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Original Research Article

Prevalence of Intestinal Helminths Infestation and Associated Risk Factors among Pupils in Basic Schools at Aboshareef Area, Kosti Locality, White Nile State, Sudan, 2019

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Abstract

Intestinal helminths infections are major parasitic diseases causing public health problems in Sudan, especially among children. A cross-sectional school-based study was conducted among pupils to estimate the prevalence of intestinal helminths and associated factors. We enrolled a total of 337 pupils selected in this study. Data were collected using a structured pre-tested questionnaire. Fresh stool samples collected and examined using duplicate Kato-Katz techniques. The presence of eggs considers a positive result. The sample size was distributed proportionally over the schools according to the weight and sampling unit was selected using simple random sampling. Data were collected through trained data collectors and analyzed using SPSS version 25. The prevalence of intestinal helminths among primary school pupils was 39.2%. The types of helminths detected in this study are hookworm with a prevalence of 24%, followed by *A. lumbricoides* 11%, *Trichuris trichiura* 4.2%, *Hymenolepis nana* 3.3%, Taenia species 3.6% and *Entrobius vermicularis* 5.9%. A high association was observed between infection with helminths and sex ($p < 0.001$), source of drinking water ($p < 0.05$), the type of toilet at school ($p < 0.001$), absence of sanitary facilities near or inside latrine in houses ($p > 0.05$) and educational level of the mother ($p < 0.001$). Therefore, Studying the prevalence of intestinal helminths among primary school pupils with the associated risk factors in developing countries may predict health status. Therefore, help in better diagnosis, the efficacy of medicine and improve public health.

Keywords: Aboshareef, Intestinal helminths, Kato-Katz, Kosti, Prevalence, Sudan

INTRODUCTION

Approximately two billion people worldwide infected with intestinal helminths, especially in poor environments with limited resources. Children are the age group most vulnerable and affected by the infection. There are three main groups of intestinal helminths; it is the most prevalent helminths called soil-transmitted helminthiases, which are found all over the world (Alemu et al., 2018). Soil-transmitted helminthiases (STH) defined as a group of parasitic diseases caused by nematode worms that transmitted to humans via faecally contaminated soil. It is the most prevalent infection of humans living in sub-Saharan African countries. The latest estimates indicate that more than 2 billion people infected with these parasites. The highest prevalence occurs in areas with

poor sanitation and unsafe drinking water supplies (Samuel et al., 2017). Historically, infection with soil-transmitted helminthiases (STH) was prevalent in developed countries but sustained control efforts with economic development help to reduce the prevalence. In other parts of sub-Saharan Africa and Southeast Asia, and so far, there has been little change in the prevalence of soil-transmitted helminthiases during the latter half of the twentieth century in these areas (Mirisho et al, 2017) .In recent years political and financial support increased for the global control of STH infection, with a strong focus on a school-based de-worming program (Mirisho et al., 2017). Morbidities associated with STH infection include iron deficiency anemia, malnutrition, growth and developmental disorders including short stature and cognitive developmental disorders. Effects on the growth of children caused by changes in appetite, digestion, absorption of nutrients, and iron deficiency. The impact of STH infection leads to poor school performance and attendance so that when they reach their adulthood, their productivity tends to decrease and their pregnancy tends to be harmful, which in turn impairs the progress of children's education and the nation's economic development (Shumbej et al., 2015). *Ascaris lumbri-coides, Hookworm (Ancylostoma duodenale and Necator americanus)* and *Trichuris trichiura (T.trichiura*) are the most common STHs which have reported among several hundred millions of people worldwide (Debalke, et al, 2013). STHs are predominantly transmitted when faeces containing eggs deposited into the environment, develop to an infective stage and are transmitted via ingestion or across the skin boundary (hookworm) (Greenland et al., 2015). More than 1.5 billion people infected with soil-transmitted helminths or 24% of the world's population. About 267 million preschool-age children and over 568 million school-age children live in areas where these parasites are intensively transmitted and need treatment and preventive interventions (Greenland et al., 2015). The global target is to eliminate morbidity related to soil-transmitted helminthiasis in children by 2020. This goal will obtain by regularly treating at least 75% of the children in endemic areas (WHO, 2019). In the developing countries such as Sudan, intestinal helminths infections are still a major parasitic illness causing public health problems, especially among children. In the present work, a cross-sectional school-based study was conducted among pupils to estimate the prevalence of intestinal helminths and associated risk related factors.

MATERIALS AND METHODS

Study area

The current cross-sectional school-based study takes place in White Nile State, Kosti city in the period from December 2018 to February 2019. White Nile State is located in the Southwestern part of Sudan between (30^{o} 8' – 30^{o} 13' N and 28: 22 – 28 E), about 360 km from Khartoum. The state occupied an area 127300 km^2 and it is bordered from the North by Khartoum State, from West by North Kordufan State, by South from South Sudan country and by Gezira State from East. The area located across three different climatic zones; Savannah with low and high rainfall and flood plans. The State is mainly flat but interrupted in some areas with a small hill and seasonal streams (Khors). The State is inhabited in different parts by different soil types but most areas dominated by sandy soil (Elmalih et al., 2018; Tamomh et al., 2018).

Study population

The study population was included the whole primary school pupils in the Aboshareef area. The study population includes all pupils from first-class to eight, and they are 4045 pupils distributed in 4primary schools; 2012 boys and 2033 girls.

Inclusion criteria

All enrolled pupils during the study period from class one to class eight included in the current study.

Exclusion criteria

(1) Pupils who had not attended the same school for at least the past six months excluded from this study. (2) Pupils also were excluded if they had anti-helminthic in the previous six months. (3) Pupils who are absent during the data collection also were excluded.

Sampling

Sample size

The sample size is calculated using the formula:

$n_0 = \frac{z^2 PQ}{e^2}$ (Jain, et al, 2015).

Where: n_0 = Desired sample size, Z = Standard normal deviate; usually set at 1.96 which corresponds to 95% confidence level, p =Proportion of intestinal helminths from previous studies, q =1-p, and e = Precision level (degree of accuracy required usually set at0.05 level).When we apply the above equation:

$n_0 = \frac{1.96^2 * 0.325 * 0.675}{0.05^2} = 337$ sample units.

Sample distribution (Techniques)

The sample size was selected proportionally from each school using the following formula:

$$n_p = \frac{n_0 * Np}{N}$$

Where: n_p = required sample size from each school, n_0 = Whole sample size, N_p = number of pupils in school and N = Total number of pupils in all schools. Then simple random sampling used to obtain the required sample size from each class.

Data collection

Questionnaire

A pre-tested structured questionnaire used to collect sociodemographic data and risk factors among the study participants. The questionnaire was pre-test for validity and reliability to the study from one school which was selected from the study area and not included in this study.

Laboratory investigation

Before a day of stool collection, the school was visited for verbal permission and speak with pupils to inform their parents. On the next day of permission visit, each student provided with clean stool container and asked to provide a stool sample after filling the questionnaire and advised to bring fresh stool immediately after collection at school latrine. The specimens collected weigh about 10 grams. The samples were sent to the parasitology department to examined by a lab technician. All the samples collected in the day processed within the same day. Fecal samples examined for eggs of helminths using two smears with the Kato-Katz technique within 24 h of sampling. The Kato-Katz method implemented following the WHO guideline for stool examination (Cha et al., 2017; Tamomah et al., 2016). Kato-set used contained from (template with a hole, nylon screen and plastic spatula), newspaper, microscope slides, cover glass as coverslip soaked in glycerol malachite green solution, fresh stool and gloves. Stool samples were collected in clean stool containers and then transported to the laboratory at room temperature to examined immediately after arrival at the laboratory. Duplicate Kato-Katz stool smears were prepared immediately after the submission of the stool to the lab. In the lab glass slide labeled with the same sample number in the container and then placed a plastic template on top of the slide. Then place a small amount of the fecal sample on a newspaper and press a piece of nylon screen on top of the fecal sample. By using a spatula, scrape the sieved fecal material through the screen so that only the debris remains and scrape up some of the sieved feces to fill the hole of the template with avoiding air bubbles and leveling the feces off to remove any excess. Carefully template was lift-off and placed it in a bucket of water mixed with concentrated detergent to reused. After that, a piece of cover glass soaked in methylene blue glycerol solution with 10% concentration for 24 hours, placed over the fecal sample and placed a clean slide over the top of cover glass and press it evenly downwards to spread the feces in a circle. After the preparation of the sample, the slide was placed under the microscope and examine the whole area in a systematic zigzag pattern. The presence of egg considers a positive result. Eggs intensity determined by multiplying eggs count per slide by 24 to give the number of eggs per gram (EPG) (WHO, 2012).

Data analysis

First, questionnaires were coded and entered in an excel sheet for revision and checkup; then, data exported to the SPSS program. The frequencies of all variables calculated including the prevalence of intestinal helminths for all school pupils. Comparison between different variables and prevalence of intestinal helminths conducted using a Chi-squared test and Fisher's Exact Test and multiple regression to identify any association between helminths infestation and risk factors and P-value less than 0.05 considered statistically significant. The analysis conducted using SPSS v 25.

Ethical statement

The study was approved by the Institutional Ethics Committee of Public Health Research Board, Faculty of Public and Environmental Health University of El Imam El Mahdi. Community leaders, local health authorities and parents of pupils were informed during sensitization meetings about the purpose, procedures, potential risk, discomforts, and benefits of the study prior to the survey and sample collection.

RESULTS

The Sociodemographic characteristics of the study group which includes age group; 55.2% in a category less than 10 years, 31.2% between 10 – 13 year and 13.6% more than 13 years (the mean 9 ± 2.1 years). The distribution of gender: 49.1% and 50.1% male and female, respectively. The education level of fathers: The majority of pupil's fathers are illiterate 79.5%, while 12.8% attained primary school, 4.7% had a secondary school certificate and the rest 3% attained university. The

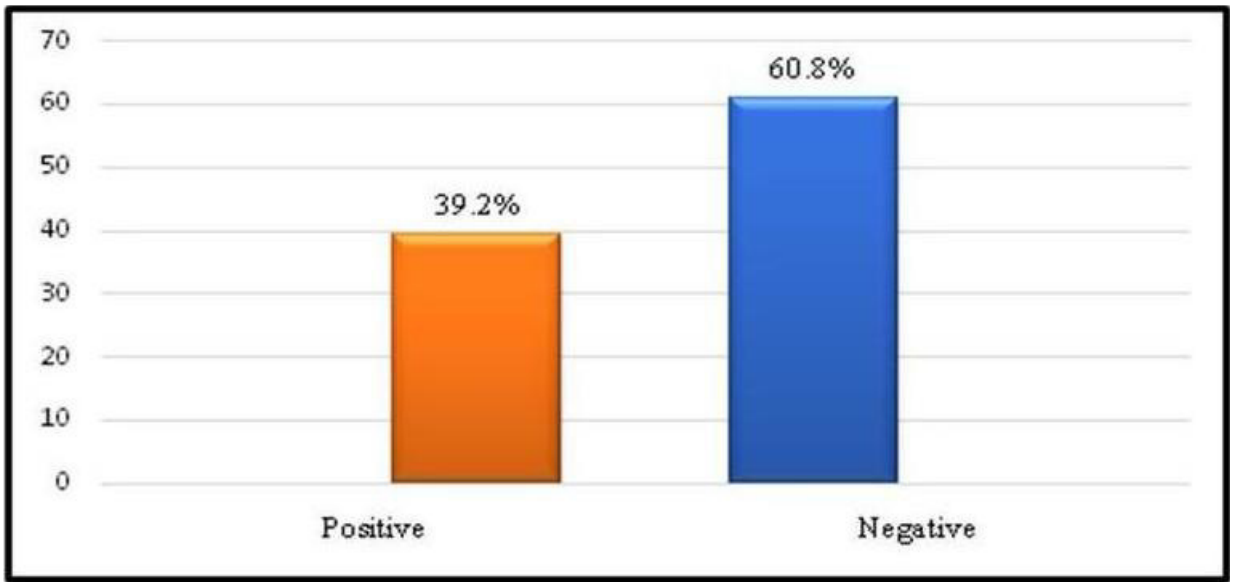

Figure 1. Detection of intestinal helminths in Stool samples among school pupils

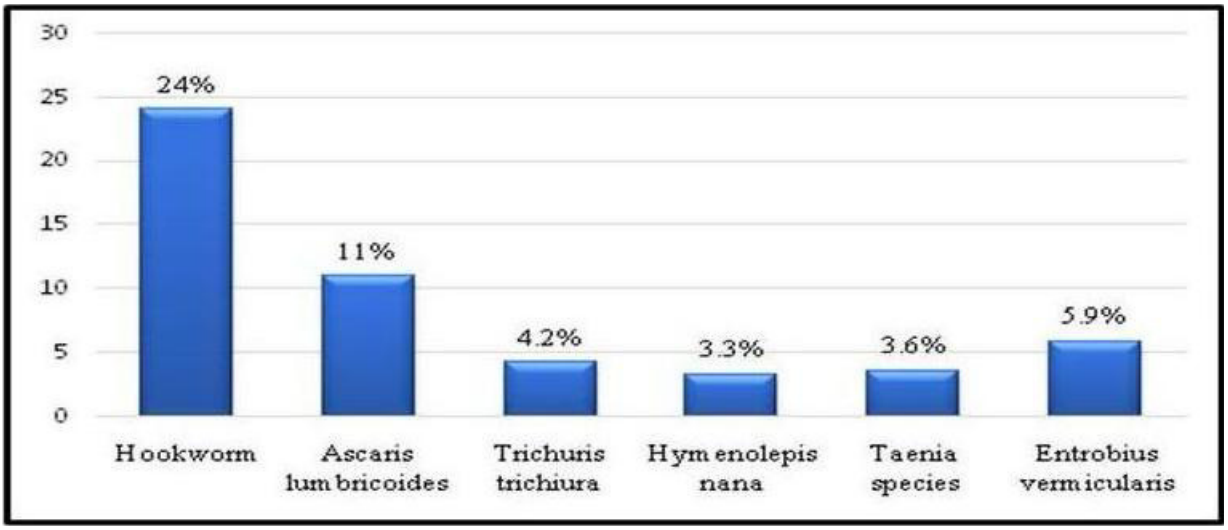

Figure 2. Distribution of helminths determined among study participants.

Table 1. Sociodemographic characteristics of study participants. (n=337)

Variables		Frequency	%
Age groups	Less than 10 years	186	55.2
	10 - 13 year	105	31.2
	More than 13 year	46	13.6
	Total	337	100.0
Gender	Male	168	49.9
	Female	169	50.1
	Total	337	100.0
The educational level of father	Illiterate	268	79.5
	Basic school	43	12.8
	Secondary school	16	4.7
	University	10	3.0
	Total	337	100.0

Table 1. Continue

Occupation of father	Farmer	37	11.0
	Employee	13	3.9
	Not working	2	.6
	Deceased	7	2.1
	Free businesses	278	82.5
	Total	337	100.0
The educational level of the mother	Illiterate	75	22.3
	Basic school	109	32.3
	Secondary school	121	35.9
	University	32	9.5
	Total	337	100.0
Occupation of mother	Housewife	270	80.1
	Employee	3	.9
	Worker	64	19.0
	Total	337	100.0

Table 2. Association between infestation with intestinal helminths and sociodemographic characteristics using multiple regression (n = 337)

Variables		Result of diagnosis		Total (%)	χ^2	P-Value	OR	95% Confidence Interval for OR	
		Positive (%)	Negative (%)					Lower Bound	Upper Bound
Age	Less than 10 years	75(22)	111(33)	186(55)	1.143	.565	.794	.393	1.605
	10 - 13 year	37(11)	68(20)	105(31)			.613	.285	1.317
	More than 13 year	20(6)	26(8)	46(14)			--	--	--
Total		132(39.2)	205(60.8)	337(100)					
Gender	Male	82(24)	86(25.9)	168(49.9)	*FE	<.001	2.028	1.250	3.290
	Female	50(15)	119(35.1)	169(50.1)			--	--	--
Total		132(39.2)	205(60.8)	337(100)					
Father educational level	Illiterate	105(31)	163(48.5)	268(79.5)	6.241	.100	1.637	4.204	6.376
	Basic school	20(6)	23(6.8)	43(12.8)			1.933	4.400	8.488
	Secondary school	2(0.6)	14(4.1)	16(4.7)			7.011	8.665	5.673
	University	5(1.5)	5(1.5)	10(3.0)			--	--	--
Total		132(39.2)	205(60.8)	337(100)					
Father occupation	Farmer	20(6)	17(5)	37(11)	6.204	.184	1.511	.702	3.251
	Employee	5(1.5)	8(2.3)	13(3.8)			3.141	3.141	3.141
	Don't work	0	2(0.6)	2(0.6)			3.447	3.447	3.447
	Dead	4(1.1)	3(1)	7(2.1)			2.910	.569	14.882
	Free businesses	103(30.4)	175(52.1)	278(82.5)			--	--	--
Total		132(39.2)	205(60.8)	337(100)					
Mother educational level	Illiterate	25(7.5)	50(15)	75(22.5)	16.562	<.001	5.882	1.218	28.394
	Basic school	50(15)	59(17)	109(32)			9.864	2.121	45.876
	Secondary school	54(16)	67(20)	121(36)			10.111	2.167	47.163
	University	3(1)	29(8.5)	32(9.5)			--	--	--
Total		132(39.2)	205(60.8)	337(100)					
Mother occupation	Housewife	111(33)	159(47)	270(80.4)	2.155	.340	1.674	.910	3.080
	Employee	1(0.3)	2(0.6)	3(1)			6.482	.291	144.351
	Laborer	20(6)	44(13.4)	64(18.6)			--	--	--
Total		132(39.2)	205(60.8)	337(100)					

*OR = Odds Ratio, *Fisher's Exact Test, *p< 0.05 was considered statistically significant.

Table 3. Association between infestation with intestinal helminths and risk factors. (n – 337)

Variables		Result of diagnosis		Total (%)	χ^2	P-Value	OR	95% Confidence Interval for *OR	
		Positive (%)	Negative (%)					Lower Bound	Upper Bound
Source of water at school									
Water system		55(16.5)	112(33)	167(49.5)			.566	.341	.938
Donkey cart		77(22.7)	93(27.8)	170(50.5)	5.401	.020	--	--	--
Total		**132(39.2)**	**205(60.8)**	**337(100)**					
Type of toilet at school									
Simple pit latrine		95(28.3)	78(23)	173(51.3)			4.708	2.837	7.813
VIP		37(10.9)	127(37.8)	164(48.7)	36.983	<.001	--	--	--
Total		**132(39.2)**	**205(60.8)**	**337(100)**					
Sanitary facilities in house latrine									
Water		121(37)	173(53)	294(90)			3.516	.887	13.930
Soap and water		3(1)	17(5)	20(6)	6.809	.033	1.238	.115	13.369
No facilities		3(1)	10(3)	13(4)			--	--	--
Total		**127(39)**	**200(61)**	**327(100)**					
Washing hand with soap after using the toilet	Yes	3(1)	14(4)	17(5)	*FE	.062	.643	.085	4.869
	No	129(38.2)	191(56.8)	320(95)			--	--	--
Total		**132(39.2)**	**205(60.8)**	**337(100)**					
washing hand with soap before eating	Yes	5(1.5)	14(4)	19(5.5)	*FE	.237	.658	.221	1.964
	No	127(37.7)	191(56.8)	318(94.5)			--	--	--
Total		**132(39.2)**	**205(60.8)**	**337(100)**					
Wearing shoes when going to the toilet	Yes	107(31.8)	182(54)	289(85.8)	*FE	.048	.811	.402	1.635
	No	25(7.4)	23(6.8)	48(14.2)			--	--	--
Total		**132(39.2)**	**205(60.8)**	**337(100)**					

*OR = Odds Ratio, *Fisher's Exact Test, *p< 0.05 was considered statistically significant.

occupation of fathers: 11% of fathers are farmer, 3.9% employee, 0.6% do not work, 2.1% dead and do often are free business 82.5%. The education level of mothers: 22% are illiterate, 32.3% primary school. 35.9% secondary school and 9.5% attained university. The occupation of mother: The majority are housewife 80.1%, 0.9% are employees and 19% laborer.

DISCUSSION

This cross-sectional school-based study conducted to estimate the prevalence of intestinal helminths and possible risk factors associated with the infection among primary school pupils. The result of the current study showed that the overall prevalence of intestinal helminths infestation was 39.2%; the males represented 62% and females are 38%. Our results were lower than that found among children in central of Sudan 90.4% (Ahmed, et al, 2010) , in white Nile state 56.9% (Suliman et al., 2019), in Nigeria 78% (Oluwaseyi and Olufumilayo, 2017), in Khartoum 64.4% (Gabbad and Elawad, 2014), in Alhag Yousif, East Nile locality 70% (Siddig et al., 2017) and 46.3% in Arbaminch Zuria District, Southern Ethiopia (Alemu et al., 2018) . The prevalence of helminths infection was however relatively higher in the current study than that found among children in the Accra region of Ghana 17.33% (Mirisho et al., 2017), in Anambra State, Southeastern Nigeria 21.7% (Onyido et al., 2017), in North-Western Tigray, Ethiopia 12.7% (Teshale et al., 2018), in Kassala 22.2% (Mohammed et al., 2009), and relatively closer to the finding of a study conducted in Al-kalakla, Khartoum, which revealed that the prevalence was 30%. (Muhajir et al., 2017). The difference in the prevalence could attribute to the timing of the study, sampling, weather variation, environmental condition and other geographical factors in these study areas. In the current study, six common intestinal helminth species identified in participants stool samples, the most common one being hookworm with the prevalence of 24%, followed by *A. lumbricoides* 11%, *Trichuris trichiura* 4.2%, *Hymenolepis nana* 3.3%, *Taenia species* 3.6% and *Entrobius vermicularis* 5.9%. Different studies from the world demonstrate various prevalence rate of common intestinal helminths among school children. In Elengaz area, the rates of helminths were *Hymenolepis nana* 26.4%, *Taenia saginata* 8.6%, *Entrobius vermicularis* 6.2% (Gabbad and Elawad, 2014), in Southern Ethiopia

A lumbricoides was with the highest frequency 56, 14.3% followed by hookworms 55, 14.1% and *Hymenolepis nana*17, 4.3% (Alemu et al., 2018), in Alhag Yousif Area H*ymenolepis nana* 19%, *Enterobius vermicularis* 1.2% and *Ascaris lumbricoides* 1.2% (Siddig et al., 2017). in Wolaita zone, Southern Ethiopia*, hookworm* infection (27.6%), *A. lumbricoides* (8.9%), *E. vermicularis* (2.8%), *Taenia species* (2.6%), *T. trichiura* (1.2%) and *H. nana* (0.6%) (Alemayhu, et al, 2017) and in central Sudan *Ascaris lumbricoides* 32.5%, *Hymenolepis nana* 30.6%, *Trichuris trichiura* 6.3% and *Ancylostoma duodenale* 7.6% (Ahmed, et al, 2010). Such variations in the prevalence of helminths infections likely attributed to variations of inappropriate water supplies, sanitation, and hygiene among study areas. Interestingly, in the current study boys had a higher prevalence of helminths infestation than girls and the difference was statistically significant ($p < 0.001$). The current study result was agreed with Siddeg *et al* in Alhag Yousif Area "The study found that intestinal parasites were more prevalent among the male students (80%) than the females (60%)" (Siddig et al., 2017), and disagreed with Mirisho et al in Ghana "there was no significant difference in helminths infestation between males and females" (Mirisho et al., 2017), and also disagreed with Alemu et al "there was no statistically significant difference between the prevalence of intestinal infestation across gender" (Alemu et al., 2018). These study showed that there was no statistical association between infestation with intestinal helminths and age ($\chi^2 = 1.143$) and ($P > 0.05$), this result is similar to the result of Samuel and his colleagues "the analysis showed that the prevalence of intestinal helminths infection was not significantly associated with the age of children" (Samuel et al., 2017). The strong statistical association observed between infestation with intestinal helminths and educational level of the mother ($\chi^2 = 16.562$) and ($P<0.001$), this result is similar to that mentioned by Teshale and his colleagues "Level of education of mother is statistically significant with intestinal helminthes infection" (Teshale et al., 2018). This study demonstrated that there was no statistical association between infestation with intestinal helminths and Washing hands with soap after using the toilet, washing hands with soap before eating and wearing shoes when going to the toilet ($p > 0.05$). The current study was reported statistical association showed between infestation with intestinal helminths and wearing shoes when going to the toilet ($\chi^2 = 3.918$) and ($P = 0.048$). Also, the current study showed no statistical association between infestation and educational level of father ($\chi^2 = 6.241$) and ($P>0.05$), and occupation of father ($\chi^2 = 6.204$) and ($P>0.05$), and no statistical association between infestation and occupation of mother ($\chi^2 = 2.155$) and ($P>0.05$). In this study, the statistical association observed between infestation with intestinal helminths and source of drinking water at school ($p<0.05$), and also significant association demonstrated between infestation with intestinal helminths and present of sanitary facilities in house latrine ($p<0.05$). The current study showed a strong statistical association between infestation with intestinal helminths and type of latrine at school ($p <0.001$); this result is similar to that reported by Samuel "statistical significant between infestation and type of latrine observed" (Samuel et al., 2017).

CONCLUSIONS

We conclude that this study revealed the intestinal helminths consider a health problem and especially among pupils in developing countries. Studying the prevalence of intestinal helminths among primary school pupils with the associated risk factors in developing countries may predict or explain the health status. Therefore, help in a better diagnosis, efficacy of medicine and improve the local public health.

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Competing interests

The authors declare that they have no competing interests.

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