareness. All these contribute to the development and transmission of many intestinal parasites including hookworm. Illness can result from exposure to harmful parasitic agents through skin contact with contaminated soil, ingestion of soil or contaminated material (most likely in younger children), drinking contaminated water, ingestion of unwashed fruits or vegetables grown on contaminated land. These factors affect the health of people, especially those living in the rural parts (WHO, 1996). This study was aimed at elucidating the prevalence and risk factors of hookworm infection in a tourist destination in Cross River State, Nigeria.

### **MATERIALS AND METHODS**

#### **Study subjects**

This research work was carried out among children from two clusters of Primary schools in Obudu Local Government Area (LGA) of Cross River State, Nigeria. The two clusters were the high fee paying (HFP) schools cluster and the low fee paying (LFP) schools cluster. The ages of the pupils ranged from one to nine years.

#### **Study design**

Comparable number of pupils from both the HFP and LFP schools was recruited into the study. Awareness sessions regarding the study were conducted for teachers and parents / guardians of the pupils. Both stool collection and

questionnaire administration were carried out. Vials for stool samples were given to children whose parents have been shown how stools were to be collected. Parental consent was a necessary pre-requisite for participation in the study.

**Questionnaire administration**

A well-structured questionnaire was used to obtain data on the socio demographic and risk factors that could lead to the transmission of hookworm and other intestinal parasitic infections in school-aged children. The questionnaire was made up of 3 parts; 1. Personal information: (Name, sex, Age, class, Height, weight, school performance etc). 2. Socio-economic factors such as the educational level and occupation of parents of the children. 3. Environmental and health data of the children.

**Collection of stool samples**

The children were given a stool-sample container with tight fitting lid bearing a sample spatula. Name of each child, date and serial number were written on his/her sample container for easy identification. The parents were requested to collect the samples from the children before the latter would bath. Using the questionnaire sheet,

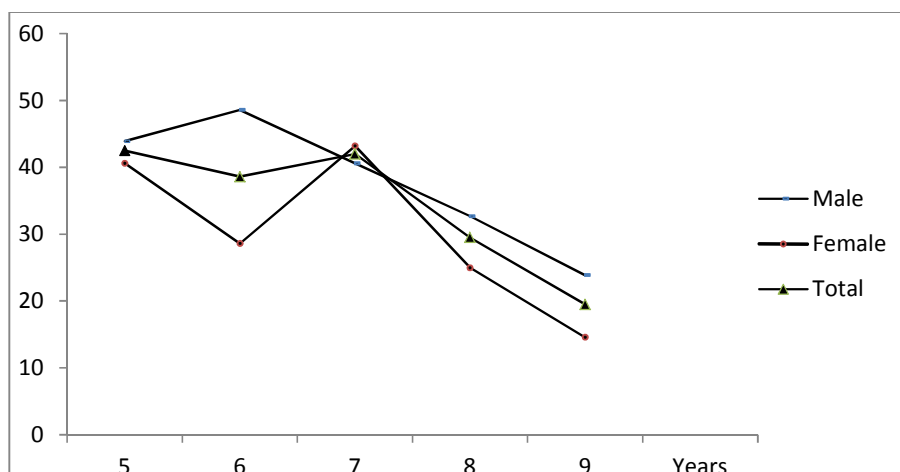
various information were obtained and received together with the stool samples at school by the class teachers. None of the children reported of any gastrointestinal symptoms during the period of sample collection.

**Laboratory examinations of stool samples**

The stool samples were taken to the laboratory for further processing for presence of the parasite's eggs. The brine method, which is a standard Sodium chloride flotation method was used to establish the presence of hookworm eggs. All the samples were processed in the laboratory within 48 hours of collection in the field.

**RESULTS**

A total of 387 children were examined, 197 from low-fee paying (LFP) schools, and 190 from high-fee paying (HFP) schools. Overall prevalence among primary school children from both HFP and LFP schools pooled together was 33.6%; and was significantly higher (38.1%) among children from LFP schools than those from HFP schools (28.9%) ( $\chi^2$ -test,  $p > 0.05$ ). Prevalence generally decreased with age among the children (Figure 1).



**FIGURE 1.** Prevalence of hookworm infection among primary school children in both the Low-fee paying and High-fee paying schools in Obudu pooled together

Prevalence in relation to age and sex among LFP schools is presented in Table 1. Prevalence among this cluster was comparable between males and females in all ages ( $\chi^2$ -test,  $p < 0.05$  for all tests). However, prevalence was significantly higher among the younger children (5- and 6-year olds) than the older ones (7-9 years olds) ( $\chi^2$ -test,  $p > 0.05$ ).

**TABLE 1.** Prevalence of hookworm in relation to age and sex in Low-Fee-Paying Schools.

Age (years)	Males		Females		Total	
	No. exam	Positive (%)	No. exam	Positive (%)	No. exam	Positive (%)
5	23	12 (52.2)	17	10 (58.8)	40	22 (55.0)
6	17	9 (52.9)	17	8 (47.1)	34	17 (50.0)
7	15	5 (33.3)	20	6 (30.0)	35	11 (31.4)
8	19	8 (42.1)	18	6 (33.3)	37	14 (37.8)
9	29	7 (24.1)	22	4 (18.2)	51	11 (21.6)
Total	103	41 (39.8)	94	34 (36.2)	197	75 (38.1)

For the HFP schools (Table 2), prevalence was significantly higher among males (34.0%) than females (23.0%), and this difference was evident in all the ages

( $\chi^2$ -test,  $p > 0.05$  for all tests). Unlike the observation in LFP schools, prevalence among the ages in HFP schools was highest among the 7-year olds (52.9%).

**TABLE 2.** Prevalence of hookworm in relation to age and sex in High-Fee-Paying Schools

Age (years)	Males		Females		Total	
	No. exam	Positive (%)	No. exam	Positive (%)	No. exam	Positive (%)
5	18	6 (33.3)	15	3 (20.0)	33	9 (27.3)
6	18	8 (44.4)	18	2 (11.1)	36	10 (27.8)
7	17	8 (47.1)	17	10 (58.8)	34	18 (52.9)
8	33	9 (27.3)	18	3 (16.7)	51	12 (23.5)
9	17	4 (23.5)	19	2 (10.5)	36	6 (16.7)
Total	103	35 (34.0)	87	20 (23.0)	190	55 (28.9)

The risks of getting infected with hookworm if a child was in a High-fee paying primary school as against a Low-fee paying one in Obudu was compared in relation to various sub-groups of the primary school children and presented in Table 3. Overall, the risk of getting infected with hookworm was reduced by 34% by being in HFP schools

as against LFP schools. In all but one sub-group of children, hookworm infection risk was consistently reduced in HFP schools. The highest reduction of risk of infection of 69% and 62% were observed among the 5 and 6-year olds schooling in HFP schools. The only exception was among the 7-year olds that recorded.

**TABLE 3.** Comparing risks of getting infected with hookworm if a child was in a High-fee paying primary school as against a Low-fee paying one in Obudu in relation to various sub-groups of the primary school children

Sub-groups	Odds ratio	Remarks
Males	0.78	Risk of getting infected at HFP schools reduced by 22%
Females	0.53	Risk of getting infected at HFP schools reduced by 47%
All children	0.66	Risk of getting infected at HFP schools as against LFP schools was reduced by 34%
5-year olds	0.31	Risk of getting infected at HFP schools reduced by 69%
6-year olds	0.38	Risk of getting infected at HFP schools reduced by 62%
7-year olds	2.45	Risk of getting infected at HFP schools is 2 times higher than in the LFP schools
8-year olds	0.51	Risk of getting infected at HFP schools reduced by 49%
9-year olds	0.73	Risk of getting infected at HFP schools reduced by 27%

Assessment of risk factors of hookworm infection among primary schools children in Obudu was analyzed in Table 4. The risk of developing hookworm in the group of primary school children that wash their vegetables before eating them is less than among those who do not wash theirs. Washing vegetables before eating them conferred some level of protection from getting hookworm infection, reducing the risk of infection by 95%. Washing of hands before eating also reduced the risk of getting infected by

94%. However, Geophagy increased the risk of getting infected by 85%. The chances of getting infected varied significantly depending on mother's level of education; children whose mothers had no formal education were far more likely to be infected than children whose mothers had tertiary level education (Odds ratio: 54.4). The chances of the children getting infected reduced considerably as their mothers' level of education improved.

**TABLE 4.** Assessment of risk factors of hookworm infection among primary schools children in Obudu.

Risk factors	Odds ratio
Washing vegetables before eating them	0.05
Washing hands after using the toilet	0.06
Geophagy	0.85
Mother's level of education:	
No formal education versus Tertiary level education	54.4
No formal education versus Secondary education	39.0
No formal education versus Primary education	10.1
Primary education versus Tertiary education	5.4
Primary education versus Secondary education	3.8
Secondary education versus Tertiary education	1.4

A comparative analysis of the performances of the HFP and LFP schools in the risk factors assessment indicated significant differences ( $\chi^2$ -test;  $p < 0.05$  for all tests) between the two clusters of schools (see Table 5). In the HFP cluster, 79.0% and 72.1% of the children respectively

washed their vegetables before eating them and washed their hands after defecating compared to 3.0% and 23.1% respectively in the LFP cluster. Only 23.7% of the children in the HFP cluster practiced Geophagy compared to 48.4% in the LFP cluster. Generally, the risk of getting infected

with hookworm infection was higher among children in the LFP cluster than those in the HFP cluster (OR: 1.5).

**TABLE 5.** Comparison of food and sanitation-related risk factors of hookworm infection between High-fee paying and Low-fee paying schools in Obudu.

	HFP			LFP			$\chi^2$ -test
	<sup>a</sup> +v	<sup>b</sup> -ve	Total (%)	<sup>a</sup> +v	<sup>b</sup> -ve	Total (%)	
Wash vegetables before eating them?							
Yes	4	129	133 (70.0%)	2	4	6 (3.0%)	p > 0,05
No	51	6	57 (30.0%)	73	118	191 (97.0%)	
Total	55	135	190 (100.0)	75	122	197 (100.0)	
Wash hands after using the toilet?							
Yes	6	131	137 (72.1)	7	39	46 (23.1)	p > 0.05
No	49	4	53 (27.9)	68	83	151 (76.9)	
Total	55	135	190 (100.0)	75	122	197 (100.0)	
Geophagy?							
Yes	18	27	45 (23.7)	20	58	78 (48.4)	P > 0.05
No	37	108	145 (76.3)	55	64	119 (51.6)	
Total	55	135	190 (100.0)	75	122	197 (100.0)	

<sup>a</sup>+v means Number of positive cases

<sup>b</sup>-ve means Number of negative cases

## DISCUSSION

Establishing a clear demarcation line between the rich and poor for use as a socio-economic variable is sometimes difficult and quite subjective. To overcome this problem, this study adopted the concept of grouping the children according to the schools they attend. In other words, a child could belong to either the high fee paying cluster or to the low fee paying cluster. Generally, wards of rich people in Nigeria are sent to the high school fee paying schools. Results from this study indicate higher prevalence of infection and higher risk of getting infected in the low fee paying schools. Reasons for this are many. In the study area and in many areas in resource limited countries such as Nigeria, there are relatively more educated and enlightened persons in the rich people cluster than in the poor people cluster. This group of people had better personal hygiene and sanitation practices than people in the poor people cluster. This observation corroborates an earlier finding in Calabar, a proximal area in Cross River State, Nigeria (Uttah and Effiom, 2009), and also findings in Iran (Nematian *et al.*, 2004), and Bangladesh (Bath *et al.*, 2010). In Malaysia the educational level was the most important factor significantly associated with better enlightenment about intestinal parasites including hookworm (Nasr *et al.*, 2013). According to the report, educated individuals were likely to be more exposed to information about intestinal helminths and good hygiene practices than illiterate individuals; hence improving the level of education in the community was expected to increase the ability of people to gain a wider understanding of intestinal helminth infections (Nasr *et al.*, 2013).

Enlightened people were more likely to inculcate good personal hygiene and sanitation practices into their children. This perhaps, explains why practices such as was washing of hands after defecation, and before eating food was adhered to more significantly by the high fee paying school children than the low fee paying school children, hence the significant disparity in their infection rates risk levels. Furthermore, the rich can afford better toilet system that minimizes contact with infective eggs of hookworms. The environment of the rich peoples cluster reduces the

risk of hookworm infection. In contrast, the general environment of the poor does enhance hookworm transmission. For example, the absence of concrete floors in places of residence, the evidently inadequate and descript sanitary facilities as well as the faeces-ridden playgrounds characteristic of poor neighbourhoods are all important factors in hookworm epidemiology (Hotez *et al.*, 2006). Moreover, the poor live in crowded places where more people share toilets which are most times in state of disrepair. The children of the poor go about barefooted most of the time except, perhaps, when attending school or on special occasions only, and this increases the risks of getting infected with hookworm (Nasr *et al.*, 2013). The risk of getting infected decreased as the children became older and agrees with some studies in Nigeria (Uneke *et al.*, 2007; Adefioye *et al.*, 2011). There are contrasting findings in different reported studies around the world regarding the relationship between prevalence of hookworm and age groups. Considering the closeness of the age of the children in this study (1-9 years), greater sample size may be required to establish a conclusion. However, the younger children are known to be more involved in geophagy compared to the older ones (Uttah and Effiom, 2009). Geophagy increased the risk of getting infected in this study. The findings on geophagy in this study corroborate a previous study in Calabar (Uttah and Effiom, 2009). Prevalence of geophagy was high in both clusters of schools, although significantly higher in the low fee paying schools. Geophagy and intestinal parasites such as hookworm infections are known to be more prevalent in children from poor background (ATSDR Workshop 2000). This could be as a result of a combination of factors principal of which include tolerant background, hunger and peer pressure (Uttah and Effiom, 2009). Nutritional status of the child could influence the desire to eat soil (More and Sears. 1994). Many of these geophagous children consume soils inadvertently and are considerably non-selective in sites they choose to eat (Wiley and Solomon, 1998). In this study, there was association between geophagy and hookworm infection corroborating findings made in similar study in Calabar (Uttah and Effiom, 2009). Hookworm is a very important

public health problem of global significance (Nasr *et al.*, 2013). It forms an evil triad with ascariasis and trichuriasis, to become one of the most important predictors of malnutrition, micronutrient deficiencies, poor cognitive function, school absenteeism and a dismal academic performance among children (Nokes and Bundy, 1994; Dreyfuss *et al.*, 2000; Guyat, 2000; Al-Mekhlafi *et al.*, 2005; WHO, 2005). This triad has devastating impact that may affect the economic productivity of endemic communities and trap them in a cycle of poverty, underdevelopment and disease (Bleakley, 2007; Hotez *et al.*, 2009; Molyneux and Malecela, 2011; Nasr *et al.*, 2013). In spite of this gargantuan impact of hookworm on children health in sub-saharan Africa and Asia (Bethony *et al.*, 2006; WHO, 2012), it is still among the most neglected tropical diseases (Nasr *et al.*, 2013). This underscores the need to intensify efforts at public enlightenment on the epidemiology of hookworm infection by comprehensively outlining and explaining the various practices, attitudes, eating preferences and other activities that constitute risk factors of the infection.

### CONCLUSION

In conclusion, hookworm infection is endemic in Obudu and highly prevalent among primary school children, especially those in the low fee paying schools. It is recommended that control programmes be initiated and sustained. Considering the limited resources available to health authorities in endemic areas, deworming programmes could be targeted at children in low fee paying schools. Furthermore, awareness campaigns in understandable formats, preferably in local dialects should be embarked upon vigorously. This should emphasize the need for attitudinal changes and improvements in personal hygiene and sanitation.

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