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Hookworm infection: A severe health problem in peri-urban community of North central, Nigeria

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ABSTRACT. In sub-Saharan Africa, hookworm infection is one of the most important tropical diseases of humans. A cross-sectional survey was conducted to investigate the prevalence, intensity and epidemiological factors of hookworm infection in Ogele community of Kwara State. Faecal samples of participants were randomly collected and screened for eggs of the parasite using kato-katz thick smear techniques. Risk factors of infection were investigated with structured pre-tested questionnaires. Of the 471 subjects examined, overall prevalence was 142 (30.1%) with mean egg intensity of 3256.04 epg (95% CI: 2977.68-3534.39). The prevalence and intensity of infection were observed to be age- and sex- dependent ($p<0.05$) with peak occurrence at > 40 years age group. Logistic regression analysis revealed that infection was influenced by the nature of occupation (with adjusted odd ratio (OR) of 4.349, 95% CI: 2.585-7.318) educational status of the subjects and their parent particularly mother (with OR of 0.695 CI: 0.317-1.524), toilet facilities (with OR of 1.491, 95% CI: 0.925-2.403), source of drinking water and the presence of bush around the habitation (with OR of 0.410 95% CI: 0.207-0.810). These findings have suggested that the listed risk factors which play a major role in the transmission of the disease need to be taken into account when formulating sustainable control strategies for hookworm and other intestinal parasites in Nigeria and elsewhere.

INTRODUCTION

Human hookworm infection is a soil-transmitted intestinal helminthiasis caused by *Necator americanus* or *Ancylostoma duodenale*. It is one of the most common neglected tropical diseases of man with severe public health implications on both children and adult populations in many resource-poor communities worldwide (de Silva *et al.*, 2003). Global estimation of 740 million cases of the disease occur in areas of rural poverty in the tropical and subtropical regions of the world with about 38 million cases in Nigeria alone (Hotez & Kamath 2009). The infection holds a unique place in modern history because of its predominant occurrence among the world's most impoverished people. Developmental cycle of the parasite is direct; humans acquire infection when the infective larval stages living in the soil penetrates the skin (Nagahana *et al.*, 1963). The severity of infection is related to the number of adult worms in the host (worm burden) and the duration of infection. Individuals with low worm burden are usually asymptomatic, suggesting that they do not provoke diseases that will require serious medical attention. This is not the case in an individual with heavy worm burden which is associated with severe and fatal syndromes leading to significant physical growth retardation, malnutrition, cognitive and educational impairments in children (WHO 2003; WHO & UNICEF 2004). The chronic stage of the infection may result in blood loss; iron deficiency anemia and hypoalbuminemia which develop when blood loss exceeds the intake and reserves of host iron and protein (Stoltzfus *et al.*, 1997). The

epidemiological data baseline of the parasite is very scarce in the study area. This cross sectional survey is aimed to investigate the prevalence, the burden and associated risk factors of hookworm in Ogele community of Kwara state, Nigeria. This study can serve as a guide in developing sound intervention strategies to reduce the disease in this and other endemic communities in Nigeria and other countries with peculiar socio-environmental conditions.

MATERIALS AND METHODS

The Study area and population

This community-based study was conducted in Ogele, a peri- urban in Asa Local Area of Kwara State, Nigeria. It is a small linear settlement located along the old Ogbomosho road, about 13km from Ilorin, the state capital. The climate of the study area is typically tropical, with well-defined wet (April–October) and dry (November–March) seasons, a mean annual precipitation of over 1133.4mm, mean annual temperature of 24°C and relative humidity of 85%. Ogele community is located in the transitional zone between the deciduous forest (rainforest) and savannah grassland. Majority of the population are of Yoruba ethnic group with small proportion of Hausa, Nupe and Fulani. Peasant farming such as growing of cassava, maize, vegetables and yam dominate the study area, wage earners are few. Generally, sanitation status of the study area is poor; most houses are devoid of toilets and ventilation, with dumpsites located close to human habitations. The community is inadequately provided with essential amenities such as electricity and portable water supply. The community only has one primary school, a secondary school and health Centre. The majority of the inhabitants are Muslims with few Christians and traditionalists.

Sample collection and Laboratory procedures

Prior to the study, Community leaders and opinion groups were visited to seek for their consent. All individuals who granted us their consent are eligible for the study except those with history of taking anthelminthic. Thereafter, participants were trained on the proper handling of the stool in labeled wide-mouth screwed-capped containers. Simultaneously, pre-tested questionnaires were administered to all volunteers to obtain demographic, socioeconomic and environmental variables. Stool sample were collected and processed for microscopic examination using Kato-katz thick smear method as described by WHO (1991). The Kato slides were examined within I hour of preparation by skilled technicians at University of Ilorin, parasitology laboratory. Egg counts per slide were converted to egg per gram of faeces (epg) by multiplying number of eggs on the slide by 24. The intensity of infection for positive individuals was then expressed as light, moderate and heavy infections according to WHO (2002) protocol.

3.4 Data Analysis

All statistical analysis was performed using excel and SPSS (Statistical package for social science) version 16. Differences in the prevalence and intensity of infection between ages and sexes were tested using the Chi square (X^2) and one way ANOVA tests respectively. Intensity of helminth infection was expressed as arithmetic means. Values are considered statistically significant when P-values were less than 0.05. Logistic regression analysis was used to determine association between the variables and the prevalence of the infections using estimated adjusted odd ratio at 95% confidence intervals as basis of judgment.

RESULTS

A total of 508 people were recruited for the study out of which 37 people declined participation or did not meet the inclusive criteria. Of the remaining 471 (228 (48.4%) males and 243 (51.6%) females), 142 (30.1%) were infected with hookworm with average egg count intensity of 3256.04epg (Table 1). Prevalence and intensity were of the same pattern; both are significantly comparable with age and sex. While prevalence was

Table 1. Prevalence and intensity of hookworm infection in relation to age, gender, socio-demographical and environmental factors

Variable	No. examined	No. infected	Prevalence (%)	Intensity (eggs per gram faeces)		
				Mean	Std. Dev.	95% confidence interval
Age (years)						
≤10	103	2	1.9	1452.00	967.32	7239.04 – 10143.04
11-20	110	5	4.5	2720.40	1509.21	846.47 – 4594.33
21-30	112	32	28.6	3513.50	1397.59	3009.61 – 4017.39
31-40	40	26	65.0	3458.92	1318.93	2926.20 – 3991.65
≥41	106	77	72.6	3762.17	1888.46	2733.54 – 3590.80
P. value			<0.0001	0.038		
Gender						
Male	228	81	35.5	3879.89	1518.162	3144.20 – 3815.58
Female	243	61	25.1	2958.79	1839.859	2487.58 – 3430.00
P. value			0.014	0.049		
Source of water supply						
Pipe-borne	35	1	2.9	576.00	–	–
Bore-hole	198	65	32.8	2943.85	1805.02	2496.59 – 3391.11
Others	238	76	31.9	3558.30	1496.49	3216.34 – 3900.26
P. value			0.001	0.025		
Toilet facilities						
Cesspit	40	6	15.0	2381.83	1051.27	1278.60 – 3485.07
Water system	74	9	12.2	2914.67	1757.63	1563.64 – 4265.70
Bush	357	127	35.6	3321.53	1691.53	3024.49 – 3618.57
P. value			0.001	0.336		
Education status of the individuals						
Primary school	113	12	10.6	3117.17	1321.28	2277.67 – 3956.67
Secondary school	163	52	31.9	3388.71	1030.70	3101.76 – 3675.66
Tertiary	61	17	27.9	2970.47	2106.94	1887.18 – 4053.76
Illiterate	134	61	45.5	3249.84	2041.22	2727.06 – 3772.62
P. value			0.001	0.828		
Education status of mother						
Educated	67	12	17.9	2961.33	1505.24	2004.95 – 3917.72
uneducated	290	61	21.0	3451.46	1665.89	3024.81 – 3878.11
No response	114	69	60.5	3134.52	1719.76	2721.39 – 3547.65
P. value			0.001	0.462		
Occupation						
Wage earner	66	13	19.7	2982.15	1406.05	2132.49 – 3831.82
Farming	138	68	49.3	3653.19	1513.95	3286.74 – 4019.64
Unemployed	267	61	22.8	2871.67	1820.88	2405.32 – 3338.02
P. value			0.001	0.024		
Bush around habitation						
Yes	381	114	29.9	3233.04	1715.61	2914.70 – 3551.37
No	90	28	31.1	3349.68	1540.07	2752.50 – 3946.85
P. value			0.825	0.743		
Family size						
<6	385	111	28.8	3177.82	1683.72	2861.11 – 3494.53
>6	86	31	36.0	3536.10	1653.15	2929.72 – 4142.48
P. value			0.187	0.295		
Total	471	142	30.1	3256.04	1677.85	2977.68 – 3534.39

Table 2. Logistic regression analysis relating the prevalence hookworm infection with risk factors

Exposure variables	Adjusted odd ratio (OR)	95% confidence interval	P. value
Lack of portable water	1.491	0.925 – 2.403	0.101
Farming activities	4.349	2.585 – 7.318	<0.0001
Lack of toilet facilities	0.245	0.100 – 0.602	0.002
Bush around habitation	0.976	0.570 – 1.671	0.929
Education status	0.695	0.317 – 1.524	0.033

unimodal, increasing from the youngest age group (1.9%) to the peak (72.6%) in the ≥ 40 age group, intensity distribution was bimodal with peaks in 21-30 (3513.50 epg) and ≥ 40 (3762.17 epg) years' age groups. Genderwise, male were highly affected than their female counterparts (35.5%, 3879.89epg vs. 25.1%, 2958.79 epg). Prevalence and intensity of infection was statistically significant (p>0.05) among group of people that are farmer (49.3%, 3653.19 epg), and those that lack portable water supply (31.9%, 3558.30 epg). The occurrence of the infection was more significant (P=0.001) with the education status of the individual, illiterates have the highest prevalence (45.5%) but it was not statistically significant with intensity of the infection. The presence of bush around the habitation and the family size relate neither to prevalence nor the intensity of the hookworm infection.

The stratification of the eggs count with respect to age showed that adult age group particularly 40+ years were highly infected with moderate to heavy infection. However, our logistic regression analysis to determine the relative effect of the significant risk factors on the prevalence of infection, revealed that lack of toilet facilities (OR 0.245 95% CI 0.100–.0.602 P = 0.002), farming activities (OR 4.349 95%CI 2.585–7.318 P<0.0001) and educational status of individual (OR 0.695 95% 0.317–1.524 P = 0.033) were related significantly to the prevalence of the hookworm infection in the study area.

DISCUSSION

Hookworm infection is an important health problem, particularly in many rural and peri-urban communities of Nigeria. The high prevalence of 30.1% reported in this study confirmed the endemicity and underscored the health burden of the disease in Nigeria and tropical Africa as earlier reported by several authors (Babamale *et al.*, 2015, Hotez *et al.*, 2008). Heavy intensity of infection recorded in this study suggests long-term transmission, commonly observed in endemic communities which may be attributed to several factors among which is promiscuous defecation, low access to proper sanitation, water supply facilities and often walking bare-footed during agricultural activities that characterized our study area. Also, the high prevalence of the infection in this study may be influenced by physical and chemical composition of the soil featured in the study area as earlier reported by Ugbomoiko *et al.* (2006).

Age and gender -pattern of the infection is significant, the degree of the occurrence and the intensity of the infection typically rises monotonically with increasing age to a plateau in adulthood and higher in male than their female counterparts'. This observation contrasts the convex age-intensity patterns in West Africa (Udonsi *et al.*, 1980; Behnke *et al.*, 2000). However, it is in accordance with studies in China and Vietnam where the highest intensity of hookworm infections occur among the elderly (Bethony *et al.*, 2002; Gandhi *et al.*, 2001), thus infection is a renowned cause of reduction in working productivity in older adolescents and adults. The prevalence of infection was higher in males than females, though age was more significant than gender. This gender-difference in hookworm infection is largely a consequence of sex-related differences in exposure rather than differences in susceptibility to infection. In Mali, for

example, males are more commonly infected (Behnke *et al*., 2000) – this is not unconnected to the fact that males are involved in constructing houses which frequently incorporate human faeces into materials to strengthen household structure. Same observed in this study where males are more involved in the farming activities characterised with widespread use of faeces as night-soil fertilizer (Humphries *et al*., 1997) thus, exposing them to infection.

The momentous influence of farming activities and source of drinking water on both the prevalence and burden of the infection in the study area suggested that both skin penetration and contamination of water are the media for contacting infection, thus suggesting *Necator americanus* and *Ancylostoma duodenalis* as etiology of the infection in the study area. This has however been reported by Ugbomoiko *et al*., 2006 in the southwestern part of Nigeria.

Other risk factors such as toilet facilities, educational status of the individual and mother do not observe to influence the intensity but prevalence of the disease in this study. This is in agreement with several studies in different endemic area of the world such as Crompton 2000; Asaolu *et al*., 2003; and Ugbomoiko *et al*., 2012. Since the transmission of hookworm involves contamination of the environment by hookworm eggs, it is expected that the risk factors for infection may include poor personal and household sanitations, the result of this study has agreed with several others that suggested that hookworm infection is associated with the absence of a latrine (Olsen *et al*., 2001), and low socioeconomic status of individuals or community (Holland *et al*., 1989). Our result revealed significantly higher prevalence and intensity of hookworm infection in individuals from poorer households than those from better-off households. This is not different from results of Raso *et al*. (2004) in rural Cˆote d'Ivoire and Olsen *et al*. (2001) in Panama.

Our regression analysis of the risk factors divulged that farming activities is an important predictor in the transmission of the infection which has serious influence on the prevalence and burden of the hookworm infection with predictive values of 4.329 adjusted ratio 95% CI: 2.585-7.318, P <0.0001 i.e. farmers in the study area are four times likely to have infection that others. It was also observed that there was significant association between lack of toilet facilities and the prevalence of hookworm infection. This indicated buccal transmission as early reported by Nagahana *et al*. (1963).

Therefore, Our findings have indicated that economic development and reduced poverty, good knowledge about the transmission and management practice of soil-transmitted helminths, regular use of anthelminthic drugs, improved socio-economic status and environmental-personal hygiene will provide protection against hookworm infection in the study area and elsewhere.

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