Nepalese Journal of Zoology

ISSN: 2705-4403 (Print) & 2705-4411 (Online)
www.cdztu.edu.np/njz

Volume 7 | Issue 1 | June 2023

https://doi.org/10.3126/njz.v7i1.56307

Research article

Prevalence of gastrointestinal parasites among primary school children in Bhaktapur, Nepal

Anju Karmacharya[1] | Punya Ram Sukupayo[1]*

[1] Department of Zoology, Bhaktapur Multiple Campus, Bhaktapur, Nepal
*** Correspondence:** sukupayo2punya@gmail.com

Suggested citation: Karmacharya, A. and Sukupayo, P. R. 2023. Prevalence of gastrointestinal parasites among primary school children in Bhaktapur, Nepal. Nepalese Journal of Zoology **7**(1):20–25. https://doi.org/10.3126/njz.v7i1.56307

Article History:
Received: 23 March 2023
Revised: 26 June 2023
Accepted: 29 June 2023

Publisher's note: The statements, opinions and data contained in the publication are solely those of the individual author(s) and do not necessarily reflect those of the editorial board and the publisher of the NJZ.

Abstract

Gastrointestinal parasitic infections are the most common and persistent infections caused by helminths and protozoa mainly in developing countries like Nepal. The present study was conducted from September 2019 to June 2020 to find out the prevalence of gastrointestinal parasites among primary school children in Bhaktapur District, Nepal. A total of 190 stool samples were collected and examined microscopically by the sedimentation technique and the floatation technique. The overall prevalence was found to be 16.84%. The prevalence was significantly higher ($p<0.05$) among students in public schools (29.23%) than in private schools (10.40%). Similarly, higher prevalence was found among boys (19.27%) in the sex-wise study, Muslim (33.33%) students than others and among vegetarian (30%) students. The source of drinking water and parents' education and occupation were also found to be factors affecting the rate of prevalence of gastrointestinal parasites (GIPs). The study revealed eight different types of GIPs (*Ascaris lumbricoides*, *Entamoeba coli, E. histolytica, Enterobius vermicularis, Giardia lamblia, Ancylostoma duodenale*, *Schistosoma mansoni,* and *Taenia solium).* Among them, *Giardia lamblia* (55.55%) was the most dominant species. Efforts should be focused on improving the efficacy of administering anthelminthic drugs.

Keywords: Bhaktapur; Gastrointestinal parasites; Prevalence; School children

1 | Introduction

Gastrointestinal parasitic infections (GIPIs) are common infections posing significant public health challenges worldwide (Ghislain Roméo & Khan Payne 2017; Al-Yousofi et al. 2022). These infections particularly affect developing countries including Nepal (Quihui et al. 2006; Thapa Magar et al. 2011). The WHO estimates that around 3.5 billion people globally suffer from GIPIs, with approximately 450 million individuals affected (Hassen Amer et al. 2016). GIPIs are mainly transmitted through faecal-contaminated food and water (Houweling et al. 2016), and preschool children are at a high risk of infection, accounting for 12% of the global burden of gastrointestinal parasitic diseases (Ahmadiara & Hajimohammadi 2017). These infections can cause physical and mental retardation, with children under 5 years bearing the greatest burden due to poor hygiene practices and consumption of contaminated substances (Walana et al. 2014; Ayeh-Kumi et al. 2016; Kwenti et al. 2016; Ohiolei et al. 2017; Opara et al. 2012).

The main parasites responsible for GIPI are helminths and pathogenic intestinal protozoa (Juárez & Rajala 2013). They include *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, *Necator americanus*, *Taenia solium, Hymenolepis nana*, *Diphyllobothrium latum*, *Schistosoma mansoni, Entamoeba histolytica, Giardia lamblia, Balantidium coli, Isospora belli*, and *Cryptosporidium* species (Bethony et al. 2006; Hotez et al. 2009; Juárez & Rajala 2013). Transmission of *A. lumbricoides* and *T. trichiura* occurs through the ingestion of infective eggs from contaminated hands, water, or food, while hookworm species are transmitted through the skin by infective larvae. Whereas, *E. histolytica, G. lamblia*, and *Cryptosporidium* species are transmitted through the consumption of infective cysts via contaminated food and water.

In Nepal, *A. lumbricoides, H. nana*, and *T. trichiura* are the most common helminths, while *G. lamblia* and *E. histolytica* are the most common protozoan intestinal parasites (Yadav & Prakash 2017). The country has long faced a high prevalence of intestinal parasites, ranging from 13% to 81% (Khadka et al. 2013; Kunwar et al. 2016). In response, Nepal has implemented deworming

programs targeting preschool and school-age children, including a deworming campaign integrated with nationwide vitamin A supplementation (Kunwar et al. 2016). However, reports on the impact of these programs are outdated, and intestinal parasites continue to be prevalent among Nepali schoolchildren due to poor sanitation practices such as untreated drinking water and inadequate hand hygiene (Shrestha et al. 2021). Evaluating GIPIs in public and private schools ensures efficient resource allocation. It helps policymakers and health authorities prioritize interventions and allocate resources where they are most needed, considering the different socio-economic backgrounds of students in these school settings. Therefore, this study aimed to assess the prevalence of intestinal parasites among primary-level school children in Bhaktapur, Nepal.

2 | Materials and methods

2.1 | Study area

Bhaktapur is a city located at 27°40'22.7" North latitude and 85°25'25.8" East longitude in the eastern corner of the Kathmandu Valley in Nepal. It occupies an area of 119 km^2. Samples were collected from a public school in Suryabinayk municipality and a private school in Bhaktapur municipality (Fig. 1).

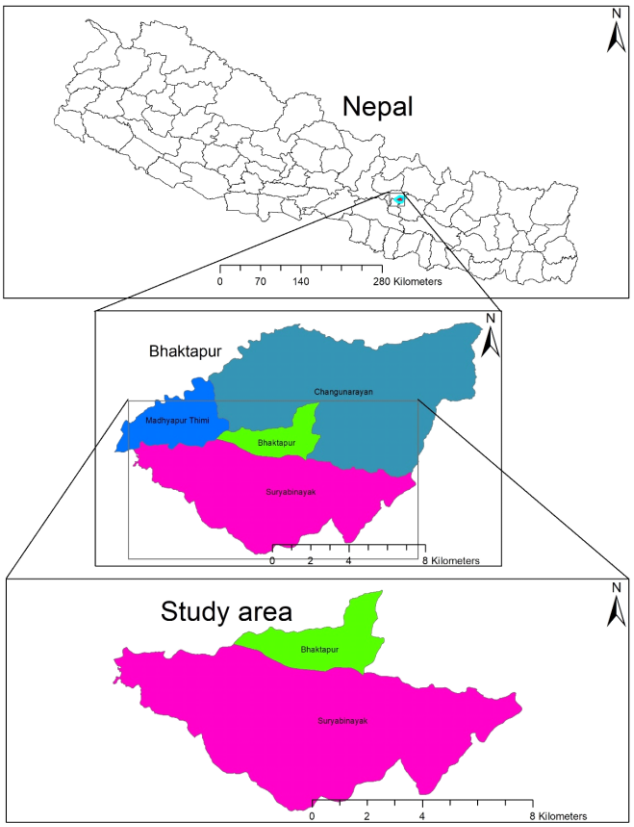

Figure 1. Map of the study area

2.2 | Study population

The study included primary-level students ranging from grade lower kindergarten (LKG) to grade four. To ensure a representative sample, a process of randomization was employed. Out of the total population of 128 primary-level schoolchildren, 65 students and out of 364 primary-level students, 125 students were randomly selected from the public and private school respectively. This random selection aimed to minimize bias and provide a diverse representation of students from different grades within the chosen schools.

2.3 | Questionnaire survey

Different structured questionnaires were prepared and interviewed among parents and schoolchildren. The questionnaires were utilized to assess the information about their gender, age, grade, use of the anthelminthic drug within six months, food habits, parent's occupation, and education level and source of drinking water.

2.4 | Stool sample collection and transportation

The importance of stool examination and the health implications of intestinal parasites were explained to the selected students and their parents. Written consent was obtained from the parents, and oral consent was obtained from the students. Stool containers were provided to the students, with instructions to collect approximately 10 grams of stool without urine contamination. All collected samples were transported to the laboratory at Iwamura College of Health Science in Bhaktapur, where they were preserved using 1-2% formalin.

2.5 | Faecal examinations

The samples were first checked with the naked eye for any adult stage of the parasites and then these were prepared for microscopic examination. Initially, each faecal sample was examined qualitatively using the direct smear method followed by the formal-ether sedimentation technique (Allen & Ridley 1970) and salt floatation techniques (Demelash et al. 2016). In sedimentation technique, the stool sample was mixed with a saline and allowed to settle for about five minutes. The sediment at the bottom was then examined under a microscope to identify and analyze the parasites present. In floatation techniques, a concentrated saline solution was added to the stool sample, and the mixture was vigorously stirred. A coverslip was then placed on the surface of the liquid, and the floating eggs of parasites adhere to it. The coverslip was carefully removed and examined under a microscope for the identification and characterization of the parasites. The slides were observed under low power first at 10X and followed by high power at 40X of the microscope. The result was considered positive when at least one parasite egg is present (Lorenzini et al. 2007). The parasite stages were identified by using standard morphological criteria (WHO 1984; Arora & Arora 2015) (Foreyt 2013). Infections with more than one species of helminth parasite (poly-parasitism) are referred to as mixed infections.

2.6 | Statistical data analysis

Statistical analysis was done by using R version 3.2.2. Pearson's chi-square test was used to evaluate bivariate relationships between the result and specific explanatory factors. P< 0.05 was taken as statistically significant for all analyses.

3 | Results

A total of 190 stool samples were collected. Among them 16.84% (n=32) of samples were found to be positive for one or multiple gastrointestinal parasites. A total of 65 samples were collected from students of public school and remaining 125 samples were collected from the students of private school. The significantly (Table 1, p<0.05) higher prevalence 29.20% (n=19) of GIPs was recorded (χ^2=9.5242, p=0.0020, df=1) among the students of public school than private school 10.40% (n=13) (Table 1). Among 190 samples, 109 from boys and 81 were from girls. The boys had higher infection than in the girls (19.27% v/s 13.58%). In the study, samples were collected from the students of class UKG to four. The class-wise prevalence showed the highest prevalence of GIPs among the students of grade one (23.53%, N=34) and the least prevalence among the students of grade four (11.36%, N=44). Only 50% (n=95) of the students participated in the current study were taken anthelminthic drugs within last six month. The higher rate of infection 21.05% (n=20) was recorded among non-medicated students than the medicated students 12.63%

Table 1. Sociodemographic characteristics with respect to their prevalence of GIPs among school children

Variables	Classification	Total samples No., (%)	Intestinal parasites		χ2	Df	P value
			Positive No., (%)	Negative No., (%)			
School	Public	65 (34.21%)	19 (29.23%)	46 (70.77%)	**9.52**	**1**	**0.002**
	Private	125 (65.79%)	13 (10.40%)	112 (89.60%)			
Gender	Male	109 (57.37%)	21 (19.27%)	88 (89.73%)	0.71	1	0.40
	Female	81 (42.63%)	11 (13.58%)	70 (86.42%)			
Cast	Brahman	29 (15.26%)	5 (17.24%)	24 (82.76%)	2.81	5	0.73
	Chhetri	64 (33.68%)	10 (15.62%)	54 (84.38%)			
	Dalit	9 (4.74%)	1 (11.11%)	8 (88.89%)			
	Musalman	3 (1.58%)	1 (33.33%)	2 (66.67%)			
	Newar	49 (25.79%)	11 (22.45%)	38 (77.55%)			
	Tamang	36 (18.95%)	4 (11.11%)	32 (88.89%)			
Class	UKG	35 (18.42%)	7 (20%)	28 (80%)	2.38	4	0.67
	1	34 (17.89%)	8 (23.53%)	26 (76.47%)			
	2	31 (16.32%)	5 (16.13%)	26 (88.87%)			
	3	46 (24.21%)	7 (15.22%)	39 (84.78%)			
	4	44 (23.16%)	5 (11.36%)	39 (88.64%)			
Food habit	Vegetarian	10 (5.26%)	3 (30%)	7 (70%)	0.50	1	0.48
	Non-vegetarian	180 (94.74%)	29 (16.11%)	151 (83.89%)			
Source of drinking water	Well	4 (2.11%)	2 (50%)	2 (50%)	3.74	2	0.15
	Tap	168 (88.42%)	26 (15.48%)	142 (84.52%)			
	Jar	18 (9.47%)	4 (22.22%)	14 (77.78%)			
Education level of parents	Primary and below	39 (20.53%)	8 (20.51%)	31 (79.49%)	2.84	3	0.42
	Secondary	82 (43.16%)	16 (19.51%)	66 (80.49%)			
	Intermediate	37 (19.47%)	3 (8.11%)	34 (91.89%)			
	Bachelor	32 (16.84%)	5 (15.63%)	27 (84.38%)			
Father's occupation	Agriculture	33 (17.37%)	8 (24.24%)	25 (75.76%)	5.22	7	0.63
	Army	4 (2.11%)	0 (0%)	4 (100%)			
	Business	16 (8.42%)	4 (25%)	12 (75%)			
	Driver	12 (6.32%)	3 (25%)	9 (75%)			
	Foreign employment	15 (7.89%)	2 (13.33%)	13 (86.67%)			
	Labour	66 (34.74%)	8 (12.12%)	58 (87.88%)			
	Officer	36 (18.95%)	5 (13.89%)	31 (86.11%)			
	Teacher	8 (4.21%)	2 (25%)	6 (75%)			
No. of family members	≤ 5	106 (55.79%)	20 (18.87%)	86 (81.13%)	0.84	2	0.66
	6 to 10	73 (38.42%)	10 (13.70%)	63 (86.30%)			
	> 10	11 (5.79%)	2 (18.18%)	9 (81.82%)			
Use of anthelminthic drug	Taken within last six months	95 (50%)	12 (12.63%)	83 (87.37%)	1.84	1	0.17
	Not taken in last six months	95 (50%)	20 (21.05%)	75 (78.95%)			

Table 2. Infection rate of specific intestinal parasites

Category	Intestinal parasites	Positive %
Protozoans	*Entamoeba coli*	3 (8.33%)
	Entamoeba histolytica	6 (16.67%)
	Giardia lamblia	20 (55.55%)
Helminths	*Ascaris lumbricoides*	3 (8.33%)
	Enterobius vermicularis	1 (2.78%)
	Schistosoma mansoni	1 (2.78%)
	Ancylostoma duodenale	1 (2.78%)
	Taenia solium	1 (2.78%)
Total		36 (100%)

(n=12) (Table 1). Similarly, about 95% (n=180) students participated in present research were non-vegetarian. Interestingly, the prevalence of gastrointestinal parasites was higher in vegetarian students 30% (n=3) than in non-vegetarian 16.11% (n=151). No significant associations were observed between gender, grade, drug administration, and dietary habits with the prevalence rate of intestinal parasites (Table 1, $p>0.05$).

Similarly, children of six different casts (Brahman, Chhetri, Dalit, Musalman, Newar, and Tamang) were participated in the research work. Among them Musalman students (33.33%) were found highly infected by one or multiple infection followed by Newar students (25.79) whereas Dalit and Tamang had least infection (11.11%). Interestingly, the highest prevalence (20.51%) was found among the students whose parents had only a primary level of education and the lowest (15.63%) with a bachelor's level. No children of the army were found to be infected, even though the children of businessmen, drivers, and teachers were highly infected (25% of each). The number of family member was also found insignificant (Table 1, $p>0.05$) with the infection rate although the minimum infection rate (13.70%) was observed among the students belonging to family with six to ten members than smaller or bigger family. The maximum students involved in the research used tap water (168/190) and very few used well water (4/190). The prevalence was highest among the students who use well water (50%, n=2) for drinking and least among the tap water user (15.48%, n=26).

The study revealed eight different types of GIPs (*Ascaris lumbricoides*, *Entamoeba coli, E. histolytica, Enterobius vermicularis, Giardia lamblia,* hook worm, *Schistosoma mansoni,* and *Taenia solium*) belonging to three different phyla (Protozoa, Platyhelminthes, and Aschelminthes). Among them, *Giardia lamblia* was the most prevalent gastrointestinal parasite (55.55%) and *Enterobius vermicularis*, *Schistosoma mansoni*, *Taenia solium*, and *Ancylostoma duodenale* were found to be the least prevalent (2.78%) (Table 2).

4 | Discussion

The GIPs are serious public health problem in developing countries like Nepal. The study collected 190 stool samples from two schools in Bhaktapur. The overall prevalence of gastrointestinal parasites was 16.84%, consistent with previous findings in Nepal (Kathmandu 12.40%, Birgunj 13.90%, Pokhara 15%, Itahari 13%, Dharan 11.5%, Bhaktapur 13.40% (Dahal et al. 2018; Shakya et al. 2012; Khadka et al. 2013; Sah et al. 2013 Shrestha et al. 2021; Sharma et al. 2020) and globally (Gondar 16.7%, Tigray 12.7%) (Ayele et al. 2021; Teshale et al. 2018). However, the prevalence of present study was lower than the previous research conducted by (Yadav & Prakash 2017) and in Bhaktapur, 46.77% (Sukupayo 2007), and Nkondjock (Cameroon), 24.5% (Ghislain Roméo & Khan Payne 2017), Sukumbasi Basti in Kathmandu, 43.3% (Thapa Magar et al. 2011), Lower Dir 71.75% (Rahman et al. 2022), and Karachi, 52.8% (Mehraj et al. 2008) of Pakistan, Hail (Saudi Arabia), 45.38% (Hassen Amer et al. 2016). Interestingly, the present finding was higher than prevalence rate recorded in Iran (6.5%) by Hormozgan University of Medical Sciences (Turki et al. 2017). The students of public school were found highly infected by intestinal parasites than the private school students (29.20% vs 10.40%). The research carried by Padmakanya Multiple Campus, Kathmandu also reported similar pattern of infection with 66.7% in public school and 33.3% in private school (Dahal et al. 2018). The higher positive cases among public schoolchildren might be due to lack of knowledge among parents and use of untreated water for drinking, carelessness in personal hygiene.

Several studies have shown conflicting results regarding the prevalence of gastrointestinal parasitic infections between boys and girls (Ghislain Roméo & Khan Payne 2017; Sukupayo 2007; Khadka et al. 2013; Turki et al. 2017). In our study, we found a higher infection rate among boys, possibly due to their increased outdoor activities and exposure to soil-transmitted helminths and waterborne parasites (Yentur Doni et al. 2015). The use of untreated well water as a drinking source was associated with a higher prevalence of gastrointestinal parasitic infections, consistent with previous findings (Shakya et al. 2012). This highlights the importance of implementing systematic water distribution or treating water before consumption to reduce infection rates. Parental literacy level and occupation were found to be associated with the intensity of parasitic infections, consistent with studies conducted in Itahari (Nepal) (Sah et al. 2013), Gondar (Ethiopia) (Ayele et al. 2021), Karachi (Pakistan) (Mehraj et al. 2008), and Bandar Abbas (Iran) (Turki et al. 2017). Economic and social factors may contribute to this relationship. Students belonging to families with five or fewer members had the highest prevalence of gastrointestinal parasitic infections, similar to findings in North Western Tigray (Teshale et al. 2018). The reasons behind this association require further investigation. Among different ethnic groups, Musalman students had the highest intestinal infection rates, contrary to studies conducted in Kirtipur (Dahal et al. 2022), and Dharan (Shrestha et al. 2021). This discrepancy could be attributed to factors such as limited access to safe drinking water and poor hygiene practices due to lack of knowledge and awareness (Khadka et al. 2013).

The present study identified eight different species of gastrointestinal parasites (GIPs) among primary-level school children, with *Giardia lamblia* being the most common parasite, accounting 55.55% of the infections. Similar findings of high *Giardia* prevalence have been reported by various authors from different parts of the world (Mehraj et al. 2008; Thapa Magar et al. 2011; Khadka et al. 2013; Poudyal et al. 2017; Turki et al. 2017; Sharma et al. 2020). One possible reason for the high rate of *Giardia* infection could be the use of untreated water for drinking. *Giardia* is known to be transmitted through contaminated water sources, and if the water supply in the study area was not adequately treated, it could have contributed to the high prevalence. On the other hand, *Ascaris* was found to be dominant in Dharan, Nepal (Shrestha et al. 2021), in Nkondjock, Cameroon (Ghislain Roméo & Khan Payne 2017), in Lower Dir, Pakistan (Rahman et al. 2022), in Gondar, and Ethiopia (Ayele et al. 2021), and *Ancylostoma* was prevalent in Hail, Saudi Arabia (Hassen Amer et al. 2016), and Dharan, Nepal (Sah et al. 2013). These variations in dominant parasite species could be attributed to differences in geographical locations, environmental factors, sanitation practices, and hygiene habits in these areas. Interestingly, the study found lower prevalence rates for *Ancylostoma duodenale*, *Taenia solium* and *Enterobius vermicularis,* which aligns with the findings of previous research conducted in Bhaktapur (Shrestha & Maharjan 2013). Overall, the observed prevalence rates of different GIPs among the primary-level school children can be influenced by a combination of factors, including water quality, hygiene practices, geographical location, and local epidemiological factors.

The higher prevalence of gastrointestinal parasitic infection among vegetarian students (30%) compared to non-vegetarian students (16.11%) could be attributed to factors such as the consumption of unwashed vegetables and fruits, as indicated by previous research in Itahari (Sah et al. 2013). However, this finding is inconsistent with a previous study conducted in Kathmandu (Dahal et al. 2018). Similar to present results, previous studies (Sukupayo 2007; Thapa Magar et al. 2011; Yadav & Prakash 2017; Dahal et al. 2018) have consistently shown that the use of anthelminthic drugs in the last six months is associated with a lower rate of parasitic infection among schoolchildren. These findings highlight the significance of regular administration of anthelminthic drugs as a preventive measure.

5 | Conclusions

In conclusion, the study found a 16.84% prevalence of gastrointestinal parasites among schoolchildren, with *Giardia lamblia* being the most common parasite. Public school students had a significantly higher prevalence (29.20%) compared to private school students (10.40%). Efforts should be made to enhance the effectiveness of anthelminthic drug administration. This can be achieved by implementing strategies such as improving drug distribution systems, ensuring proper compliance with treatment protocols, and providing adequate follow-up measures. Comprehensive health education for children and their parents can empower them with the knowledge and skills needed to prevent gastrointestinal parasite infections.

Acknowledgements

Authors would like to thank Bhaktapur Multiple Campus, teachers and students of Shree Jyoti Secondary School and Nyatapola Secondary School for their participation in the study. We express our sincere gratefulness to the staffs of Iwamura College of Health Science for their valuable co-operation.

Authors' contributions

Karmacharya, A. and Sukupayo, P. R. designed the research, collected data and performed laboratory work. Karmacharya, A. analyzed the data and wrote the manuscript; Sukupayo, P. R. supervised the research work. All authors reviewed and approved the final manuscript for publication.

Conflicts of interest

Authors declare no conflict of interest.

References

Ahmadiara, E., Hajimohammadi. B. 2017. Notification, an important neglected essential education for children in kindergartens and primary schools (Education about Parasitic Infections in Kindergartens). International Journal of Pediatrics **5**:5723–5724.

Allen, A. V. and Ridley, D. S. 1970. Further observations on the formol-ether concentration technique for faecal parasites. Journal of Clinical Pathology **23**:545–546.

Al-Yousofi, A., Yan, Y., Al-Mekhlafi, A. M., Hezam, K., Abouelnazar, F. A., Al-Rateb, B., et al. 2022. Prevalence of Intestinal Parasites among Immunocompromised Patients, Children, and Adults in Sana'a, Yemen Chieffi PP [ed.]. Journal of Tropical Medicine **2022**: 1–12.

Ayeh-Kumi, P. F., Addo-Osafo, K., Attah, S. K., Tetteh-Quarcoo, P. B., Obeng-Nkrumah, N., Awuah-Mensah, G., et al. 2016. Malaria, helminths and malnutrition: a cross-sectional survey of school children in the South-Tongu district of Ghana. BMC Research Notes **9**: 242.

Ayele, A., Tegegne, Y., Derso, A., Eshetu, T. and Zeleke, A. J. 2021. Prevalence and Associated Factors of Intestinal Helminths Among Kindergarten Children in Gondar Town, Northwest Ethiopia. Pediatric Health, Medicine and Therapeutics Volume **12**:35–41.

Bethony, J., Brooker, S., Albonico, M., Geiger, S. M., Loukas, A., Diemert, D., Hotez, P. J. 2006. Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. The Lancet **367**:1521–1532.

Dahal, A., Roka, D. B., Prasad, S. M., Shrestha, S. 2022. Prevalence of intestinal parasitic infection among school children in Kirtipur Municipality, Kathmandu. Nepal Medical College Journal **24**:121–126.

Dahal, C., Katwal, P., Thapa, A., Sharma, D., Khadka, R. 2018. Intestinal parasitosis among the school children of Kathmandu, Nepal. Tribhuvan University Journal of Microbiology **5**:89–96.

Demelash, K., Abebaw, M., Nagash, A., Alene, B., Zemene, M., Tilahun, M. 2016. A Review on Diagnostic Techniques in Veterinary Helminthlogy. Nature ans Science **14**:109–118.

Foreyt, W. J. 2013. Veterinary Parasitology Reference Manual. 5th ed. John Wiley & Sons.

Ghislain Roméo, N. and Khan Payne, V. 2017. Prevalence and Intensity of Gastro-Intestinal Helminthiasis Among School Age Children in Nkondjock, Littoral-Cameroon. International Journal of Biomedical Engineering and Clinical Science **3**:85.

Hassen Amer, O., Ashankyty, I. M. and Haouas N. A. S. 2016. Prevalence of intestinal parasite infections among patients in local public hospitals of Hail, Northwestern Saudi Arabia. Asian Pacific Journal of Tropical Medicine **9**:44–48.

Hotez, P. J., Fenwick, A., Savioli, L. and Molyneux, D. H. 2009. Rescuing the bottom billion through control of neglected tropical diseases. The Lancet **373**:1570–1575.

Houweling, T. A. J., Karim-Kos, H. E., Kulik, M. C., Stolk, W. A., Haagsma, J. A., Lenk, E. J., et al. 2016. Socioeconomic Inequalities in Neglected Tropical Diseases: A Systematic Review. PLoS Neglected Tropical Diseases **10**:e0004546.

Juárez, M. M. and Rajala V. B. 2013. Parasitosis intestinales en Argentina: principales agentes causales encontrados en la población y en el ambiente. Revista Argentina de Microbiología **45**:191–204.

Khadka, K. S., Kaphle, H. P., Gurung, K., Shah, Y. and Sigdel, M. 2013. Study of Intestinal Parasitosis among School Going Children in Pokhara, Nepal. Journal of Health and Allied Sciences **3**:47–50.

Kunwar, R., Acharya, L. and Karki S. 2016. Trends in prevalence of soil-transmitted helminth and major intestinal protozoan infections among school-aged children in Nepal. Tropical Medicine & International Health **21**:703–719.

Kwenti, T. E., Nkume, F. A., Tanjeko, A. T. and Kwenti, T. D. B. 2016. The Effect of Intestinal Parasitic Infection on the Clinical Outcome of Malaria in Coinfected Children in Cameroon. PLoS Neglected Tropical Diseases **10**:e0004673.

Lorenzini, G., Tasca, T. and Carli, G. A. D. 2007. Prevalence of intestinal parasites in dogs and cats under veterinary care in Porto Alegre, Rio Grande do Sul, Brazil. São Paulo **44**: 9.

Mehraj, V., Hatcher, J., Akhtar, S., Rafique, G. and Beg, M. A. 2008. Prevalence and factors associated with intestinal parasitic infection among children in an urban slum of Karachi. PLoS ONE **3**:e3680.

Ohiolei, J. A., Isaac, C., Omorodion, O. A. 2017. A review of soil transmitted helminthiasis in Nigeria. Asian Pacific Journal of Tropical Disease **7**:841–848.

Poudyal, N., Shrestha. L., Gautam, S., Yadav, D., Baral R. and Gurung, R. 2017. Prevalence of intestinal parasitic infection/infestation in differently abled people of Dharan, Nepal. International Journal of Biomedical Research **8**:538–40.

Rahman, H. U., Khatoon, N., Arshad, S., Masood, Z., Ahmad, B., Khan, W., et al. 2022. Prevalence of intestinal nematodes infection in school children of urban areas of district Lower Dir, Pakistan. Brazilian Journal of Biology **82**:e244158.

Sah, R., Paudel, I., Baral, R., Poudel, P., Jha, N. and Pokharel, P. 2013. Prevalence of intestinal helminthic infections and associated risk factors. Indian Journal of Community Health **25**:134–139.

Shakya, B., Shrestha, S., Madhikarmi, N. and Adhikari R. 2012. Intestinal parasitic infection among school children. Journal of Nepal Health Research Council. **10**:193–196.

Sharma, M., Sapkota, J., Jha, B., Mishra, B. and Bhatt, C. P. 2020. Prevalence of Intestinal Parasitic Infestation among Public School Children of a Community. Journal of Nepal Medical Association **58**:293–296.

Shrestha, B. K., Tumbahangphe, M., Shakya, J., Rai, A., Dhakal, K., Dhungana, B., et al. 2021. Prevalence and Related Risk Factors of Intestinal Parasitosis among Private School-Going Pupils of Dharan Submetropolitan City, Nepal Marchand B [ed.]. Journal of Parasitology Research **2021**:1–10.

Shrestha, R and Maharjan, M. 2013. Prevalence of intestinal helminth parasites among school-children of Bhaktapur district, Nepal. Nepalese Journal of Zoology **1**:48–59.

Sukupayo, P. R. 2007. Prevalence of intestinal helminth parasites among students of Dyola School of Bhaktapur. https://elibrary.tucl.edu.np/bitstream/123456789/8141/2/Chapter.pdf (last accessed 22 Feb 2023).

Teshale, T., Belay, S., Tadesse, D., Awala, A. and Teklay, G. 2018. Prevalence of intestinal helminths and associated factors among school children of Medebay Zana wereda; North Western Tigray, Ethiopia 2017. BMC Research Notes **11**:444.

Thapa Magar, D., Rai, S., Lekhak, B. and Rai, K. 2011. Study of parasitic infection among children of Sukumbasi Basti in Kathmandu valley. Nepal Medical College Journal: NMCJ **13**:7–10.

Turki, H., Hamedi, Y., Heidari-Hengami, M., Najafi-Asl, M., Rafati, S., Sharifi-Sarasiabi, K. 2017. Prevalence of intestinal parasitic infection among primary school children in southern Iran. Journal of Parasitic Diseases **41**:659–665.

Walana, W., Tay, S. C. K, Tetteh, P. and Ziem, J. B. 2014. Prevalence of intestinal protozoan infestation among primary school children in Urban and peri-urban communities in Kumasi, Ghana. Science Journal of Public Health **2**:52–57.

Yadav, K. and Prakash, S. 2017. Study on Intestinal Parasitic Infections in Muslim community of Janakpurdham, Nepal. Janaki Medical College Journal of Medical Science **4**:36–45.

Yentur Doni, N., Gürses, G., Şimşek, Z. and Yıldız Zeyrek, F. 2015. Prevalence and associated risk factors of intestinal parasites among children of farm workers in the southeastern Anatolian region of Turkey. Annals of Agricultural and Environmental Medicine **22**:438–442.