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PREVALENCE OF SOIL TRANSMITTED HELMINTHS AMONG UNDER FIVE CHILDREN AND ASSOCIATED ENVIRONMENTAL FACTORS IN SELECTED MATERNAL HEALTHCARE CENTRES IN IBADAN, NIGERIA

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Abstract: Neglected Tropical Diseases (NTDs), which are common in sub-Saharan Africa, Latin America, China, and East Asia, include soil-transmitted Helminths. Over 1.45 billion individuals are affected on a global scale. Children under the age of six are at a greater risk of contracting Soil Transmitted Helminths (STH) infections.This study was designed to investigate the prevalence of STH infections in stool samples obtained from selected under five children in maternal healthcare centres in Ibadan. The objectives of this study were to determine the prevalence, associated environmental factors of STH infections and identify the types of STH present. A cross sectional survey was conducted among 384 people in two maternal healthcare centers in Ibadan. A total of 100 stool samples were collected between December 2021 and January 2022 from two different locations and parasitological examination of the stool samples were done for the presence of STH eggs using a Kato-Katz thick smear technique. Furthermore, questionnaires which probed into their knowledge of cause, symptoms, predisposing factors to infection, level of hygiene and sanitation of each respondent were administered. The spatial distribution of STH prevalence were determined. The parasitological examination of the 100 stool samples collected showed that 36% were positive for STHs. Parasite types found included Hookworm (Necator americanus (20.9%) and Ancylostoma duodenale (20.6%)), Trichuris trichiura (24.8%) and Ascaris lumbricoides (37.5%). Adeoyo hospital had the highest prevalence of Ascaris (26.1%) while Oni and Sons hospital had the highest prevalence of Trichuris (24.8%). The male gender had a higher infection of Ascaris (52.4%) while the female gender had a higher infection rate of Trichuris (72.7%). There was no statistical relationship between knowledge of

STH and infections. The presence of viable STHs eggs/ larvae in soil suggests possible active transmission and high rate of exposure to infective agents among the school children. There is a need for health education on risk associated with STH infection in the environment. The study recommends chemotherapy treatment to control the infection in the study area.

Keywords: Soil, Environmental Factors.

Background to the study

The worm-like parasites known as soil transmitted helminthes (STHs) feed on a living host to obtain nutrition and protection, occasionally inflicting harm on the host (Ogbaini-Emovon et al., 2014). Different species of parasitic worms are the cause of helminths that spread through soil (WHO, 2020). They are primarily found in warm, humid regions with inadequate sanitation and hygiene, which includes temperate zones during the warmer months (CDC, 2020).The most common STH's which are found worldwide are *Trichuris trichiura, Ascaris lumbricoides* and the hookworms (*Necator americanus* and *Ancylostoma duodenale*) and they stand out because of their widespread prevalence and distribution that result in hundreds of millions of human infections (Pullan and Brooker, 2012). They are transmitted by eggs present in human faeces, which contaminate the soil in areas where sanitation is poor (WHO, 2020). They infect many animals and humans through soil contaminated with faecal matter containing the eggs/larvae of the parasites, foodstuffs and/or water supplies (Chhabra and Singla, 2009). High incidence rate of STH infections occur in the Americas, China, East Asia and Sub Saharan Africa (WHO, 2020). Prevalence rate of 15.6% in Thailand (Anantaphruti *et al*., 2004), 88.4% in Turkey (Ulukanligil *et al*., 2001), 69.9 % in Tuvalu (Speare *et al*., 2006), 53% in Guinea (Glickman *et al*., 1999), 40.2% in China (Mofid *et al*., 2011), 92.6% in India (Naish *et al*., 2004), and 43.5% in Ethiopia (Belyhun *et al*., 2010) were reported from the different parts of the world.

These infections mainly affect the poorest and most deprived communities which are characterised by poor sanitation, lack of portable water, inadequate health facilities, poor housing, overcrowding and squalid environment (Midzi *et* al.2014; Rujeni *et* al.2017; WHO, 2020).

Classified as neglected tropical diseases; STH's are still among the most prevalent neglected tropical diseases (James *et* al., 2018; WHO, 2020) because they inflict tremendous disability and suffering yet can be controlled or eliminated (CDC, 2020). Soil transmitted helminths are endemic in 166 countries worldwide (Pullan *et* al., 2014) and approximately infect 1.5 billion people worldwide, occurring mainly in sub-Saharan Africa, South and North America, China and East Asia (WHO, 2020). Over 267 million preschool age children and over 568 million school age children live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions. About 33.9 million cases was reported among school age children in sub-Saharan Africa with cases largely concentrated in five countries including Nigeria (Sartorius *et al.,* 2020). Karshima (2018) in a review reported an overall prevalence of 54.8% of STH infections in Nigerian children.

According to Humphries *et al*., (2012), parasites belong to two major phyla; phylum Platyhelminthes known as the flatworms (flukes and tapeworms) and phylum nematoda known as roundworms. Soil transmitted helminths are caused by the ingestion of eggs of *Ascaris lumbricoides* and *Trichuris trichiura* or by active penetration of the skin by larvae of *Ancylostoma duodenale* and *Necator americanus* (hookworms) in the soil (Mwandawiro *et al*., 2019; WHO, 2020). The study of Dada (2016) showed that the most common target organs of infections are the alimentary tract and circulatory system, with effects of infections predominantly found and pronounced in these organs. *Ascaris lumbricoides* is the largest, most common parasitic worms in humans responsible for the disease known as ascariasis, and infects humans when an ingested fertilized egg becomes a larval worm that penetrates the wall of the duodenum and enters the bloodstream (Odu *et al*., 2011). According to Sowemimo and Asaolu, (2011), most tapeworms and roundworms develop in the human body and lay their eggs there. The eggs then pass out of the body through feaces and can infect others. Ibrahim *et al*., (2014) reported that the transmission of human intestinal helminthes parasites can occur

through the ingestion of contaminated vegetables, the use of contaminated water for drinking, cooking, irrigation, washing of food especially fruits, eating of undercooked food of animal origin and walking barefoot. Dada *et al*., (2015) reported that helminthes are regarded as a major source of public health hazard owing to their high prevalence and their effect on both nutrition and immune status of the population.

Under five is a shorthand term for children under 5 years of age especially those who are not in full-time education. It is a period of rapid growth and relatively high nutritional requirements. Children under this age die mostly from preventable and treatable causes and mortality at this age is a commonly used public health indicator. They traditionally combine nutrition and growth monitoring, immunisation and simple curative treatment. Children in this age group are known to practice habits that may predispose them to STH infections such as crawling, playing with soil that may be contaminated with STH's and placing hands in their mouths.

Factors such as poor sanitation, lack of portable water, inadequate health facilities, poor housing, overcrowding and squalid environment predominantly predisposes under 5 children to STH infections. (Midzi *et* al., 2014; Rujeni *et* al, 2017; WHO, 2020). Affected children are usually malnourished and anaemic because of the resultant nutritional deficiency (Freeman *et al.*, 2015). Long term effects associated with the condition include diminished physical fitness, growth retardation and delayed intellectual development and cognition (Hotez *et al*., 2008)

Soil-transmitted helminthes are among the leading causes of global health problems especially among the poorest and deprived communities where implementation of control measures is difficult (Karshima, 2018). It is classified by the World Health Organisation (WHO) as neglected tropical diseases (WHO, 2012) and are among the most prevalent neglected tropical diseases (James *et* al., 2018). Soil transmitted helminths are endemic in 166 countries worldwide (Pullan *et* al., 2014) and approximately infect 1.5 billion people worldwide, occurring mainly in sub-Saharan Africa, South and North America, China and East Asia (WHO, 2020). Over 267 million preschool age children and over 568 million school age children in Africa live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions (WHO, 2020). About 33.9 million cases was reported among school age children in sub-Saharan Africa with cases largely concentrated in five countries including Nigeria (Sartorius *et al.,* 2020).

Karshima, 2018 reported an overall prevalence of 54.8% of STH in a study to systematically review the distribution of STH infections in Nigerian children. Soil transmitted helminths prevalence in Nigeria has remained unchanged since the 1970s (Ekundayo *et al*., 2007). The major contributors to persistence of infections are cultural, socio-economic and environmental factors (Ekundayo *et al*., 2007; WHO, 2015). Unhygienic and common practice of indiscriminate defecation or dumping excrement have persisted in Nigeria which has contributed to the persistence of infections (WHO, 2015). Substantive evidence suggest that the most vulnerable group are children where infections are acquired through playing with contaminated soil and pica habits (Karshima, 2018).

Although, there are a lot of studies on the prevalence of STH's among children of school age in Nigeria (Salawu *et al*., 2014; Dada, 2016; Opara *et al*., 2021), there are fewer studies on the prevalence of STH's among preschool age children especially those between the ages of 1-4 years. Oyo state is one of the many states with fewer or no studies on the prevalence of STH's among preschool age children especially those between the ages of 1-4 years.

Furthermore, in Nigeria, intervention programs has been exclusively school-based including Oyo state, this potentially excludes school aged children who are out of school and preschool aged children who are majorly under five years (Freeman *et al*., 2019). In addition, community based strategic drug administration which is vital to the control of STH infections requires epidemiological assessment and disease prevalence in communities as guides for choosing and instituting treatments (Karshima, 2018) and there is not enough studies on under five children to provide epidemiological background for interventions in this age group. Infection of these parasites in children may result in malnutrition,

anaemia, poor school performance, delayed physical growth and impaired cognitive functions (Djuardi *et al*., 2021).

Finally, caregivers (parents and guardians) are considered a critical group due to their functional role as caregivers. Caregivers are highly influential within their families and at the community level, however without enough knowledge, they tend to mislead others or engage in risky practices that predispose their young children to STH infections (Schatz, 2007 and Sacolo *et* al., 2018). Therefore, data obtained from this research will help inform policies on STH prevention, control and treatment in Nigeria.

This study aims to determine the prevalence of STH infections and the factors associated with STH infections among under 5 children in the study area so as to provide basis for appropriate strategies against STH infections.

Broad objective

The broad objective of this study is to determine the prevalence of soil transmitted helminth parasites among under 5 children and the associated predisposing environmental factors in selected maternal healthcare centers in Ibadan.

Specific objectives

The specific objectives are to:

1. Determine the prevalence of soil transmitted helminth in under-5 children in the study area.
2. Identify the associated environmental factors predisposing under 5 children to STHs infections.
3. Identify STH species in under-five stool samples in the study area.

Materials and Methods

Description of the Study Area

This study was carried out at Adeoyo Maternity Teaching Hospital, Yemetu and Oni and Sons Memorial hospital, Ring Road which are both located in Ibadan, the capital city of Oyo State which is the largest metropolitan city with an area of 3,080km^2 (Osayomi and Orhiere, 2017) in Nigeria and population of 3,649,000 in 2021 (Osayomi and Orhiere, 2017). Ibadan is located at about 119km northeast of Lagos and 120km east of the Nigerian international border with the Republic of Benin (Osayomi and Orhiere, 2017) and falls within latitude 7^{o}22’39.22”N and longitude 3^{o}54’21.28”E with an elevation of 230m above sea level (Osayomi and Orhiere, 2017). A cross-sectional study design was used to determine the prevalence of soil transmitted helminth parasites among under 5 children and the associated predisposing environmental factors in selected maternal healthcare centers in Ibadan. The study population involved were pre-school aged children that are under the age of 5 years. Consent was sort from mothers/caregivers that bring these children to the healthcare centers.

Sampling Technique

A purposive sampling technique was employed. Healthcare centers were purposively selected because of their involvement in maternal and child care. The maternal healthcare centres that were selected include: Oni and Sons Memorial Hospital, Ring-Road, Ibadan and Adeoyo Maternity Teaching Hospital, Yemetu, Ibadan. Following the method described by Fritsche *et al.*, (2011), stool samples were collected from study participants using sterile universal bottles labelled with a unique ID and dated

Sample preparation and Laboratory Analysis

The appearance of the stool samples were observed macroscopically whether it is formed, unformed, semi-formed and recorded. The color was also observed and recorded, the presence or absence of pus, blood or mucus were also observed and recorded.The stool samples were examined for the presence of STH parasites using the Kato-Katz thick smear technique as described by WHO (WHO, 2002).

Eligibility Criteria

Inclusion Criteria

1. Under five children whose parents/caregiver are willing to participate in the study and have attended the centre for the last 3 months.
2. Children under the age of 5 who are yet to undergo laboratory analysis on soil transmitted helminth in the last 3 months were included in the study

Exclusion Criteria

1) Children under five who are ill at the time of the study.
2) Children not within the age range.
3) Children who are below the age of 5 but have undergone laboratory analysis on soil transmitted helminths infection in the last 3 months were excluded from the study

Instrument for Data Collection

A primary data was collected through a structured questionnaire circulated among parents whose children are eligible to participate in the study. It was administered to the mothers/caregivers to obtain necessary The questionnaire and divided into 3 sections; Section A: Socio-demographic characteristics. Section B: Knowledge of Mothers of Under-Five Children about STH Infections. Section C: Associated Environmental Factors Predisposing Under-Five Children to STH Infections.

Data Management, Analysis and Presentation

Data obtained were entered into MS excel, coded, cleaned and checked for completeness and accuracy, compiled, and imported to SPSS for windows version 20 for statistical analysis. Descriptive analysis including frequency was used to summarize demographic characteristics of the study participants. A Pearson correlation analysis was carried out to establish the correlation between environmental factors that predisposes individuals to soil transmitted helminths and the distribution of soil transmitted helminths in the study area. The chi square analysis was used to determine the significant differences among two or more categorical variables such as accommodation types, parent's/caregivers occupations, level of education etc.

Ethical Consideration

Ethical approval was sort from the OYO State Research Ethics Review Committee and UI/UCH Ethics Review Committee.

Results

Socio-Demographic Characteristics of Respondents

Table 1 shows the socio-demographic characteristics of respondents. About 69% of the respondents' age group falls between 25-34years. The average age of respondents is 31.41±5.33. More than two-fifths of the respondents attended tertiary education. The majority (92.7%) of the respondents are married. Many (64.8%) of the respondents' occupations were gainfully employed. More than half of the respondents are Christian. Most (78.9%) of the respondents are Yoruba. About 58% of the respondents' Parity is less than two. More than two-fifths of the respondents enhanced #30000 or less as an average income. More than half of the respondents' children are female. The total average age of respondents' children is 23.79±13.17 months. Most (83.9%) of the respondents' children position in the family are within 1 to 3. More than half of the respondents' childbirth weight is greater than four. Most (79.7%) of the respondents' house is rented. The average number of households is 1.29±0.91. Most (48.4%) of the mothers had tertiary education while 92.7% of the mothers were married and 64.8% of the mothers were gainfully employed.

Table 1: frequency distribution of socio-demographic characteristics of respondents

Variable	N	%
Age (Year)		
<24	21	5.5
25-34	264	68.8
35-44	80	20.8
≥45	19	4.9
Mean+SD	31.41±5.33	
Mother Education Level		
No formal	14	3.6
Primary	21	5.5
Secondary	163	42.4
Tertiary	186	48.4
Marital status		
Married	356	92.7
Others	28	7.3
Mothers Occupation		
Gainfully employed	249	64.8
Unemployed	135	35.2
Religion		
Christianity	209	54.4
Islam	172	44.8
Traditional	2	0.5
Others	1	0.3
Ethnicity		
Yoruba	303	78.9
Igbo	64	16.7
Hausa	16	4.2
Others	1	0.3
Parity		
<2	222	57.8
≥2	162	42.2
Average Income		
≤30000	183	47.7
31000-60000	87	22.7
>60000	114	29.7
Mean±SD	71510.33±41855.27	
Sex (Child)		
Female	169	44
Male	215	56
Child Age (Months)		
Mean±SD	23.79±13.17	
Position in the Family		
1-3	322	83.9
4-6	62	16.1
Child Birth Weight		
<2.5	95	24.7
2.5-4	90	23.4
>4	199	51.8
Mean+SD	8.80±5.63	

Type of House		
Owned	78	20.3
Rented	306	79.7
Number of Household		
Mean+SD	1.29±0.91	
Number of People living in the house		
Mean+SD	5.54±3.83	

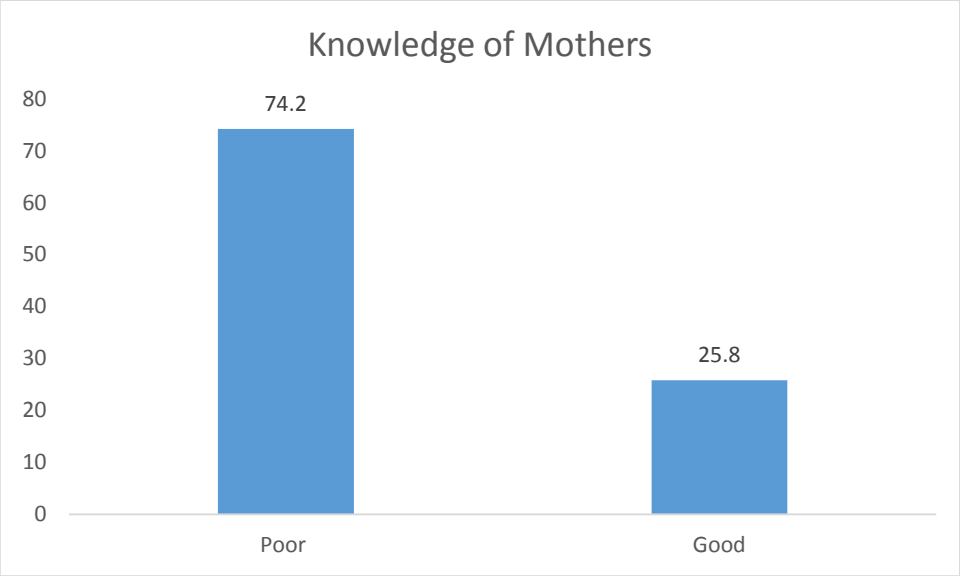
Knowledge of Under-Five Children on Soil Transmitted Helminths Infections

Table 2 shows the knowledge of under-five mothers on transmission of helminths infections. More than half of the respondent don't know about STH before. About 35% of the respondents don't know STH can be transmitted through ingestion of contaminated food, water (34.6%) or soil (37%). Few (39.3%) of the respondents know that diarrhea is one of STH symptoms. Majority (91.1%) of the respondents know that is right to deworm their child at least one in a year. More than half of the respondents know that eating an unwashed or uncooked fruits or vegetables can be a risk to STH. Most (71.6%) know that worm infestation can make their child to be vomiting and having diarrhea. More than half (57.3%) of the respondents know that deworming of their child twice in a year will reduce complication of STH among Under five children. About two-third (67.2%) of the respondents give their child herb to drink. Many (64.8%) of the respondents know proper cooking of food can help to prevent STH infection.

Table 2: frequency distribution of STH knowledge among mothers of under-five

Variable	Yes (%)	No (%)	Don't know (%)
Heard about STH	160(41.7)	217(56.5)	6(1.6)
STH can be transmitted through the ingestion of contaminated food	129(33.6)	136(35.4)	119(31)
STH can be transmitted through the ingestion of contaminated water	136(35.5)	133(34.6)	115(29.9)
STH can be transmitted through the ingestion of contaminated soil	127(33.1)	142(37)	115(29.9)
Diarrhea is one of the symptoms of STH	151(39.3)	86(22.4)	147(38.3)
Deworming of child is important in a year	350(91.1)	22(5.7)	12(3.1)
Unwashed fruits and uncooked vegetables increase the risk of STH for under-5 children	223(58.1)	35(9.1)	126(32.8)
STH is an infection that can never be prevented because worms are natural in the body	92(24)	180(46.9)	112(29.2)
Worm infestation can make your child to be vomiting and having diarrhea	275(71.6)	22(5.7)	87(22.7)
STH infections cannot cause malnutrition for a child	83(21.6)	176(45.8)	125(32.6)
Worms are the number of child that one will bear and are not harmful	55(14.3)	282(73.4)	47(12.2)
STH can cause diarrhea to children	152(39.6)	95(24.7)	137(35.7)
Deworming twice in a year reduces complication from STH	220(57.3)	49(12.8)	115(29.9)
Do your child drink herb	258(67.2)	126(32.8)	
Washing of hand is one of the ways that STH can be prevented	251(65.4)	23(6)	110(28.6)
Proper cooking of food prevent STH infections	249(64.8)	32(8.3)	103(26.8)

Figure 1 shows the knowledge of Soil Transmitted Helminths Infections among mothers of Under-5 children. About 74% of the mothers had a poor knowledge on STH Infections.



Environmental Factors Associated with Predisposing Under-five Children to STH Infection

Table 3 shows the environmental factors that are associated with the predisposing of under five children to STH infection. Majority (97.7%) of the respondents has a toilet-facilities in their house, with water closest (75.3%) is the most common toilet facility used by the respondents. About 92of the respondents have a source of drinking water, with about two-fifths of the respondents' source of water is borehole.

Table 3: Frequency distribution of factors associated with predisposing U-5 to STH Infection

Variable	N	%
Toilet facilities in your house		
Yes	375	97.7
No	9	2.3
If yes, type of toilet		
Water Closet	289	75.3
Pit latrine	91	23.7
Sanplat	2	0.5
Bucket/Pan	2	0.5
Drinking water		
Yes	354	92.2
No	30	7.8
If yes, type of drinking water		
Well	130	33.9
Municipal water	39	10.2
Sachet	53	13.8
Borehole	162	42.2

Children's and Mothers Habit on Predisposing Factors to STH Infection

Table 4 shows the children habit in predisposing factor to STH infection. More than half of the respondents' child play with sound and always wear their slippers whenever they are playing with sand. Majority (90.9%) of the respondents' child don't have long nails, but do wash their hands after they defecate. More than four-fifths of the respondents' child wash their hands before eating and cleaned them up after defecating. Most (88%) of the respondents don't give their child raw food, also

assist their child whenever they want to defecate and engaged in regular hand-washing. More than third-fifths of the respondents don't keep long nails nor live in an open field.

Table 4 frequency distribution of children and mothers habit on predisposing factors to STH infection

Variable	Yes (%)	No (%)	Can't say
Children playing in the sand	198(51.6)	185(48.2)	1(0.2)
Children wear slippers when they play in the sand	208(54.2)	171(44.5)	4(1)
Defecating on their own	187(48.7)	197(51.3)	
they have long nail	33(8.6)	349(90.9)	2(0.5)
Washing of hands after defecating	349(90.9)	23(6)	12(3.1)
Eating food that falls on ground	153(39.8)	192(50)	39(10.2)
Washing of hand before eating	327(85.2)	35(9.1)	22(5.7)
Wearing of Covered shoes	129(33.6)	250(65.1)	5(1.3)
Cleaning up after defecating	370(96.4)	9(2.3)	5(1.3)
Buying of foods outside	139(36.2)	241(62.8)	4(1)
Given of raw food to children	43(11.2)	338(88)	3(0.8)
Assisting of children whenever they want to defecate	338(88)	45(11.7)	1(0.3)
Engaging in regular hand wash	334(87)	36(9.4)	14(3.6)
Do you keep long nail	117(30.5)	265(69)	2(0.5)
Living in an open field	137(35.7)	243(63.3)	4(1)

Figure 2 shows the prevalence of STH among under five. About 36% of the select children had STH present in them.

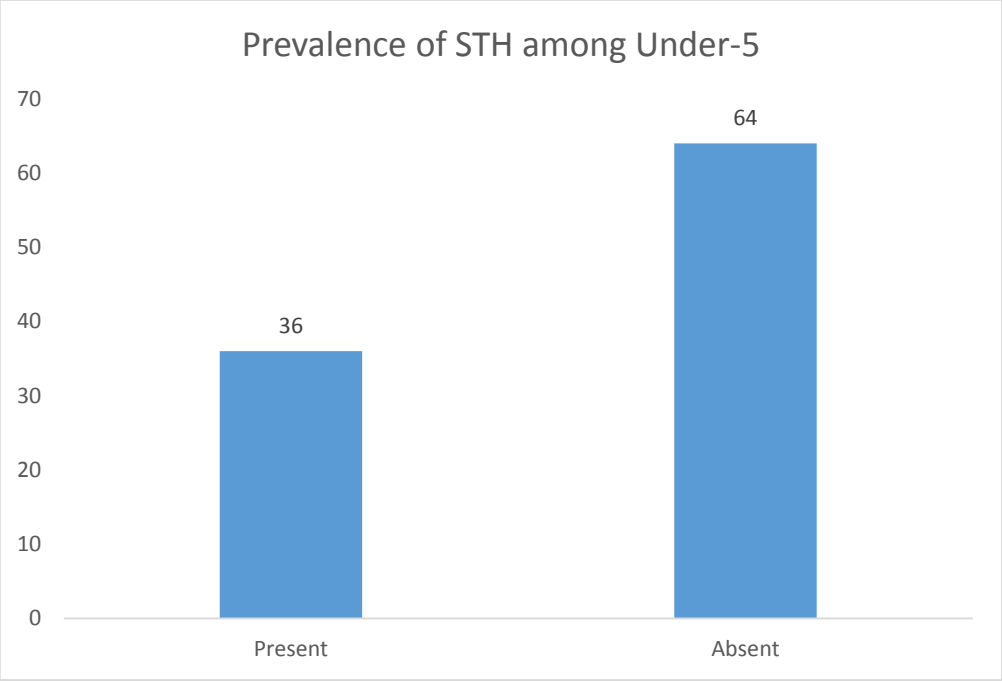


Figure 2

Figure 3 shows the types of STH present in the stool samples examined. About 40% of the respondents has *Ascaris lumbricoides*.

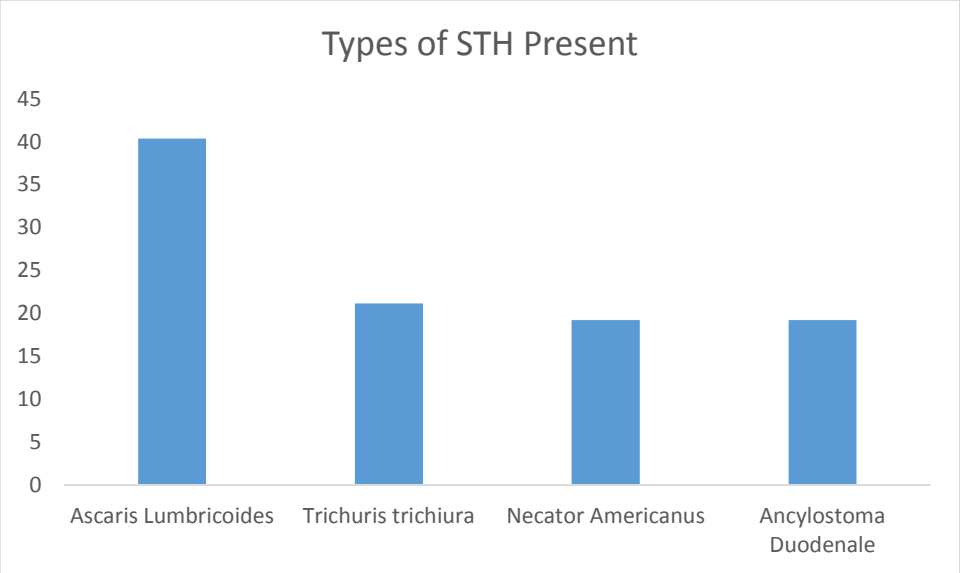


Figure 3 Prevalence of STH infections relative to Hospitals

Table 5a shows the prevalence of STH infections relative to the hospitals and the types of STH present. The proportion of STH infections was high among respondents child at Oni and Son (37.4%) compared to those respondents child at Adeoyo (35.4%) respectively at P-value>0.05. Table 5b shows the types and prevalence of STH relative to the hospitals. *Ascaris lumbricoides* (26.1%) and *Necator americanus* (12.3%) is more prevalent in Adeoyo hospital while *Trichuris trichiura* (17.1%) and *Ancylostoma duodenale* (11.4%) is more prevalent in Oni and Sons hospital at P-value>0.05.

Table 5a prevalence of STH infections relative to hospitals

Variables	**Present STH**	**Absent STH**	**$\chi 2$**	**P-value**
Types of Hospital				
Adeoyo	23(35.4%)	42(64.6%)	0.03	0.861
Oni-Son	13(37.1%)	22(62.9%)		

Table 5b association between hospital and type of STH

Hospital	***Ascaris lumbricoides***	***Trichuris trichiura***	***Necator americanus***	***Ancylostoma duoenale***	**$\chi 2$**	**P-values**
Adeoyo	17(26.1%)	5(7.7%)	8(12.3%)	6(9.2%)	7.67	0.104
Oni&Son Total	4(11.4%) 21(37.5%)	6(17.1%) 11(24.8%)	3(8.6%) 11(20.9%)	4(11.4%) 10(20.6%)		

Association between Co-Infection and Hospital

Table 6 shows the association between co-infection and hospital. There is a high proportion of co-infection among respondents in Adeoyo hospital (18.5%) compared to those in Oni & Sons hospital (11.4%) at P-value>0.05.

Table 6 association between co-infection and hospital

Variables	Adeoyo	Oni & Sons	χ^2	P-value
Co-infection				
Yes	12(18.5%)	4(11.4%)	0.84	0.36
No	53(81.5%)	31(88.6%)		

Association between Respondents Child Sex and Present of STH

Table 7 shows the association between the sex of respondent's child and presence of STH. There is a high proportion of STH among those that are male (37.5%) compare to those that are female (34.6%) at P-value>0.05.

Table 7 association between child sex and presence of STH

Variables	Present STH	Absent STH	χ2	P-value
Child Sex				
Male	18(37.5%)	30(62.5%)	0.90	0.76
Female	18(34.6%)	34(65.4%)		

Comparison of Child Age with Presence of STH

Table 8 shows the difference between respondent's child age and the presence of STH. There was no significant difference of presence of STH across the child age at t (98) =-0.67, P=0.501.

Table 8 difference between presence of child age and STH

Variables	**Outcome**	Mean±SD	df	T	P-value
Child Age	Absent	24.82±14.21	98	0.67	0.501
	Present	22.83±14.15			

Association between environmental factors and presence of STH infections

Table 9 shows the association between environmental factors and presence of STH infections. About 40% of respondents who uses water closet as their toilet facility are positive for STH and there is no statistical significance (P>0.05). There is a high proportion (44.4%) of STH among those that use sachet water as their source of drinking water compared to those that use well (27.8%) as their source of drinking water at P-value>0.05. There is a high proportion (50%) of STH among those that have long nails compared to those that do not have long nails (34.5) at P-value>0.05. Furthermore, there is a high proportion (64.3%) of STH among respondents that don't wash their hands regularly compared to those that wash their hands regularly (31.7%) at P-value=0.06.

Table 9 association between environmental factors and presence of STH

Variable	STH (%)	No STH (%)	χ2	P-value	Df	Mean	SD
Sex			0.09	0.76	1	1.52	0.5
male	18(37.5)	30(62.5)					
female	18(34.6)	34(65.4)					
Hospital			0.03	0.86	1	1.35	0.48
Adeoyo	23(35.4)	42(64.6)					
Oni and Sons	13(37.1)	22(62.9)					
Knowledge of STH			0.05	0.83	1	1.43	0.49
NO	20(35.1)	37(64.9)					
YES	16(37.2)	27(62.8)					

Herbs consumption			3.3	0.7	1	1.67	0.47
No	16(48.5)	17(51.5)					
Yes	20(29.9)	47(70.1)					
Types of toilet			7.73	0.1	4	2.07	0.73
water closet	31(39.2)	48(60.8)					
pit latrine	4(22.2)	14(77.8)					
Sanplat	1(50)	1(50)					
bucket/pan	0(0)	1(100)					
Source of drinking water			1.91	0.59	3	2.62	1.33
Well	10(27.8)	26(72.2)					
municipal water	2(33.3)	4(66.7)					
sachet water	8(44.4)	10(55.6)					
Borehole	16(40)	24(60)					
Playing in sand			0.2	0.6	1	1.53	1.5
No	18(38.3)	29(61.7)					
Yes	18(34)	35(66)					
Wearing slippers in the sand			0.57	0.75	2	1.51	0.52
can't say	0(0)	1(100)					
No	17(36.1)	30(63.9)					
Yes	19(36.5)	33(63.5)					
Long nails			1.67	0.43	2	1.11	0.35
can't say	0(0)	1(100)					
No	30(34.5)	57(65.5)					
Yes	6(50)	6(50)					
Wash hands after defecation			1.68	0.43	2	1.89	0.37
can't say	1(50)	1(50)					
No	1(14.3)	6(85.7)					
Yes	34(37.4)	57(62.6)					
Eat food from ground			0.01	0.99	2	1.39	0.55
can't say	1(33.3)	2(66.7)					
NO	20(36.4)	35(63.6)					
YES	15(35.7)	27(64.3)					
Wash hands before eating			5.3	0.07	2	1.63	0.71
can't say	8(61.5)	5(38.5)					
NO	2(18.2)	9(81.8)					

YES	26(34.2)	50(65.8)					
Wear covered shoes			0.76	0.68	2	1.32	0.49
can't say	0(0)	1(100)					
NO	23(34.8)	43(65.2)					
YES	13(39.4)	20(60.6)					
Regular hand washing			5.73	0.06	2	1.78	0.5
can't say	1(25)	3(75)					
NO	9(64.3)	5(35.7)					
YES	26(31.7)	56(68.3)					
Live in open field			2.33	0.31	2	1.29	0.48
can't say	1(100)	0(0)					
NO	26(37.7)	43(62.3)					
YES	9(30)	21(70)					

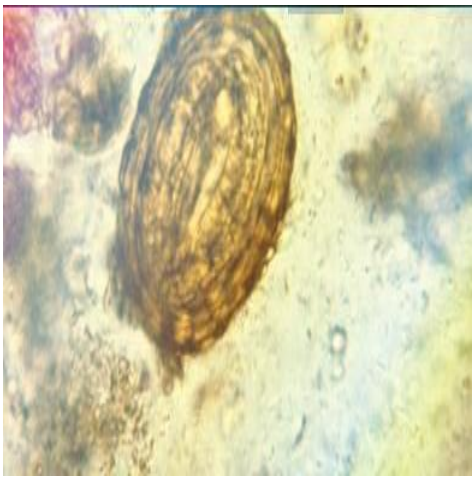


Plate 1: Egg of *Ascaris lumbricoides*

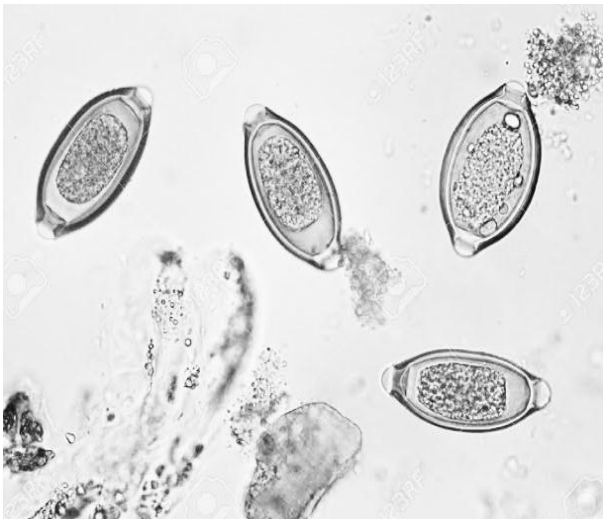


Plate 2: Eggs of *Trichuris trichiura*

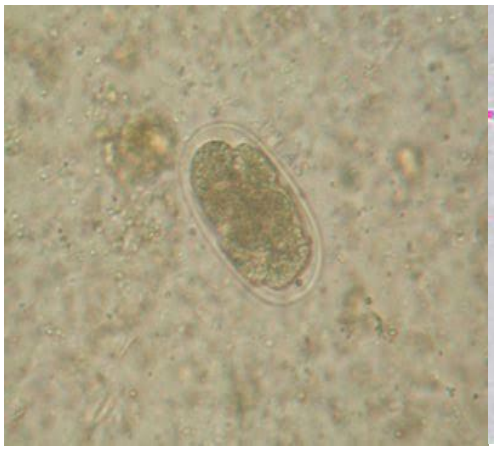


Plate 3: Egg of *Ancylostoma duodenale*

Plate 4: Egg of *Necator americanus*

SUMMARY, CONCLUSION AND RECOMMENDATION

This cross-sectional study revealed that Soil Transmitted Helminth infections are prevalent (36%) among under five children in Ibadan, Nigeria. The present finding showed that the prevalent of STH was lower compared with report of Hassan and Oyebamiji, (2018), Karshima, (2018) and Pasaribu *et al*., (2019) who reported a prevalence of 70.8%, 54.8% and 57.24% respectively but higher than. This may be attributed to differences in diagnostic methods, environmental hygienic conditions, and the difference in age groups (Muluneh *et al*., 2020). In this study, *Ascaris lumbricoides* (37.5%) was the most predominant STH species, followed by *Trichuris trichiura* (24.8%), *Necator americanus* (20.9%) and *Ancylostoma duodenale* (20.6%). This is similar to the report of Adeoye *et al*., (2007) in Lagos, Nigeria but contrary to the report of Odu *et al*., (2011) in Rivers state, Nigeria which reported the predominance of *Trichuris trichiura* and the report of Opara *et al*., (2012) and Usip and Matthew, (2015) both in Akwa Ibom state, Nigeria who reported the predominance of hookworms respectively. These variations may be attributed to differences in environmental factors such as temperature, rainfall, humidity and soil moisture

The high prevalence of *Ascaris lumbricoides* (37.5%) observed in this study may be attributed to the consumption of raw foods like vegetables and fruits without washing and the unhygienic habits of children eating without washing their hands. This is in agreement with the findings of Sowemimo and Asaolu, (2011) who observed that the consumption of raw foods without proper washing and the habit of eating with unclean hands that may have been contaminated with polluted soil, which often contain infective eggs that enhance transmission from hand to mouth can increase the risk of *Ascaris lumbricoides*. The prevalence of hookworms (*Necator americanus* (20.9%) and *Ancylostoma duodenale* 20.6%)) observed in this study may be attributed to the living habits of mothers and caregivers and the habit of walking and playing barefooted on soil that may have been contaminated with faecal matter which is in agreement with the findings of Dada *et al*., (2015) who reported that individuals who walk barefoot in faecal contaminated soil are at risk for hookworm infection.

The relatively higher prevalence of infections recorded among respondents that use water closet (39.2%) compared to those that use pit latrines (22.2%) is in agreement with the report of Dada *et al*., (2015) who attributed it to be due to the poor quality of hygiene of the toilets, irregular supply of water to flush the toilets and the unacceptable higher numbers of person per toilet.

CONCLUSION

There should be a renewed interest in understanding the epidemiology, diagnosis, prevention, and control of these illnesses because STH infections generally occur at alarming rates in communities where people have poor hygiene and low sanitation orientation. It is evident from the study's data that the prevalence of STH infections in the study area is still quite high. This can be attributed to factors such as poor sanitation and the hygiene condition of respondent’s homes, low level of knowledge of STH among parents, social habits of the children, poor government intervention especially in the area of orientation/education of parents, lack of clean, safe and drinkable source of water and, lack of public toilets for those without sanitary toilets at home. These infections can be controlled by regular environmental sanitation, health education on improvement of sanitation, provision of safe water, a proper system to regularly identify and treat infected individuals and proper monitoring from health authorities.

RECOMMENDATION

The following measures should be implemented to lower STH infections in the study area, in light of the findings of this investigation: Regular orientation of the inhabitants living in the area on public health interventions;

1. Government should provide good infrastructure to eradicate the spread of STH infections;
2. Regular and proper sanitation as at when due;
3. Government should provide chemotherapy treatment for those suffering from the infections;

4. Regular and proper deworming of students and inhabitants should be done at intervals;
5. Clean, safe and drinkable water should be provided by government;
6. Clean public toilets should be provided for those without toilet facilities at home;
7. Proper monitoring of this facilities should be done by assigned officers.

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