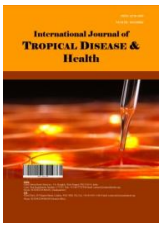

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Risk Factors Associated with Gastrointestinal Helminthic Infections among School Aged Children in Kurmi Local Government Area, Taraba State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors VYA and WNY designed the study. Authors VYA and VUO performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. All Authors managed the analyses of the study. Authors VYA, VUO and AOH managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

One of the parasitic infection faced by school age children in developing countries is intestinal parasitic infection. This study was designed to determine risk factors associated with gastrointestinal helminthic infections among school age children. A total of 600 stool samples were randomly examined by direct smear method under microscope and formol-ether concentration technique. A structured questionnaire was used to collect data on socio-noneconomic status of the children's parents and other variables. Of this, (n=252; 42%) were found to be infected with gastrointestinal helminths infections given a breakdown of male (n=148; 24.7%) and female (n=104; 17.3%). However, there was no significant difference in prevalence among the socio-economic status. Parent whose occupation was farmer (n=169; 28%) also recorded high rate of infection, the

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lowest prevalence was seen among civil servants (n=19; 3%). Parents with little or no knowledge of intestinal helminths were found to be statistically significant (n=199; 33.1%, p<0.02; α =0.02) The highest rate of infection was recorded among children who had dirty finger nails (n=232; 38.6%), followed by those who walked barefooted(28.2%),then open defecation (n=147; 24.6%), hand washing after defecation (n=195; 30,7%,), habit of eating raw/roasted meat (n=136; 22.3%), hand washing before meal (n=102; 17.02%) and keeping of dirty clothes and bed linens (n=180; 30%) . Such a relatively high prevalence rate of helminthic infection in the study area could be used as a base line for the concern bodies to launch de-worming intervention campaigns.

Keywords: Risk factor; gastrointestinal; helminths; infections; hygiene; environmental.

1. INTRODUCTION

Intestinal parasitic diseases constitute a global health burden in developing countries mainly due to fecal contamination of water and food [1], sympathetic climatic and poor environmental sanitation, low level of education or illiteracy, low socio-economic status, sociocultural factors etc. enhancing parasitic transmissions [2]. Globally, it has been estimated that more than two billion (2 billion) of the world's population are infected annually by gastrointestinal helminths mainly the Soil Transmitted Helminths (STH). These parasites dwell in the gastrointestinal tract of humans and other animals. The most common parasitic intestinal nematodes in humans are *Ascaris lumbricoides* (the large intestinal roundworm that causes Ascariasis). Current estimates suggested that *Ascaris lumbricoides* can infect over a billion, *T. trichiura* can infect 795 million, and hookworms can infect 740 million people [3]. The transmission of human intestinal helminths parasites can occur through the ingestion of contaminated vegetables, the use of contaminated water for drinking, cooking, irrigation, improper washing of food especially fruits, eating of undercooked food of animal origin and walking barefooted [4]. Poorly washed vegetables may contain eggs of nematodes such as *Ascaris lumbricoides, Trichuris trichiura*, and *Enterobius vermicularis* and cestodes such as *Taenia* spp especially through the use of human faeces as manure commonly practiced by vegetable farmers [5]. Infection can be asymptomatic with low worm load and symptomatic with heavy worm load. Conditions associated with intestinal helminths include intestinal obstruction, vomiting, weakness and stomach pain [6]. At highest risk of morbidity are pre- school age pupils and pregnant women [7]. Negative effects of helminths infections include diminished gastro intestinal impairment, iron deficiency, anaemia and low birth weight in mothers. In children, growth retardation delayed intellectual development and cognition [8,9]. Intestinal helminthic parasites produce a variety of acute, chronic and debilitating intestinal infections, some of which culminate in death of the host [10]. They reduce school attendance among children and impair their ability to pay attention in the classroom as reported by Pan America Health Organization [11]. These diseases not only represent a tremendous health burden, but they also keep those affected trapped in poverty, sadly ensuring that the most marginalized and vulnerable populations remain in a vicious cycle. This study is aimed at determining the risk factors (ignorance, eating of contaminated food or water, environmental sanitations, hygiene practices etc.) associated with gastrointestinal helminths infections and the relationship between intestinal helminthic infections and socio-economic status among school aged children in the area.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Kurmi Local Government Area of Taraba State, Nigeria. It lies between Latitudes 5° 31' and 7° 18'N, longitudes 10°18' and 11° 37'E at an elevation of 872 feet (265 km). It has an area of 1681 sqm with the population of 91,531 based on the 2006 census [12].

2.2 Study Design

A Cross-sectional research design was used in this study. Stool specimens were collected and examined for intestinal helminths from children in the area. Six wards were selected, in each of the six wards, 100 pupils were randomly sampled. This design gave an overview of the prevalence of gastrointestinal helminths infections (GHIs) across the area. Children identified to be infected with intestinal helminths were examined based on age and sex. The fieldwork involved the use

of questionnaires and house-to-house visits (face to face interview).

2.3 Study Population

About 600 samples were obtained and the study population included school age children within 2 to 17 years old. Children who were not allowed by their parents or guardians to participate in the study and those who have received anti-helminthic drugs within the past three months were excluded from the study. The Inclusion Criteria: (1) Children within targeted age category of 2 to 17 years, (2) Eligible children whose parents gave assent to the study in full.

2.4 Sample Size Determination

Fisher formula was used to determine the desired sample size. The samples size allowed estimation of prevalence of gastrointestinal helminths infection (GHIs) by 50 percent.

$$n = \frac{Z^2pq}{d^2}$$

Where;

d = degree of accuracy was set at 0.05
Z = standard normal distribution was at 95% Confidence Interval = 1.96
P = prevalence of GHIs 0.5 , q = 1 – p, n = sample size

Therefore,

=The minimum sample size was 384.16 ≈ 384
Assuming a 15% of non-response rate of 196 children, the adjusted minimum sample size was 580, approximately 600 samples.

2.5 Faecal Sample Collection

Prior to the distribution of the containers, a proper orientation was made on how to collect the samples. Children or parents/guardians were given tight fitting transparent sterile universal specimen container containing 10% formalin.The stool samples were were collected into the container. All stool specimens were properly labeled with the subject's identification number, age, sex and date of collection. The stool samples were taken to the laboratory for macro and microscopic examination. Diagnosis was based on identification of the characteristic helminth's ova using characteristics outline by Cheesbrough [13].

2.6 Faecal Sample Processing

Examinations of faecal samples were carried out using standard procedures as described in [13]. Children identified to be infected with intestinal helminths were analyzed based on age, sex and helminthic load from the primary data collected. Macroscopic and microscopic examinations were carried out on the stool.

2.7 Macroscopic Examination of Stool Samples

This method was used to describe the appearance of the stool i.e. the physical appearance such as color (whether the stool is black, yellow, or green), consistency (to know whether the stool is formed, semi-formed, unformed or watery) and consistency (presence of blood/mucus, or pus). Blood can also be found in the stools of an individual suffering from haemorrhoids, ulcerative colitis, or tumors of the intestinal tract indicating Ascariasis. A normal stool sample appears brown and formed or semi-formed.

2.8 Microscopic Stool Samples Analysis Using Formol-Ether Concentration Technique

Formol-ether concentration technique as described by [13] was employed in this study. This technique was employed in order to concentrate the eggs of the helminths if present. Using an applicator stick, about 2 g of the stool sample was picked and transferred into centrifuge tube containing 4 ml of 10% formal saline and centrifuged for 3 min at 3000 rpm. The supernatant was decanted and to the deposit (sediment), another 4 ml of 10% formal saline was added and centrifuged for 3 min at 3000 rpm. About 10 ml of ether was added to the suspension mixed vigorously for about 10 seconds and centrifuged at 300 rpm for 3 minutes. After centrifugation, four layers were observed; the top layer of ether, a plug layer of faecal debris, a formalin layer and sediment at the bottom where the parasites concentrate. An applicator stick was used to loosen the layer of faecal debris by a spiral movement and the other top 3 layers were carefully poured off in single movement. Normal saline was added to the tube and mixed using a disposable pipette, a drop of the suspension was transferred unto a clean grease-free microscope slide and with cover slip. The preparation was examined microscopically using x10 and x40 objectives [13].

2.9 Direct Wet Smear Method

A clean grease-free microscopic slide was used and a drop of normal saline was placed in the middle of the left half and a drop of lugol iodine solution was added in the middle of the right half of the slide. An applicator stick was used to take a small portion of the stool and mixed with the drop of saline and immediately covered with a cover slip. Same was done for the iodine solution. The preparation was examined under the microscope using x10 and x40 objectives.

2.10 Data Analysis

Statistical techniques such as percentages, graphical depictions, frequency counts were used mainly to analyze the primary data collected. Data from questionnaire were coded, ranked and analyzed using SPSS version 20.1 at Significance level $P \leq 0.05$.

3. RESULTS

Table 1 depict Personal Hygiene practices among the children in relation to GHIs on personal hygiene practices as shown in Table 1; those with no toilet facilities (n=118; 19.8%) recorded the highest rate of infections than those with toilet facilities (n=133; 22.3%).

For defecation habit; those that defecate in an open field (n=147; 24.6%) were the most infected than those that have latrine (n=107; 17.9).

Washing of hands after defecation: (n=145; 24.1%) do not wash hands after defecation, (n=69; 11.1%) sometimes wash their hands after defecation and (n=40; 6.6%) always wash their hands after defecation;

For cleansing after defecation; those that used clothes/leaves after defecation to clean themselves, (n=169; 28.1%) recorded the highest rate of infections, followed by those that used water (n=61; 10.1%) and the least were those that used nothing to clean themselves after defecation (n=22; 3.6%)

For trimming of finger nails; (n=232; 30.0%) do not trim their finger nails out of which (n=232; 38.6%) were found to be infected, while (n=20; 3.3%) always trim their finger nails and (n=20; 3.3%) were infected.

Based on washing of clothes; those that sometimes wash the clothes (n=180; 30.0%) took the lead, followed by do not wash their clothes (n=53; 8.8%) and the least were those that always wash clothes (n=17; 2.8%).

For different type of latrine; those with mud type of latrine (n=176; 29.4%) recorded the highest number of infections followed by those that have cement type of latrine (n=66; 11.0%) and the least were those that have tiled type of latrine (n=8; 1.3%).

Hand washing before meals; (n=149; 24.8%) of those that sometimes wash their hands before meals recorded the highest number of infections, followed by do not those that wash hands before meal (n=67; 11.2%) the least were those that always wash hands before meals (n=35; 5.8%).

For hand washing after playing with soil; those that sometimes wash hands with soap after playing with soil (n=121; 20.1%) took the lead, followed by those that do not wash hands with soap after playing with soil (n=104; 17.3%), and the least were those that always wash hands with soap after playing with soil that (n=27; 4.5%).

Based on environmental risk factors in relation to GHIs as shown in Table 2. Shoe wearing: those that do not wear shoes on ground soil (n=169; 28.2%) had the highest number of infections, followed by those that Sometimes wear shoes (n=120; 20.0%) and the least were those that always wear shoes on grounded soil (n=283; 13.8%).

For sweeping of environment; those that sweep their environment once in a while, (n=118; 19.6%) and once a day, (n=116; 19.3%) recorded the highest rate of infections, followed by those who sweep their environment twice a day (n=17; 2.8%).

Source of drinking water; those that had stream as their source of drinking water (n=103; 17.1%) recorded the highest rate of infection, followed by those who used dug well water (n=84; 14.0%) and least infected were those that used pipe water as their source of drinking water (n=5; 0.8%).

Table 1. Personal hygiene practices among the children in relation to GHIs infections

		Intestinal helminthic infection			
Variables	**Index**	**No sampled**	**Prevalence (%)**	**x^2**	**P**
Presence of toilet	Yes	436	133 (22.3)	91.261	0.365
	No	159	118 (19.8)		
Defecation habit	Latrine	391	107 (17.9)	132.232	0.426
	Open field	215	147 (24.6)		
Wash hand after defecation	Yes	207	40 (6.6)	91.118	0.363
	No	306	145 (24.1)		
	Some times	87	67 (11.1)		
Cleansing after defecation	Water	347	61 (10.1)	201.110	0.502
	Cloth/leaves	226	169 (28.1)		
	Nothing	27	22 (3.6)		
Trimming of finger nails	Yes	271	20 (3.3)	243.164	0.537
	No	329	232 (38.6)		
Washing of clothes	Always	209	17 (2.8)	166.735	0.467
	Sometimes	324	180 (30.0)		
	Not at all	64	53 (8.8)		
Type of latrine	Mud	275	176 (29.4)		
	Cement	261	66 (11.0)		
	Tiles	62	8 (1.3)		
Hand Washing before meal	Yes	208	35 (5.8)	124.577	0.416
	No	76	67 (11.2)		
	Some times	313	149 (24.8)		
Hand washing after playing with soil	with soap	257	27 (4.5)	118.143	0.106
	without soap	130	104 (17.3)		
	Some times	313	121 (20.1)		

(%=percentage)

For treatment of water; those that do not treat their water before drinking (n=216; 36%) were found to be highly infected than those that treat their water before drinking (n=35; 5.8%).

As for mode of water treatment; those that do not use anything to treat the water (n=189; 31.5%) recorded the highest rate of infections, followed by those that boiled it before drinking (n=38; 6.3%) whereas the least infected were those that use chemical (n=10; 1.6) to treat water before drinking.

In lieu of rearing of animals; those that rear animals in their homes (n=183; 31.0%) were highly infected than those that do not rear animals (n=66; 11.0%);

For eating of pork/beef: those that eat pork/beef (n=157; 26.1%) recorded the highest rate of infection than those that do not eat pork/beef (n=95; 15.8%).

Based on eating undercooked /raw meat: those that eat undercooked/raw meat (n=136; 22.6%) were mostly infected than those that do not eat undercooked/raw meat (n=116; 19.3%).

Going to streams; those that go to streams always (n=159 26.5%) were the most infected, followed by those that sometimes go to the stream (n=72; 12.0%) and the least were those that do not go to the stream at all (n=22; 3.6%). Reasons for going to the streams; swimming/washing (n=110; 18.3%) recorded that the highest number of infections, followed by fetching of water (n=80; 13.3%) and the least were those that have no reason for going to the stream at all (n=22; 3.6%).

Socio-economic status of parents in relation to Gastrointestinal Helminths infection among school aged children. In terms of children's parent level of education; (n=106; 17.6%) recorded the highest percent of infections among those with no education, followed by those with primary education (n=88; 14.6%), and the least infected were those with tertiary education. For parents occupation; Parents who were farmers (n=169; 28%) indicated the highest number of infections, followed by those who were into trading (n=61; 10.1%) while the least infected were civil servant (n=19; 3.1%). In lieu of materials status of the children's parents; married parents (n=98; 16.3%) took the lead, followed by

single parent (n=70; 11.6%) and widow parent (n=44; 7.3%) and the least were separated parent (n=32; 6.3%).

Based on the knowledge of Gastrointestinal helminths Infection; Parent with no knowledge of GHIs (n=199; 33.1%) recorded the highest percent rate of infection while those with the knowledge of GHIs infections (n=52; 8.8%) had the least rate of infections.

For source of GHIs; those with no idea about the source of GHIs (n=130; 21.6%) were the most infected, followed by those who confirmed the source from faeces (43; 7.1%) and those who confirmed the source from soil (n=46; 7.6%) whereas the least were from those who confirmed the source from food/vegetable. On information about GHIs; those who are ignorant of the information (n=116; 19.3%) took the load followed by those that heard the information in schools (n=50; 8.3%) and the least were those had the information in the health care centers.

4. DISCUSSION

This study revealed that most of the studied communities do not use latrines (they practice open field defecation), Also, most of the latrines in the study area were not well taken care of and children passed excreta and urine indiscriminately in them leading to increase prevalence of parasitic infections since most of them enter the toilet barefoot and do not wash their hands after using the toilet due to lack of water. This has led

Table 2. Environmental risk factors in relation to GHIS among the children

	Index	No sample	Prevalence	X^2	p- value
Shoes wearing	Yes	368	83 (13.8)	144.205	0.440
	No	231	169 (28.2)		
	Some times	306	120 (20.0)		
Sweeping of environment	Once a day	288	116 (19.3)	82.024	0.308
	Twice a day	97	17 (2.8)		
	No sweeping day	183	118 (19.6)		
	Often sweeping	32	1(0.1)		
Sleeping facilities	Mat	260	181 (30.2)		
	Bed	335	67 (11.1)		
	Bare floor	4	4 (0.6)		
Source of drinking water	Pipe water	76	5 (0.8)	159.593	0.458
	Bore whole	255	60 (10.0)		
	Stream water	142	103 (17.1)		
	Dug well	127	84 (14.0)		
Water Treatment	Yes	170	35 (5.8)	45.515	0.267
	No	425	216 (36.3)		
Mode of water treatment	Boiling	121	38 (6.3)	37.741	0.225
	Filtering	54	15 (2.5)		
	Use of chemical	51	10 (1.6)		
	Nothing	374	189 (31.5)		
Raring of animals	Yes	352	183 (30.6)	37.283	0.242
	No	245	66 (11.0)		
Eat pork/beef	Yes	330	157 (26.1)	9.359	0.124
	No	270	95 (15.8)		
Eat undercooked /roasted meat	Yes	272	136 (22.6)	13.072	0.146
	No	332	116 (19.3)		
Going to stream	Yes	254	159 (26.5)	78.603	0.341
	No	114	22 (3.6)		
	Sometimes	231	72 (12.0)		
Reasons for going to stream	Fetching water	193	80 (13.3)	57.958	0.297
	Fishing	190	39 (6.5)		
	Swim/washing	194	110 (18.3)		
	Not going	122	22(3.6)		

(%=percentage, x^2 =chi square, $p<0.05$)

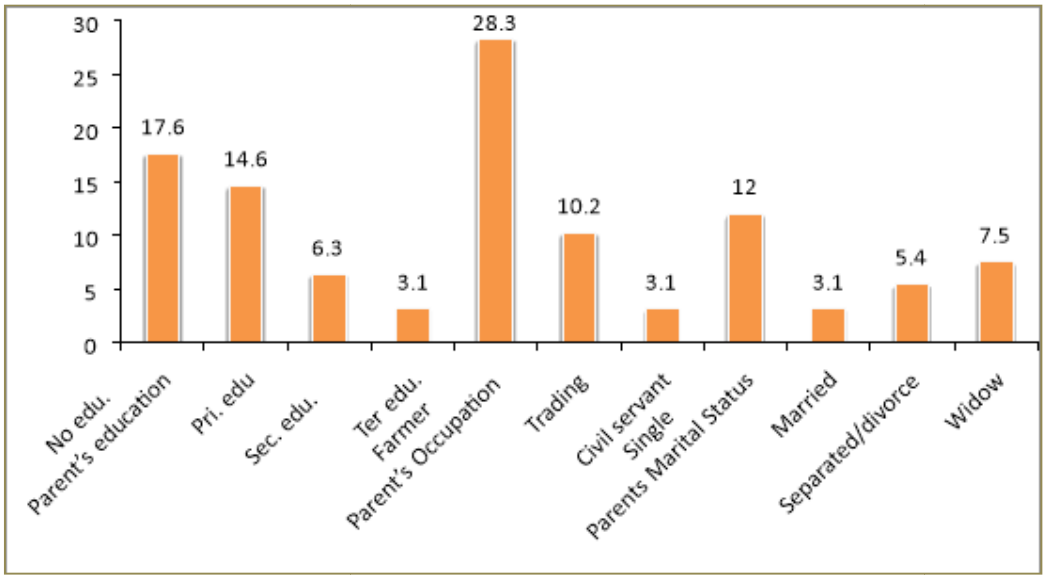

Fig. 1. Socio-economic status of the children's parents in relation to gastrointestinal helminths infection

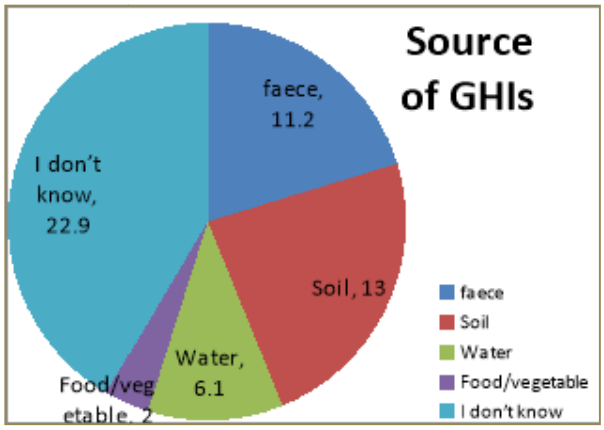

Fig. 2. Knowledge and source of gastrointestinal helminths infection among the children

to high rate of this helminthiasis infection seen among them. Type of toilet facility showed a significant association with hookworm infection. This could be attributed to the fact that most infections discovered among the children were in households with pit latrines that were earthed/mud without slab. Use of these kinds of latrines that do not have improved flooring can favor hookworm eggs that hatch in soil, releasing mobile larvae or infective filarial that can penetrate the skin hence increased infection. Also, toilets which were not regularly cleaned and made with mud without slab encouraged the breeding of latrine flies (*Fannia scalaris*) which transmits intestinal infections. This is supported by previous studies that revealed a significant association between availability and kind of toilet/latrine facility and GHIs infections in children [14,15].

The socio-economic status has been indicated to exaggerate the already prevailing conditions which could be indicators of infection such as low sanitation, poor housing and lack of education. Moreover, some of the children in the study population could have acquired intestinal infections from the practice of not washing raw foods such as fruits or peeling unwashed fruits with one's teeth or even eating certain water plants in a raw state. These raw fruits

occasionally contain ova of certain helminths that could infect children, especially those of helminths which causes an intestinal infection such as Ascariasis, Trichuriasis, Strongyliosis, Taeniasis etc. This result concurs with the findings of Hotez et al. (2007) and Nasr et al. (2013) [16,17] that these infections occur as a result of insufficient water supply, poor hygiene practices, poor socio-economic status of the children's parents and contamination of vegetable with faecal materials in the farms.

In respect to environmental sanitation; these findings establish a significant relationship between household source for drinking water and GHIs infections among school aged children. As for source of drinking water; those that use dug well were mostly infected, this is due to the fact that most of the wells were uncovered which could have serve as a reservoir for the eggs of these helminths; People always defecate in the streams which are used as source of drinking water and most of the boreholes surroundings are not always kept clean, hence high chances of environmental contamination. Moreover, water from boreholes and wells are taken without boiling /untreated thus enhancing GHIs infections. Those who used piped borne water in contrast had very low prevalence of GHIs infections suggesting that piped water was safer with regard to GHIs infections. The findings agreed with studies conducted in South-Eastern Nigeria in 2013 and Urban Karachi in 2008 [15,18] who revealed that those using dug well, surface water and borehole as source of their drinking water had the highest prevalence of *A. lumbricoides* and Hookworm.

Finally, it was observed that socio-economic status of the parent contributed to the increase in the risk factor of the infections and showed a significant association with infection of gastrointestinal helminths among the children. In our findings, majority of the children's parent had only completed primary education and a few had no education. As a result, low level of education among the parents could be the reason for high infection. Children' parents with high level of education, provide better sanitation condition for their children than parents who are not educated. It has been observed that mothers are often responsible for both food preparation and the health education of children in the family; hence they significantly influence the health of their children. therefore, if a child's mother is educated, she is more likely to know about the dangers of intestinal helminths infections and how to prevent it, and thus more likely to incorporate safe health behaviors into the home such as hygiene practices, boiling water before drinking etc. The better the educational level of the mothers, the lower the parasitic infection rate in children. The result agreed with the findings of Katz and Hotez. (2004); who revealed those children's parents (especially mothers) who had knowledge of GHIs infections, are capable of preventing parasitic infections in their children than those without knowledge and that less educated mothers had higher risk of intestinal parasites.

Majority of the children being infected were those whose parents are mostly farmers and traders who are financially challenged and could not provide footwears for their children, soap for washing their clothes, and other sanitation protective factors for GHIs. The findings were concurred with the study done in South-Eastern Nigeria in 2013 and work by Hotez et al. (2006) [15,19] who disclosed that occupation of the parents was significantly associated with infection by GHIs among school aged children.

5. CONCLUSION

The most prominent factors predisposing school aged children to intestinal helminths infections were parent's children education level, habit of hand washing before meal and after defecation, occupation washing of fruits/vegetable before eating, lack of access to safe water, availability and type of defecation facility, indiscriminate defecation, sanitary condition, biting of soiled finger nails, socio-economic status, etc. Toilets which were not frequently cleaned encouraged the breeding of latrine flies (*Fannia scalaris*) which transmit intestinal helminths infections. Despite the identified chemotherapy approach of GHIs in the study area, these infections remained a public health problem as was attested by the prevalence findings.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

Permission was obtained from the director of Primary Health Care, and the Educational Secretary (ES) of Kurmi Local Government Area. Additional permission was sought from the

village heads of the communities selected. Children were informed of their rights to refuse to participate in the study and to withdraw at any time during the study without jeopardizing their rights.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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