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Research Article

RISK FACTORS ASSOCIATED WITH HOOKWORM INFECTION AMONG PATIENTS ATTENDING USMANU DANFODIYO UNIVERSITY CLINIC, MAIN CAMPUS, SOKOTO, SOKOTO STATE, NIGERIA

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ABSTRACT

To determine the risk factors associated with Hookworm infection among patients attending Usmanu Danfodiyo University Clinic, main Campus, a cross sectional study was conducted. A total of 100 stool samples were collected and analyzed using wet mount and Formol ether concentration techniques. An overall prevalence of 71.0% was obtained. Prevalence was higher among males (73.2%), age group 3-17 years (89.5%), farmers (90.0%) and patients who do not wash hands after meals (87.2%). Chi square and Binary logistic regression statistical analyses indicated no significant association of hookworm infection and gender, age, occupation and hand washing after meals (P>0.05). However, it was found that open defecation (χ^2=2.563, P= 0.045), ignorance of hookworm infection (χ^2=0.127, P= 0.043), having dirty finger nails (χ^2=17.04, P= 0.034), walking barefooted (χ^2=12.366, P= 0.045), not washing hands after toilet (χ^2=59.507, P= 0.000) and fetching water from wells and rivers (χ^2= 25.127, P= 0.029) were the most important risk factors associated with hookworm infection in the study area. Mass drug administration, health education, personal hygiene, and provision of portable drinking water and public toilets are highly recommended among the study population.

Keywords: Hookworm, Patients, Danfodiyo, Clinic, Risk Factors.

INTRODUCTION

Hookworm infection is neglected tropical disease caused by parasitic nematodes; *Ancylostoma duodenale* and *Necator americanus* which infect about 740 million people (Stoltzfus *et al*., 1997). The infection is a soil-transmitted helminthiasis and was classified as a neglected tropical disease (CDC, 2011). Hookworm infection is among the most common infections worldwide and affects most poor communities. Hookworm infection occurs in sub Saharan Africa, The America, china and East Asia. About one third of the world's hookworm infections occur in the Sub Saharan Africa, with the greatest number of cases occurring in Nigeria (38 million cases), Democratic Republic of Congo (31 million cases), followed by Angola, Ethiopia (30 million) and Côte d'Ivore (10-11 million cases) (WHO, 2015).

Transmission of hookworm infection is occurring either by faecal-oral route or by skin penetration (Despommier *et al*., 2000). After entry into the body, the larva moult twice before it matures into adult worms. The adult worm inhabits the duodenum and jejunum attaching itself to the intestinal mucosa to feed on the blood (Pawlowski *et al*., 1991). The infection is characterized by abdominal pain, nausea, vomiting, anorexia, fatigue, dyspnea, pallor, koilonychias, pale sclera, melena, chlorosis, and poor academic performance. During heavy infections, an adult hookworm can consume up to 0.2 ml of the blood per day causing iron deficiency anemia and malnutrition. (Hotez, 1989; Hotez & Pritchard, 1995). Diagnosis of hookworm infection can be achieved through clinical, parasitological, molecular and immunological diagnostics techniques (WHO, 2015). Treatment with anthelminthic dugs with a single dose of albendazole (400mg/day) is a feasible, effective, and low cost approach to control hookworm infection (Nasr *et al*., 2013). The infection can be prevented through the provision of public

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health education, provision of safe drinking water, and provision of sanitation facilities.

In Sokoto State, it has been estimated that hookworm infection affects 46.00% of Almajiris (Victor *et al*., 2017), 3.00% of boarding school children (Adamu *et al*., 2012) and 2.03% of school-aged children in Wamakko Local Government, Sokoto State (Adetunji & Oloke, 2013). Risk factors include walking barefooted in warm climates where sanitation is poor, contaminated soil, contaminated food and water in parts of the world with poor sanitation, lack of hygiene and open defecation are important risk factors for the transmission of hookworm infection (CDC, 2017).

As far as the authors are concerned, no research of this nature was carried out in the study area, therefore, this study was carried out to add to the existing baseline data and provide information on hookworm infection among patients attending clinics/hospitals to help governmental and non-governmental organizations to provide interventions to control the menace of hookworm infection in the study area. Prevalence and risk factors of hookworm infection among the study subjects in the study area was also assessed.

MATERIALS AND METHODS

Study Area

The study was conducted at Usmanu Danfodiyo University Clinic, Main Campus, Wamakko Local Government, Sokoto State, Nigeria. Wamakko Local Government lies between latitude 12^0 'N and 13^0 58N longitude 04^0 8' E and $6^0$54E. The Clinic was established in 1976 with registration No. SO/37P., the Health Service Management Committee which was saddle with the task of maintaining a high standard of the medical and center care services in the university community was inaugurated in 1984. The University Health Center provides public health and medical services to Staff, their families, dependents, and students. It caters for an average number of 95 patients per day. A part from staff and students of the University, people from villages around the university also visit the clinic. Most of these people are farmers and engage in open space defecation and also use night soil as farm manure.

The University Clinic provides the following services: Pharmaceutical services, General Outpatient services, In Patient Service, laboratory Service, Radio diagnostic service, Maternal and Child Health Service. The Clinic opens 24 hours a day, 7 days a week. However, routine medical consultation is available only between 8:00 am to 9:00 pm every day (including weekends), only emergency services are available after 9:00 pm. The clinic has 6 medical doctors, 22 senior staff and 43 junior staff. The clinic has laboratory unit, Maternal Health Care Unit, Child Care Unit, Pharmacy Unit, Nursing Unit, Medical Record Unit, Public Health Unit and Administrative Unit. Consultations and drugs are free for registered staff and students. A twenty four (24) hour ambulance service is also available on the main campus due to the distance between the university clinic and student's hostel.

Study Population

The study population was made up of the patient attending Usmanu Danfodiyo University Clinic, Main Campus, Sokoto State, Nigeria. Sample size was calculated using the single proportion formula with confidence interval of 95% and precision of 5% using the formula: $N= Z^2pq/d^2$ where N= sample size to be determined, Z= standard normal deviate at 95% confidence interval (= 1.96), P= Prevalence from a previous study; this was obtained from the study conducted in Jos-North, Plateau State, Nigeria by Adenusi & Ogunyomi, (2003) where they recorded a prevalence of 5.41% was recorded, Q= 1-p and d= tolerable error (∞= this is usually set at 0.05). From the above formula, the sample size obtained was 78.6, but the researchers decided to make it 100.

Ethical Clearance

Ethical clearance was obtained from Usmanu Danfodiyo University Clinic Management Board (Ref. No. UDUS/R/ACA/01/.25). An informed consent was obtained from the patients after explaining the purpose and procedure of the study. Patients were not forced and were free to withdraw at any stage of the study.

Collection of Faecal Samples

One hundred stool samples were collected from the study participants by selecting the first five (5) patients referred to the laboratory on each sampling day. Each patient was given a labelled clean screw capped container and guided on how to collect their stool samples. Faecal samples collected were transported to Parasitology Laboratory, Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria for analysis.

Questionnaire Administration

Structured questionnaire was administered to each study participant to obtained information on risk factors of hookworm infection and demographic data. Information such as gender, age, occupation, source of drinking water, the type of toilet used, hand washing before and after meals, frequency of shoe wearing among other things were obtained using the questionnaire. Each questionnaire was numbered to tally with the number of the stool sample collected from each participant.

Analysis of Faecal Samples

The Faecal samples were first analyzed by wet preparation as described by Alli *et al*. (2011). A drop of fresh physiological saline was placed on one end of a clean slide and a drop of iodine was placed on the other end of the slide. Using an applicator stick, a small amount of stool was emulsified in saline and another in iodine solution.

Each preparation was covered with cover slip gently to avoid air bubbles and examined under a microscope for the presence or absence of hookworm parasite, larvae or ova. The slide was then examined under the microscope using ×10 and ×40 objectives respectively. Negative samples were subjected to a concentration method as described by Cheesbrough (2006).

For the Formol ether concentration technique, 1g of each faecal sample was emulsified in 4 ml of 10% Formol saline contained in a screw-cap bottle. The emulsified faeces were sieved into a beaker using a 400 µm mesh sieve and the suspension was transferred into a centrifuge tube and 3ml of diethyl ether was added. The tube was covered and shaken vigorously for 1 minute and then centrifuge at 3,000 rpm for. After centrifuge, the sediment was thoroughly shake and transferred on to clean glass slide using Pasteur pipette and covered with a cover slip. The slide was examined under the microscope first using ×10 objective to detect the presence or absence of hookworm ova (Alli *et al.*, 2011). Hookworm ova or larvae were identified using chart provided by WHO (2004).

Statistical Analysis

Data obtained were checked and analyzed using Epi Info version 7.0. Prevalence of hookworm infection was calculated with the formula; (No. infected/ No. examined) ×100. Chi square test was used to test the association between hookworm infection and age, sex, occupation, the source of drinking water, type of toilet used, washing hands before and after a meal, wearing/not wearing of shoe, and knowledge about hookworm infection. Binary logistic regression was used to observe independent risk factors for hookworm infection. P-values less than 0.05 were considered significant.

RESULTS AND DISCUSSION

Out of 100 stool samples examined for hookworm infection, an overall prevalence of 71.0% was obtained. Gender specific prevalence of hookworm infection revealed that males 56(73.2%) were more infected than females 44(68.2%), although Chi square statistical analysis indicated no significant association between gender and hookworm infection (χ^2 = 0.142, df =1, P> 0.05, T_{cal} = 2.380). The occurrence of hookworm infection did not significantly associate with age, although, patients aged 3-17 years had the highest prevalence 19 (89.5%) while patients 18-32 years recorded the least prevalence 66(63.6%), χ^2 = 3.134, df = 4, P>0.05 T_{cal} = 80.761 (Table 1).

The occurrence of hookworm infection was highest among those patients that engage in farming 11(90.9%) while civil servants had the least prevalence of hookworm infection 9(55.5%). Statistical analysis indicated no significant association between hookworm infection and patients occupation (χ^2 = 1.715, df =3, P>0.05, T_{cal} = 41.391). The occurrence of hookworm infection significantly associated with well and river as sources of drinking water, as patients who used well as source of drinking water had the highest prevalence 47(87.2%), while those who used tap recorded the least prevalence of hookworm infection 74(33.8%) (χ^2= 11.685, df= 3, P<0.05, T_{cal} = 25.127) (Table 2).

The prevalence of hookworm significantly associated with the type of toilet used, as patients who defecate in an open space had the highest prevalence 36(86.1%) while those who used water closet recorded the least rate of hookworm infection 38(47.4%), (χ^2 = 11.49, df = 2, P<0.05, T_{cal} = 2.563). The occurrence of hookworm infection significantly associated with not washing hands before meals (χ^2= 8.772, df = 1, P<0.05, T_{cal} = 0.014). Patients who do not wash their hands before meal recorded highest 39(87.2%) while those who practice hand washing before meal had the lower prevalence 61(60.7%) Table 3. Hand washing after meal did not significantly associate with hookworm infection (χ^2= 0.323, df=1, P>0.05, T_{cal}= 59.507), although the prevalence was highest among patients who wash hands after meal 97(71.1%) and least among those who do not wash their hands after meal 3(66.7%) (Table 3).

Prevalence of hookworm infection was found to be highest among patients who use water alone to wash their hands after toilet 52(84.6%) while those who use water and sand had the least prevalence 2(50.0%). Chi square analysis indicated a significant association of hookworm infection with the material used to wash hands after defecation (χ^2= 8.978, df= 3, P<0.05, T_{cal}= 66.296). The result of this study showed that patients with dirty finger nails were the highest infected 55(89.1%) while those with clean finger nails had the lowest prevalence 45(48.9%). Statistical analysis indicated significant association of hookworm infection with dirty finger nails (χ^2= 17.524, df= 1, P<0.05, T_{cal}= 17.04) Table 4.

In relation to the frequency of wearing shoe, participants who walk barefooted were the highest infected 10(80.0%) while those who always wear shoes were the least infected 59(66.1%). Chi square analysis showed a significant association of hookworm infection with walking barefooted (χ^2= 6.639, df =2, P<0.05, T_{cal}= 12.366). The occurrence of hookworm infection significantly associates with ignorance of hookworm infection (χ^2= 17.524, df= 1, P<0.05, T_{cal}= 0.127). Patients ignorant of hookworm infection had the highest infection rate 55(89.0%) while those who had prior knowledge of hookworm infection recorded the lowest prevalence 45(48.9%) (Table 4).

The results of binary logistic regression analysis revealed several independent risk factors for hookworm infection in the study area Table 5. Open defecation (P= 0.045), ignorance about hookworm infection (P= 0.043), having dirty finger nails (P= 0.034), walking barefooted (P= 0.045), not washing hands after toilet (P= 0.000), and fetching water from well and river (P= 1.620) each were identified as being independently associated with the occurrence of hookworm infection in the study area.

The results of this study demonstrated that 71.0% of the study population had Hookworm infection. The 71.0% infection rate observed in the study area is higher than the 46.0% observed by Adetunji & Oloke, (2013) among Almajiris in Sokoto metropolis, Sokoto, Nigeria, and 2.03% reported by Muhammad *et al.,* (2018) among school-aged children in Wamakko Local Government, Sokoto State. However, similar high prevalence of 72.5% was reported by Rabi'u and Haruna (2017) in Dawakin Kudu Local Government, Kano State, Nigeria. This prevalence reflects the high rate of exposure of the patients to the risk factors associated with hookworm infection; such as poor personal hygiene, open space defecation, and walking barefooted (Motarjemi *et al*., 1993).

The lack of significant association of hookworm infection with gender and age observed in the present study indicated that regardless of gender or age, patients are equally exposed to hookworm infection. This agrees with the findings of Mu'azu *et al.,* (2017) and Muhammad *et al.,* (2018) who separately reported lack of significant association of hookworm infection with gender and age. Worthy of note is that (Adenusi & Ogunyomi, 2003) found hookworm infection to significantly associate with age in primary school children in Jos, Plateau State. He opined that younger children move about more frequently, playing in pools of water barefooted and more exposed, while older ones wear shoes and are less prone to infection, as the possible reason for the variation. The lack of significant association of hookworm infection with age observed in the current study could due to the fact that the study subjects are adults and oral transmission could play a significant role in spreading hookworm infection in the study area since occurrence of hookworm infection significantly associated with unhygienic finger nails and not washing hands before meals as evidently reported in this study.

Table 1. Prevalence of Hookworm infection in relation to gender and age group.

Parameter	No. Examined	No. Infected	Prevalence (%)
Gender			
Male	56	41	73.2
Female	44	30	68.2
Age Group			
3-17	19	17	89.5
18-32	66	42	63.6
33-47	7	6	85.7
48-62	5	4	80.0
63 and above	3	2	66.7
Total	100	71	71.0

Table 2. Prevalence of Hookworm infection in relation to source of drinking water and occupation

Parameter	No. Examined	No. Infected	Prevalence (%)
Source of Drinking Water			
River	6	5	83.3
Tap Water	74	25	33.8
Well	47	41	87.2
Occupation			
Business	13	9	69.2
Civil Servant	9	5	55.5
Farmers	11	10	90.9
Students	67	47	70.1
Total	100	71	71.0

Table 3. Prevalence of Hookworm infection in relation to type of toilet used, hand washing materials after defecation, hand washing before meal and hand washing after a meal.

Parameter	No. Examined	No. Infected	Prevalence (%)
Type of Toilet Used			
Pit Latrine	26	22	84.6
Open Space	36	31	86.1
Water Closet	38	18	47.4
Hand washing materials after toilet			
Water and Soap	39	21	53.8
Water alone	52	44	84.6

Water and Sand	2	1	50.0
Others	7	5	71.4
Hand washing before the meal			
Yes	61	37	60.7
No	39	34	87.2
Hand washing after a meal			
Yes	97	69	71.1
No	3	2	66.7
Total	100	71	71.0

Table 4. Prevalence of hookworm infection in relation to dirty finger nails, shoe wearing, and knowledge of hookworm infection.

Parameter	No. Examined	No. Infected	Prevalence (%)
Dirty Finger Nails			
Yes	55	49	89.1
No	45	22	48.9
Shoe Wearing			
Always	59	39	66.1
Sometime	31	24	77.4
Not at all	10	8	80.0
Knowledge of Hookworm infection			
Yes	45	22	48.9
No	55	49	89.9
Total	100	71	71.0

Table 5. Results of Binary Logistic Regression analysis showing independent Risk Factors for hookworm infection

Risk Factor	B	S.E	Wald	df	Sig.	Likely hood Ratio	Confidence Interval (95%)	
							Lower	Upper
Open defecation	-0.06	.046	0.022	1	0.045	1.942	0.425	2.087
Knowledge of hookworm infection	-0.432	.559	.597	1	0.043	2.649	0.217	1.943
Dirty Fingernails	-0.826	.390	4.486	1	0.034	1.438	0.204	0.940
Walking barefooted	-1.149	.623	3.398	1	0.045	1.317	0.930	1.075
Not washing hands after toilet	.895	.220	16.507	1	0.000	2.448	0.210	0.884
Fetching water from well and river	-1.478	.490	.952	1	0.029	1.620	0.238	1.619

In the present study, there was significant association of hookworm infection with rivers and wells as source of participant's drinking water. This confirms the observation by Isyaku *et al*. (2014) in Sokoto State who also found occurrence of hookworms to significantly associate with the source of water. According to the author the significant association could be due to contaminants being introduced into the wells via the containers used in drawing the water and or direct dumping of dirt's into the wells. The lack of significant association of hookworm infection with patient occupation is an indication that regardless of their occupation, participants are equally exposed to the source of hookworm infection. This is in conformity with the existing studies of (Ziegelbauer *et al*., 2012) who reported lack of significant association of hookworm infection with the occupation. However, this contradicts the findings of (Adamu *et al*., 2012; Sanusi *et al*., 2016) who separately observed a significant association of hookworm infection with subject's occupation.

There was significant association of hookworm infection with open defecation. This could be due to a lack of toilet facility, poor personal hygiene and favorable conditions for the transmission of hookworm infection. This is in conformity with the findings of (Cheesbrough, 2006). On the other hand, (Ziegelbauer *et al*., 2012) observed lack of significant association between type of toilet and hookworm infection. The significant association between hookworm infection and washing hands before a meal, washing hands after the meal, the frequency of shoe wearing and hand washing after toilet, with hookworm infection might be due to poor personal hygiene and lack of portable drinking water. This agrees with previous studies by (Adetunji & Oloke, 2013; WHO, 2015). However, it is in contrast with the results of studies conducted by (Alemu *et al*., 2011; Kattula *et al* 2014; Nasr *et al*., 2013) where they found significant association between hookworm infection and washing hands before and after meal. In the present study, the occurrence of hookworm infection

significantly associates with dirty finger nails of the patients. This corresponds with the previous studies conducted by (CDC, 2017; Nasr *et al*., 2013) and could probably be due to poor personal hygiene and contamination of the hands with vegetables that are contaminated with untreated night soil. Moreover, ignorance of hookworm infection shows significant association among patients in the study area. This might be due to a lack of awareness in the study area. Similar findings were reported by Hossain and Bhuiyan (2016).

CONCLUSION

The prevalence of hookworm infection among patients attending Usmanu Danfodiyo University Clinic, Main Campus, Sokoto is high. This could be attributed to lack of toilet facilities poor personal hygiene, poor sanitary condition, lack of awareness about hookworm infection, its source of infection and possible preventive measures. It is, therefore, recommended that regular cutting of finger nails, the creation of awareness on hookworm infection to the communities, mass chemotherapy, and provision of toilet facilities to curb the menace of hookworm infection among the people in the study area.

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