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Parent occupation as risk factor of hookworm infection in primary school children in Sokoto, Nigeria

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Abstract
Hookworm infection is one of the neglected tropical diseases that pose health risk to school-age children. A cross-sectional survey was conducted to study the occurrence of hookworm infection among primary school pupils in two LGAs in Sokoto. Feacal samples of participants were collected and screened for Hookworm ova using wet mount and formol-ether concentration techniques. Risk factors of Hookworm infection were assessed using structured questionnaire. The results of the study revealed 13.0% of the pupils were positive for hookworm. Binary logistic regression analysis indicated being males with farming background as the risk factors of infection in the study areas (p<0.05). Therefore, results of the study is suggestive of the fact that parent occupation plays a significant role in the transmission of the infection and needs to be taken into consideration when designing control strategies for hookworm in the study area.

Keywords: Sokoto, hookworm, pupils, risk factor, parent occupation

Introduction
Hookworm is a nematode (roundworms) of the order *Strongiloida* and family *Ancylostomatidae* that have hooked mouthparts to attach themselves to the intestine wall of the host (CDC, 2020) [15]. Hookworms are soil-transmitted nematode parasites that can leave for a long time in the small intestine of their human hosts, where they food on blood and can lead Iron Deficiency Anaemia (IDA) in people who have moderate to high numbers of adult worms, which is referred as hookworm disease (Alex *et al.*, 2016) [1].

Ancylostomiasis and Necatoriasis are common hookworm infections in humans, caused by the species *Ancylostoma duodenale* and *Necator americanus* respectively (Babamale and Uade, 2016) [40]. People with hookworm infection pass hookworm eggs in their faeces. If these are exposed to the environment, they have the potential to spawn larvae (immature worms) that can pierce the skin. Additionally, people can get infected with *Ancylostoma duodenale* through contaminated food (CDC, 2020) [15]. Risk factors include walking barefoot in warm climates, Poor personal hygiene, Low educational attainment, Poor household sanitation and unfinished house floor, Use of feces as fertilizer, open defecation, Age, having dirty nail, not washing hand after meal (Hossain and Bhuiyan 2016, Bala *et al.*, 2019) [21, 10].

An estimated 576-740 million people in the world are infected with hookworm (CDC, 2020) [15]. Developing countries are the most affected and within these, the major cases occur among school aged children (Agbo *et al.*, 2019) [4].

Sub-Saharan Africa, America, China, and East Asia all have cases of hookworm infection. Sub-Saharan Africa is home to around one third of all hookworm infections in the globe. The countries with the most instances are Nigeria (38 million), the Democratic Republic of the Congo (31 million), Angola, Ethiopia (30 million), and Cote d'Ivore (10-11 million) (WHO, 2015) [38].

School-aged children are most at risk of infection and morbidity, such as slowed cognitive and physical development, for the majority of helminth species. (Palmeirim *et al.*, 2018) [32]. Helminthiases are frequently disregarded despite the harm they cause to public health, educational attainment, social development, and economic growth (Utzinger *et al.*, 2012) [36].

Preventive chemotherapy (monthly deworming of school-aged children and other high risk populations) is one of the main WHO-recommended techniques for the prevention, control, and elimination of hookworm infections. Other important strategies include sanitation and clean water supplies complemented by personal cleanliness and health education (Palmeirim *et al.*, 2018) [32].

Materials and Methods

Study Area: This study was conducted in Maganawa primary school and Gidan Salihu Model primary school Sokoto. Maganawa primary school is located in Wammako local government Area of Sokoto State Nigeria. It has latitude N 12°57'7.82136" and Longitude E 5°11'50.90964. While Gidan Salihu Model primary School is located in Sokoto North local government Area of Sokoto State. It has Latitude N 13°4'19.8318" and Longitude E 5°12'17.09388". Sokoto state is located in the extreme Northwest of the country on the national border with the Republic of Niger. Its capital and largest city is city of Sokoto. Sokoto is located near to the confluence of the Sokoto River and River Rima. As of 2005 it has an estimated population of more than 4.2 million.

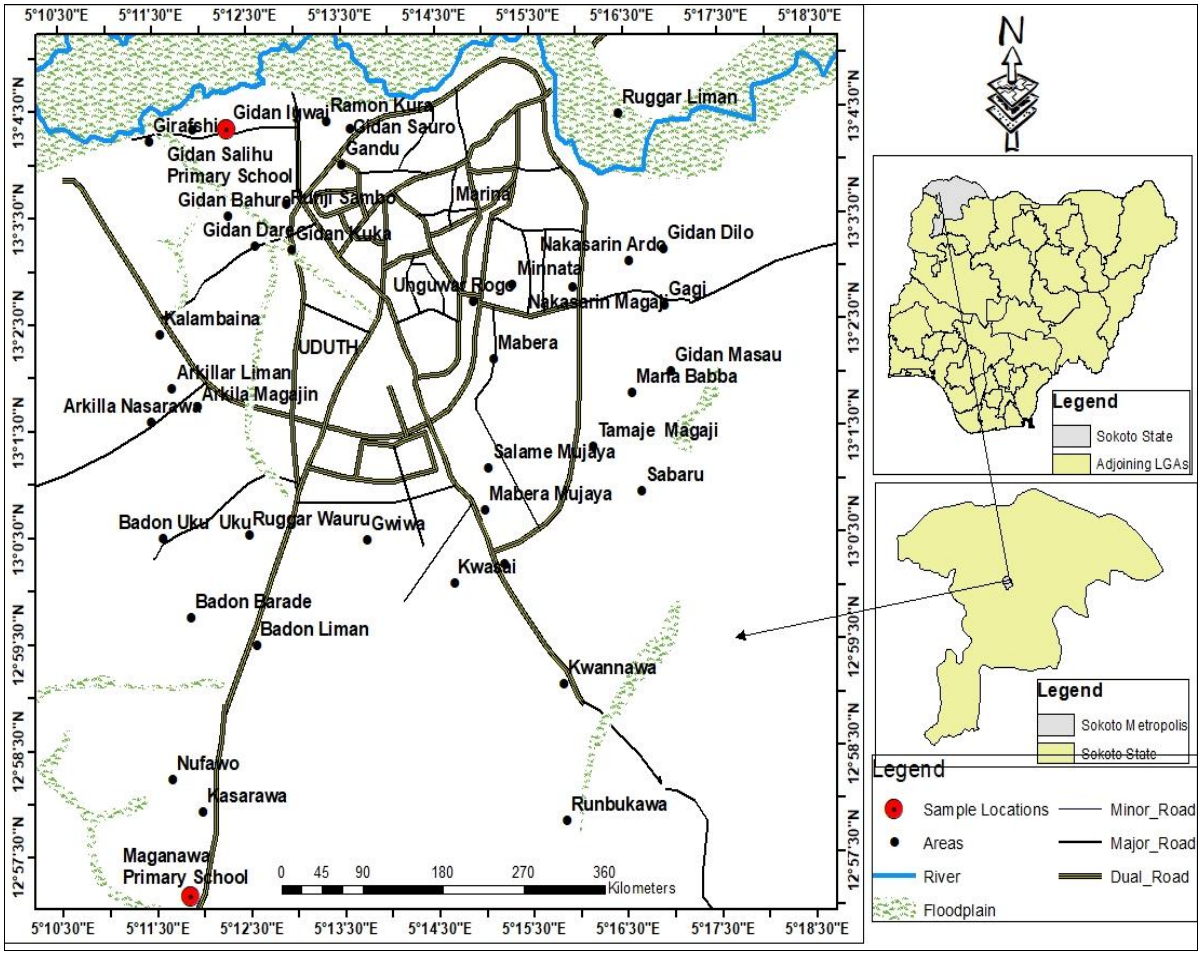

Fig 1: Map of Study area (Source; Geographical information system, Udusok 2023

Study population

The study population was the primary five pupils attending the Maganawa primary school and Gidan Salihu Model Primary Sokoto. The study subjects were chosen using a proportional probability procedure, with the first child in the school register being chosen initially, then each subsequent child.

Sample size was calculated using Fisher *et al.* (1998) [46] method: $N= Z^2pq/d^2$

Where,

N = The desired sample size

Z =The standard normal deviate (1.96) at the 95 per cent level of confidence.

P =Prevalence from a previous study; this was obtained from the study conducted in by Iduh *et al.* (2015) [22] where they recorded a prevalence of 46.0%

q = 1 - p

D = Design Effect = 1

D = The level of statistical significance required

Therefore: $N = \frac{1.96^2 \times 0.46\ (1- 0.46) = 44.7}{(0.05)^2}$

From the above formula, the sample size obtained is 44.7, but the researcher decided to make it 100.

Ethical clearance

Ethical Clearance to carry out this research was sought through the introductory letter from the Department of Zoology, Usmanu Danfodiyo University to the Local Government Education Authority and approval letter was sent to Headmaster for his assistance and cooperation. In addition, informed consent was sought from the parents and guardians of the school children and confidentiality of data and information from this study was maintained.

Questionnaire Administration

Simple structured closed-ended questionnaire was administered to pupils to gain information of the parents or guardians of subjects regarding child and household socio-demographic, water and sanitation characteristics. These items included subject age, sex, source of water, type of toilet, shoe wearing habit, occupation of their parents, having dirty nails, personal hygiene practices. To correspond with the number of the stool sample that was taken from each participant, each questionnaire was given a unique number.

Collection of samples

Stool specimens were collected from school children in class 5 for laboratory analysis in the primary schools selected for the study. Wide mouthed specimen bottles with screw caps and spoons were used to collect samples in the morning. The sample bottles were properly labeled with date, number, class, age and sex of the pupil. Necessary precaution was taken to avoid contamination of samples. The faecal samples collected were taken to the Parasitology laboratory, Department of Zoology, Usmanu Danfodiyo University Sokoto, Nigeria for microscopic examination.

Analysis of faecal samples collected

The faecal samples collected were analyzed by two methods which include Wet mount preparation and Formol ether concentration technique.

Wet mount Preparation

According to Alli *et al.* (2011) [7], the wet preparation method was used to evaluate the fecal samples first. On one end of a clean slide, a drop of fresh physiological saline was added, and on the other end, a drop of iodine. A little sample of stool was emulsified in saline solution and another in iodine solution using an applicator stick.

The presence of the hookworm parasite, larvae, or ova was checked under a microscope after each preparation was carefully covered with cover slip to prevent air bubbles. The slide was examined under the microscope using × 10 and × 40 objectives respectively. Negative samples were subjected to a concentration method as described by Cheesbrough (2006) [47].

Formol ether concentration method

About 4 mls of 10% Formol-saline solution were measured and poured into a mortar. 1 gram of stool was weighed, placed into the mortar bowl and using a pestle the stool was thoroughly emulsified. The stool emulsion was 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 and a rubber cork placed onto the mouth of the tube. The tube was then shaken thoroughly for twenty seconds, taking care to hold the cork firmly in place. The tube contents were centrifuged at 3,000 revolutions per minute for 3 minutes and using an applicator stick, the plug of debris was removed. The remaining fluid (supernatant) in the tube was decanted into the sink, leaving at the bottom a button of stool for microscopic examinations. Using Pasteur pipette, the entire button was carefully dislodged from the tube bottom and poured directly onto a clean microscope slide. The entire preparation was examined using x10 objective Hookworm ova or larvae was Identified using chart provided by WHO (2004) [37].

Results

Out of 100 stool samples examined for presence of intestinal parasites, 21 samples were found to be infected given an overall prevalence of 21.0%. Ova of hookworm 13 (13.0%) and ova of *Ascaris* 8 (8.0%) were recorded. The results of prevalence of hookworm infection based on Schools showed that pupils from Gidan Salihu primary school were the highest infected having accounted for 8(16.0%) while those from Maganawa primary School accounted for 5 (10.0%) of hookworm infection as shown in Table 1.

Table 2 showed the proportion of Hookworm infection among the Gender. It was observed that males have the highest hookworm infection 61 (19.7%) compared to the females 39 (2.6%).

Age groups 8 to 9 had the highest prevalence of hookworm infection (16.7%), followed by 10 to 11 (10.6%), and age groups 12 and above (9.1%) as shown in Table 3.

In relation to source of drinking water, 10 (40.0%) of pupils that obtained water from well were found with hookworm when compared to only 90 (10.0%) that obtained water from tap. None of the pupils go to river to fetch water as showed in Table 4.

Table 5 showed the distribution of the hookworm infection with respect to hand washing before and after meal and the presence of dirt under fingernails. The highest prevalence of hookworm infection was recorded among pupils that do not wash hand before eating 10 (40.0%) while the lowest prevalence was observed among pupils that wash hand before eating 90 (10.0%). Similarly, prevalence of hookworm infection was highest among pupils that do not wash hand after eating 12 (25.0%) as against 88(11.4%) for those that wash hand after completing their eating. With respect to presence of dirt under fingernails, hookworm infection was high among pupils with dirt fingernails 80 (16.3%). However, no infection was observed among pupils with clean nails. Prevalence was highest among the pupils that walked barefooted 48 (22.9%) when compared with 52 (3.8%) of those who wear shoes. Pupils whose parents were farmers 30 (36.7%) recorded highest rate of hookworm infection in the study area. These were followed by pupils whose parents were traders having accounted for 11 (9.1%). The least prevalence of hookworm was recorded among pupils whose parents work in civil service 59 (1.7%). Hookworm Infection was found to be higher among pupils who did not wash fruits before consumption 27 (22.2%) when compared with 73 (9.6%) among those who wash fruit before consumption as showed in Table 6. Table 7 shows the prevalence of hookworm infection with respect to defecation and hygiene practices after defecation. There was highest prevalence of hookworm infection among pupils that practice open defecation 3 (100.0%), followed by those that use pit latrine 84 (11.9) while no positive sample was recorded among pupils that use water closet as the medium of passing out their excreta 13 (0.00%). Similarly, higher hookworm infection was observed among pupils that did not wash hands after defecation 5 (80.0%) while only 95 (9.5%) of those that washed hands after defecation have occurrence of infection.

Of the 95% of pupils that confirmed to wash hand after defecation, the infection rate was highest among pupils that wash hands with water only after defecation 35 (14.3%) while the lowest prevalence was observed among those that washed hands with soap and water 60 (6.7%) as showed 8.

The results of binary logistic regression analysis

In the research locations, the results of binary logistic regression revealed separate risk variables for hookworm infection. Gender (P=0.040) and Parent occupation (P=0.017) were firmly established as factors that raised the risk of hookworm infection in the research locations. Males are at a risk of 2.1 times more likely to be infected than females and also pupils whom their parents are farmers at a risk of 2.9 times likely to be infected than their counterparts. However, age (P=0.495), source of water (P=0.099), hand washing before eating (P= 0.782), hand washing after eating (P=0.842), washing of fruit (P=0.191), walking barefooted (P=0.996), dirt finger nails (P=0.998), defecation practice (P=0.997), hand washing after defecation (P=0.997), materials to wash hand after defecation (P=0.823) were not significantly associated with the infection in the study areas as shown in Table 9.

Table 1: Prevalence of hookworm infection in schools

Primary School	No Examined	No Infected	Prevalence%
Gidan Salihu	50	8	16.0
Maganawa	50	5	10.0
Total	100	13	13.0

Table 2: The gender-related frequency distribution of hookworm infection

Gender	No examined	No infected	Prevalence%
Male	61	12	19.7
Female	39	1	2.6
Total	100	13	13.0

Table 3: Age-specific prevalence of hookworm infection

Age group	No examined	No infected	Prevalence%
8-9	42	7	16.7
10-11	47	5	10.6
12 and above	11	1	9.1
Total	100	13	13.0

Table 4: Hookworm infection rates based on the source of the water

Source of water	No examined	No infected	Prevalence%
Well water	10	4	40.0
Tap water	90	9	10.0
River	0	0	0.0
Total	100	13	13.0

Table 5: Prevalence of Hookworm infection in relation to Dirty under fingernails, Hand washing before and after eating

Parameter	No examined	No infected	Prevalence%
Hand washing before meal			
Yes	90	9	10.0
No	10	4	40.0
Hand washing after meal			
Yes	88	10	11.4
No	12	3	25.0
Dirt fingernails			
Yes	80	13	16.3
No	20	0	0.0
Total	100	13	13.0

Table 6: Prevalence of Hookworm infection in relation to washing of fruit, walking barefooted and parent occupation

Parameter	No examined	No infected	Prevalence%
Washing of fruit			
Yes	73	7	9.6
No	27	6	22.2
Walking barefooted			
Yes	48	11	22.9
No	52	2	3.8
Parent Occupation			
Farming	30	11	36.7
Trading	11	1	9.1
Civil servant	59	1	1.7
Total	100	13	13.0

Table 7: Prevalence of Hookworm infection in relation to defecation practice and hygiene practice after defecation

Parameter	No examined	No infected	Prevalence%
Defecation practice			
Open defecation	3	3	100.0
Pit latrine	84	10	11.9
Water closet	13	0	0.0
Hand washing after defecation			
Yes	95	9	9.5
No	5	4	80.0
Total	100	13	13.0

Table 8: Prevalence of Hookworm infection in relation to materials to wash hand after defecation

Materials	No examined	No infected	Prevalence%
Defecation practice			
Water only	35	5	14.3
Water and soap	60	4	6.7
Total	95	9	9.5

Table 9: Binary logistic Regression analysis showing independent Risk factors for hookworm infection

Risk factors	B	S.E	Wald	DF	Sig	Exp (B)	95% CL	For Exp. (B)
							Lower	Upper
Age	0.193	0.282	0.466	1	0.495	1.213	0.687	2.109
Gender	2.191	1.065	4.231	1	0.040*	8.943	1.109	72.129
Source of water	0.003	2.126	0.000	1	0.999	1.003	0.016	64.696
Hand washing before eating	-1.481	5.361	0.076	1	0.782	0.227	0.000	8322.779
Hand washing after eating	-1.131	5.671	0.040	1	0.842	0.323	0.000	21689.825
Washing of fruit	-2.343	1.791	1.712	1	0.191	0.096	0.003	3.213
Walking barefooted	21.211	415.921	0.000	1	0.996	1628374362	0.000	
Parent occupation	2.968	1.244	5.689	1	0.017*	19.456	1.697	223.026
Dirty fingernails	17.655	7059.420	0.000	1	0.998	46493982.39	0.000	
Defecation practice	38.495	9162.347	0.000	1	0.997	5.224E+16	0.000	
Hand washing after defecation	-41.210	7486.720	0.000	1	0.996	0.000	0.000	
Materials to wash hand	0.354	1.578	0.050	1	0.823	1.424	0.65	31.386

*Significant at $p<0.005$

Discussion

The discovery of a 13.0% prevalence of hookworm in pupils from study areas provides proof that the students had intestinal infection. Numerous neglected tropical diseases, which are still major health issues in the twenty-first century, affect children in Nigeria (Bishop, 2017) [12].

The 13.0% overall prevalence of hookworm in this study is however high when compared with findings of Agbo *et al.* (2019) [4] who reported 9.0% of hookworm infection among Pupils of University of Calabar Staff School. The prevalence from this study is also high when compared with 4.5% of hookworm reported by Mohammed *et al.* (2021) [28] among primary school children in Sokoto and 4.9% of hookworm among school children in Samaru, Zaria by Bishop *et al.* (2022) [13].

The result is however low when compared with result of study conducted in the North-east Nigeria by Wosu and Onyeabor (2014) who reported 80.9% of hookworm infection and finding in River state by Abah and Irene (2015) [2] who reported 25.0% of the infection among Primary School children. Bishop *et al.* (2022) [13] had attributed the variation in the prevalence of hookworm to rife environmental and free from filth factors. They explained that children won't contract soil-transmitted helminths if a population has sufficient sanitary facilities, appropriately disposes of human and animal waste, and maintains good personal hygiene.

Lack of association of infection between the schools reported in this study was similar to observation made by Abah and Wokem (2016) [3] in Abia state. The researcher attributed their findings to the level of emphasis placed on good healthful habit and personal hygiene by the schools' managements. However, this is contrary to finding of Bishop *et al.* (2022) [13] in Samaru, Zaria who reported significant association of hookworm infection with schools. According to Bishop *et al.* (2022) [13], there are more children attending public schools than sanitary facilities can accommodate; as a result, school grounds are not gated, playgrounds are exposed to numerous contaminants, and there is a general lack of sanitation. The majority of private schools are not overcrowded, and they maintain accep. Table environmental and sanitary conditions for learning.

The observed significant association of infection with the male in this study was contrary to report by Bala and Yakubu (2010) [11] in Jos, Mu'azu *et al.* (2017) [41] in Kano and Muhammad *et al.* (2018) [27] in Sokoto who stated that all Gender are equally exposed to infection. However, the observed significant association of hookworm infection with males verifies a previous account of a clear sex bias in hookworm infections in Nigeria. (Agi and Awi-waadu, 2008) [5] and consistent with reports from African (Brooker, 2007) [14] and Asia (Brooker *et al.*, 2007; Jiraananku *et al.*, 2011) [14, 23] countries where hookworm infections in males have been demonstrated to be more severe than in females. Significant association of gender with infection is in accordance with report of (El-Nadi *et al.*, 2017; Heba *et al.*, 2018) [17, 20] in Egypt who found that males were significantly infected than females. Maryo (2017) [25] in

Ethopia found that the higher infection prevalence was in females than males. It is possible that behavioral and sex-dependent differences in exposure to infection are the cause of the significant difference in hookworm infections between the gender that is higher in males than females. Men frequently engage in risky behaviors, such as playing football or playing in streams or still water. It might also be because they assist their parents with farming, where it has been noted that human and animal feces are occasionally mixed when fertilizing agricultural plots. This practice has been linked to a higher prevalence of hookworm infection in those who use fresh human feces, as opposed to treated human feces or non-faecal fertilizer (Goncalves *et al.*, 2016) [18].

Lack of significant different in age group observed in this study agreed with reports of study by Gyang *et al.* (2017) [19], Mu'azu *et al.* (2017) [41] in Kano, Muhammad *et al.* (2018) [27] in Sokoto, Bala *et al.* (2019) [10] in Sokoto and Bishop *et al.* (2022) [13] in Zaria who independently discovered no relationship between age and hookworm infection and claimed that all age groups were equally vulnerable to infection. Lack of significant different in age group was not in accordance with the study conducted in Ethopia by Suntaravitun and Dokmaikaw (2017) [34] who found that the age group of 9 years had the significantly highest overall infection rate. Additionally, it was in contrast to a study done in Morocco that revealed that children over the age of 10 had the highest frequency of infection rates (Messaad *et al.*, 2014) [26]. The Lack of significant association in age group from this study could be explained by a shared contaminated environment by the children of all age group.

Infection does not significantly associate with the source of water which agreed with the earlier reports by Pandya *et al.* (2017) [42] in India and Mohammed *et al.* (2021) [28] in Sokoto. However, this is contrary to the observation made by Assudani *et al.* (2015) [8] in India and Bala *et al.* (2019) [10] in Sokoto who separately noted the occurrence of hookworm infection was significantly higher in those that having drinking water from open well. It is also in contrast to findings of Babamale and Ugbomoiko (2015) [40] in Kwara and Punsawad *et al.* (2018) [33] in Thailand who reported significantly higher hookworm infection in those that obtained drinking water from Bore-hole and tap respectively. According to the Bala *et al.* (2019) [10] the substantial correlation may result from contaminants being dumped directly into the wells or injected via the water-drawing containers.

In this study, hookworm infection does not significantly associated with hand washing before and after eating which conformed with previous study by Heba *et al.* (2018) [20] in Egypt who found no evidence of a connection between children who did not wash their hands before and after eating . The findings of studies conducted by Alemu *et al.* (2011) [43], Nasr *et al.* (2013) [30], and Kattula *et al.* (2014) [24], indicated a substantial connection between hookworm infection and washing hands before and after meals, are in contrast with this assertion. Because children are too young to fully appreciate the value of maintaining general body cleanliness, they tend to be less conscious of their personal hygiene. This may explain why there is no conclusive link between hookworm infection and hand washing before and after eating. The study revealed that infection was not found to be associated with shoes wearing habit. The Similar observation was made by Bishop *et al.* (2022) [13] among primary school pupils in Zaria. It is also comparable with the findings of Punsawad *et al.* (2018) [33] in Thailand. However, it disagreed with previous study by Bala *et al.* (2019) [10] in Sokoto who reported significant association between infection and shoe wearing habits. Because the hookworm's mode of transmission is not limited to skin penetration but also includes the fecal-oral route, the lack of a significant association between hookworm infection and shoe use may be explained. As a result, parent occupation in this study was a significant factor in developing hookworms.

Occupation of parent has been shown to have associated with infection and pupils' whose parents are farmers were significantly infected than their counterparts. This conforms to the work of Obiukwu *et al.* (2008) [31] who reported similar observation among primary pupils in Anambra and Babamale *et al.* (2015) [40] who also reported significant association of hookworm infection with parent occupation among school-age children in Okuta community Kwara state. However, increased infection rate among farmer's children may be as a result of poor sanitation and frequent contact with polluted soils where the infective larval stages are found because they usually accompany their fathers to the farm where there father may likely be farming on lands to which untreated human and animals wastes are applied as manure which is a great risk for transmission of different soil-transmitted helminthes as reported by Ugbomoiko *et al.* (2006) [35]. It may also due to the fact that these children are not old enough and don't know the implication, they may accidentally or intentionally ingested the contaminated soil while working in farm.

This study's discovery that hookworm infection is not linked to dirt under fingernails shows that pupils are equally exposed to the source of hookworm infection whether or not there is dirt beneath their fingernails. This agreed with report of Mahmud *et al.* (2015) [44] in Ethopia who reported that unadjusted difference in intestinal parasite infection rate was not significant for the nail clipping among school age children. However, the lack of significant association in presence of dirt finger nails does not corresponds with the previous studies conducted by (Nasr *et al.*, 2013; CDC, 2017; Bala *et al.*, 2019) [30, 16, 10] who separately reported significant different in the infection rate with respect to dirt under fingernails. The author asserts that there is a strong correlation between hookworm illness and filth beneath fingernails, and that this correlation is likely caused by poor personal hygiene and contamination of the hands with unwashed vege. Tables. (Bala *et al.*, 2019) [10].

Lack of significant different in the occurrence of hookworm infection in relation to defecation practice observed in this study is in conformity with the findings of Ziegelbauer *et al.* (2012) [45] and Pandya *et al.* (2017) [42] in India who also observed lack of significant association between defecation practice and hookworm infection. However, this contradicts the findings of Babamale and Ugbomoiko (2015) [40] in kwara and Bala *et al.* (2019) [10] in Sokoto who separately observed a significant association of hookworm infection with subject's defecation practices. It is possible that a lack of toilet facilities, poor personal hygiene, and conducive settings for the transmission of hookworm infection are to blame for the link between hookworm infection and defecation practice Bala *et al.* (2019) [10]. The current investigation found no significant correlation between hand

washing after defecation and the development of hookworm infection, which concurred with report of Jiraanankul *et al.* (2011) [23] in Thailand and Pandya *et al.* (2017) [42] in India who found that the incidence of hookworm infection in hand washing after defecation were not significantly different. However, it did not match with report of Ahmed *et al.* (2017) [6] in Eritrea who reported significant association in the occurrence of hookworm infection and hand washing after defecation. The lack of a statistically significant correlation between the incidence rate of hookworm infection and hand washing after defecation is likely caused by children's generally poor knowledge of the transmission of intestinal parasites from their feces to their mouths through unwashed hands, or possibly by the absence of hand washing facilities close to the toilet.

Conclusion

The infection rate of hookworm in stool samples of school children collected in this study was 13.0%. The infection was significantly found in gender and parent occupation of the schoolchildren. Pupils who walk barefooted, age group 8 to 9 years, obtained drinking water from well, did not wash hand before and after eating, have dirt under finger nails, practiced open defecation and did not wash hand after defecation were more infected than their counterparts. However, the relationship was not statistically significant.

Recommendations

1. Public enlightenment program on good personal hygiene, the mode of transmission and adverse effect of the hookworm infection should be embarked upon by the appropriate authorities to help in reducing the risk of the infection
2. The parents should be discouraged in taking young children to the farm until when they are old enough to caution themselves while working in the farm
3. To guarantee the complete elimination of this infection, the government, non-governmental organizations, and private citizens should assist in the provision of social amenities.
4. The Parents/ teachers should ensure that pupils are regularly cutting their finger nails
5. Pupils should be inculcating into the habit of regular shoe wearing.
6. Schoolchildren should be routinely dewormed at least twice a year with anti-helminthic medications such albendazole or combination therapy with praziquantel, with a focus on male students. This would significantly lower the frequency and severity of infections.

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