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EPIDEMIOLOGY AND DIAGNOSIS OF SOIL-TRAMITTED HELMINTHS AMONG SCHOOL-AGED CHILDREN FROM SELECTED SCHOOLS IN KEFFI, NASARAWA STATE, NIGERIA

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Abstract

The public health and socio-economic consequences of soli-transmitted helminthes (STH) are of immense concern in the rural communities of developing countries. A total Two hundred (200) fresh stools samples of primary school pupils in the selected school were collected and examined for Soil Transmitted Helminths using standard parasitological techniques. Out of the 2100 samples examined, 18 (18) had Soil Transmitted Helminths accounting for an overall prevalence of 9.0%. The prevalence of Soil Transmitted Health with respect to Schools showed that Yelwa II Primary School had the highest prevalence with 12.5%, followed by Nuruddeen and Abdu-Zanga Primary Schools with 10.0%, (P>0.05). this research also showed that the prevalence of Soil Transmitted Health with respect to sex showed that 5.5% of males and 3.5% of females had 3.5% (P>0.05). The prevalence of soil-transmitted helminths with respect to parent occupation showed that pupils whose parent were farmers had the highest prevalence rate of 9 (13.8%), followed by traders with a prevalence rate of 10.0% (P>0.05). The prevalence of STH with respect to parental educational status showed that pupils whose parent attended primary school had the highest prevalence rate of 8 (9.0%), followed by pupils whose parent attended secondary school with a prevalence rate of 6 (8.0%) (P>0.05). Parent and school authorities should maintain adequate personal hygiene through handwashing habits in school and at home.

1. INTRODUCTION

Intestinal parasitic infections are among the most widespread chronic human infections worldwide (Wosu and Onyeabor, 2014). Intestinal parasitic infections represent a large and serious medical and public health problem in developing countries. These infections constitute a global health burden, causing morbidity in 450 million people, most of whom are children (Wosu and Onyeabor, 2014). In Sub-Saharan Africa, intestinal helminths are

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the most common diseases with very high negative public health and socioeconomic impacts (Stoltzfus *et al.*, 2014). In Nigeria, high morbidity rates in children are correlated with intestinal parasitic infection (Stoltzfus *et al.*, 2014; Yimer *et al.*, 2015). Amebiasis, giardiasis, ascariasis, hookworm infection, and trichuriasis are among the most common intestinal parasitic infections worldwide (Stoltzfus *et al.*, 2016).

According to Wosu and Onyeabor (2014), although most parasites can be tolerated asymptomatically in the latent phase, active infections, especially by multiple parasites, can cause health problems and developmental deficits in school children. Reinfection is a major concern in endemic areas with precarious socioeconomic conditions. In poor settings, a large proportion of individuals can be reinfected within a relatively short time (Stothard *et al.*, 2020).

The distribution and prevalence of various intestinal parasites vary by region. This is due to several environmental, social, cultural, and geographical factors. They spread mostly in areas with poor sanitation and are most common in tropical developing countries of the African, Asian, and South American continents (CDC, 2011). According to Stothard *et al.* (2020), intestinal parasitic infections are closely associated with poor economic status, poor personal and environmental sanitation, overcrowding conditions, and limited access to potable water, cultural beliefs, tropical climate, and low latitude. The people whose incomes are below the federal poverty threshold of underdeveloped nations experience a cycle in which undernutrition and repeated infections lead to excess morbidity that can continue from generation to generation (Stothard *et al.*, 2020).

People of all ages are affected by this cycle of prevalent intestinal parasitic infections, although school-aged children are more affected (Sundeep, 2014). It has long been recognized as an important health problem, especially among Nigerian children (Sundeep, 2014). School children carry the heaviest burden of the associated morbidity due to their dirty habits of playing or handling infested soils, eating with soiled hands, unhygienic toilet practices, drinking and eating contaminated water and food (Stothard *et al.*, 2020). Intestinal parasites are transmitted to humans when fecal matter enters the mouth.

This can occur through contaminated food or water, oral sex play, or non-sexual intimate contact, such as changing of a baby's diaper (WHO, 2008; CDC, 2011). They may also penetrate the body through the skin (in the case of hookworm infection and intestinal schistosomiasis) or if contaminated soil is ingested accidentally. Other parasites that live in animals, such as pigs and cows, can infect humans by eating undercooked meat or drinking unpasteurized milk (Sundeep, 2014).

Swimming in contaminated water may also result in the infestation of certain parasites, such as *Schistosoma mansoni*, which is responsible for intestinal schistosomiasis. Parasitic intestinal infestations often occur when several people have symptoms simultaneously. This is especially likely if many people are exposed to the same supply of contaminated food or water (CDC, 2011).

The public health importance of gastro-intestinal tract parasites is due to their high morbidity in school children and women during their child-bearing years, which might result in increased metabolic rates, anorexia, chronic anemia, and diarrhea.

Intestinal parasites can cause different signs and symptoms in patients. A list of symptoms include: abdominal pain, chills, chronic fatigue, colitis, abdominal distension, digestive disturbance, fever, enlargement of various organs, headaches, weight loss due to malnutrition, weakness, immunodeficiency, nausea/vomiting insomnia, skin ulcers, rectal prolapse, mental problems, lung congestion, memory loss, night sweats, and sometimes mentally related disorders (Sundeep, 2014).

Diarrhea, including that of intestinal parasitic origin, remains one of the most common illnesses in children and one of the major causes of infant and childhood morbidity in developing countries (Sundeep, 2014). The World

Health Organization (2011) reported that the mean hemoglobin level is affected by high parasitic loads, hence the need to check the hemoglobin parameters.

Sundeep (2014) reported that the public-health and socio-economic consequences of intestinal helminthes are of considerable global concern, especially in children's health and development, where it causes malnutrition, which compromises their learning capabilities in their formative years.

Children are most affected because of their vulnerability to nutritional deficiencies (Sundeep, 2014). Poor people in developing countries experience a cycle in which undernutrition and repeated infections lead to excess morbidity that can continue from generation to generation (Sundeep, 2014).

Apart from morbidity-related problems associated with intestinal worms, they have great effects on nutritional status and cognitive performance, especially among preschool and school-aged children (Ahmed *et al.*, 2012). Ahmed *et al.* (2012) conducted a study on the prevalence and nutritional effects of helminth infections in pre-school rural children in Nigeria and reported that approximately three-quarters of children infected with intestinal parasites were undernourished. Moreover, they cause iron deficiency anemia, loss of appetite, and other physical and mental problems (Ahmed *et al.,* 2012). Intestinal parasitic infections cause decreased intake of nutrients in the body due to their interface with absorptive surfaces, physical obstruction of the intestinal lumen, production of proteolytic substances, and consumption of nutrients intended for the body (Tamramat and Olowu, 2018).

2. Soil-transmitted Helminthiasis

Of the 100 species of helminths reported from the human intestinal tract, nematodes such as *A. lumbricoides*, hookworm, and *T. trichiura* are the most common species (Cheesbrough, 2005). It is estimated that at least one-third of the global population is chronically affected by intestinal para

Sites, and the prevalence of infections varies from one country to another and sometimes from one area to another in the same country (WHO, 2006). The public health importance of intestinal helminth infections continues due to their effects on both the nutritional and immune status of infected individuals, particularly those living in tropical and subtropical areas. Intestinal helminthic infections mainly affect the physical and mental development of children who are the most vulnerable. The prevention and control of these parasites are mainly achieved through mass drug distribution. However, chemotherapy alone does not solve these problems, and the role of other measures such as sanitation and health education should also be considered. The success or failure of control measures may depend mainly on human behavior and practices. Therefore, the participation of the community in an active programme directed toward the improvement of their health and standard of living is significant (WHO, 2006).

Soil-transmitted helminth (STH), a group of group with NTD commonly known as intestinal worms, are parasites that serve as major contributors to morbidity and disease incidence in developing countries. The causal agents of STH are any of the following worms: *Ascaris lumbricoides*, *Trichuris trichiura, and* hookworms. Infection is caused by the ingestion of eggs in contaminated food or water (*A. lumbricoides* and *T. trichiura*) or via penetration of the skin by larvae in the soil (hookworms). Infections by *A. lumbricoides* and *T. trichiura* usually have a maximum intensity at the age of 5-10 years, whereas the maximum intensity of hookworm infection is at the age of 20-25 years (Orji, 2015; Parija and Srinivasa, 2021). Despite the low cost of treatment (i.e., standard drugs costingless than $0.05 per course), many developing countries have not mobilized resources and institutions to achieve a high coverage rate of deworming (WHO, 2006). For instance, a WHO report showed that Bangladesh, India, Indonesia, and Thailand had national coverage of treatment for school-age children below 25%, with coverage in Thailand lower than 1% (WHO, 2012). Significant associations of STH infections with malnutrition, VAD, IDA, and poor cognitive and educational performance have been reported in several previous studies, especially among children in rural areas (Ahmed *et al.,* 2012).

3. The Parasites

Ascaris lumbricoides (common roundworm), T. *trichiura* (whipworm), Ancylostoma *duodenale, Necator americanus* (hookworms), and *Strongyloides stercoralis* (threadworm) are STH species. *A. lumbricoides, S. stercoralis,* and hookworms live inside the human small intestine, while *T. trichiura* lives in the cecum for one to several years. They are known as STH because eggs/larvae that pass through feces need about 2-3 weeks to mature in the soil before becoming infective (WHO, 2014). This study will focus on the three main STH species, *A. lumbricoides, T. trichiura,* and hookworms. The biological Soil-transmitted helminth (STH), a group of NTDs commonly known as intestinal worms, are parasites that serve as major contributors to morbidity and disease incidence in developing countries (Wilson*et al.*, 2018). The causal agents of STH are any of the following worms: *Ascaris lumbricoides, Trichuris trichiura, and* hookworms. Infection is caused by the ingestion of eggs in contaminated food or water (*A. lumbricoides* and *T. trichiura*) or via penetration of the skin by larvae in the soil (hookworms). Infections by*A. lumbricoides* and *T. trichiura* usually have a maximum intensity at the age of 5-10 years, whereas the maximum intensity of hookworm infection is at the age of 20-25 years (Stephenson, 1987). Despite the low cost of treatment (i.e., standard drugs costingless than $0.05 per course), many developing countries have not mobilized resources and institutions to achieve a high coverage rate of deworming (WHO, 2006). For instance, a WHO report showed that Bangladesh, India, Indonesia, and Thailand had national coverage of treatment for school-age children below 25%, with coverage in Thailand lower than 1% (WHO, 2012). Significant associations of STH infections with malnutrition, VAD, IDA, and poor cognitive and educational performance have been reported in several previous studies, especially among children in rural areas (Abera *et al.*, 2013; Absar *et al.*, 2010).

Table 2.1: Characteristics of the adult worms of 3 main STH species. (Source: Abou-Zeid*et al.*, 2013; Brooker *et al.*, 2006)

Characteristics	***T. trichiura***	***A. lumbricoides***	**Hookworms (*N. americanus* and *A. duodenale*)**
Length (mm)	30-50	150-400	8-13
Location in host	Cecum	Jejunum	Duodenum, jejunum
Infective stage	Ova	Ova	Larva
Egg output (eggs/female worm/day)	2,000-20,000	Up to 200,000	10,000-30,000
Life expectancy at the infective stages	10-30 days	28-84 days	3-14 days
Adult life span in a host	1-2 years	1-2 years	3-4 years
Pre-patency (Period for adult development t sexual maturity)	50-84 days	50-80 days	28-50 days
Larva development time to infective stage	20-100 days	8-37 days	2-14 days

4. Clinical Manifestations of STH infection

The disease caused by the main STH species is called soil-transmitted helminthiasis or STH infection. The clinical manifestations of STH infections differ by species. Moreover, the clinical manifestations of STH infection are proportional to the intensity of infection. Light intensity is usually asymptomatic, whereas moderate-to-heavy infections are associated with severe complications (Kelly*et al.*, 2016). The clinical features of STH infections are classified into acute signs and symptoms associated with early larval migration through the skin and viscera, and chronic symptoms resulting from parasitism of the gastrointestinal tract by adult worms (Kazora and Mahm, 2018).

5. Impact of Soil-transmitted Helminth Infection

Early Larva Migration

Many tissue reactions can occur during the early migration of Ascaris and hookworm larvae to the lungs. The larvae can provoke an inflammatory reaction consisting of eosinophilic granuloma (the accumulation of eosinophils in the lung of response to Ascaris

Infection) associated with fever, a nonproductive cough, wheezing, dyspnea,

Blood in sputum produced during severe illness. These symptoms are described as follows:

Loeffler's syndrome, in which Ascaris remains the most common cause worldwide, particularly among children (Kelly*et al.*, 2016; Kidane*et al.*, 2014).

Regarding hookworm infections, repeated exposures to *N. americanus* and *A. duodenale* filariform larvae resulted in ground itch, local papular rash, and pruritus on the hands and feet (Kikafunda and Tumwine, 2006). Similar to Ascaris, third-stage larvae migrate to the lungs and cause Loeffler's syndrome, in which the resulting pneumonitis is not as severe as in Ascaris infection (Knopp *et al.*, 2019). Moreover, oral ingestion of *A. duodenale* larvae can result in Wakana syndrome, which is characterized by pharyngeal

Irritation, cough, vomiting, and dyspnea (Kikafunda *et al.*, 2018).

6. Intestinal Parasitism by Adult Worm

During the late intestinal phase of Ascaris infection, gastrointestinal symptoms can occur due to the presence of large numbers of adult Ascaris in the small intestine. These conditions involve abdominal pain and distension, lactose intolerance, and malnutrition (Koplan *et al.*, 2019).

In Trichuris, the adult worm is usually partially embedded in the mucosa by the anterior end, while the posterior end lies free in the lumen of the large intestine. These adult worms can be seen in the colon and rectum in cases of severe infection and can cause colitis. It produces a clinical picture that resembles inflammatory bowel disease, including chronic abdominal pain, tiredness and diarrhea (sometimes bloody diarrhea) (Kongs *et al.*, 2011).

For hookworms, the symptoms are associated with intestinal inflammation stimulated by feeding hookworms which bite the intestinal mucosa and suck blood voraciously producing anticoagulant during feeding, which allows bleeding to continue (Hassan *et al.*, 2014). Based on the intensity of infection, the symptoms vary from nausea, abdominal pain, and intermittent diarrhea, which may contain blood to progressive anemia in chronic cases (Hollm-Delgado *et al.*, 2018). Moreover, intense chronic infections associated with gross intestinal blood loss and hypoproteinimia may cause palpitations, pallor of the mucous membranes, fatigue and weakness, shortness of breath, hemorrhages, and edema. The presence of more than 40 adult worms in the small intestine is estimated to be sufficient to cause anemia and reduce host hemoglobin concentrations below 11 g/dl (Horton, 2018). It was reported that hookworm infections drain nearly 50 ml of blood per day when the egg per gram (epg) of feces is about 250, thereby decreasing the red blood cell count, hemoglobin, and serum proteins (Hotez *et al.*, 2018).

7. Other Complications of STH Infections

STH infections are usually asymptomatic, particularly when the infection intensity is low. However, preschool children, school-age children, and women of childbearing age are at higher risk of prominent morbidity due to STH infections (WHO, 2011).

Moreover, STH infections are associated with moderate-to-heavy infections. For instance, adult Ascaris worms can form a mass in the lumen of the ilium leading to intussusceptions, partial or complete obstruction, intestinal perforation, and peritonitis, which can be fatal due to septicemia and the toxic effect of peritonitis (Hotez and Ehrenberg, 2009). Moreover, adult Ascaris worms can enter the lumen of the appendix leading to acute appendicitis. In addition, the ectopic migration of adult worms can cause cholecystitis, pancreatitis, and hepatic abscesses (Hotez and Ehrenberg, 2009).

Similarly, heavy infection by whipworm causes a serious complication syndrome called Trichuris Dysentery Syndrome (TDS). Children with TDS suffer from rectal bleeding, diarrhea, prolapsed rectum, and clubbing of the fingers (Hotez and Kamath, 2009). Heavy trichuriasis may also lead to growth deficits in children, IDA, intellectual and cognitive impairments, and poor school performance (Houmsou *et al.*, 2010). Likewise, blood loss from severe hookworm infections can lead to severe IDA, especially in children and pregnant women (Hual *et al.*, 2012). Severe IDA caused by hookworm infection during pregnancy can have adverse effects on the mother, fetus, and the neonate (Huang and White 2016).

Furthermore, the effects of STH infections may continue into adulthood. For instance, hookworm-IDA can decrease physical fitness, shorten working life, and reduce the working capacity of infected individuals (Iduh *et al.*, 2015).

Similarly, the negative impact of STH infections on cognitive function and school performance in children may have a longer effect on their productivity in adulthood (Ikeh and Aziah, 2015). Moreover, the devastating impact of STH infections may affect economic productivity and trap endemic communities in a cycle of poverty, underdevelopment, and disease (Ikeh and Aziah, 2015). The negative impacts of STH infections in children and adults.

8. Laboratory Diagnosis of STH infection

The laboratory diagnosis of STH infection is based on detecting characteristic eggs and/or larvae in stool samples collected from infected individuals. The following techniques are commonly used for stool examination to detect STH eggs and larvae:

i. The direct smear technique: It should be performed on every stool sample received in the laboratory. The motile larvae of Strongyloides or hookworms can also be detected. As the eggs of other species.

ii. Formalin-ether sedimentation technique: This technique is the method of choice for all intestinal parasitic infections, including STH, especially light infections. The method uses formalin, which is a fixative reagent, and prevents any further development of the stages.

iii. Kato-Katz technique: It is the gold standard technique recommended by the World Health Organization for the diagnosis of STH infections. Egg counting is very useful for evaluating the intensity of infections (WHO, 2002). In this technique, cellophane tape soaked in malachite green solution is used as a clearing agent (Delpeuch*et al.*, 2017). A known size of fecal material is used, and the number of eggs in the whole slide is to be counted.

iv. McMaster technique: This technique detects and counts STH eggs in fecal samples. Egg counting was performed using a counting chamber that enabled a known volume of fecal suspension to be examined microscopically (Desta-Haftu *et al.*, 2014; De Silva *et al.*, 2013).

v. FLOTAC technique: It has been recently developed as an innovative direct method for the diagnosis of intestinal parasitic infections. In this method, a cylindrical device with two 5-ml flotation chambers (FLOTAC apparatus) is used to prepare up to 1g of stool for microscopic examination. This technique is useful for fresh or preserved fecal samples (Dopouy-Cement, 2014).

vi. Harada Mori culture: A small amount of feces is incubated on a filter paper strip in a test tube containing water for culturing and recovering nematode larvae of hookworms and Strongyloides. This method is useful for detecting light hookworm infections (Eckamann and Gillin, 2011).

9. Treatment of STH Infections

Currently, some drugs are widely used for the treatment of STH infections, with albendazole and mebendazole being the most commonly used. These drugs are safe, cheap, and active against these parasites and should be taken when treating pregnant women and children aged below 2 years (WHO, 2005). The most widely used drugs are:

i. Albendazole: Albendazole is a broad-spectrum anthelmintic agent administered as a single dose of 400 mg, which is reduced to 200 mg for children aged below 24 months. This single dose is highly effective against ascariasis and hookworm infections, whereas Strongyloides and Trichuris infections may require more doses, such as a 3-day course of treatment (Ehiaghe *et al.*, 2013; WHO, 2005). Basically, albendazole prevents the formation of microtubules by binding to the worm βtubulin and inhibits the parasite microtubule polymerization which causes death of adult worms within few days (Eleni*et al.*, 2014). The drug is poorly absorbed by the host, and most of its anthelminthic action occurs directly in the gut. Hence, albendazole and other benzimidazole derivatives do not kill immature worms and cannot prevent re-infection, which can occur soon after treatment (El-Ridi and Tallima, 2014).

ii. Mebendazole: Mebendazole is also a benzimidazole derivative that is available as flavored chewable tablets (100 and 500 mg) or as an oral suspension (100 mg/5ml). Similar to albendazole, mebendazole is administered as a single dose, which is effective against Ascaris and hookworm infections, whereas in trichuriasis, a 3-day course of treatment should be administered (Emmy-Igbe*et al.*, 2011). The drug is very insoluble in water and poorly absorbed from the gastrointestinal tract, which limits its effect on worms in the gut only Emmy-Igbe*et al.*, 2011.

iii. Other drugs: Levamisole and pyrantel pamoate can also be administered as a single dose. They are effective against STH infections. Pyrantel pamoate is less effective against hookworm infections but highly effective against trichuriasis (WHO, 2005).

Many studies have shown that anthelmintics have low efficacy. For instance, albendazole (400 mg) as a single dose is the drug of choice for Ascaris and hookworm infections and has a high cure rate; however, the cure rate for Trichuris infection was low (Ben-Musa and Ibrahim, 2017). The low efficacy of Trichuris treatment could be attributed to the adult worms embedded in the mucosa of the large intestine. A previous study in Mexico showed that the efficacy of albendazole against Ascaris was 100%, but it was only 35% against Trichuris (Biu *et al.*, 2012). Another study in Lao PDR found that the cure rates of hookworm infection were 36% and 18%, respectively (Biwott *et al.*, 2014). A similar problem has been reported with pyranteloxantel for treating trichuriasis, and the cure rate was 32% (Buret, 2018). Likewise, a study in Zanzibar, Tanzania, showed that the efficacy of mebendazole or albendazole alone against trichuriasis was very poor, with cure rates of 19% and 10%, respectively (Campbell *et al.*, 2014).

In Malaysia, resistance to hookworm infections with pyrantel pamoate was reported during the 1970s, resulting in the termination of the national mass deworming program (Cauyan et *al.*, 2018). Previous studies have reported similar low efficacy of albendazole tablets in treating trichuriasis among Orang Asli communities (Cauyan *et al.*, 2018 *et al.*, 2014; Caulfield *et al.*, 2016).

10. Prevalence of Intestinal Parasitic Infection

The distribution and prevalence of various intestinal parasites differ from region to region because of several environmental, social, and geographical factors, as well as human behavior. Because many parasitic lifecycle require warm weather for host-to-host transmission, intestinal parasitic infections are more prevalent in temperate and tropical regions. The impacts of these infections are more significant in low- and middle-income countries where they contribute to greater economic impact, morbidity, and mortality (Amuta *et al.*, 2010).

11. Prevalence in African populations

Intestinal parasitic infections are highly prevalent in tropical countries, especially among school-aged children (Amuta *et al.*, 2018). Amuta *et al.* (2018) investigated the prevalence of intestinal parasitic infections in the Yadot Primary School in the Delo-Mena district, Bale zone, South Eastern Ethiopia and reported an overall prevalence of 26.2%. In Sudan, the prevalence of infections with *S. mansoni among* 6,122 children from 27 schools in the White Nile Province was 10.1% (Ahmed *et al.*, 2012). In Kenya, a prevalence of 23.7% was reported among food handlers (Anumba *et al.*, 2016). In the Dadeldhura district of Nepal, Amuta *et al.* (2018) reported a prevalence of 31.13%. A population-representative survey of children aged 0-10 years from Afghanistan reported an overall infection prevalence of 41% (Anumba *et al.*, 2016). In Eastern Cape Province, South Africa, Anumba *et al.* (2016) reported a prevalence of 64.8% among primary school children.

12. Prevalence of STHs in Nigeria

In Nigeria, the prevalence of intestinal parasitic infection varies from one geographical zone to another. In Nigeria, a high prevalence of intestinal parasitic infection is apt to occur in a low socioeconomic condition, characterized by inadequate water supply, poor hygiene, and poor sanitary disposal of feces and ignorance of simple health-promoting behaviors (Anumba *et al.*, 2016).

Ikeh and Aziah, (2015) conducted work in Gwagwalada, FCT-Abuja, Nigeria, and reported a 42.9% prevalence of intestinal parasitic infections. In Jos, Emmy-Igbe *et al.* (2011) reported a 57.8% prevalence of intestinal parasitic infections. In Borno State, Biu *et al.* (2012) reported a prevalence of intestinal parasitic infections of 60.0% among school-aged pupils in the Mafa Local Government Area. In Sokoto State, North- western Nigeria, Mohammed *et al*. (2015) reported a 54.4% prevalence of intestinal parasitic infections. Another study by Iduh *et al.* (2015) documented a prevalence of 74.5% among Almajiris in the Sokoto metropolis, Nigeria. In Bauchi, Samaila *et al.* (2016), in a study on the prevalence of intestinal helmnth infections among two selected public primary schools in Bauchi Metropolis, reported a prevalence of 9.1 %.

An intestinal parasitic infection prevalence rate of 25.0% was reported by Kikafunda *et al*. (2018) among children with diarrhea in Abeokuta, Ogun State, Nigeria. In Benin City, the total prevalence of intestinal parasitic infection was 3.9 % in a study conducted by Iduh *et al.* (2015) among patients at a tertiary hospital. In Benin, an intestinal parasitic infection prevalence of 20.7% was recorded in an orphanage home by Nwaneri and Omuemu (2013). A study by Kikafunda *et al*. (2018) in the AIfedore Local Government Area of Ondo State found a 48.9% prevalence of intestinal parasitic infections. Okpala *et al.* (2014) reported a prevalence of intestinal parasitic infection of 13.8% in Edo, South-Since, Nigeria. Kikafunda *et al*. (2018) reported prevalence of 48.40% in Osun State, Nigeria. Ojurongbe *et al.* (2014) reported a prevalence of intestinal parasitic infections of 46.3% in Osogbo, Osun State.

A study on intestinal parasitic infections among primary school children in Rivers State, in 2011 revealed (27.66%) prevalence of different intestinal parasites, namely Ascaris *lumbricoides* (51.78%), hookworm (25.0%), *Trichuris trichiura* (15.18%), *Strongyloides stercoralis* (7.14%), *Taenia sp*. (0.89%), and *Enterobius vermicularis* (0.01%), (Abah and Arene, 2015). In Akwaibom, Opara *et al.* (2012) reported a prevalence of intestinal parasitic infections of 67.4% among school-aged children. In Akwaibom, Kelly *et al.*(2016), recorded prevalence of 59.1% among primary school pupils in the Abak Local Government Area.

A study on the prevalence of intestinal parasites conducted by Kelly *et al.* (2016) among school children in Owerri Municipality, Nigeria revealed a prevalence of (47.7%). Kelly *et al.* (2016) also reported *Ascaris lumbricoides* as the most prevalent (18.5%), followed by *Trichuris trichiura* (10.7%), *Entameba histolytica* (7.3%), *Strongyloides stercoralis* (6.0%), and Hookworm (5.3%). Another study on the prevalence of intestinal parasites among schoolchildren in Imo State conducted by Opara and Udoidung. (2012) recorded (48.7%) prevalence. Opara and Udoidung. (2012) observed a prevalence of 24.8% in a study carried out in Owerri Metropolis, Eastern Nigeria. A cross-sectional survey was conducted by Opara and Udoidung. (2012) to determine the prevalence of intestinal parasites among students of post primary institutions in two contrasting communities (Owerri Municipal and Mbaitoli Council Area) in Imo State. The prevalence rate was 43.0%. Opara *et al.* (2012) reported a prevalence of 58% in Day–Care Centers in Owerri municipality, Imo State, Nigeria. In tropical rain forest communities in Umuahia North Local Government of Abia State, Opara and Udoidung (2012) reported intestinal helminths prevalence of (75.7%). In Enugu, a prevalence of 38.85% was reported in a study conducted by Opara *et al*. (2012).

In Anambra, Oluboyo *et al.* (2012) reported a prevalence of 12.8% of intestinal parasitic infections. An intestinal parasitic infection prevalence of 72% has also been reported in school-aged children in Anambra State. In Anambra, Kongs *et al.* (2011) obtained intestinal parasitic infection prevalence of 63.16% in orphanage homes. Kongs *et al.* (2011) reported an 18.5% prevalence of intestinal helminthes among children in Ogbaru, Anambra State, with *A. lumbricoides* (9.5%), hookworm (7.5%), *Trichuris trichiura* (1.5%), E. vermicularis (1%), and *Taenia* species (1%). In Umuukwu, Aram, Anambra State, Ezeagwuna *et al.* (2011) reported a 47% prevalence of intestinal parasitic infections among schoolchildren. Uli, Ihiala Local Government Area, Orji (2015) reported a prevalence of 18% of intestinal parasitic infections. In addition, Stoltzfus *et al.* (2016) observed a prevalence of intestinal parasitic infections of 38.6% among patients admitted to the Accident and Emergency Unit of Nnamdi Azikiwe Teaching Hospital Awka, Anambra State. In Ebonyi State, Stoltzfus *et al.* (2016) recorded the prevalence of intestinal parasitic infections prevalence57.2% from the fingers of school children in Ohaozara. In lead mining areas in Abia State, Stoltzfus *et al.* (2016) recorded a prevalence of 34.6%. In addition, Odo *et al.* (2016) reported a prevalence of intestinal parasitic infection of 52.5% in Uwani, Enugu State.

13. Stoll egg counting

The yolk counting technique was performed as described by Funk *et al.* (2013). Three (3) grams of fecal sample were weighed. Forty-two (42) ml of sterile water was placed in a dish. Using a Popsicle stick, 3 g of the fecal sample was pressed through a sieve into the water. The sieve is lifted and held over the dish. The remaining water in the fecal samples was pressed out (Funk *et al.*, 2013).

While stirring the water-feces mixture, 0.15ml of the suspension was taken and spread over 2 slides. Each slide was covered with a coverslip. Both slides will be examined for worm eggs. The total number of eggs counted x100 represented the number of eggs per gram of feces (Funk *et al.*, 2013).

14. Materials and Methods

Materials

15. Glassware

Microscope, glass slides, cover sleep, cotton wool, taste tube rack, gloves, universal container, spatula, cellophane strip soaked in glycerol malachite green solution, 10% formol saline, disposable plastic tubes, applicator sticks, gauge, EDTA tubes, conical glass, popsicle sticks, a sieve, custard dish, pasture pipettes, and Wasserman test tubes were used.

16. Reagents

Buffer solution, 33% zinc sulfate solution, iodine solution, sodium nitrate solution, 10% formol saline

17. Methods

18. Study Area

This study was conducted in Keffi metropolis. Keffi is about 138 km^2 and a Population of 124,900 as of the 2016 census. The postal code of the area is as follows: 961. Keffi is at 8.84861 (latitude and decimal decrees) 7.87361 (longitude in decimal decrees) at an altitude of meters. The average elevation of Keffi is 338 meters (Akwa *et al*., 2007).

19. Ethical Clearance

Ethical permission for this research was obtained from the Keffi Local Government Education Authority and Department of Microbiology, Nasarawa State University Keffi, Nasarawa State after issuance of an introduction letter.

20. Sample Collection

A total of Two Hundred (200) fresh stool samples from primary school pupils in the selected L.G.E.A primary schools (St. The data from Peter Pilot Primary School, Abdu Zanga Primary School, Yelwa II Primary School, Nuruddeen Primary School and Baptist Primary School were collected using an applicator stick into a universal container. Each participant was given instructions on how to collect stool. Each universal cap container was labeled with questionnaire number of the pupils and kept in an ice pack. Stool samples were taken to the Microbiology Laboratory, Faculty of Natural and Applied Sciences, Nasarawa State University Keffi, within 1 h of laboratory examination.

21. Sample Size Determination

The sample size was determined using the following formula (Fisher *et al.*, 1998):

1 +

Here, N = population size.

Z= Z-Score

e = Marging of error

P = standard deviation.

= 168.4309

22. Stool Analysis

23. Macroscopic Examination

Macroscopic examination of the collected stools was performed as described by Cheesbrough (2007). The color, consistency and nature of the feces was observed and recorded. Stool specimens were examined for the presence of worm-like soil-transmitted helminth eggs with the aid of a hand lens (Cheesbrough, 2007).

24. RNA-Detection Based Method

RNA from STH can be detected using a more advanced PCR-based method, such as multiplex PCR or real-time quantitative PCR (qPCR), circulating microRNAs (miRNAs), and the detection of egg DNA.

25. Results Presentation

Macroscopic Examination of Soil-transmitted Helminths

Table 4.1 shows the results of the macroscopic examination of STH among school-aged children. The macroscopic examination was characterized by the color and consistency of the stool, which included mucoid, watery, formed, and bloody. The total number of watery stools collected were 70, which had (7.1%) of Ascaris, 4.2% of hookworm and 0.0% of *Trichuris trichura.* Watery stools had the highest prevalence at 11.4%, followed by formed and bloody stools at 4 (4.0%) and bloody stools at 2 (8.7%). The prevalence of STH on macroscopic examination was statistically significant (P> 0.05).

Table 4.1: Macroscopic examination of soil-transmitted helminths

Characteristics	Number of Sampled Samples	*Ascaris lumbricoides*	Hookworm	*Trichiuris trichura*	Total
Watery Stool	70	5 (7.1%)	3 (4.2%)	0 (0.0%)	8 (11.4%)
Mucoid stool	23	0 (0.0%)	2 (8.7%)	0 (0.0%)	2 (8.7%)
Bloody stools	10	3 (30.0%)	1 (10.0%)	0 (0.0%)	4 (40.0%)
Formed stool	97	2 (2.1%)	1 (1.0%)	1 (1.0%)	4 (4.1%)
Total	200	10 (5.0%)	7 (3.5%)	1 (0.5%)	18 (9.0%)

X^2 = 17.9990

P-value = 0.0351*

26. Prevalence of Soil-transmitted Helminths among School Aged Children

Table 4.1 shows the prevalence of soil-transmitted helminthes (STH) among school- aged children. *Ascaris lumbricoides* had the highest prevalence rate with the total of 10 (5%), followed by Hookworm with the prevalence rate of 7 (3.5%) and followed by *Trichuris trichiura* with the least prevalence of 1 (0.5%) from the five selected primary schools that samples were collected. Yelwa II had the highest prevalence rate of STH with the total of 5 (12.5%), followed by Nuruddeen and Abdu-Zanga Primary School with the prevalence rate of 4 (10%), followed by Baptist primary school with the prevalence rate of 3 (7.5%), followed by Saint Peter with the prevalence rate of 2 (5%) which had the least prevalence. The prevalence of STH among school aged children were statistically insignificant (P> 0.05).

Table 4.2: Prevalence of Soil-transmitted Helminths among School Aged Children

	SCHOOLS					
STH	**A**	**B**	**C**	**D**	**E**	**Total**
Ascaris lumbricoides	2 (1%)	2 (1.0%)	3 (1.5%)	1 (0.5%)	1 (1.0%)	10 (5%)
Hookworm	2 (1.0%)	1 (0.5%)	1 (0.5%)	1 (0.5%)	2 (1.0%)	7 (3.5%)
Trichiuris trichura	0 (0.0%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	0 (0.0%)	1 (0.5%)
Total	4 (10.0%)	3 (7.0%)	5 (12.5%)	2 (5.0%)	4 (10.0)	18 (45.0%)

Key: A = NURUDDEEN, B = BAPTIST, C = YELWA II, D = SAINT PETER, E = ABDU-ZANGA

X^2 = 3.7577

P-value = 0.8609

27. Gender-related Prevalence of Soil-transmitted Helminths

Table 4.2 shows the gender-related prevalence of soil-transmitted helminths among school-aged children. Males had the highest prevalence at 11 (55) and Females had the lowest prevalence at 7 (3.5%). The prevalence of sex-related STH was statistically insignificant (P> 0.05).

Table 4.3: Gender Related Prevalence of Soil Transmitted Helminths

Gender	Number of Sampled Samples	*Ascaris lumbricoides*	Hookworm	*Trichiuris trichura*	Total
Male	100	5 (5.0%)	5 (5.0%)	1 (1.0%)	11 (11.0%)
Female	100	5 (5.0%)	(1.0%)	0 (0.0%)	7 (7.0%)
Total	200	10 (5.0%)	6 (3%)	1 (1.0%)	18 (9.0%)

$X^2 = 3.5533$
P-value = 0.3138

28. Age-related Distribution of Soil Transmitted Helminths

Table 4.3 shows the age-related distribution of STH. The highest distribution was found in the age group of 1-5 years representing 9 (12.16%), followed by the age range of 6-10 years with the prevalence rate of 6 (8.6%), while the lowest distribution was found in the age range of 11-15 years with the prevalence rate of 2 (3.6%). The prevalence of STH among age were statistically insignificant (P> 0.05).

Table 4.4. Age-Related Distribution of Soil Transmitted Helminth

Age	No Sampled	*Ascaris lumbricoides*	Hookworm	*Trichiuris trichura*
1-5	74	7 (9.5%)	2 (2.7%)	0 (0.0%)
6-10	70	2 (2.9%)	4 (5.7%)	1 (1.4%)
11-15	56	1 (1.8%)	1 (1.8%)	0 (0.0%)
Total	200	10 (5.0%)	7 (3.5%)	1 (0.5)

$X^2 = 7.9310$,

P-value = 0.2431

29. Occupation-Related Percentage Distribution of STH

Table 4.4 shows that the occupational distribution of soil-transmitted helminthes was high among pupils whose parents were farmers with a total prevalence rate of 9 (13.8%), followed by traders with a prevalence rate of 4 (10%), followed by other unspecified ones with a prevalence rate of 3 (4.8%). The lowest prevalence rate was observed among pupils whose parents were civil servants with a prevalence rate of 2 (6.3). The prevalence of STH related to occupation were statistically insignificant (P> 0.05).

Table 4.5: Parental occupation-related percentage distribution of STH

Occupation	Number of Sampled Samples	*Ascaris lumbricoides*	Hookworm	*Trichiuris trichura*	Total
Farming	65	5 (7.7%)	3 (4.6%)	1 (1.5%)	9 (13.8%)
Trading	40	2 (5.0%)	2 (5.0%)	0 (0.0%)	4 (10.0%)
Civil Servant	32	1 (3.1%)	1 (3.1%)	0 (0.0%)	2 (6.3%)
Others	63	2 (3.2 %)	1 (1.6%)	0 (0.0%)	3 (4.8%)
Total	200	10 (5.0%)	7 (3.5%)	1 (0.5%)	18 (9.0%)

$X^2 = 4.5080$,

P-value = 0.8749

30. Educational Status of Parents in relation to STH

Table 4.5 shows the educational status of parent which include; primary (1^0), Secondary (2^0), and Tertiary (3^0) institutions. Children whose parents attended 1^0 schools had the highest prevalence rate of 8 (9%), followed by children whose parents attended 2^0 schools with the prevalence rate of 6 (8.0%), and the least was observed for children whose parents attended 3^0 institutions with the prevalence rate of 4 (11.1%). The prevalence of STH according to parental education status was statistically insignificant (P> 0.05).

Table 4.6: Educational Status of Parents with Regard to STH Infection

Education	**Number of Sampled Samples**	***Ascaris lumbricoides***	**Hookworm *A. duodenale***	***Trichiuris trichura***	**Total**
Primary	89	5 (5.6%)	3 (3.4%)	0 (0.0%)	8 (9.0%)
Secondary	75	3 (4.0%)	2 (2.7%)	1 (1.3%)	6 (8.0%)
Tertiary	36	2 (5.6%)	2 (5.6%)	0 (0.0%)	4 (11.1%)
Total	200	10 (5.0%)	7 (3.5%)	1 (0.5%)	18 (9.0%)

$X^2 = 2.4735$
P-value = 0.8714

31. Discussion

The prevalence of soil-transmitted helminthes was low in Keffi (Emmy-Igbe*et al.*, 2011). Due to sensitization and awareness. *Ascaris lumbricoides* had a high prevalence rate of 10 (5%), followed by hookworm with a prevalence rate of 7 (3.5%), and *Trichuris trichiura* had the lowest prevalence of 1 (0.5%).

STH was high in Nuruddeen and AbduZanga because of the school facilities and settings, followed by Baptist primary school with a prevalence rate of 3 (7.5%), followed by Saint Peter, which had the least prevalence.

The rate of STH was high in the age bracket of 1-5 years 9 (12.16%), low in the age group of 6-10 years with prevalence rate of 6 (8.6%) and lower in age groups 11-15 years 2(3.6%), which could be seen through the age category that involves 1-5 years, engage most with activities linking them to have high contact level with soil such as playing regularly with mud and sand, which is contrary with the study conducted by Emmy-Igbe*et al.*(2011).

Moreover, this age group is observed with poor attitudes toward personal cleanliness, which contributes most to STH. In addition, it may be because they eat smacks and food wrapped with papers from doubtful sources, which may have been contaminated, as suggested by Emmy-Igbe *et al.* (2011).

The distribution of STH based on sex showed that out of 100 males examined, 11 (5.5%) were infected with STH and 7 (3.5%) out of 100 females examined. Although there was no significant difference ($P<0.05$) between prevalence in females and that of males, the prevalence rate in males 11 (5.5%) was higher than that in females 7 (3.5%). This can be attributed to male exposure levels to eating sand, playing on sand, licking of fingers/biting of nails, walking with the feet while playing or going for an errand, hawking, use of unwashed hands to share food items and other domestic work.

This result agrees with previous studies by Owaka *et al.* (2016), which stated that children whose parent is peasant farmers often go to farm with their male children, who were found frequently with bare feet. For this reason, males are more vulnerable than females since they join their parents to farm.

Although the findings of this study may have minor discrepancies with those of other studies from different countries, they still indicate that STH in the body system can cause disease burden (Lurwan *et al.*, 2017).

Discrepancies observed in the findings of this study and previous studies by other researchers could be attributed to differences in place of study (i.e geographical location). The impact of parasitic infections may extend far beyond visible human disease into the spheres of chronic non-perceived unwellness, socioeconomic losses, and missed development opportunities (Lurwan *et al.*, 2017), which is supported by the findings of the present study.

In accordance with the assertion by Lurwan *et al.* (2017), however recommend and consider that health authorities should incorporate drugs and control natural water sources.

The findings from this study thus support the need for establishing a health programme for the control of gastro-intestinal parasites in the community. For this reason, measures should be adopted to monitor, control, or prevent the inversion of the body system by parasites and/or eggs/cysts. The obvious preventive measures would include: the improvement of general sanitation standards through the installation of suitable sewage treatment and disposal facilities and the provision of pipe-borne water supply as prerequisites for successful prevention and control.

In agreement with Lurwan *et al.* (2017), toilet facilities should be available to discourage indiscriminate defecation and urination in public places. Social amenities in the form of recreation centers, amusement parks, schools and commercial establishments should be provided with toilet facilities and water to improve the quality of life for the people. However, further studies are therefore needed.

The nested Polymerase Chain Reaction (nested-PCR) technique was employed to detect the RNA genes in the identified soil-transmitted helminths. Specifically, the STH was subjected to semi-nested PCR and Restrictive Fragment Length Polymorphism (RFLP) to identify the chromosomal and cytoplasmic genes, which were detected at the 28s rRNA ITS–1, 2 and 5.8s region for *Ascaris lumbricoides* and *Trichuris trichura, respectively, where* it exhibited between 85%–95% sensitivity.

However, for hookworms (*Necator americanus* &*Ancylostoma duedenale*), a real-time PCR (PCR-Luminex) molecular-based technique was employed, and the genes were detectable at the internal transcribed spacers–2 (ITS–2) between the 16s and 23s rRNA in the gene loci with a sensitivity of approximately 98% to the gene markers.

32. Summary

i. The prevalence of soil-transmitted helminthes according to school, and Yelwa II had the highest prevalence at 12.5%

ii. Males had the highest prevalence of soil-transmitted helminths than females with respect to sex.

iii. The prevalence of STH with respect to parental occupation showed that pupils whose parents were celebrities had the highest prevalence of 9 (13.8%) Followed by traders at a prevalence rate of 10%.

iv. Regarding parental educational status, pupils whose parents attended primary schools had the highest prevalence rate of 8 (9.0%), followed by pupils whose parents attended secondary schools with a prevalence rate of 6 (8.0%).

33. Conclusion

Based on age, pupils aged between 11 and 15 years are less susceptible to soil-transmitted infection than the ages of six and ten. By implication, pupils aged between one and five were the most vulnerable.

The study concluded that sex, age, nature of schools, the methods or techniques adopted for the determination of the prevalence of soil-transmitted helminthes among primary school pupils, and the occupation of parents play principal roles in analyzing the source of STH, the prevalence rate, detection of the infection, as well as the creation of awareness, particularly in the promotion of education to enlighten the pupils regarding the significance of personal hygiene.

34. Recommendations

i. School authorities should provide toilet facilities for students to prevent defecating outside

ii. Parents should deworm their children.

iii. Parents and school authorities should maintain adequate personal hygiene. Through hand-washing

iv. The government should provide healthcare facilities for local governments.

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QUESTIONNAIRE

School:---

Questionnaire Number:---

Date of Study:--

Ward or Area:--

Demographic Information

Sex:------------------------------ Date of birth: ------------------

Aged Year:---------------------- Date of birth: ------------------

Medical History

1. Have you been treatfor of worms in school for the last 5 months? Yes or No:
2. Are you currently taking any deworming drugs? Yes or No:
3. Do you have any complaints? If Yes, indicate the nature (a) abdominal) pain (b) nausea and vomiting) (c) Lack of appetite) (d) Intestinal motility).

Social Economic Factors

4. Mother/guardian’s educational level (a) primary, (b) secondary, and (c) Tertiary
5. Occupational of head of household (a) Farming ( ) (b) Trader) (c) Civil Servant ( ).
6. What water sources are available in the area? (a) Boreholes and (b) rain) (b) Stream/river)

Risk Factors

7. Do you wash your hands before eating? (a) Yes ( ) (b) ( ).
8. Do you wash fruits before eating? (a) ( ) (b) ( )
9. Do you have a toilet at home? (a) Yes) (b) No ( )
10. Is your toilet a latrine ( ) or water-based toilet ( )
11. Do you wash your hands after stooling? (a) Yes ( ) (b) No ( ). How often? (a) ( ) Always ( ) Never