Research Article

Prevalence of Nematode Infection Among School Children of District Malakand, Pakistan

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Abstract | Present study was aimed to determine the association of socio-demographic and socio-economic profiles to the prevalence roundworm and hookworm infections among school children in district Malakand, Pakistan. A cross-sectional study, involving 200 school children was conducted between October 2018 to September 2019. The risk factor was identified by using the Interviews, observation, and anthropometric indices assessment. The stool samples were collected and preserved in 10% formalin solution and safely transported to Parasitology Laboratory, University of Malakand for parasite examination. Each of the samples was processed in direct smear methods and examined under microscope first under low power objectives and then higher power Lense. Evidence of infection was noted by the presence of helminth eggs. Out of 200 samples 65% (n=130) were found to be infected with 2 species of soil transmitted helminths including 27% (n=54) *A. lumbricoides* and 35.5% (n=71) *A. duodenale*. Regarding ages, 11-12 years were highly infected. Females were observed to be infected more than male students. Children of unemployed mother and father were more infected than employed parents. Children living in cemented house were more infected than non-cemented. Children defecating in latrine were highly infected than children having defecation in open environment. Children with pet animals were highly infected than all others. Regarding drinking water sources, the children use well water were more infected than tape waters as a drinking source. Further studies are required on the same area to understand the prevalence and intensity of infection. Health programs should be suggested on personal and environmental hygiene practices.

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Keywords | Intestinal parasites, Soil transmitted helminths, Low socio-economic status, Unhygienic, Parasite of pathogenic importance

Introduction

The major health issue of children from rural areas in developing countries is Soil Transmitted Helminth (STH) infection and the school age children (4-15 years) is an important cause of morbidity due to the harboring the highest intensity of worm's infestation (Oyibo et al., 2023). Some major species of helminth parasites are responsible for common disease in humans which is *Ascaris lumbricoides*,

Trichuris trichiura, hookworm (*Ancylostoma duodenale* and *Necator americanus*) and *Strongyloides stercoralis* (Ojurongbe *et al*., 2011). Approximately, 2 billion people are suffered with STH in all over the world, which are endemic in most tropical countries; though, this might be an underestimate of the true global dispersion (Albonico *et al*., 2008).

The main source of the Infection and transmission of disease is poor hygienic habits such as improper disposal of human and animal faeces. Moreover, STH infections are also linked with poverty, lack of sanitation, lack of resources and overpopulation (Ojurongbe, 2013) mental retardation in children and other physical health problems in endemic countries are also the significant reason.

This infection is transmitted through ingestion of uncooked products which contain infective eggs of helminthic worms or soil contaminated with human feaces containing infective eggs. It is confirmed that the number of worms is directly related to disease and a significant decrease of worm may condense onward the rate of transmission thus intensity of helminth infection is an important pointer of ascariasis in addition to prevalence values (Adeyeba and Akinlabi, 2002).

All worms cause 4.5 billion infections including 1.0 billion for *Ascaris lumbricoides* which leads 20 thousand death per year, hookworm infection 900 million rated 50-60 thousand deaths and whipworm 750 million, filarial worms 657 million leads to 20-50+ thousand death per year, schistosomes 200 million leads 0.5-1.0 million death per year (Saboyá *et al*., 2013).

Soil transmitted helminths (STH) alone infect over one billion people in the world. Many of them were infected by more than one species of STH. It has been estimated that 56,000 deaths occur due to *A. lumbricoides*; 60000 due to hookworm and 70000 due *to Trichuris trichura* each year and STH mainly affect children leading to poor growth, lack of exercise or physical activity, reduce mental growth and function and learning ability (Tiwari *et al*., 2013). Geo helminths are volume two of world class parasites. Present study was aimed to assess the prevalence of geo-helminths infection among school children of district Malakand, Pakistan. Studies on intestinal parasites were carried out in Malakand region such as (Khan *et al*., 2011, 2014, 2015, 2016, 2017a, b, 2018a, b, c, d, 2019a, b, 2020, 2021a, b, 2022, 2023; Noor-un-Nisa *et al*., 2012; Arshad *et al*., 2019; Rahman *et al*., 2021; Ulhaq et al., 2021; Iqbal *et al*., 2021; Garedaghi et al., 2021; Rahman *et al*., 2022; Subhan *et al*., 2023). Current study was aimed to investigate the prevalence of nematode parasitic infection in school children of district Malakand, Pakistan.

Materials and Methods

Study area

The present study was carried out in five schools of district Malakand, Pakistan from October 2019 to November 2019. Malakand district is present in Khyber Pakhtunkhwa Province, Pakistan. The area lies on 793m above from sea level. 952 km^2 is the total area and 596 people per km^2 is population density was recorded. The climate in Malakand is warm and temperate. 19.9°C and 67.8°F is Average annual temperature and annual rainfall is 743 mm| 29.3 inches.

Study design and protocol

Before the initiation of the study, an intensive learning session was carried out. Training session for the study includes how to convince the students and their parents/guardians? How to collect the stool samples? And how to analyze stool samples? The training session was carried out by the research supervisor. A smart structured questionnaire was setup originally in English form according to the research objectives and local situation. The questionnaire included Socio-demographic characteristics and Socio-economic profile of the students.

Schools' visits

Five schools (Two schools of boys and three of girls) of the study area Thana in district Malakand were visited for collection of data. Before the initiation of study, meeting with school principals were conducted for the purpose of discussing the importance of the study and to take permission to carry it out. The simple random sampling technique were carried out from the selected schools. The importance of the research study was enlightened to the participants and their respective teacher.

Data collection procedure

Consenting pupils were included. The data was collected through distribution of questionnaires. The questionnaires were translated in to the local

language Pashtu. To confirm the relative information, the verbal interview was given by the child mother. Many information was included in the interview such as, information on socio-demographic data, environmental and behavioral factors. At the time of conversation, hand hygiene and teeth condition were also checked. The interview included information such as child age, class, mother and father job status, source of drinking water, existence of toilet at their house, presence or absence of animals. And the last, questionnaires were checked for correctness, sequences and completeness.

Labelled plastic bottles and applicator sticks were distributed on each student. Careful explanation was given to all the students on proper collection and instructed to bring stool samples properly on next day. The samples were collected on the following day. Collection of stools and interviews were obtained along with students' privacy and maintained the data were kept strictly confidential. Careful examination was done by each fecal sample for color, consistency, blood, mucus and occurrence of adult worms. All the specimens were then checked for their label, quantity.

Laboratory examination

The stool samples were transported to Parasitology Laboratory, department of Zoology, University of Malakand. They were examined both macroscopically and microscopically.

Macroscopic examination

The appearance of each fecal sample was carefully examined macroscopically with naked eyes for color, consistency, blood, mucus and presence of adult worms. After that, specimens were checked for label on their bottle and quantity.

Normal saline solution preparation

Samples that fulfilled with study were emulsified in a 10% formalin solution. A minute portion of faces is diluted with normal saline solution and it is taken on a white slide. And put a cover slip on it, spread out the emulsion in to a thin, fairly uniform and transparent layer. The unstained preparation was used.

Microscopic examination

A portion of each stool sample was examined under microscope to detect the different form such as cysts, trophozoites, eggs and larva of intestinal helminths and the residual part of the samples was preserved in 10% formalin solution for further study. The slide was first examined under low power objectives lenses. Starting from one end of the cover slip, the whole slide is examined. Any suspicious object is centered and focused under high power objective lenses. Formal ether concentration was the most sensitive and considerable technique for stool examination to recognize the intestinal helminths in easy way.

Results and Discussion

Out of 200 samples 65% (n=130) were found to be infected with only 2 species of soil transmitted helminths including 27% (n=54) *A. lumbricoides* and 35.5 % (n=71) hookworm. Regarding ages 11-12 years of ages were highly infected (Figure 1 and Table 1). Females were observed to be infected more than male students (Figure 2 and Table 2). Children of unemployed mother and father were more infected than employed parents (Figures 3-4 and Tables 3-4). Children living in cemented house were more infected than non-cemented (Figure 5 and Table 5). Children defecating in latrine were highly infected than children having defecation in open environment (Figure 6 and Table 6). Children with pet animals were highly infected than all others (Figure 7 and Table 7). Regarding drinking water sources, the children use well water were more infected than tape waters as a drinking source (Figure 8 and Table 8).

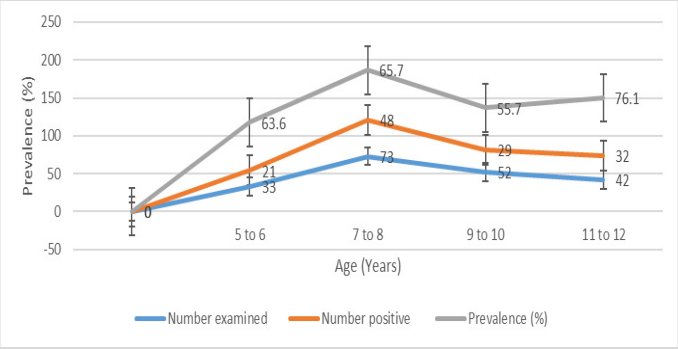

Figure 1: *Over all age wise relationship of roundworm and hookworm infection in school children.*

Table 1: *Prevalence of roundworm and hookworm infection in relation to different ages of school children.*

Age groups	Parasite n (%)					
	A. lumbricoides	Prevalence	Hookworm	Prevalence	Total	Prevalence
5-6	10	18.5	14	19.7	24	19.2
7-8	23	42.5	22	30.9	45	36
9-10	8	14.8	16	22.5	24	19.2
11-12	13	24.0	19	26.7	32	25.6
Total	54	27	71	35.5	125	62.5

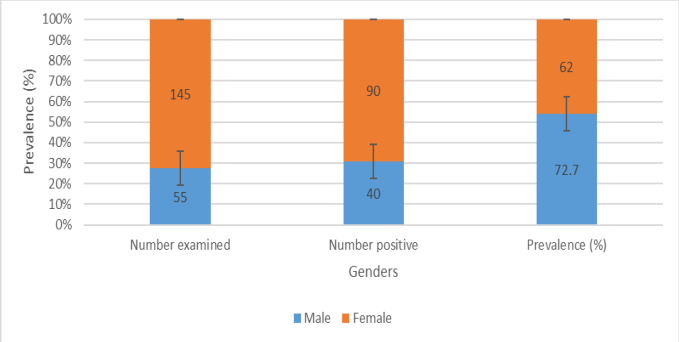

Figure 2: *Over all sex wise relationship of roundworm and hookworm infection in school children.*

Table 2: *Prevalence of roundworm and hookworm infection in relation to sex of school children.*

Gender	Parasite n (%)					
	A. lumbricoides	Prevalence	Hookworms	Prevalence (%)	Total	Prevalence (%)
Male	17	31.4	26	36.6	43	34.4
Female	37	68.5	45	63.3	82	65.6
Total	54	27	71	35.5	125	62.5

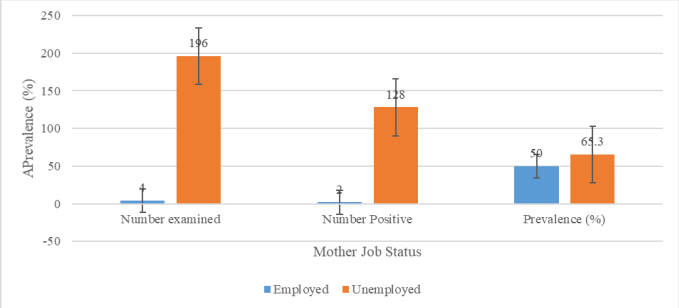

Figure 3: *Mother employment status and roundworm and hookworm infection of school children.*

Table 3: *Prevalence of roundworm and hookworm infection in relation to mother employment status of school children.*

Mother job	Parasite n (%)					
	A. lumbricoides	Prevalence (%)	Hookworms (%)	Prevalence (%)	Total	Prevalence (%)
Employed	0	0	0	0	0	0
Unemployed	54	100	71	100	125	100
Total	54	27	71	35.5	125	62.5

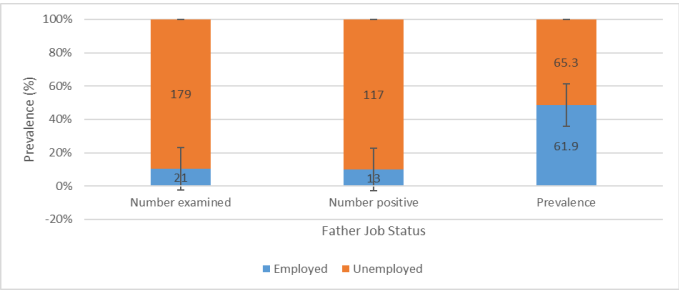

Figure 4: *Father employment status and roundworm and hookworm infection of school children.*

Table 4: *Prevalence of roundworm and hookworm infection in relation to father employment status of school children.*

Father job status	Parasite n (%)					
	A. lumbricoides	Prevalence (%)	Hookworms	Prevalence (%)	Total	Prevalence (%)
Employed	5	9.25	10	14.08	15	12
Unemployed	49	90.7	61	85.9	110	88
Total	54	27	71	35.5	125	62.5

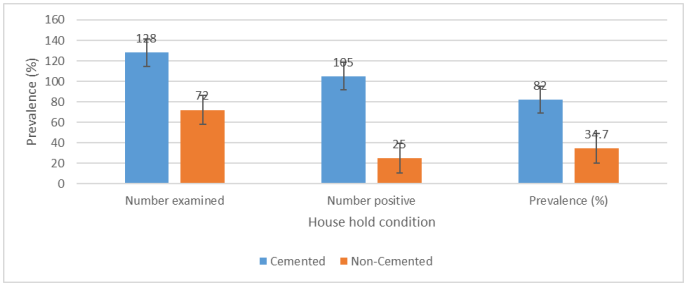

Figure 5: *House hold conditions and roundworm and hookworm infection of school children.*

Table 5: *Prevalence of roundworm and hookworm infection in relation to house hold condition in school children.*

House hold conditions	Parasite n (%)					
	A. lumbricoides	Prevalence (%)	Hookworms	Prevalence (%)	Total	Prevalence (%)
Cemented	36	66.6	44	61.9	80	64
Non cemented	18	33.3	27	38.0	47	37.6
Total	54	27	71	35.5	125	62.5

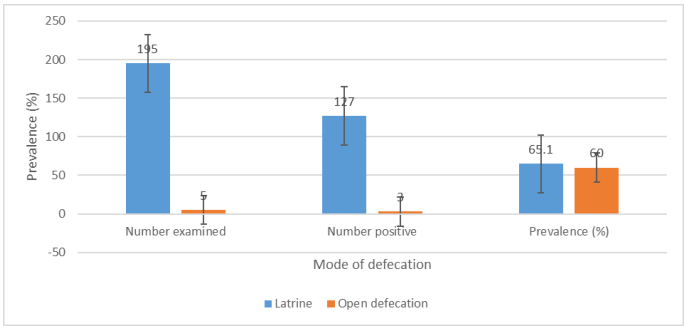

Figure 6: *Mode of defecation in relation to roundworm and hookworm infection in school children.*

Table 6: *Prevalence of roundworm and hookworm infection in relation to mode of defecation in school children.*

Defecation	Parasite n (%)					
	A. lumbricoides	Prevalence (%)	Hookworms	Prevalence (%)	Total	Prevalence (%)
Pit	1	1.85%	Nil	Nil	1	0.8
Latrine	51	94.4%	71	100%	122	97.6
Open defecation	2	3.7%	Nil	Nil	2	1.6
Total	54	27%	71	35.5%	125	62.5

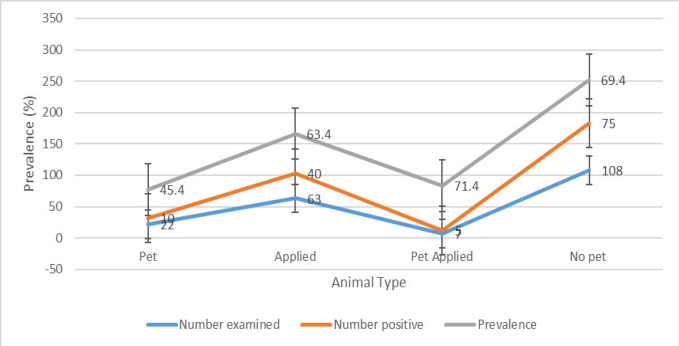

Figure 7: *Animal types in relation to roundworm and hookworm infection in school children.*

Table 7: *Prevalence of roundworm and hookworm infection in relation to animal type in school children.*

Animals	Parasite n (%)					
	A. lumbricoides	Prevalence	Hookworms	Prevalence (%)	Total	Prevalence (%)
Pet	5	9.25	7	9.85	12	9.6
Applied	14	25.9	23	32.3	37	29.6
Both	4	7.4	1	1.40	5	4
No	31	57.4	40	20	71	56.8
Total	54	27	71	56.3	125	62.5

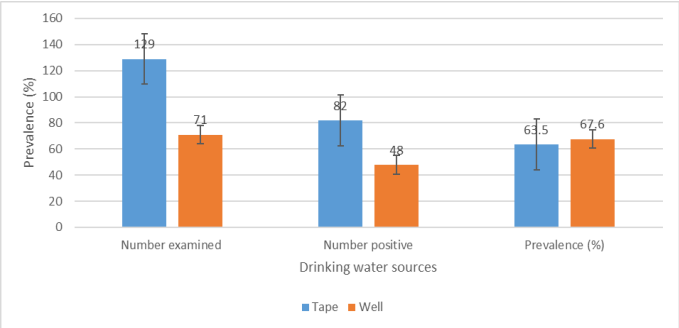

Figure 8: *Drinking water sources and roundworm and hookworm infection in school children.*

Table 8: *Prevalence of roundworm and hookworm infection in relation to drinking water sources in school children.*

Drinking water	Parasite n (%)					
	A. lumbricoides	Prevalence (%)	Hookworm	Prevalence (%)	Total	Prevalence (%)
Tape	38	70.37	47	66.1	85	68
Well	16	29.6	24	33.8	40	32
Total	54	27	71	35.5	125	62.5

The current research study provides information concerning geo-helminth parasite infections among government primary school children in district Malakand, Khyber Pakhtunkhwa, Pakistan. Females' students were in majority as compared to male. One hundred and thirty individuals were found to be infected with one or more than one geo-helminth. The most predominant helminths parasite in this study were hookworms (35.5%), followed by *A. lumbricoides* (27%). Most research studies have confirmed the efficacy, acceptability and cost-effectiveness of school-based control of geo-helminth infections (Leslie *et al.*, 2011; Zani *et al.*, 2004).

Malnutrition is the main cause of geo-helminth parasite which could affect the weight and height of infected person (Stephenson *et al.*, 2000). Result of the present research work show that geo-helminth infections were highly prevalent among primary school children in district Malakand, Pakistan. This valuable result suggests the establishment of a health program in all primary school for the control of the helminths infection. Health education along with Mass deworming of school children should be implemented in this area. Also, educate for personal hygiene as well as facility of moveable water and improve sewage disposal.

Different epidemiological studies were carried out in many countries which shown that the condition of an individual is an important cause in the prevalence of intestinal helminths infection, the rate of prevalence was greater in children in any place. Therefore, the present study was conducted to evaluate the prevalence value of different intestinal parasite infections and associated risk factors in school children of Malakand district, the current research observed the overall prevalence rate of intestinal worms was (65%). This highest prevalence rate is mainly due to the area and living style of study subjects.

There was a suitable relationship of the parasite infections among ages and genders. The individuals with age group 7-8 years were highly infected followed by 9-10, 11-12 and 5-6 years. However female students were found highly infected as compared to male. Hookworms were the highest in prevalence followed by *A. lumbricoides.*

Concerning the relation of age group and parasitic infections, present study reveals infection rates according to age groups 21(63.6%), 48 (65.7%), 29 (55.7%) and 32 (76.1%) in age group 5-6, 7-8, 9-10 and 11-12 years, respectively. Whereas, the relationship of sex with prevalence of infection, present study indicates 40 (72.7%) and 90 (62.06%)

infection in male and female, respectively. How so ever, age from 11-12 years and sex wise male were found to be more parasitized than male.

Compared with the results of related studies conducted in other regions, the present study showed low prevalence rate of infection for *Ascaris lumbricoides*, while the prevalence value of this nematode infection was quite high (39.8%) in district Swat located in North of KPK Pakistan (Khan *et al*., 2015). Waheed et al. (2014) reported 54.5% of the infection in school children of Dir upper, (Khan *et al*., 2011) reported 39.0% of the prevalence, Noor-un-Nisa *et al*. (2012) worked on shepherds of district Swat and reported 30.1% of infection. The greater geography of this nematode parasite to specific individual may be a single environmental, cultural, and association study. Although in contrast to the distribution of other parasites in the human population of Pakistan, this parasite is widely distributed.

Prevalence of *A. lumbricoides* in the school children of Berisso, Argentina was 53.0% as reported in a study conducted by Molina *et al*. (2011). In a study conducted in south Ethiopia the prevalence was 42.1% (Bugssa *et al*., 2015). Tang and Luo (2003) recorded in rural communities of China 41.4% of prevalence of this parasite. Khalil et al. (2012) conducted a study on intestinal parasitic infections in Gilgit-Baltistan and reported that *A. lumbricoides* infection is widely prevalent with extensive geographical distribution while this nematode is absent in some parts of the country.

According to our analysis the prevalence rate of hook worm was 71(35.5%). The finding of the present study was in consistence to the report value of (Khan *et al*., 2015) their finding reveals highest prevalence rate of this nematode infection (39.8%) in district Swat.

Although the prevalence of hookworm species in South Ethiopia school children was 3.6% (Bugssa *et al*., 2015). Alkhalife (2008) recorded the prevalence of this nematode in Saudi Arabia to be 13.2%. Tang et al. (2011) worked on rural communities of China and found the prevalence to be 17.7%. Hookworm spreads in many areas but considerable difference in the rate of prevalence.

Conclusions and Recommendations

Present study provides data on prevalence of geo-helminth infections among school children in five schools of district Malakand, Pakistan. A total of 200 individuals provided stool specimens. The respondents were between 5 to 12 years old, 55 were males and 145 were females. Tape water was the principal source of drinking water (64.5%). The laboratory examination demonstrated evidence of *A. lumbricoides* 31.48%, 68.5%; hook worms 36.6%, 63.3% for male and female, respectively. Hook worms infection was the most prevalent among children, although males had a higher infection rate than females childrens. The results of investigation of this remote and least scientifically explored part of Pakistan indicated that the children tended to have low intensity of infections, hence prevalence of infections were high.

Acknowledgement

The authors are thankful to the participant of different school children, there parents, guardians and teaching and non-teaching stop of the school for providing their assistance during the study

Novelty Statement

This study is the first on its type in nature. The WHO recognized Malakand as endemic zone for soil transmitted helminth, this why the nematode investigation is important in human population of the region.

Author's Contribution

Yousef Abdal Jalil Fadladdin: Conceptualization and Software.
Ateeq Ullah: Writing original draft and methodology.
Rahila Nawaz: Formal analysis.
Yagoob Garedaghi: Review and editing.
Abbas M.A. Al-Azab and Mashael Abdullah Aldamigh: Review and editing.

Ethical statement
The present work was approved by the ethical review committee, University of Malakand and give permission from head of the schools to conduct data. Informed verbal consent was also obtained from students and respective teacher.

Conflict of interest
The Authors have declared no conflict of interest.

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