Prevalence and Risk Factors of Gastrointestinal Parasites in Preschool and School-Aged Children of Kapan, Katmandu, Nepal

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A dissertation submitted
In partial fulfilment of the requirements for the award of the degree of Master of Science in Zoology with special paper Parasitology

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April, 2025

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Declaration

I hereby declared that the work presented in this dissertation entitled "Prevalence and risk factors of gastrointestinal parasites in preschool and school-aged children of Kapan, Kathmandu, Nepal" has been prepared by myself, and has not been submitted for the purpose of any other degree. All sources of information have been specifically acknowledged by reference to the author(s) or institutions(s).

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Certificate of acceptance

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Abstract

Protozoan and helminth intestinal parasitic infections are widespread worldwide and have been identified as the leading cause of parasitic diseases globally, continuing to be a major public health concern in impoverished developing nations. The purpose of the study was to determine the prevalence and risk factors for intestinal parasitic infections in the preschool and school-aged children of Kapan, Kathmandu District of Nepal. Altogether, 148 stool samples were collected. 88 samples of preschool children with ages (3 to <6 years) were collected from Life Skills School and remaining 60 samples of school-aged children with ages (6 to ≤10 years) were collected from 45 different households of Kapan studying in different private schools. The samples were then preserved in 2.5% potassium dichromate for a cross-sectional, purposeful investigation. A standard questionnaire was employed in the study to evaluate the risk factors. Microscopical examinations were performed on the fecal samples, and normal saline wet mount, iodine mount, and concentration methods, such as flotation and sedimentation, were followed. The overall prevalence of intestinal parasitic infections was 24 (16.21%) out of 148 stool samples. The IPs in 3 to <6 years age group was 19.31% and in 6 to ≤10 years age group was 11.66%. Sex-wise prevalence showed overall 15.66% in males and 16.92% in females. The prevalence of intestinal parasitic infection in males and females of preschool children was 18.36% and 20.51% respectively, and the prevalence of intestinal parasitic infection in males and females of school-aged children was 11.76% and 11.53% respectively. However, there was no statistical association between age, sex and parasitic infection (p>0.05). The nail-biting habit (p=0.008), untrimmed nail (p=0.018), untreated water (p=0.013) and not-use of anti-helminth before (p=0.039) were found to be associated with the intestinal parasitic infection (p<0.05). Maintaining personal hygiene, implementing a biannual mass deworming program and spreading awareness about intestinal parasites and infection management measures, using community centers, local media, and educational institutions as information-dissemination venues are crucial for stopping and managing the spread of parasitic infection.

शोध सारांश

प्रोटोजोअन र हेल्मिन्थ आन्द्राको परजीवी संक्रमणहरु विश्वव्यापी रुपमा व्यापक रहेका छन् र विश्वव्यापी रुपमा परजीवी रोगहरुको प्रमुख कारणका रुपमा पहिचान गरिएको छ । यस गरिब विकासोन्मुख राष्ट्रहरुमा प्रमुख सार्वजनिक स्वास्थ्य चिन्ताको रुपमा रहेको छ । यस अध्ययनको उद्देश्य नेपालको काठमाडौं जिल्लाको कपनका पूर्वप्राथमिक र विद्यालय उमेरका बालबालिकामा आन्द्राको परजीवी सङकमणको व्यापकता र जोखिम कारकहरु निर्धारण गर्नु रहेको छ । सर्वप्रथम १४८ मल नमुनाहरु संकलन गरियो । ८८ वटा मल नमुना पूर्वप्राथमिक विद्यालयका (३ देखि ६ वर्ष मुनिका) जीवन कौशल विद्यालय बाट र ६० वटा मल नमुना विद्यालय उमेरका (६ देखि १० वर्ष सम्मका) विभिन्न ४५ वटा घरपरिवारका निजि विद्यालयका बच्चाहरुबाट सङ्कलन गरियो । त्यसपछि उद्देश्यपूर्ण अनुसन्धानका लागि मल नमुनालाई २.५% पोटेशियम डाइक्रोमेटमा संरक्षित राखिएको थियो । जोखिम कारकहरुको मूल्यङ्कन गर्न अध्ययनमा एक स्तरगत प्रश्नावली प्रयोग गरिएको थियो । मलका नमूनाहरु सामान्य सेलाइन, वेट माउन्ट, आयोडिन माउन्ट, एकाग्रता विधिहरु जस्तै फ्लोटेसन् र सेडिमेन्टेसन गर्दै माइक्रोस्कोपिकल विधिबाट परीक्षण गरिएको थियो । बच्चाहरुमा फेला परेका आन्द्राको परजीवी संक्रमणको समग्र व्यापकता १४८ मल नमूनाहरु मध्ये २४(१६.२१%)मा थियो । आन्द्राको परजीवी ३ देखि ६ वर्ष मुनिका उमेर समूहमा १९.३१ % थियो र ६ देखि १० वर्ष सम्मका उमेर समूहमा ११.६६ % थियो । लिङ्ग अनुसार पुरुषमा १५.६६ प्रतिशत र माहिलामा १६.९२ प्रतिशत संक्रमण देखिएको थियो । पूर्वप्राथमिक विद्यालयका बालक र बालिकाहरुमा परजीवी संक्रमणको व्यापकता क्रमशः १८.३६ % र २०.५१ % थियो भने विद्यालय उमेरका बालक र बालिकाहरुमा क्रमशः ११.७६ % र ११.५३ % थियो । लिङ्ग, “उमेर समूह” र परजीवी संक्रमण बीच कुनै सम्बन्ध थिएन । (p > ०.०५), नङ टोक्ने बानी (p= ०.००८), नङ नकाट्नु (p= ०.०१८), पानीको उपचार नगर्नु (p= ०.०१३), र वार्षिक औषधी प्रयोग नगर्नु (p= ०.०३९), लाइनै आन्द्राको परजीवीको संक्रमणको कारकको रुपमा देखाएको छ । (p<०.०५), व्यक्तिगत स्वच्छता कायम राख्नु र द्विवार्षिक जुकाको औषधी सामूहिक कार्यान्वयन गर्नु महत्वपूर्ण छ । यसबाट अन्द्राको परजीवी सङकमणको फैलावट रोक्न र व्यवस्थापन गर्न मद्दत पुग्छ । परजीवी संक्रमणको फैलावट रोक्न र व्यवस्थापन गर्न सामुदायिक केन्द्रहरू, स्थानिय मिडिया र शैक्षिक संस्थाहरूलाई सूचना प्रसार स्थलको रूपमा प्रयोग गरेर आनद्राको परजीवी र संक्रमण व्यवस्थापन उपायहरूको बारेमा जागरूकता फैलाउनु महत्वपूर्ण छ ।

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List of abbreviations

Abbreviated form	Details of Abbreviation
µm	Micrometer
aOR	Adjusted Odds Ratio
CDZ	Central Department of Zoology
CI	Confidence Interval
Et.al.	and his Associates
FEA	Formalin-ethyl Ac
GBD	Global Burden of Disease
IoST	Institute of Science and Technology
IPIs	Intestinal Parasitic Infections
LSS	Life Skills School
OR	Odds Ratio
PD	Parasitic Diarrhea
p-value	Probability Value
rpm	Revolutions Per Unit
Sp.	Species
STHS	Soil Transmitted Helminths
VDC	Village Development Committee

1. Introduction

1.1 Background

A class of worms known as intestinal parasites often develop their adult forms in the gut's lumens. These parasites, which cause severe morbidity and mortality in both humans and domestic animals, include roundworms, hookworms, and whipworms, among others. These elements include ignorance, poverty, hunger, and inadequate sanitation. Because of this, parasitic disorders in general have turned into markers of the low socioeconomic standing of the nations where the infections are common (Ijagbone & Olagunju, 2006). Despite continuous advancements in treatment, parasitic diarrhea (PD) continues to rank among the world's major causes of morbidity and mortality. Intestinal parasites are responsible for some of the most serious health problems in tropical and subtropical areas, including food contamination, which has an impact on the global economy. They pose a controllable risk to public health, particularly in low-and moderate-income countries. Intestinal parasite infections affect over 3.5 billion people globally, and more than 200,000 deaths are documented annually (Hajare et al., 2021). The parasite that causes amebiasis, *Entamoeba histolytica*, is also a major problem in developing nations (Cruz-Cruz et al., 2018). Children's intestinal parasitic infections can cause serious side effects such as anemia, growth and development disorders, malnourishment, malabsorption, and physical and psychological effects (Mahmoudvand et al., 2020). The transmission of intestinal parasitic infection can be facilitated by certain factors such as poor personal or group hygiene and overcrowding in preschools, schools, orphanages, and families (Khadka & Maharjan, 2018). Intestinal helminths are transmitted in a particular order: (i) worm eggs are excreted into the soil by infected persons through open defecation; (ii) ideal moisture and temperature conditions allow these eggs to develop into infectious worm eggs (roundworm and whipworm) or larvae (hookworms); and (iii) infection happens when people consume these eggs through contaminated fruits, vegetables, or drinking water, or when larvae living in the soil penetrate human skin (Biswas et al., 2024). The characteristic symptom, pruritus ani, is produced by local irritation brought on by migratory worms or their eggs. Following localized scratching, autoinfection and further contamination of the environment occur (Cook, 1994). Most school children experience bedwetting, loss in body weight, emotional instability, loss of appetite and irritability (Chang et al., 2009). Due to touch transmission and eggs that contain invasive larvae within hours of being laid, school-age individuals have particularly high infection rates and neurological signs, such as itchiness in the anal (Kim et al., 2003). This nematode has a brief (20–30 days) and straightforward life cycle (no intermediate host is needed). Although the majority of *Ascaris* infestations are asymptomatic, infected people may have fever, respiratory discomfort, and severe lung inflammation. Abdominal pain, nausea, diarrhea, loss of appetite with accompanying malnutrition, and ultimately intestinal blockage by adult worms are other symptoms (Dold & Holland, 2011). Through the nostril, pinworm eggs can potentially enter the human digestive system. Additionally, reports of retro infection by nematode larvae through the anus have been made (Wang et al., 2017). Data on intestinal parasite infection in Nepali school-age children, however, are scarce. In fact, only a few studies have looked into intestinal parasite infections and have discovered significant regional variations in the prevalence of these diseases in school-age children in Nepal. According to published research, the most frequent helminth species affecting children in Nepal were *A. lumbricoides*, *T. trichiura*, and hookworm, while *E. histolytica* and *G. intestinalis* were the most prevalent intestinal protozoa (Pradhan et al., 2014). Governments and policymakers can use risk mapping to help implement and track disease control programs by understanding the elements that affect transmission in a given area. Prior to starting any control program, it is also critical to ascertain the degree of community awareness and associated practices. The risk factors for IPIs in children have been found to be inadequate access to safe drinking water, a dense population, poor personal hygiene, and low nutritional status. In Kathmandu, Nepal, IPIs is a significant public health issue affecting schoolchildren. The study revealed that the frequency of IPIs in schoolchildren is strongly correlated with school type. Additionally, it was shown that protozoa were more common than helminths, which may be related to drinking water. The age of children, ethnicity, parental occupation and socioeconomic position, and parasite illnesses are all strongly correlated (Shrestha et al., 2019). Due to a lack of critical information, targeted control efforts are unable to lower rates of infection and transmission. Other possible bottlenecks include inadequate research, a lack of awareness of the issue, and a lack of follow-up (Nath et al., 2022). Furthermore, poor health, high population density, poverty, and malnutrition create ideal conditions for the spread of disease. Public health officials may find the study's conclusions useful in establishing and enhancing the goals of ongoing control efforts.

1.2 Statement of problem

Preschool and school-aged children continue to contract parasite diseases in spite of several public health initiatives, such as deworming programs and health education campaigns. To guide improved policy and programmatic responses, it is imperative to measure the present prevalence, pinpoint the socioeconomic and environmental elements that contribute, and gauge the success of current treatments, People with poor access to sanitary facilities and lack of clean water supply are disproportionately affected by intestinal parasites, especially preschool and school-aged children. The children are unaware of infection and often engage in habits like biting their nails, eating fruits and vegetables without washing them, wandering barefoot, and playing with household pets. It also causes diarrhea, stomach pain, anemia, stunted growth and development, and malnutrition, which negatively impacts productivity and quality of life in poor countries. The spread of intestinal parasites is greatly aided by factors such as lack of behavioral education, inadequate hygiene, and ignorance of the routes of transmission. To understand the prevalence and contributing factors of parasitic illnesses in preschoolers and school-agers is the aim of this study and to improve the development and well-being of this vulnerable group and help build more effective health solutions.

1.3 Objectives

1.3.1 General objective

- To determine the prevalence and risk factor of intestinal parasites in preschool and school-aged children of Kapan, Kathmandu District, Nepal.

1.3.2 Specific objectives

- To examine the age and sex-wise distribution of intestinal parasites among preschool and school-aged children of Kapan.
- To find out the behavioral factors that are associated with intestinal parasitic infections in preschool and school-aged children in Kapan.

1.4 Research hypothesis(es) or Research question(s)

The study raises few questions in which our further research will be based. These questions are as follows:

1. Is there a significance difference in age and sex-wise distribution of intestinal parasites?
2. What are the behavioral factors associated with preschool and school-aged children in the intestinal parasitic infections?

1.5 Significance of study

Intestinal parasite infections generally have always been an important public health issue in both tropical and sub-tropical regions, generally in developing countries like Nepal. Nutrition and child health have been recognized by the Nepal government as essential elements of its national development plan. An important factor that influences parasite infections are given top priority in the Multi-Sector Nutrition Plan (MSNP II: 2018–2022) and the National Health Policy (2019). This research contributes to evidence-based policymaking and aids in the improvement of public health interventions by producing data on the prevalence, risk factors, and outcomes of IPIs. By tackling the burden of parasitic infections, lowering child morbidity and mortality, and fostering lifelong health, the Sustainable Development Goals (SDGs) directly contribute to good health and well-being. In order to achieve food security and better nutrition for kids, Zero Hunger aids in the knowledge and management of IPIs. High-quality education and the relationship between health and education support improved academic achievement. In order to create safer surroundings for kids, clean water and sanitation emphasize the necessity of better WASH practices and infrastructure in communities and schools. The findings of this study can help guide the planning, execution, and oversight of community-based interventions, school health initiatives, and nationwide deworming campaigns. Additionally, it can assist in focusing on high-risk populations and areas, which can result in more effective use of available resources. Youngsters are especially vulnerable if they are not properly cleansed after handling contaminated dirt found in places they may visit often, like school playgrounds and sandboxes. Children's growth, cognitive development, and academic performance are all directly impacted by intestinal parasite infections, which are a serious public health concern in Nepal among preschool and school aged children. In addition to improving individual health outcomes, preventing parasite infections in children aids larger national and international initiatives to combat poverty, raise educational standards, and advance sustainable development.

2. Literature review

2.1 Intestinal parasitic infection and associated risk factors

Healthy-looking people who have *E. histolytica* cysts in their stool are considered to have a primary reservoir infection, which is an illness that is contracted orally from tainted food or beverages. If sewage contaminates the water supply, an outbreak could break out (Dasgupta, 2000). Many intestinal helminths parasites consequences are related to the size, movement and longevity (Arora, 2010). The associated risk factors in schoolchildren of three rural schools in Colombia indicate that poor water quality was the primary source of gastrointestinal parasite infection in the children under tests. Furthermore, the molecular typing of *G. intestinalis* revealed that cysts originating from humans and animals were contaminating water (Hernández et al., 2019). Preschool age, living in a rural area, having a low family income, not having access to clean water, not washing your hands before meals, after coming into contact with dirt, and after using the restroom, eating raw or unwashed vegetables, having pets or ruminants at home, and having close contact with stray animals are all significant risk factors for IPIs (Elmonir et al., 2021).

2.2 In the global context

The GBD uses disability-adjusted life years (DALYs), which add together years of life lost to premature mortality and years lived with disability, to calculate disease burden. Millions of DALYs are caused each year by protozoal infections and soil-transmitted helminths together. According to the GBD 2019 report, communities and children in settings with little resources are disproportionately impacted by IPIs (IHME, 2020). A serious public health issue that impacts the health of elementary school students in low and middle-income countries (LMICs) with inadequate access to water, sanitation, and hygiene is intestinal parasitosis (Aschale et al., 2021). Open defecation, direct soil contact, the type of latrine utilized, and the presence of free-roaming animals were all substantially linked to parasitic illnesses (Nath et al., 2022). A cross-sectional survey on school children age (7-11) suggests that the overall prevalence of helminths and pathogenic intestinal protozoa in 602 participants out of 623 registered children were 32.0% and 47.1% respectively. The most common helminths species found was *Hymenolepis nana* (25.8%) whereas the prevalence of *A. lumbricoides*, hookworm *and E. vermicularis* were below 5% and protozoan parasites namely *G. intestinalis*, *E. histolytica/E. dispar* was 26.4% and 25.9% respectively. Unimproved drinking water sources and sanitary facilities was main caused of infection (Matthys et al., 2011).

A study was conducted to examine the nature of the relationship between helminth infection and the nutritional status of schoolchildren in Tikur Wuha Elementary School in northwest Ethiopia. A total of 403 schoolchildren had their nutritional condition and intestinal helminth infection (based on stool samples) assessed. Stunted, underweight, and intestinal helminth-infected individuals made up 29.3%, 28.3%, and 58.3% of the 403 study participants, respectively (Degarege & Erko, 2013). A cross-sectional investigation in children 15 years or less estimated that 22% of people had parasite diarrhea. Large households, residential location, water supply, low socioeconomic position, and low parent education were found to be the main causes of diarrhea. *Ascaris lumbricoides* 2.2%, *Hymenolepis nana* 9.82%, *Trichuris trichiura* 5.4%, *Entamoeba histolytica* 23.44%, and *Enterobius vermicularis* 12.7% were the next most common parasites, with a 45.54% infection rate, followed by *Giardia lamblia* (Al-Kubaisy et al., 2014). A cross-sectional study was conducted in the Lipis area of Pahang state, Malaysia, to examine the prevalence and risk factors of intestinal polyparasitism among Asli schoolchildren; 98.4% of the children had at least one parasite species. 71.4% of them were polyparasitic. *Trichuris trichiura*, *Ascaris lumbricoides*, hookworm, *Giardia duodenalis*, *Entamoeba* spp., and *Cryptosporidium* spp. infections were among the most common, with relative prevalences of 95.6%, 47.8%, 28.3%, 28.3%, 14.1%, and 5.2% (Al-Delaimy et al., 2014). A small number of research studies were carried out in suburban regions close to Yangon, Myanmar, showing the incidence of *Giardia lamblia, Entamoeba coli, Entamoeba histolytica*, and *Endolimax nana* in students and their parents. A total of 821 stool samples—265 from guardians and 556 from schoolchildren—were analyzed. The typical age for guardians was 36 years old, while the median age for schoolchildren was 6. Males made up 14.6% of the guardians and 53.1% of the schoolchildren. Each intestinal protozoan species' total prevalence was as follows: *G. lamblia* 3.4% (28/821), *E. coli* 3.5% (29/821), *E. histolytica* 1.2% (10/821), and *E. nana* 3.0% (Kim et al., 2016). A study determined the overall percentage of positive results from the stool sample of elementary school students was 50.3% (155/308). Nine species of gastrointestinal parasites were discovered, including six protozoa and three helminths. The two most common protozoan species, *Giardia intestinalis* and *Entamoeba histolytica/dispar*, were found in 31.5% and 17.5% of students, respectively. 8.1%, 5.5%, 4.9%, 4.9%, 2.9%, 0.3%, and 0.3% of pupils, respectively, had *Entamoeba coli*, *Endolimax nana,* hookworm, *Blastocystis hominis, Hymenolepis nana, S. stercoralis,* and *Chilomastix mesnili* (Liao et al., 2017). A study's objective was to ascertain the frequency of intestinal parasites and stunting in schoolchildren from two underprivileged localities in Chiapas, Mexico, who were recipients of that social program. The species with the highest prevalence (25.5%) and moderate parasitic burden (15.1%) was *A. lumbricoides*, accounting for 32.1% of the intestinal parasite prevalence. Intestinal parasites were found to be positively correlated with the mother's educational attainment, the type of footwear she wore, and the municipality in which the children lived (Cruz-Cruz et al., 2018). A study examining the frequency of polyparasitic illnesses in children in Ghana's Volta Region found that *P. falciparum* was the most common infection among the children, occurring in 383 of them [69.6%], followed by *S. haematobium* (57 [10.36%]). The prevalence of *Ascaris lumbricoides* (7 [1.27%]), intestinal protozoa (found in 11 youngsters [2%]), and hookworm (5 [0.91%]) was low. *P. falciparum* and *S. haematobium* had a significant paired connection (both present in 46 children [74.19%]; adjusted odds ratio, 2.45; P = .007) among the 62 children who had polyparasitic infection (Orish et al., 2019). A study on the prevalence of intestinal helminth infections in preschool pupils in Lugari Subcounty, Kakamega County, Kenya, showed an overall prevalence of intestinal helminth of 12.3%. *Ascaris lumbricoides* was the only species found. A 5% significance level ($p < 0.05$, confidence interval (CI) 95%) was used for statistical testing. The frequency and severity of intestinal helminths were statistically significantly correlated with variables such as the location of the school, awareness of hand washing after using the restroom, and knowledge of hand washing before eating. Despite the low prevalence and light intensity found in this study, a few factors significantly impacted the preschoolers' intestinal helminth infections. As a result, efforts to manage intestinal helminths must be stepped up (Werunga et al., 2020).

2.3 Nepalese context

A study conducted on *E. vermicularis* infection in children of Barbhanjyang VDC, Tanahun District, of Nepal identifies age-wise distribution of the parasite was insignificantly associated (p=0.868) (Dahal & Maharjan, 2015). A study performed on 27 out of 75 districts of Nepal showed a significantly decreasing trend in the prevalence of intestinal parasitic infections and was similar in males and females. The pooled prevalence in years 1996–2000, 2001–2005, 2006–2010 and 2011–2015 was 61.1%, 53.2%, 32.7%, and 20.4%, respectively. The proportion of helminths was higher in rural areas (57.6%), and the proportion of protozoa among total intestinal parasites was higher in urban areas (68.4%). Poly-parasitism was observed in 7.7% of children (Kunwar et al., 2016). According to a study on pinworm (*Enterobius vermicularis*) infection among primary-level government school children of Chhampi, Lalitpur District, the age range of 5 to 7 years had a high infection rate (4.67%). In the 11–13 age range, enterobiasis was nonexistent. Although there was no statistically significant correlation between enterobiasis and ethnicity, Janajati had a greater prevalence rate (54.54%) (Khadka & Maharjan, 2018). A study investigation on intestinal parasitic infections in schoolchildren of Kapan shows that the prevalence rate for children who drank groundwater was slightly lower (31.3%) than that of children who drank tap water (58.4%) ($p<0.001$). Children from labor families had the highest infection rate (51.3%), while those from business families had the lowest (33.3%) ($p=0.032$). The prevalence rate was lower (25%) among children who had taken anti-parasitic medication within the previous six months than it was among those who had not (44.4%) ($p=0.005$) (KC et al., 2019). A study was done to determine the prevalence rate of intestinal parasitic infestation among schoolchildren in Duwakot VDC, Bhaktapur, Nepal and it showed that out of 194 stool samples from schoolchildren, the intestinal parasitosis was present in 26 (13.40%) children. In 22 (11.34%) instances, *Giardia lamblia* was the most prevalent organism, and in 2 (1.03%) of the helminthic infection cases, the causes were Hookworm *and Hymenolepis nana,* respectively (Sharma et al., 2020). A study conducted on intestinal parasitosis prevalence and associated risk factors among Dharan private school-going students showed 46 (11.5%) out of the 400 schoolchildren enrolled in the study tested positive for intestinal parasites. This study found 43 helminths (*Ascaris lumbricoides*, *Entamoeba histolytica, Ancylostoma duodenale,* and *Trichuris trichiura*) and three (3) people with a prevalence of 0.75% for *Entamoeba histolytica. Ascaris lumbricoides* was the most common helminth, accounting for 22 (5.5%), followed by *Trichuris trichiura* (13, 3.25%), *Enterobius vermicularis* (6, 1.5%), and *Ancylostoma duodenale* (2, 0.5%) (Shrestha et al., 2021). According to the study conducted on the prevalence of intestinal parasitic infection among school children in Kirtipur municipality, Kathmandu, the positive cases of 28 (6.8%) had a protozoan infection and 45 (11.0%) had a helminthic infection. Among eight intestinal parasite species found, *A. lumbricoides* was the most prevalent. *G. lamblia* (23.3%), *E. histolytica* (15.1%), *T. trichiura* (10.96%), Hookworm (6.8%), *Enterobius vermicularis* (4.11%), *Taenia solium* (4.11%), and *H. nana* (1.37%) were in order of prevalence, followed by *A. lumbricoides* (34.2%). There were 63 (86.30%) single infections, 9 (12.33%) double infections, and 1 (1.37%) triple infection (Dahal et al., 2022). A study on GI parasites on primary school children in Bhaktapur shows an overall prevalence of 16.84% in a total of 190 stool samples that were collected and examined microscopically by the sedimentation technique and the floatation technique. The prevalence was significantly higher ($p<0.05$) among students in public schools (29.23%) than in private schools (10.40%). Protozoan and helminth parasite prevalence was slightly higher in rural areas (35.71%) compared to urban areas (27.5%) (Karmacharya & Sukupayo, 2023). According to the study performed on helminths and protozoan infection in Palpa, Nepal, the concentration of parasites in various ages, sexes and residences were investigated in which most common protozoan parasites were *Entamoeba histolytica* (38.33%) and *Giardia lamblia* (26%), whereas *Leishmania donovani* was only impacted by 0.44 %. The most contagious helminth parasite was *Ascaris lumbricoides* (16.74%), whereas the least contagious was *Hymenolepis nana* (0.44%) (Nepali et al., 2023). A cross-sectional study on contributing factors of intestinal parasitic infections among school children with malnutrition in Hetauda showed an overall incidence of IPIs of 5.71%. the with three protozoa *Giardia lamblia* (2.86%), *Entamoeba histolytica* (1.90%), and *Endolimax nana* (0.95%).

3. Materials and methods

3.1 Study area

This study was conducted in Kapan ward number 9 and 10 which is a residential area and former Village Development Committee that is now a part of Budhanilkantha Municipality in Kathmandu district in Bagmati Province of central Nepal (Figure 1). Life Skills School is one of the preschools located in Rudramati Chawk ward no 10. Kapan is a locality in Kathmandu and has an elevation of 1,417 meters.

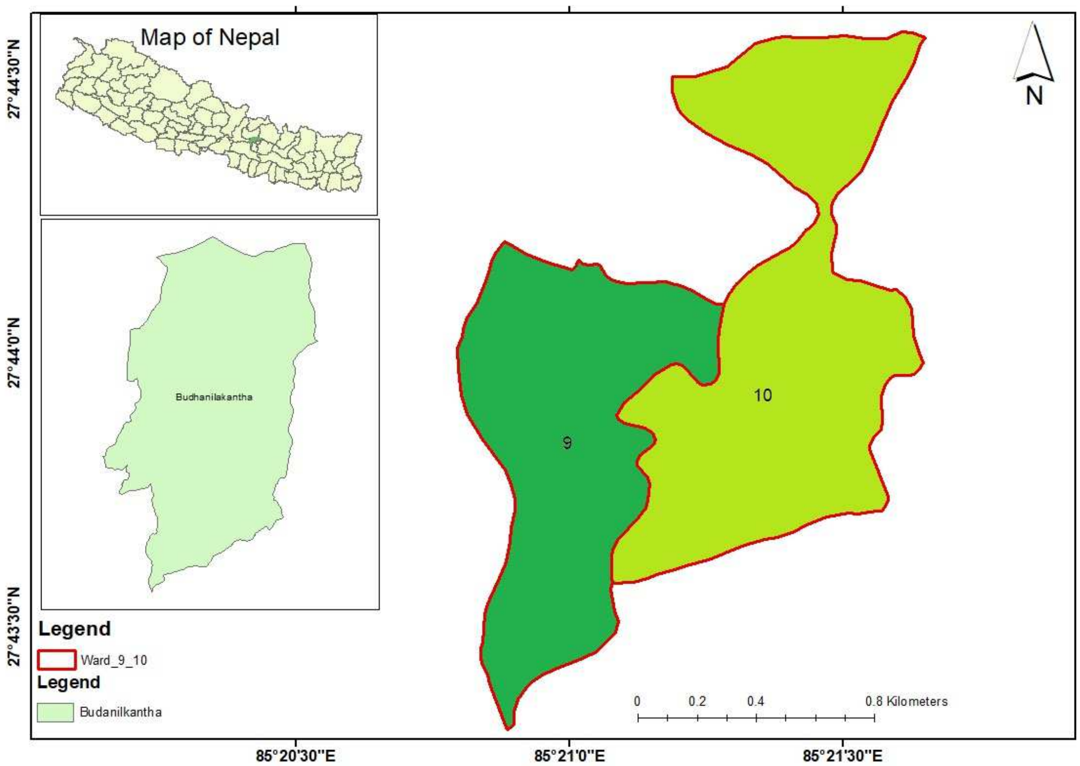

Figure 1. Map of Nepal showing ward number 9 and 10 of study area

At the time of the 2011 Nepal census, it had a population of 48,463 in 12,324 households.

3.2 Materials required

Various equipment such as stool samples, sample vials, tooth picks, forceps, glass slides, cover slips, gloves, masks, tray compound microscope were used. Chemicals such as normal saline, 2.5% potassium dichromate, iodine solution, 70 percent alcohol and Dettol hand wash was used.

3.2.1 Preparation of 2.5 % potassium dichromate

After weighing out 2.5 grams of potassium dichromate, it was dissolved in 100 milliliters of purified water. The parasites found in the fecal materials were preserved using this solution (Zajac et al., 2012).

3.2.2 Preparation of normal saline

For the unstained preparation, 8.5 grams of sodium chloride were dissolved in 1000 milliliters of distilled water to create normal saline (Zajac et al., 2012).

3.2.3 Preparation of iodine solution

10 grams of potassium iodide were dissolved in 100 milliliters of distilled water to create the iodine solution, and then 5 grams of powdered iodine crystals were gradually added. After filtering, the solution was stored in a stopper. After that, distilled water was used to dilute the solution five times or so. The solution was applied to stain the preparation such that helminth eggs and internal parasite organelles could be seen (Zajac et al., 2012).

3.3 Methods

3.3.1 Sample size

The study was conducted from July 2024 to Feb 2025. A total of 148 samples were collected using purposive sampling technique. 88 preschool children with ages (3 to <6 years old) were included in the study from Life Skills School. located in Kapan ward no. 10 and remaining 60 school-aged children with ages (6 to ≤10 years old) were included from 45 different households of Kapan ward no. 9 and 10 studying in different private schools (Figure 1). Among them, 83 were male and 65 were female (Table 3).

3.3.2 Sample collection

The parents of primary school children were provided sterile stool sample collecting vials with detailed instructions required for stool collection. A structured questionnaire was used to gather the data in a similar manner. They were asked to gather approximately 5 grams of stool in the morning using the clean stick that came with the clean plastic vials. They were set up to prevent contaminating the stool sample with unrelated objects. Every parent who was unable to provide a sample that day was asked to provide one on the following day.

A pre-tested self-administered questionnaire (Appendix 3) was employed to gather data on children's behaviors, such as their propensity for playing with household pets, nail-cutting habit, nail-biting habit, drinking water source, treatment of water, walking barefoot, personal cleanliness, existence or nonexistence of anal itch, and administration of anti-helminth drugs.

3.3.3 Preservation

Fecal matter was preserved in vials containing a 2.5% potassium dichromate solution as soon as it was collected.

3.3.4 Laboratory analysis and identification

Direct wet mount

2 gm of fecal sample was mixed carefully

↓

Single drop of each sample was put on glass slide with/without Gram's iodine stain

↓

Slide was then covered with a cover slip

↓

Slide was observed under microscope at a total magnification of 100X and 400X

Figure 2. Direct wet mount techniques (Adhikari et al., 2021).

3.3.4.1 Microscopic examination

The collected stool samples were examined under a microscope for blood, adult cestode segments, and larvae of parasites, all detected macroscopically. A direct smear procedure was followed using normal saline and iodine stain for microscopical examination.

Unstained smear preparation of stool

Using a tiny stick, a small part of the stool sample was extracted and placed on a clean glass slide; it was then emulsified with newly produced normal saline. A sanitized cover slip was positioned over it, and extra liquid was extracted using cotton.

Stained smear preparation of stool

For the identification and investigation of the nuclear materials of the protozoan cyst and trophozoites, a stained smear was prepared. The process for preparing the stained smear was similar to that of the unstained smear.

3.3.4.2 Lab protocols and techniques

The lab processing was conducted according to a rigorous protocol. First, both stained and unstained smears prepared were examined using the compound microscope's low power (10X objective). The entire field was examined, beginning at one end of the slide and working its way toward the other. Samples were viewed at high power (40X) for the proper diagnosis.

3.3.4.3 Saturated salt flotation technique

About two grams of the fecal sample were thoroughly mixed in 12 milliliters of 0.9% w/v sodium chloride (NaCl) using the saturated salt flotation technique. The material was then filtered through a strainer and transferred into a 15-milliliter centrifuge tube. After that, the filtrate was centrifuged for five minutes at 1200 revolutions per minute (rpm). The tube was then filled with 45% w/v NaCl, and the supernatant was disposed of. The sample was centrifuged once more for five minutes at 1200 rpm. After slowly and thoroughly filling the centrifuge tube with saturated NaCl, it was covered with a coverslip and left undisturbed for ten minutes. Lastly, the coverslip was gently taken off and placed on a glass slide for microscopic inspection at a total magnification of 100X and 400X, with or without Gram’s iodine (Adhikari et al., 2021).

3.3.4.4 Formal-ether sedimentation technique

This is employed to find huge trematode eggs. In a 15 ml centrifuge tube, two grams of fecal material were well combined with 12 milliliters of 0.9% w/v NaCl. After that, the sample was centrifuged for five minutes at 1200 rpm, and the supernatant was disposed of. Three milliliters of ethyl acetate and ten milliliters of 10% formalin were then added to the tube, which was then centrifuged for five minutes at 1200 rpm. The sediments were then analyzed under a microscope at total magnifications of 100X and 400X, with or without Gram's iodine, after the supernatant was disposed of (Adhikari et al., 2021).

3.3.4.5 Identification of cysts, eggs of parasites

The parasite cysts and eggs were classified according to the size, form, and color of the parasite cysts and eggs, which were used to categorize them, and various books and articles (Arora, 2010; Chatterjee, 2009; Nath et al., 2022) and the CDC webpage were used to identify them. Digital camera and identification software online resources, microscopic pictures, and morphometric analysis were also used.

3.5 Data analysis

The outcome variable was gastrointestinal parasites; whether the chosen subject tested positive or negative for any intestinal parasites based on the stool sample served as the outcome variable. A questionnaire was used to gather information on sociodemographic traits and behavioral traits. After being encrypted, the gathered data was transferred into a Microsoft Excel spreadsheet. Analysis was done by using the chi-square test and calculating odds ratios and confidence intervals for parasite infections under the study. The test was performed by RStudio. For the statistically significant difference, a 5% significance level ($p < 0.05$) and a confidence interval (CI) of 95% were taken into consideration in every instance. The strength of the relationship was measured using odds ratios and multivariable logistic regression analysis.

3.6 Socio-behavioral survey

A questionnaire was used in order to record personal information and behavioral factors. Inquiries were made regarding their propensity for playing with household pets, nail-cutting habits, nail-biting habit, walking barefoot, personal cleanliness, drinking water source, treatment of water, existence or nonexistence of anal itch, and use of anti-helminth drugs. The results thus obtained were analyzed by using odds ratios and multivariable logistic regression analysis to find significant connections (Pezzani et al., 2004).

3.7 Ethical considerations

The required permission for this study was obtained from the selected school which supported our study. The parents' consent was obtained. The participants were given a verbal explanation of the study's specific goals and methods in Nepali before the survey. The participants were fully informed about the purpose of the study and the advantages of taking part. Throughout the data collection process, participants were informed of their right to withdraw at any moment. During this study, no experimental infection was created.

4. Results

The present study was conducted in two wards of Kapan of Budhanilkantha Municipality, Kathmandu, Nepal. Altogether, 148 stool samples of preschool and school-aged children of two age groups (3 to < 6 years and 6 to ≤ 10 years, respectively) were collected and examined to determine the prevalence of intestinal parasites, and their associated risk factors were assessed via a structured questionnaire survey.

4.1 Prevalence of IPIs in preschool and school aged children of Kapan, Kathmandu, Nepal

Out of 148 samples, overall prevalence was 24 (16.21%); among them, children were found to be infected with one species of protozoan and four species of nematodes, with zero infections of cestode parasites. The prevalence of protozoan infection was 5 (3.37%), and that of helminthic infection was 19 (12.83%). The most common species of protozoan parasites discovered was *Entamoeba coli*. The helminth parasites *E. vermicularis* and *A. lumbricoides* were found to be the most common in preschool and school aged children, and of the four nematode parasites, *Strongyloides* spp. (0.67%) were shown to be the least common (Table 1).

Table 1: Prevalence of IPIs in preschool & school-aged children of Kapan, Kathmandu, Nepal

Parasitic infection	**Total (N=148)**	
	Infected children(n)	**Prevalence (%)**
Protozoan infection		
Entamoeba coli	5	3.37
Nematode infection		
Ascaris lumbricoides	10	6.75
Enterobius vermicularis	6	4.05
Trichuris trichiura	2	1.35
Strongyloides stercoralis	1	0.67
Total	**24**	**16.21**

The pie chart showed a higher prevalence of *Ascaris lumbricoides* (42%) and a lower prevalence of *Strongyloides stercoralis* (4%) in preschool and school-aged children in the overall percentage prevalence of 24 (16.21%) (Figure 3).

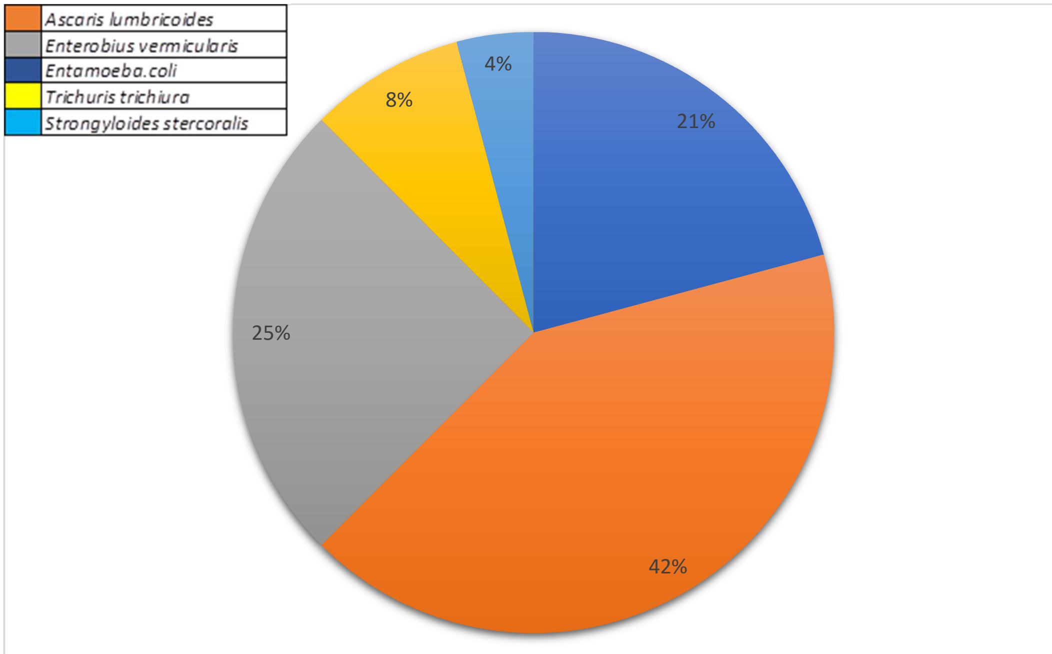

Figure 3. The percentage of IPs present in preschool and school-aged children

The study subject was categorized into two different age groups; preschool (3 to <6) and school-aged (6 to ≤ 10) years. The higher prevalence of intestinal parasites 17 (19.31%) out of 88 was found in preschool children and lower prevalence of intestinal parasites 7 (11.66%) out of 60 was found in school-aged children (Figure 4).

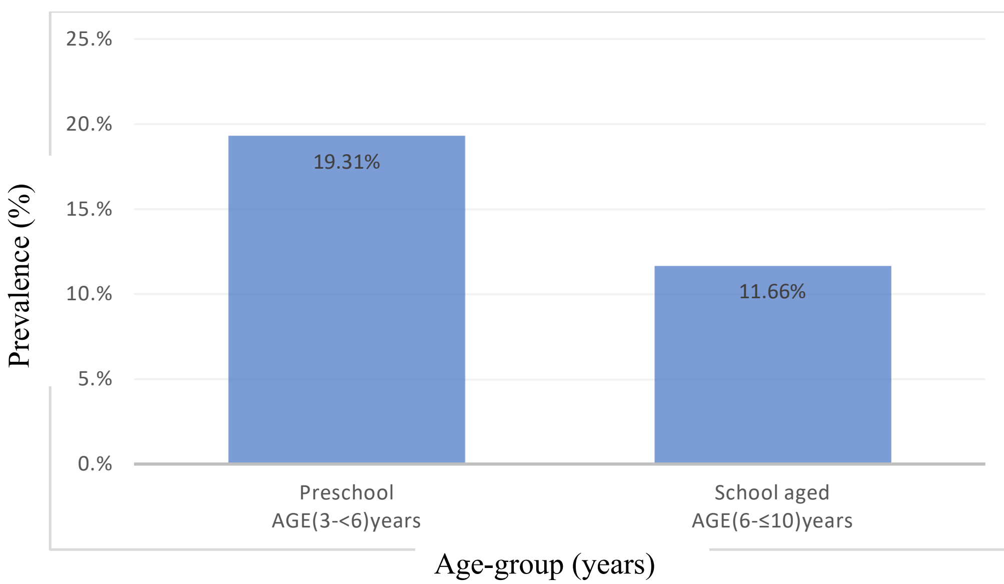

Figure 4. Age-wise prevalence of parasitic infection in preschool and school-aged children of Kapan, KTM

The parasite specific prevalence among different age-groups were analyzed and, it was found that preschool children (3 to < 6) years were highly infected by protozoan and helminths parasites in comparison to school-aged children (6 to ≤ 10) years. The prevalence of *Entamoeba coli* 4 (4.54%), *Ascaris lumbricoides* 7 (7.97%) and *E. vermicularis* 6 (6.82%) were higher in preschool children whereas *T. trichiura* 2 (3.33%) and *S. stercoralis* 1(1.67%) were higher in school-aged children (Table 2).

Table 2: Parasite specific prevalence among different age-groups of children in Kapan, Kathmandu, Nepal

Parasites	**Infected children in different age group (%)**	
	Preschool (3 to <6) years	**School-aged (6 to ≤10) years**
Protozoan infection		
Entamoeba coli	4 (4.54%)	1 (1.66%)
Total protozoan infection	**4 (4.54%)**	**1 (1.66%)**
Nematode infection		
Ascaris lumbricoides	7 (7.95%)	3 (5%)
Enterobius vermicularis	6 (6.82%)	0
Trichuris trichiura	0	2 (3.33%)
Strongyloides stercoralis	0	1 (1.67%)
Total nematode infection	**13 (14.77%)**	**6 (10%)**
Total sample population	**88**	**60**

A comparative analysis of intestinal parasitic infections between males and females revealed a slightly higher prevalence in females than in males. Overall, 13(15.66%) out of 83 males and 11(16.92%) out of 65 females were infected. Among preschool children the prevalence of intestinal parasitic infection in males and females was 9 (18.36%) out of 49 and 8 (20.51%) out of 39, respectively. Among school-aged children the prevalence of intestinal parasitic infection in males and females was 4 (11.76%) out of 34 and 3 (11.53%) out of 26, respectively (Table 3). However, there was no statistical association between sex and parasitic infection in pre-school ($\chi2=0.0634$, $p>0.05$) and school-aged children ($\chi2=0.0007$, $p>0.05$). The p-value was calculated using Fisher's exact test and the chi-square test.

Table 3: Intestinal parasitic infection among Male and Female of preschool and school-aged children of Kapan, Kathmandu, Nepal

Parasites Species	**Preschool (n=88)**		**p-value**	**School-aged (n=60)**		**p-value**
	Male	**Female**		**Male**	**Female**	
	9(18.36)	**8(20.51)**	**0.80**	**4(11.76)**	**3(11.53)**	**0.97**
Protozoan Infection	**1(2.04)**	**3(7.69)**	**0.20**	**0**	**1(3.84)**	**0.25**
E. coli	1(2.04)	3(7.69)		0	1(3.84)	
Nematode infection	**8(16.32)**	**5(12.82)**	**0.64**	**4(11.76)**	**2(7.69)**	**0.60**
A. lumbricoides	4(8.16)	3(7.69)		2(5.88)	1(3.84)	
E. vermicularis	4(8.16)	2(5.12)		0	0	
T. trichiura	0	0		1(2.94)	1(3.84)	
S. stercoralis	0	0		1(2.94)	0	
Total	**49**	**39**		**34**	**26**	

4.2 Assessment of the risk factors associated with IPIs in preschool and school-aged children of Kapan, Kathmandu, Nepal

Demographic (age, sex) and behavioral factors among preschool and school-aged children were evaluated for their associations with the prevalence of intestinal parasitic infections. Thirteen different factors were considered to assess the relationship between exposure to risk factors and possible outcomes (Table 4).

Table 4: The unadjusted association between intestinal parasitic infection and all the risk factors.

Risk factors / Sub groups		No. of Examined	No. of Infected (%)	Odds ratio	95% C. I.	p-value
Age group	(3 to <6) years	88	13(14.7)	1.56	0.55 to 4.36	0.39
	(6 to ≤10) years	60	6(10)	1		
Pre-school Sex	Male	49	9(18.36)	0.87	0.30 to 2.5	0.80
	Female	39	8(20.51)	1		
School aged Sex	Male	34	4(11.76)	1.02	0.20 to 5.02	0.97
	Female	26	3(11.53)	1		
Drinking water Source	Tap water	125	18(14.4)	0.48	0.16 to 1.37	0.16
	Well water	23	6(26.1)	1		
Treatment of water	Yes	144	21(14.5)	0.057	0.005 to 0.57	0.015
	No	4	3(75)	1		
Handwash (before toilet and after meal)	Yes	144	23(15.9)	0.57	0.05 to 5.72	0.63
	No	4	1(25)	1		
Walk bare foot	Yes	39	10(25.6)	2.33	0.94 to 5.82	0.067
	No	109	14(12.8)	1		
Nail biting Habit	Yes	23	9(39.1)	4.71	1.74 to 12.76	0.002
	No	125	15(12)	1		
Nail cut regularly	Yes	117	14(11.9)	0.28	0.11 to 0.72	0.008
	No	31	10(32.2)	1		
Clean fruits & veg. before eating	Yes	145	24(16.5)	0.39	0.03 to 4.55	0.45
	No	3	1(33.3)	1		

Bath regularly	Yes	130	20(15.3)	0.64	0.18 to 2.13	0.46
	No	18	4(22.2)	1		
Playing with domestic pets	Yes	18	5(27.7)	2.24	0.71 to 7.02	0.16
	No	130	19(14.6)	1		
Itch around anus	Yes	20	4(20)	1.35	0.40 to 4.46	0.62
	No	128	20(15.6)	1		
Anti-helminth taken before	Yes	76	7(9.2)	0.33	0.12 to 0.84	0.021
	No	72	17(23.6)	1		

From the above value of odds ratios, confidence interval, and p-value, it showed that there was no significance difference between age and sex with parasitic infection (Table 4). The nail-biting habit, nail-cutting behavior, and treatment of water were found to be the strong predictors of IPIs. Children with untrimmed nails were more likely to be infected than those with trimmed nails (OR= 0.28, 95% CI=0.11-0.72, p= 0.008). Nail-biting habit in children increased the risk of infections and illnesses because it transfers many parasite eggs from hands to the mouth (OR = 4.71, 95% CI= 1.74 to 12.76, p= 0.002). Likewise, when compared with treatment of water, untreated water has a high chance of getting protozoans infection (OR= 0.057, 95% CI=0.005-0.57, p= 0.015). and another important predictor was not using of anti-helminth drugs on an annual basis, which also has a high chance of helminths infection in children (OR=0.33, 95% CI =0.12 to 0.84, p= 0.021) (Table 4).

Table 5: An adjusted association between intestinal parasitic infection and the risk factors after multivariable logistic regression analysis.

Risk factors		**Adjusted Odds Ratio (AOR)**	**95% C. I.**	**p-value**
Nail biting Habit	Yes	4.12	1.45-11.70	0.008
	No	1		
Nail cut regularly	No	3.25	1.22-8.66	0.018
	Yes	1		
Water treatment	No	18.5	1.85-185.0	0.013
	Yes	1		
Anti-helminth taken before	No	2.89	1.05-7.94	0.039
	Yes	1		
Walks bare foot	Yes	2.05	0.80-5.25	0.135
	No	1		

Significant at $p<0.05$

From the adjusted odds ratio (Table 5). The nail-biting habit (aOR=4.12, 95% CI =1.45-11.70, p=0.008), not cutting nails regularly (aOR=3.25, 95% CI=1.22-8.66, p=0.018), water treatment (aOR=18.5, 95% CI =1.85-185.0, p=0.013) and not using anti-helminths before (aOR=2.89, 95% CI= 1.05-7.94, p=0.039) were found to be associated with the intestinal parasitic infection. Walking barefoot was not significant after adjustment (aOR=2.05, 95% CI=0.80-5.25, p=0.135).

5. Discussion

5.1 Intestinal parasitic infection

Particularly in developing nations like Nepal, intestinal parasite infections are a major cause of death and morbidity, especially for those with low socioeconomic levels who already face poverty, substandard housing and lifestyle, illiteracy and ignorance, and unfavorable environmental circumstances. The current study showed an overall prevalence of 16.21% of intestinal parasite infection (Table 1). The result was found to be similar to that of Tandukar et al. (2013), with a prevalence rate of 16.7%. Water source, unhygienic personal habits, personal cleanliness, and some degree of maternal education were the conditions most commonly linked to exceptional prevalence. In the present study, preschool children of the age group (3 to <6) showed a higher prevalence (19.31%), and school-aged children of the age group showed a lower prevalence of intestinal parasites (11.66%), which can be comparable to the findings from the study performed on school children of Kapan, where under-5-year-olds had a higher infection rate (80.0%) than those aged 5-10 (36.0%) (KC et al., 2019). In this study, enterobiasis was not found in school-aged children, which is similar to the absence of a prevalence rate in the 11–13 age group reported by Khadka and Maharjan (2018). This could be due to better hygiene practices among older children. The current study emphasizes the ongoing burden of parasitic diseases in Nepal's pediatric population by highlighting the species-wise incidence of intestinal parasite infections among preschool and school-aged children. *Ascaris lumbricoides* (7.97%), *Enterobius vermicularis* (6.82%), and *Entamoeba coli* (4.54%) were the most common parasites among preschoolers, while *Trichuris trichiura* (3.33%) and *Strongyloides stercoralis* (1.67%) were more common among school-aged children. The prevalence of *A. lumbricoides* in preschoolers is consistent with earlier research from different parts of Nepal. For example, Narayan & Shrestha (2012) found that children in rural areas had a high incidence of *A. lumbricoides*, and they attributed this to inadequate hygiene practices, contaminated water, and poor sanitation. In contrast to Shrestha et al. (2021), who reported an overall prevalence of 11.5% among 400 private school students in Dharan, this study revealed a higher prevalence of intestinal parasitic infection. However, the results were lower than those from other regions of Nepal, such as Dolakha and Ramechhap (Shrestha et al., 2018), where intestinal parasites infected 39.7% of 708 participants.

Intestinal parasite infection rates do not significantly differ between the sexes, according to earlier research from Nepal and other underdeveloped nations, which supports these findings. For example, Narayan & Shrestha (2012) found that male and female students in Kathmandu's schools had similar infection rates, indicating that environmental and behavioral exposures matter more than biological sex.

The link between drinking untreated water and contracting parasites emphasizes the structural difficulties in guaranteeing communities' and schools' access to clean water. Many schools in Nepal continue to use untreated or unfiltered water supplies, exposing kids to waterborne parasites including *Entamoeba histolytica* and *Giardia lamblia* (Dahal et al., 2022). To lessen the spread of intestinal parasites, it should be a national priority to improve water quality and guarantee that schools have access to safe drinking water.

5.2 Risk factors associated with intestinal parasitic infection

According to the current study, those who were not dewormed had the highest number of intestinal parasites, whereas those who were dewormed had the lowest number. This result was validated. Those who were not dewormed had the highest number of intestinal parasites, whereas those who were dewormed had the lowest number. Gabrie et al. (2014) from Honduras, Espinosa Aranzales et al. (2018) from Colombia, and Elmonir et al. (2021) from Egypt all endorsed this conclusion. Deworming is required because, in the Lao People's Democratic Republic, the prevalence of parasites was considerably decreased with the introduction of biannual drug administration (Nanthavong et al., 2017). For Nepalese schoolchildren, untrimmed nails constitute a straightforward but often disregarded vector for parasite illnesses. Reducing infection rates and improving child health outcomes in Nepal can be accomplished by addressing this issue through education, better sanitation, and behavioral changes (WHO, 2020). In line with research done in Nepal by Sah et al. (2013) and Taiwan by Sung et al. (2001), the current study found that nail-biting habit was likewise a significant predictor of IPIs. Biting one's nails might provide a direct oral-fecal channel for parasite infection. It was discovered that consuming unboiled or unfiltered water was a major contributing factor to the intestinal parasites. This result was consistent with findings from Malaysia by Ngui et al. (2011), from Nepal by Dhital et al. (2016), and from Cambodia by Liao et al. (2017). This can be the result of animal and human feces contaminating the water. This is consistent with the findings from Ghana by Abaka-Yawson et al. (2020) and Ethiopia by Bolka & Gebremedhin (2019). Finally, intestinal parasite infections were considerably higher in those who did not wash their hands with soap before and after meals and after bowel movements. This result was consistent with research done by Sah et al. (2013). The prevalence of overall IPIs was not substantially correlated with any of the demographic, lifestyle, behavioral, dietary, or socioeconomic status factors observed from multivariable regression analysis. However, a sizable portion of the research population's male participants reported undernutrition and an increased risk of IPIs (Parajuli et al., 2024).

6. Conclusions and recommendations

6.1 Conclusions

The overall prevalence of intestinal parasite infection was discovered in 24 (16.21%) out of the 148 stool samples. The prevalence of protozoan infection was 5 (3.37%), and that of helminthic infection 19 (12.83%). In preschool children of age group (3 to <6) showed a higher prevalence of 17 (19.31%) out of 88 and school-aged children of age group (6 to ≤10) showed a lower prevalence of intestinal parasites of 7 (11.66%) out of 60. Species-wise prevalence includes *Entamoeba coli* 4 (4.54%), *Ascaris lumbricoides* 7 (7.95%), and *E. vermicularis* 6 (6.82%) in preschool children and *Entamoeba coli* 1 (1.66%), *Ascaris lumbricoides* 3 (5%), *T. trichiura* 2 (3.33%), and *S. stercoralis* 1 (1.67%) in school-aged children. Sex-wise prevalence showed an overall 13 (15.66%) in males and 11(16.92%) in females. The prevalence of intestinal parasitic infection in males and females of preschool children was 9 (18.36%) out of 49 and 8 (20.51%) out of 39, respectively, and the prevalence of intestinal parasitic infection in males and females of school-aged children was 4 (11.76%) out of 34 and 3 (11.53%) out of 26, respectively. However, there was no statistical association between sex and parasitic infection in males and females of preschool ($\chi2=0.0634$, $p>0.05$) and school-aged children ($\chi2=0.0007$, $p>0.05$). The nail-biting habit, not cutting nails regularly, untreated water, and non-use of anti-helminth before were found to be associated with the intestinal parasitic infection.

6.2 Recommendations

The following recommendations have been made for the efficient management of intestinal parasite infections in primary school children of Kapan, Kathmandu, Nepal.

- Effective involvement of the Biannual Mass Drug Administration is necessary to guarantee that every family member has taken part.
- According to this study, there is an urgent need for control measures, such as bettering personal hygiene, sanitation habits, and the availability of safe drinking water.
- It is important to spread awareness about intestinal parasites and infection management measures, using community centers, local media, and educational institutions as information-dissemination venues.

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Appendices

Appendix 1. Photographs of intestinal parasites under 10X×40X microscope

Photograph 1. Cyst *Entamoeba coli* 12.5 µm diameter under 400X in lugol's iodine

Photograph 2. *E. vermicularis* egg 55X25 µm in normal saline in 400X

Photograph 3. *Ascaris lumricoides* egg 56X46 µm after flotation lugol's iodine in 400X

Photograph 4. *Trichuris trichiura* egg 53X27µm in lugol's iodine stain in 400X

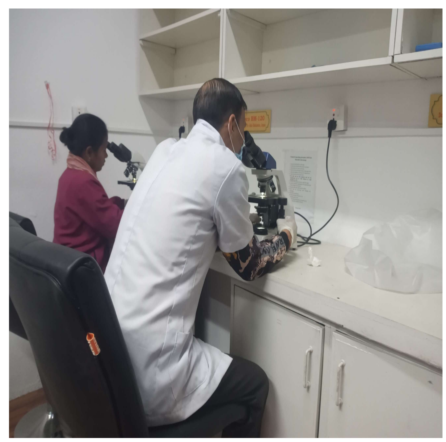
Photograph 5. *Strongyloides* eggs 70x32µm in lugol's iodine stain in 400X

Appendix 2. Photographs of Field and Lab

Photographs 6. Photo with Life Skills School teachers

Photograph 7. Interaction with school children Guardian

Photograph 8. Sample collected from study area



Photograph 9. Microscopic examination of processed sample

Appendix 3. Approval letter

Life Skills School
Budhanilkantha -10, Kapan, Kathmandu

मिति: २०८१/११/१५

श्री मनोज राज गिरी ज्यू,
कुमारीगल – ६, काठमाडौं

विषयः अनुमति प्रदान गरिएको बारे । महोदय,

प्रस्तुत विषयमा काठमाडौं महानगरपालिका कुमारीगल वडा नं. ६ का तपाईं श्री मनोज राज गिरीले यस विद्यालयमा स्वास्थ्य सम्बन्धि अनुसन्धान गर्न इच्छा व्यक्त गर्दै निवेदन दिनु भएकोमा विद्यालयको मान, प्रतिष्ठा र गोपनियतामा असर नपर्ने गरी अनुसन्धान गरी प्रतिवेदन तयार गर्न अनुमति प्राप्त दिइएको व्यहोरा अनुरोध गरन्छि ।

शान्ता खड्का
संचालक प्रचार्य

Appendix 4. Parent consent form

Parent consent form

Date: ……………………

Sir/Madam,

This is to inform you that I give my consent to the participation of my son/daughter ……………………. in the research on the topic **"Prevalence and Risk Factors of Gastrointestinal Parasites in Preschool and School Aged Children of Kapan, Kathmandu, Nepal"** for which a stool sample is required for examination. I will provide the sample and help complete the research successfully.

………………………

Parent signature

Appendix 5. Questionnaire

Name: Age: Sex: Profession:

Address:

1. Where do you get drinking water from?

   a. Tap water b. Well

2. Do you treat drinking water?

   a. Yes b. No

3. Does your child wash your hand after toilet and before meal?

   a. Yes b. No

4. Does your child walk with bare foot?

   a. Yes b. No

5. Does your child cut your nail regularly?

   a. Yes b. No

6. Does your child have the habit of nail biting?

   a. Yes b. No

7. How do you and your child clean vegetables/fruits?

   a. Yes b. No

8. Does your child bath regularly

   a. Yes b. No

If yes, when?

   a. Once a week b. Twice a week c. Once in two weeks

9. Does your child play with domestic pet?

   a. Yes b. No

If yes, what types of animals do you have?

   a. Goats b. Dogs c. Cats d. Hens e. Other

10. Does your child itch around anus region?

a. Yes b. No

If yes, When?

a. Early in the morning b. At the day time c. At the evening d. At night

11. Has your child taken anti-helminthics before?

a. Yes b. No

If yes, how long time before?

a. Before a week b. Before two-week c. Before one month

d. Before six-monte e. Before one-year