

Research Article

Prevalence and Determinants of Intestinal Parasitic Infections in Children from Four Cities in Kyrgyz Republic

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A B S T R A C T

Introduction: Parasitosis is a significant public health challenge affecting over 1.5 billion people globally. The incidence of parasitic infections has increased in Kyrgyzstan. This study aimed to evaluate the prevalence and determinants of intestinal parasitosis in children residing in four primary regions of the Kyrgyz Republic: Batken, Jalal-Abad, Naryn, and Osh.

Methods: This study was descriptive and analytical in nature. From 2015 to 2021, 39,398 faecal samples were collected from children aged 3–18 years and were analysed through sentinel epidemiological surveillance.

Results: In Batken, 1,434 children tested positive for parasitic infections, with an incidence rate of 130.24 per 1000 children screened; 260 children had mixed infections, accounting for 21.2% of the total cases. In Osh, 2,469 children were found to have infections, with a lesion index of 111.92 per 1000, and 260 children had mixed infections, accounting for 10.5% of the total cases. In Naryn, 354 children tested positive for parasitic infections, with an incidence rate of 90.46 per 1000 individuals tested, and 24 children had mixed infections, accounting for 6.8% of the total cases.

Conclusion: The results showed that the highest detection rate of mixed-infection children was 26.40% in 2021, whereas parasitic infection peaked at 6.40% in 2020.

Keywords: Soil-Transmitted Helminth Infections, Enterobiasis, Children, Parasitic Infection, Mixed Infection

Introduction

Parasitosis remains a significant public health challenge. Globally, more than 1.5 billion individuals are infected with at least one helminth. Helminthiasis is the most prevalent infection in impoverished countries worldwide.¹ The helminthic parasite, a major contributor to illness in underdeveloped nations, particularly among children, has infected almost 1/4th of the global inhabitants.²⁻⁴

Helminthiasis (worm infection) is the third most prevalent parasitosis globally considering the number of individuals, whereas malaria is the fourth most common. Intestinal worm infections are among the top four contributing factors to all diseases that might harm health.⁵

Approximately 16 million of the 50 million global deaths annually are caused by infectious and parasitosis, as reported by the WHO.⁶ More than 4.5 billion individuals are afflicted with parasitosis globally, with almost 50% being affected by small intestinal roundworms.^{7,8}

Children residing in areas with inadequate hygiene are more susceptible to geohelminth infections, whereas individuals experiencing malnutrition are at a higher risk of suffering severe consequences in terms of illness and mortality.⁹ Intestinal parasites are mature to live in the human intestine for an extended period.

To effectively manage helminths, it is necessary to decrease loads in people and minimise exposure and predisposition to reinfection. Knowing the ecological and human factors that contribute to predisposition to recurrence is important for controlling infections. It is also important to investigate how alterations in ecological factors might affect intestinal parasite patterns in wild inhabitants.⁹

Worm infections can impact individuals of all age brackets. Nevertheless, school-aged children from low-income nations are more vulnerable to infections due to poor sanitation, inadequate food consumption, and various factors that support parasite persistence.^{10,11}

Parasites in the body increase a patient's susceptibility to various illnesses. Mixed infections can result from synergies. In humans, infections can appear as either mixed or solitary, especially in young infants.¹² Mixed infections can occur when vulnerable youngsters are co-infected with two or three distinct kinds of helminth parasites.

In recent years, healthcare practitioners have observed an increase in the incidence of parasitic infections among individuals. Each year, helminthiasis instances have been reported to vary from 28,000 to 41,000, with severe signs ranging from 7900 to 10,000 per 100,000 individuals.¹³ Intestinal parasitosis is the predominant parasitosis in the Kyrgyz Republic, accounting for 85% of all reported infections.¹³ Children under 14 years of age, who weighed

a particular amount, accounted for 80.4% of the reported cases of all diseases.¹³

Worm infections in Kyrgyzstan have increased, with an annual average of 28,000–40,000 cases. More than 20 distinct varieties of helminths have been recorded in the Kyrgyz Republic. Nematodes, sometimes referred to as flatworms, include opisthorchiasis, hepatic flukes, protozoa, *Giardia*, and sometimes dysentery amoeba. Cestodes, or tapeworms, consist of pig and bovine tapeworms, dwarf tapeworms, wide tapeworms, *Echinococci*, and *Alveococci*. This study aimed to evaluate the prevalence and determinants of intestinal parasitosis in children residing in four primary regions of the Kyrgyz Republic: Batken, Jalal-Abad, Naryn, and Osh.

Materials and Methods

From 2015 to 2021, 39,398 faecal samples from children aged 3–18 years were collected and analysed through sentinel epidemiological surveillance in four cities in Kyrgyzstan. This study was both descriptive and analytical in nature. Enterobiasis was assessed by the scraping method, the Kato-Katz approach was utilised for identifying intestinal parasite eggs, and the native smearing approach was employed for detecting protozoan eggs. Turdyev and Krasilnikov's preservative was used to conserve helminth and protozoa cyst eggs in the biological material. The lesion rate per 1000 participants was computed by analysing the Sentinel Epidemiological Surveillance data, which was calculated by multiplying the number of positive cases by 1000 and dividing the result by the total number of evaluated individuals.

This study was conducted on children from selected cities. Kindergartens and schools in these towns were chosen for this comprehensive study. All parents provided written informed consent for their children to participate in the study. The research was authorised by the Ethics Committee of the IK Akhunbaev Kyrgyz State Medical Academy (Protocol No. 1, dated January 15, 2021) and the data obtained were kept private.

The statistical study was performed employing Statistica v8.0 by StatSoft Inc., Tulsa, United States. The results are presented as mean \pm standard deviation and n (%). The Student's t-test was used to evaluate differences in parameters, and statistically significant differences were determined at a significance level of $p < 0.05$. The relevant odds ratios (ORs) were calculated using MedCalc version 20.106 by MedCalc Software Ltd., Ostend, Belgium.

Results

Approximately 546,454 faecal samples obtained from individuals were analysed annually for parasitosis in the Kyrgyz Republic and represent almost 8% of the population. The survey was not adequately covered by

district laboratories. Over the past three years (2017–2019), an average of 7,59,298 individuals were examined by the Department of Disease Prevention and State Sanitary and Epidemiological Surveillance Ministry of Health of the Kyrgyz Republic. Among them, 26,197 cases were identified, representing a rate of 34.5 per 1000 surveyed.

From 2015–2021, the mean prevalence of mixed illnesses per 1000 investigated individuals was 9.8. Figure 1 shows that the highest detection rate of mixed-infection children was in 2021 at 26.40%, whereas parasitic infection peaked in 2020 at 6.40%. The indicator fluctuates between 7.5 in 2019 and 21.8 in 2017 throughout the upcoming years of observation (Figure 1).

Of the 11,010 children checked in Batken, 1,434 tested positive, resulting in an incidence rate of 130.24 per 1000 children screened, with a prevalence of 13.0%. Out of 1,434 identified instances of parasitic illnesses, 82 children were

found to have mixed infections, accounting for 21.2% of the total cases.

In total, 22,059 youngsters were evaluated in Osh. of the total, 2,469 individuals were found to be infected, with a lesion index of 111.92 per 1000 and a specific gravity of 11.2%. of the 2,469 persons who invaded, 260 (10.5%) reported mixed illnesses.

A total of 3,913 youngsters in Naryn were evaluated, of which 354 tested positive. The prevalence rate was 90.46 per 1,000 persons evaluated, having a specific weight of 9.04%. of the 354 cases of illness, 26 (6.7%) reported mixed illnesses.

A total of 2,416 youngsters in the Jalal-Abad area were examined, and 178 were diagnosed with parasitic illnesses. The incidence rate was 73.67 per 1,000 individuals investigated, with an infection rate of 7.36% among those examined. of the 178 cases, 17 (4.4%) reported mixed illnesses (Table 1).

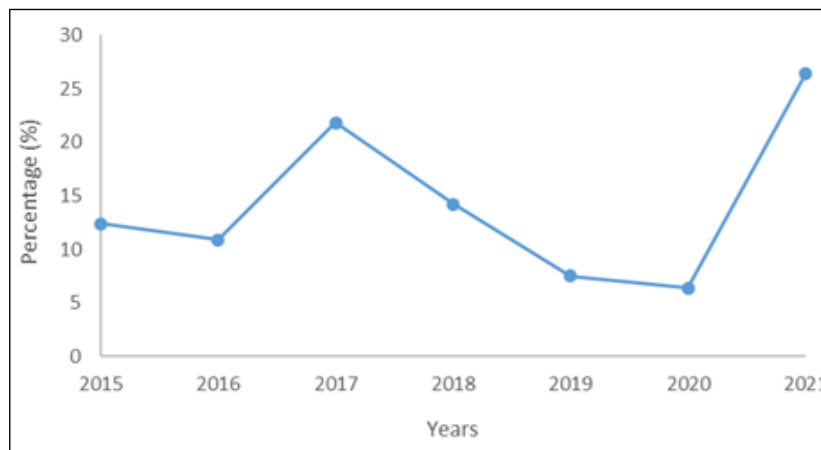


Figure 1. Frequency of Intestinal Mixed Infections in Endemic Regions of Kyrgyzstan (2015–2021)

Table 1. Invasiveness of Children with Mixed Infections by City and Region

Region	No. of Examined Persons	No. of Identified Persons	Indicator per 1000 Surveyed Persons	Prevalence of Infection Among Children (%)	No. of Children with Mixed Infections	Proportion of Infected Children (%)
Batken (n = 82)	11010	1434	130.20 ± 8.8	13.00	82 ± 7.2	5.7
Osh (n = 260)	22059	2469	111.92 ± 6.3	11.20	260 ± 8.8	10.5
Naryn (n = 26)	3913	354	90.40 ± 15.2	9.04	26 ± 8.4	7.3
Jalal-Abad (n = 17)	2416	178	73.60 ± 19.6	7.36	17 ± 9.6	9.5
Total	39398	4435	112.50 ± 22.6	11.25	385 ± 7.3	8.6

There was an uneven distribution of invasiveness frequency according to sex. In Batken, boys exhibited considerably greater levels of invasiveness than girls ($p > 0.05$), although in other places, the difference was not as pronounced (Figure 2).

The analysed data showed higher invasiveness among preschool children than among school children in the Jalal-Abad and Naryn areas, with no statistically significant difference ($p > 0.05$). Schoolchildren in the Osh and Batken areas had considerably greater invasiveness levels than preschool students ($p > 0.05$) (Figure 3).

The outcome demonstrated that nearly all children with mixed infections (96.6%) were affected by two types of parasites, whereas only a small percentage (3.4%) had three types of parasites classified by taxonomy. Our research indicated that children were affected with helminths and protozoa (62.80%) or two helminths (33.70%). Helminths

and protozoa can infect individuals through three separate routes, affecting 3.5% of the population (Figure 4).

Parasites that inhabited the intestines of mixed infestations were found. Helminths and protozoa included various parasites. First, the co-infection rate of *Ascaris* and *Giardia* was 19.70%. Second, the co-infection rate of the dwarf tapeworm and *Giardia* was 13.70%. Additionally, the co-infection rate of pinworm and *Giardia* was 26.70%. The combinations of helminths comprised *Ascaris* and pinworms, accounting for 12.40% of the infestations, and *Ascaris* and dwarf tapeworms, accounting for 3.37% of the infestations. Furthermore, the co-infection rate of pinworms and dwarf tapeworms was 20.50%. Each combination consisted of two helminths and one protozoan. The overall prevalence of pinworms, dwarf tapeworms, and *Giardia* was 3.63% (Figure 5).

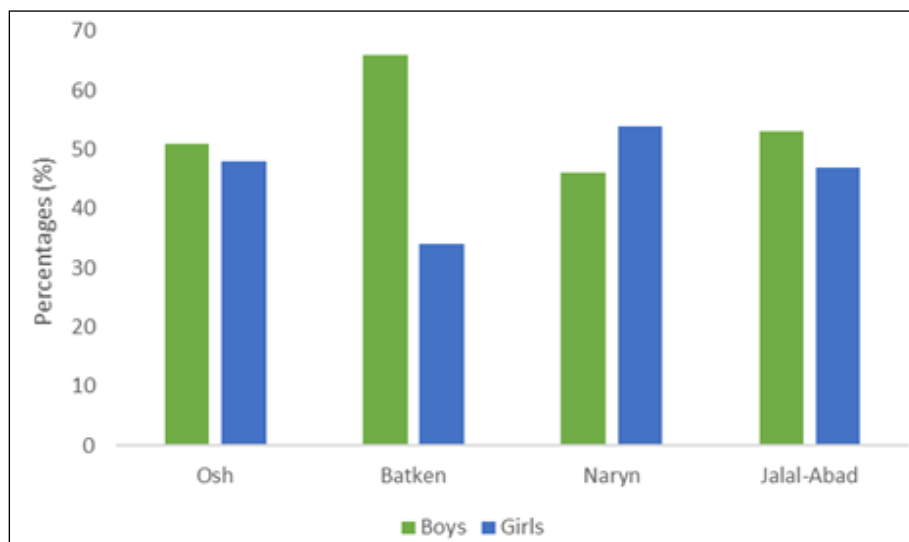


Figure 2. Gender Distribution of the Incidence of Mixed Infections in Children by Region

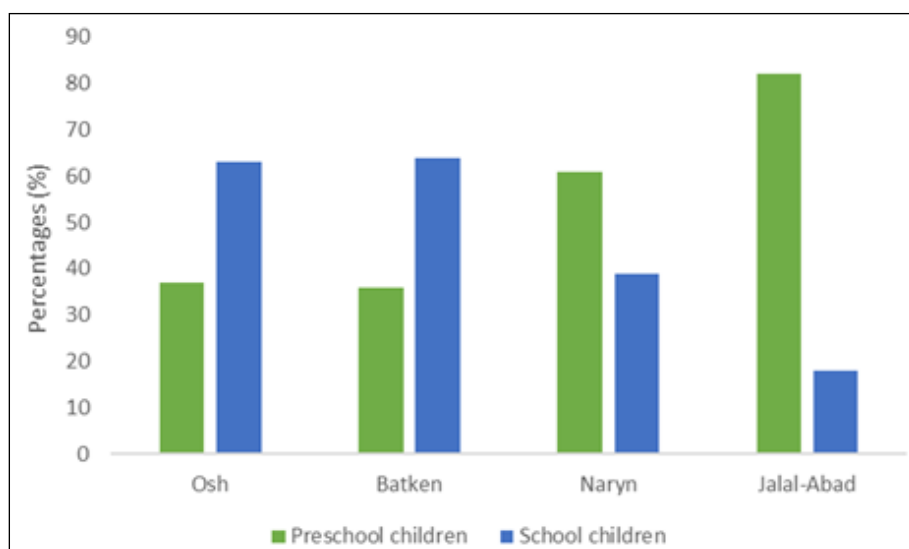


Figure 3. Distribution of Intestinal Mixed Invasions by Contingents in Children by Cities

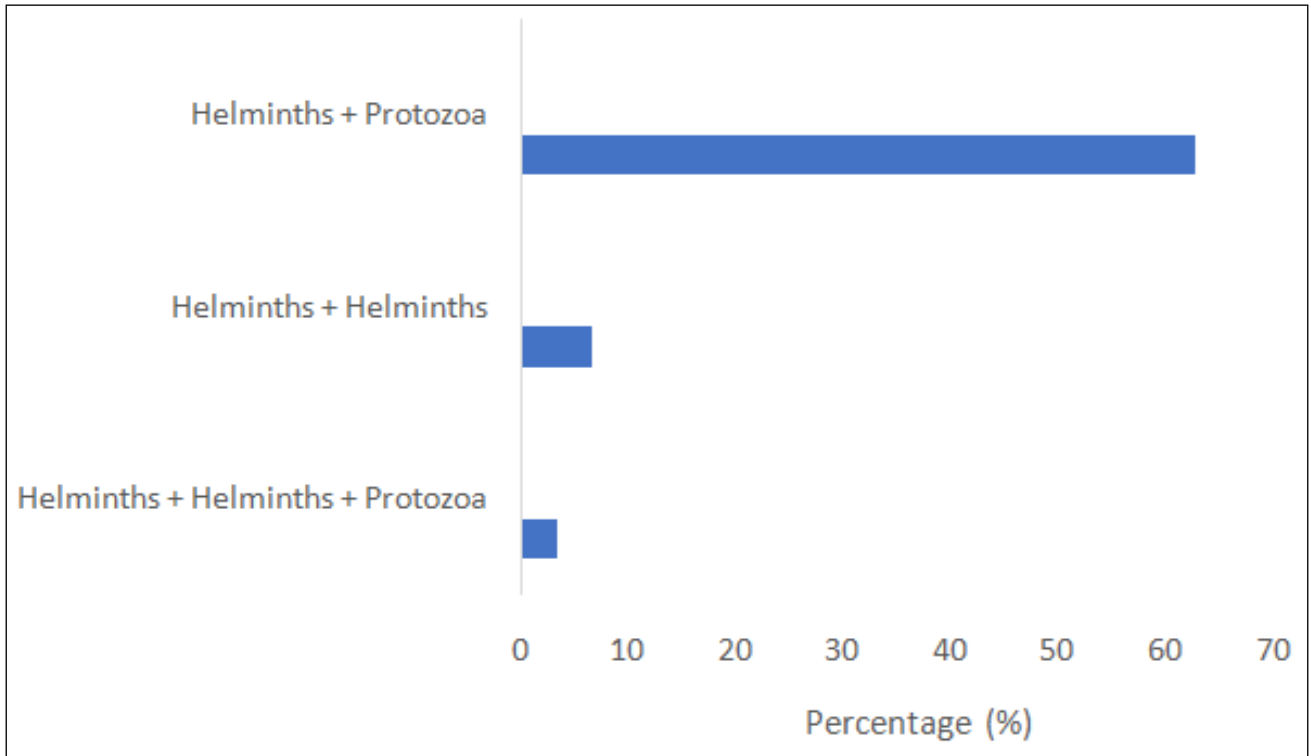


Figure 4. Compatibility of Different Types of Intestinal Parasites

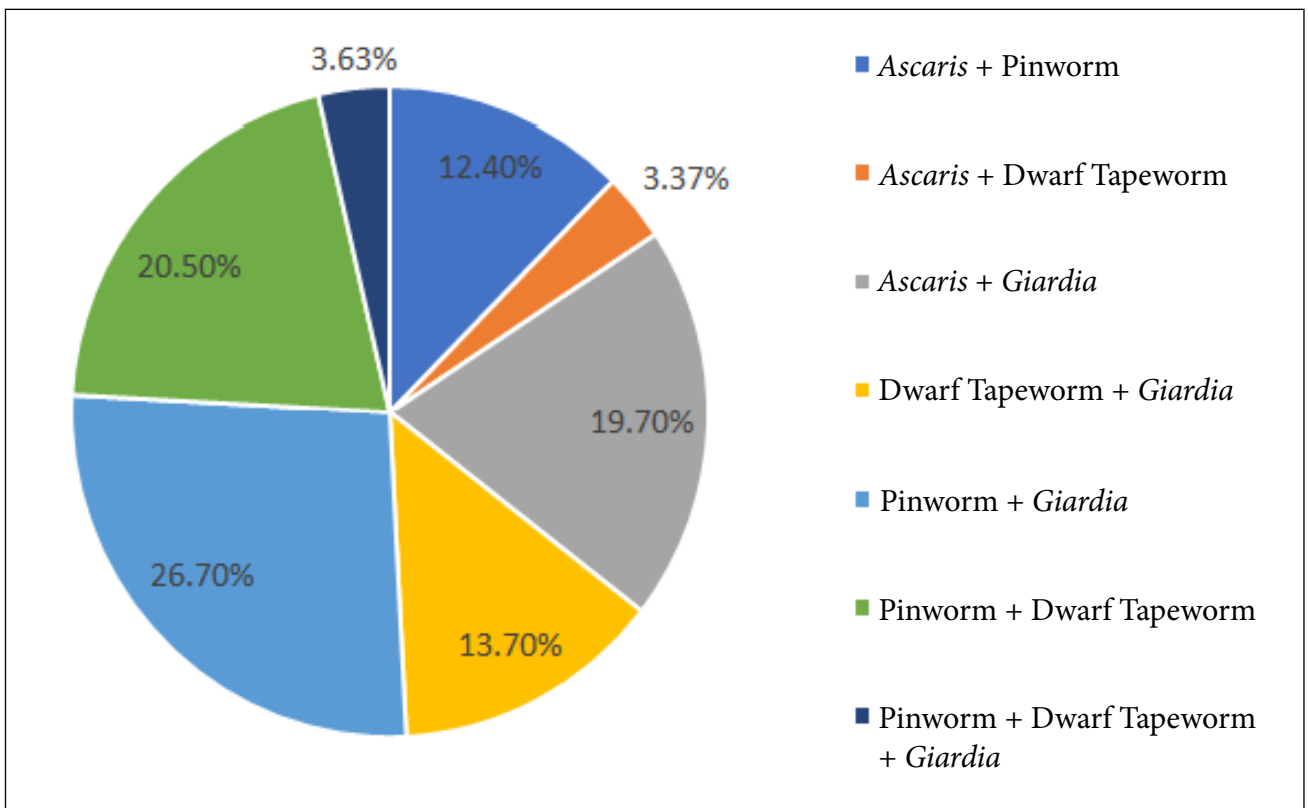


Figure 5. Frequency of Detected Mixed Infections in Children

In this study, co-infection with helminths and protozoa or pinworms and *Giardia* parasites was more frequently observed among children with mixed illnesses, accounting for 26.70% of cases. Pinworm and dwarf tapeworm co-infections were reported in 20.50% of the cases, while 3.37% of the children had infections caused by the three different parasite species.

Discussion

Helminthiasis is most commonly transmitted by contamination of the hands and household objects. In a study on parasitic disorders in children in the Samara region, 75% had mixed infections, involving two or three helminth species. Most patients were co-infected with *Giardia* (47%), then *Giardia* and pinworms (22%), *Giardia* and *Toxocara* (11%), *Giardia* and *Ascaris* (7%), *Giardia* and opisthorchiasis (3.5%), and *Giardia* and *Trichinella* (3.5%). Out of the 156 patients in the research, 117 youngsters, which accounts for 75%, had mixed illnesses. Enterobiasis and ascariasis accounted for 7% of mixed infections, while enterobiasis and toxocariasis accounted for 6%, making them the most frequent mixed illnesses at 14%.¹⁴

Complex infections in children are severe illnesses that are difficult to identify and manage. Reducing or stopping regular testing for infectious disorders, such as helminthiasis, can lead to inaccurate infection diagnosis, compromised immunity, and an increased likelihood of becoming infected by additional parasites.¹⁵

Similar results were found in a study carried out in South Cameroon, indicating that children between the ages of 6 and 10 years were affected.¹⁶ Conversely, 66% of the South Indian population is reported to be over 10 years of age.¹⁷

A combination intervention technique has been suggested for treating undernutrition and soil-transmitted helminthiasis.¹⁸ Nutritional supplements are often used to effectively treat malnutrition by alleviating nutritional deficits.¹⁹ Dietary control is combined with anthelmintic therapies to decrease the likelihood of reinfection with soil-transmitted helminths. This strategy is challenging to implement, and there is a dearth of research on its practical and public health significance.²⁰ Various illnesses such as cancer, high blood pressure, seizures, heart disease, and type 2 diabetes have shown positive responses to a ketogenic diet.^{21,22} Omega-3 fatty acid supplements have been shown to be effective in treating several ailments, including diabetes, oncological diseases, cardiovascular diseases, and inflammation.^{23–26}

Despite efforts to address this issue, parasites remain a significant public health concern in Kyrgyzstan. These infections affect both social and economic aspects of the population's health. The risk of infection among preschool and school-age children increased by 2.1 times from 2015

to 2021 in Kyrgyzstan, with mixed infections identified in 8.6% of the documented cases in the four regions. Osh and Jalal-Abad had higher rates of mixed illness, at 10.5% and 9.5%, respectively. There is minimal disparity in invasiveness between girls and boys, except for the Batken area, where men are 1.9 times more invasive than females. Preschool students in the Naryn and Jalal-Abad districts had a 1.7 times higher likelihood of being mixed compared to schoolchildren. Children in schools in the Batken and Osh areas were more prone to having mixed illnesses compared to preschoolers. The incidence of two separate parasitic species, helminths and protozoa, was considerably higher among those who were co-infected ($p > 0.005$).

Conclusion

The parasitic infection rates in the study regions were 39.8% for enterobiasis, 29.4% for giardiasis, 18.9% for ascariasis, and 11.7% for dwarf tapeworm infections. Of the 385 cases of parasitic disorders in children across the three cities, 8.6% had mixed infections with two or more parasites. Batken had the highest prevalence of parasitosis with 130.24 cases per 1000 people investigated, which accounted for 13.0% of the total. Mixed infections, in which children were infected with both helminth and protozoan parasites or pinworm and *Giardia* parasites, were more prevalent at a rate of 26.70%. Pinworms and dwarf tapeworms together made up 20.50%. Three unique parasite species affected 3.37% of the children.

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Conflicts of Interest: None

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