Prevalence of Intestinal Parasites in Bantar Community in Koshi Rural Muncipality-3, Sunsari Nepal

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Declaration

I hereby declare that the work present in this thesis entitled "Prevalence of intestinal parasites in Bantar community in Koshi Rural Municipality-3, Sunsari, Nepal" has been done by myself and has not been submitted elsewhere for the award of my degree. All the sources of information have been specifically acknowledged by references to all the author(s) or institution(s).

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Abstract

Intestinal parasitic infections contribute significantly to morbidity and mortality worldwide, particularly among individuals with low socioeconomic status and poor hygiene and sanitation. This study aimed to assess the prevalence of intestinal parasites in the Bantar community of Koshi Rural Municipality-3, Sunsari District, in relation to their socioeconomic status. A total of 150 stool samples were randomlycollected in September 2022 from individuals of various age groups and genders and preserved in a 2.5% potassium dichromate solution. The prevalence of intestinal parasites was determined through stool examinations using direct smear and concentration techniques (Sedimentation and flotation) at the Central Department of Zoology, Kirtipur, and Kathmandu. Additionally, a structured questionnaire was used to identify potential risk factors.Out of 150 participants, 95 (63.3%) were found to be infected with one or more intestinal parasites. The prevalence was higher in females (51, 34%) than in males (44, 29.3%), though the difference was not statistically significant ($P > 0.05$). The highest infection rate was observed in the 10–20 age group (23%), while the lowest (4.6%) was recorded in individuals aged 51–60 years, with no statistically significant variation ($P > 0.05$). Six species of intestinal parasites were identified, with *Ascaris lumbricoides* (18.8%) being the most prevalent, followed by *Giardia lamblia* (14.6%), *Entamoeba histolytica* (10%), *Strongyloidesstercoralis* (8.8%), *Hymenolepis nana* (8%), and *Trichuris trichiura* (3%). Single infections (46.6%) were more common than double infections (16.6%). A lack of awareness about intestinal parasitic infections was evident among most participants. The high prevalence of these infections in the Bantar community appears to be directly linked to unsafe drinking water, inadequate health education, poor sanitation, and low socioeconomic conditions, all of which contribute to the continued burden of infection within the community.

शोधसारांश

आन्द्राको परजीवी संक्रमणले विश्वव्यापी रूपमा बिरामी र मृत्युदरमा महत्त्वपूर्ण योगदान पुऱ्याउँछ, विशेष गरी कम सामाजिकआर्थिक स्थिति र कमजोर सरसफाइभएकाव्यक्तिहरूमा। यस अध्ययनले सुनसरी जिल्लाको कोशीगाउँपालिका-३ का सरदार समुदायमा सेप्टेम्बरदेखि अगस्ट २०२२ सम्मको सामाजिकआर्थिक स्थितिको सन्दर्भमा आन्द्राका परजीवीहरूको व्यापकतामूल्याङ्कन गर्ने उद्देश्य राखेको थियो ।कुल १५० स्टूल नमूनाहरू अनियमित रूपमाविभिन्न उमेर समूह र लिङ्गका व्यक्तिहरूबाट सङ्कलन गरियो र २.५% पोटासियम डाइक्रोमेट समाधानमा संरक्षित गरियो। आन्द्राको परजीवीको प्रकोपको प्रकोपलाई प्रत्यक्ष स्मीयर र कन्सेन्ट्रेसन प्रविधि (सेडिमेन्टेशन र फ्लोटेशन) को प्रयोग गरेर दिसा परीक्षणको माध्यमबाट प्राणी विज्ञान केन्द्रीयविभाग, कीर्तिपुर, काठमाडौंको परजीवी विज्ञान प्रयोगशालामानिर्धारण गरिएको थियो। थप रूपमा, सम्भावित जोखिम कारकहरू पहिचान गर्न एक संरचितप्रश्नावलीप्रयोग गरिएको थियो, १५० सहभागीहरू मध्ये, ९५ (६३.३%) एक वा बढी आन्द्राको परजीवीबाट संक्रमितभएको पाइएको थियो। प्रचलनमहिलाहरूमा बढी थियो (५१ व्यक्ति, ३४%) पुरुषहरू (४४ व्यक्तिहरू, २९.३%), यद्यपिभिन्नता सांख्यिकीय रूपमामहत्त्वपूर्ण थिएन९उश्र ०.०५)। उच्चतम संक्रमण दर १०-२० उमेर समूह (२३%) मा अवलोकन गरिएको थियो, जबकि सबैभन्दाकम४.६%) ५१-६०वर्ष उमेरका व्यक्तिहरूमा रेकर्ड गरिएको थियो, कुनै सांख्यिकीय रूपमामहत्त्वपूर्ण भिन्नता ९एश्र ०.०५) बिना। आन्द्राका परजीवीका छ प्रजातिहरू पहिचान गरिएको थियो, जसमा*Ascaris lubbricoides* (१८.८%) सबैभन्दा बढी प्रचलितथियो, त्यसपछि *Giardia lamblia* (१४.६%),*Entamoeba histolytica*(१०%), *Strongyloidesstercoralis*(८.८%), *Hymenolepis nana* (८%), *Trichuristrichuris* (८%)। एकल संक्रमण (४६.६%) दोहोरो संक्रमण (१६.६%) भन्दा बढी सामान्यथियो। आन्द्राको परजीवी संक्रमणको बारेमा चेतनाको कमी धेरै सहभागीहरूमा स्पष्ट थियो। सरदार समुदायमायी संक्रमणहरूको उच्च प्रसार असुरक्षितपिउने पानी, अपर्याप्त स्वास्थ्यशिक्षा, कमजोर सरसफाइ र न्यून सामाजिकआर्थिक अवस्थासँगप्रत्यक्ष रूपमा जोडिएको देखिन्छ ।

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List of abbreviations

Abbreviated form	full form of abbreviations
GIPs	Gastrointestinal parasitic infections
IOST	institute of science and Technology
IPIs	intestinal parasitic infections
M L	Milliliter
NaCl	Sodium chloride
Rpm	Rotation per minute
SES	Socioeconomic status soli-transmitted
STHs	Soli-transmitted Helminths
WHO	World Health organizations

1 Introduction

1.1 Background

A worldwide health concern is parasitic infections, including those caused by protozoa and helminths(Harizanov et al., 2020). Approximately 3.4 billion people have contracted intestinal (helminth and protozoan) parasites, with children accounting for the vast majority of infections(Omar & Abdelal, 2022). Unless governments, civil society, local authorities, and the international community take significant and coordinated action, the number is rising and will keep rising(B et al., 2015). The most often mentioned risk factors for intestinal parasite infections are behavioral and sex-related behaviors, dietary patterns, socioeconomic position, and insufficient access to clean water, sanitation, and personal hygiene(Chongbang et al., 2016). Parasitic illness is still a major worldwide health issue, especially in areas with low resources(Forson et al., 2017).Around 1.807–1.221 billion people worldwide have a nematode infection(Khadka et al., 2021), 603–795 million have *Trichuriasis*(Sah et al., 2021), and 586-739 million have hookworm infections(Gupta et al., 2020), according to World Health Organization (WHO) reports from 2011. Every year, these illnesses cause the deaths of at least 1990, 00 persons(Agrawal et al., 2012). More than 1.5 billion people worldwide are parasitized by common intestinal parasites, including the protozoan *Giardia duodenalis/Giardia intestinalis, hookworms, Ascaris lumbricoides, Trichuris trichiura, and Hymenolepis nana*(Forson et al., 2017). The most frequent parasitic helminths that cause infections include Ascaris lumbricoides(Shrestha et al., 2019), *Hookworm, Trichuris trichiura*(Adhikari et al., 2021), and *Taenia species*(Narayan Yadav, 2017). *Hookworms* can infect 730 million people(Harizanov et al., 2020), T. trichiura can infect 698 million(Gurung et al., 2019), and Ascaris lumbricoides can infect nearly a billion(Shrestha et al., 2016). Approximately 370 million people worldwide are afflicted by Giardia lamblia(Adhikari et al., 2021). *Ascariasis* is a common helminthic illness that is especially widespread in indigenous communities and underdeveloped areas with poor sanitation(Shrestha et al., 2019). Nearly 3.5 billion individuals are thought to be infected globally, with children making up the majority because of their lifestyle choices and immature immune systems(Saud, 2017). Numerous health concerns and issues arise in these communities as a result of inadequate sanitation and mismanaged living standards(KC et al., 2019).The most often mentioned risk factors for intestinal parasite infection are behavioral and sex-related behaviors, dietary patterns, socioeconomic position, and insufficient access to clean water, sanitation, and personal hygiene. In sardar environments, a variety of factors are identified as risk factors for intestinal parasite infections(Khadka et al., 2021). Higher infection rates are regularly linked to factors including poverty, illiteracy, poor hygiene, and lack of access to clean water(Omar & Abdelal, 2022). A hot and muggy tropical climate, poverty, illiteracy, poor hygiene, and lack of access to drinkable water are all strongly linked to the high occurrence of these illnesses(Shrestha & Maharjan, 2013).Furthermore, certain activities have been connected to an elevated risk, including exposure to fecal sludge and wastewater(Shrestha et al., 2016). In sardar, poor sanitation, a lack of hand washing habits, poor personal hygiene, and an inadequate water supply are risk factors for intestinal parasites(Prasad et al., 2024). Targeted actions are necessary to enhance living conditions and lessen the prevalence of intestinal parasite infections in impoverished areas. Open-air defecation, poor environmental conditions, poor sanitation, and the frequency of helminth and protozoa infections(Shrestha & Maharjan, 2013). Soil-transmitted helminths (STHs), specifically *Ascaris lumbricoides*, *Trichuris trichiura*, and *hookworms*, are the most frequent cause of human intestinal helminthiasis(Gupta et al., 2020). These infections can result in a variety of health issues, ranging from little discomfort to serious morbidity and death(Haile et al., 2017). Controlling and avoiding parasite infections requires the use of effective pharmaceutical techniques.

1.2 Background information of study populations

According to a census reported, by 2022, there are 142 castes and ethnic groups living in Nepal(National Statistics Of fi ce, 2021). In comparison to all community, The Bantar community in Nepal is a lesser-known but distinct ethnic group, primarily found in the eastern Terai region of the country. They are traditionally associated with agriculture and labor-intensive occupations. Historically, the Bantar community is believed to have migrated from India, particularly from Bihar and West Bengal, and settled in Nepal, blending with local cultures while maintaining their unique identity. The Bantar community follows Hindu traditions, celebrating festivals like Dashain, Tihar, and Chhath with great enthusiasm. They have their own dialects, often a mix of Maithili, Bhojpuri, and Nepali, depending on the region they inhabit. Their traditional attire is similar to other Terai-based communities, with men wearing dhoti-kurta and women wearing **s**arees. Historically, many from the Bantar community worked as agricultural laborers, but with modernization, they have diversified into various professions, including small businesses, government jobs, and trade. Despite progress, some still face socio-economic challenges, particularly in education and political representation. In recent years, the Bantar community in Nepal has been striving for greater recognition and development opportunities. Various social organizations and government initiatives have aimed to uplift their socio-economic status, ensuring better education and livelihood opportunities.

1.3 Statement of problem

The Bantar community in Nepal, primarily residing in the Terai region**,** including Morang, Sunsari, Saptari, The majority of the Bantar population lives in Sunsari and Morang District, predominantly in the villages and faces significant health challengesdue topoverty, lack of awareness, poor healthcareaccess, andsocio-economic marginalization. These factors contribute to high morbidity rates**,** malnutrition, maternal and child health issues, and limited access to healthcare services, making health conditions in the community a major concern. Unfortunately, the literacy rate among the Bantar community is low, and they rely on agriculture for their livelihoods. Although there is limited data available on the health status of the Bantar community, due to a lack of research, it is inferred that their low socio-economic status, illiteracy, lack of public health awareness, poor sanitation, and lack of healthcare services make them vulnerable to various health problems, including intestinal parasitic infections.

1.4 Objectives

1.4.1 General objectives

- To study the prevalence of intestinal parasites among Bantar Community in Koshi Rural Municipality-3, Sunsari in Nepal.

1.4.2 Specific objectives

- To evaluate the overall, sex-wise, andage-wise prevalence
- To find the relationship socio-economic status and intestinal parasites in the BantarCommunity.

1.5 Significance of the study

Because of inadequate sanitation and a lack of health information, intestinal parasite infections are a prevalent issue in poorer nations. Many forms of morbidity and mortality are specifically caused by protozoan and helminth. Parasites can lead to respiratory problems, low weight gain, delayed growth, intestinal blockage, anemia, chronic diarrhea. Intestinal parasite infection in the Bantar community has not been studied, however studying the parasite frequency in this ethnic group is very crucial. Finding the infection rate in this population will be greatly aided by the current study. The high frequency of parasitic illnesses in the nation has been caused by a number of factors, including unsanitary behaviors, a lack of health knowledge, and a low economic level. The purpose of this study is to determine how the Bantar community in Sunsari, Nepal, and their socioeconomic position relate to the prevalence of intestinal parasites. By increasing knowledge about intestinal parasite infections, the survey will reduce the risk of developing a number of intestinal parasite disorders and enhance community sanitation practices. Researchers that want to look into intestinal parasites in the Bantar community in Koshi rural municipality-3, Sunsari district, Nepal, might use the study as a guide.

2 Literature review

2.1 Prevalence of intestinal parasites

In Nepal, lots of studies have been conducted to ascertain the frequency of gastrointestinal parasites and related risk factors in various geographical areas. Major issues facing Nepal, a developing nation, include extreme poverty, malnourishment, illiteracy, and a lack of knowledge about health issues. Ethnic groups including the Magars, Sarkies, Darai, and Bote were determined to be 48.5%, 28.5%, 8.9%, and 28.9% prevalent, respectively (Chandrashekhar et al., 2009). In keeping with a study by Dev, the Badi, Tharu, and high-caste populations in Kailali had an intestinal parasite frequency of 36.19%. The prevalence was lower in high caste communities (11.24%) but the same in Badi (48.50%) and Tharu (46.67%) populations. Males were more prevalent than females in Tharu and high-caste societies, although females were more common in the Badi society. *Giardia* was a common protozoon, and *hookworm* was a common helminth. The study found that children (0–15 years old) had higher rates of infection than adults for *hookworm, Giardia, E. histolytica, E. coli, H. nana, and B. hominis*(Intestinal Parasitic Infections in Badi, Tharu and High Caste Community of Kailali and Kanchanpur, 2010). Parallel to this, a research in Lalitpur found that 16.7% of school-age children had *Giardia lamblia*, followed by *Entamoeba histolytica* and *Cyclospora Cayetaenisis*(Tandukar et al., 2013a). The study found that the kind of drinking water and hand-washing habits had a substantial impact on the parasite prevalence. Similarly, the prevalence among the residents of Kusam Municipality Parbat district was 23.08%. The age group of 51 to 60 years old was found to be highly infected with *Ascaris lumibricoides, Cryptosporidium, Enterobius vermicularis, Hymenolepis nana, Hookworm, and Taenia*(Poudel et al., 2013).

A 2017 study by Yadav and Prakash found that 63.35% of the Muslim community in Janakpurdham had at least one type of GI parasite infection, with a higher prevalence in males. The most common parasite was Giardia lamblia. The study also found that populations that lived in large joint families with low income, did not wash their hands before and after meals, defecated in open areas, did not wash their hands and feet after defecation, and neglected to trim their nails were more likely to have a higher prevalence of parasitic infections (Yadav & Prakash, 2017). Furthermore, a study carried out in Jhapa'sBirtamode Municipality discovered that 27.53% of the Satar and Chaudhary populations had intestinal helminth parasites (Chaudhary & Subedi, 2020). In Dharan squatters, the proportion of infections in children under the age of eight was nearly equivalent to 46%, with *Giardia lamblia* and *Ascaris lumbricoids* being the most common parasites, according to (Chongbang et al., 2016). Similarly, the most common helminth was *Ascaris lumbricoides*, and the most common protozoan was *Entamoeba histolytica*. The incidence of intestinal parasite infection was 40% among the Chepang and 34.2% among the Musahar group (Yadav, 2023). Likewise,According to Parajuli and the colleagues, parasite incidence among some ethnic communities in Nepal was 68.8% (Adhikari et al., 2021). A recent study found that the intestinal helminth infection prevalence in the Magar Community of Nisdi Rural Municipality in Palpa was 31.07% and the *taeniasis* prevalence was 2.5% (Thapa, 2022). Additionally, a study carried out in the Meche community of the Jalthal Village Development Committee in Jhapa between June and July 2017 revealed that the prevalence of intestinal parasites in the Meche community was 28.33%, with a higher prevalence rate in females than in males. The age groups of 21 to 40 had the highest prevalence, with Ascaris lumbricoides being the most common species, followed by *Taenia solium, Hookworm, Entamoeba coli, and Trichuris trichiura*(Dhakal, 2018).The study found that among the Badi community in surkhet, the total prevalence of parasites was 27%, Only 7.8% of the group under study had helminthic diseases, while 19% had protozoan infections. *Giardia lamblia* had the highest prevalence 16.1%, followed by Ascaris lumbricoides 5.9%, *Entamoeba histolytica* 2.9%, and both *Enterobius vermicularis* and*Hymenolepis nana* 1%. Compared to the male populatio, the female population was exposed to E. histolytica at a higher rate 5.8% (Gautam et al., 2024). The findings of a province-wide survey in Jiangsu province, Eastern China, which covered both rural and urban areas, revealed that 0.37% of participants had intestinal parasite infections, with hookworm being the most prevalent parasite (Dai et al., 2019).

2.2 Intestinal parasitic infections with risk factors

Intestinal parasitic infections (IPIs) are influenced by various factors, including lifestyle (Chongbang et al., 2016), knowledge (Joshi et al., 2004), socioeconomic status(Tang & Luo, 2003), cultural background(Shrestha et al., 2007), and environmental conditions(Satoskar et al., 2009). Key determinants include the individual's education level(Jamaiah & Rohela, 2005), children with less educated mothers(Dudlová et al., 2016), low monthly income(Forson et al., 2017), and awareness of intestinal parasites(Dudlová et al., 2016), their transmission(Bhattachan et al., 2015). Behavioral factors also play a crucial role in the spread of these infections(Dhakal & Subedi, 2019).

Poor handwashing habits(Yadav, 2017), particularly failing to use soap before and after meals or after defecation(Gupta et al., 2020), increase the risk of infection. Additionally, not wearing shoes outdoors is considered a significant risk factor(Gupta et al., 2020). Water, sanitation, and hygiene (WASH) conditions directly impact children's nutritional status and susceptibility to IPIs(Kunwar et al., 2016). Nail biting is identified as a major source of parasitic infection(Yadav, 2017), while cestode infections are primarily linked to slaughtering practices(Kantzanou et al., 2021). The likelihood of contracting IPIs is also associated with whether individuals wear shoes regularly(Agrawal et al., 2012).Water serves as a significant pathway for the transmission of intestinal parasitic infections (IPIs)(Armenda et al., 2021; Khadka et al., 2021; Prov et al., 2022). Individuals who did not use water after using the toilet had a higher prevalence of parasitic infections compared to those who used bucket water(Amin, 2002; Haile et al., 2017; Harizanov et al., 2020; Omar & Abdelal, 2022). Habits such as thumb-sucking were strongly linked to intestinal parasite transmission(Shrestha et al., 2019;Wiggins, 2021), while both nail-biting and thumb-sucking facilitated fecal-oral parasite transmission(Villalobos et al., 2017). Finger-sucking was also identified as a strong predictor of IPIs(Dhanabal et al., 2014). People who consumed water directly from the source had a greater prevalence of infection(Shrestha et al., 2016). *T. trichiura* was detected in soil with a lower contamination rate(Panda, 2012), while poor sewerage systems were known to harbor parasites(Harizanov et al., 2020). Individuals who rarely or never wore slippers were at a higher risk of IPIs(Adhikari et al., 2021), as parasites can enter the body through the skin when walking barefoot(Pradhan et al., 2014). Open defecation, improper waste disposal, and floodwater contamination significantly contribute to waterborne parasite transmission(Dhanabal et al., 2014; Narayan & Shrestha, 2012; Ulhaq et al., 2022). Additionally, consuming unwashed fruits and vegetables increased the risk of infection, particularly among vegetarians(Poudyal et al., 2017). The likelihood of cestode infection was higher among individuals consuming vegetables grown in soil contaminated with cestode eggs, as well as those eating raw or undercooked meat, especially pork and beef(Joshi et al., 2004).

3 Materials and methods

3.1 Study area

This study was conducted in Koshi Rural Municipality, located in the Sunsari district of Madesh Province, Nepal, at coordinates 26.63°N and 87.06°E. Sunsari lies approximately 522 kilometers east of Kathmandu, the national capital, and is one of the fourten districts in Madesh Province. Covering an area of 1,257 square kilometers, the district comprises six urban municipalities and six rural municipalities, with Koshi Rural Municipality being one of them. According to the Nepal census, Koshi Rural Municipality has a total population of 48,804 and spans an area of 75.98 square kilometers. It is administratively divided into eight wards. The majority of the population (66.4%) speaks Maithili as their first language, followed by 19.43% who speak Urdu, 5.22% who speak Urau, 4.8% who speak Bangla, and 2.47% who speak Nepali, along with other languages. Regarding ethnicity and caste composition, 26.64% of the population identify as Muslim, 21.82% as Yadav, 9.36% as Musar, 5.42% as Jhangad, 5.04% as Chamar, and 1.42% as Bantar.

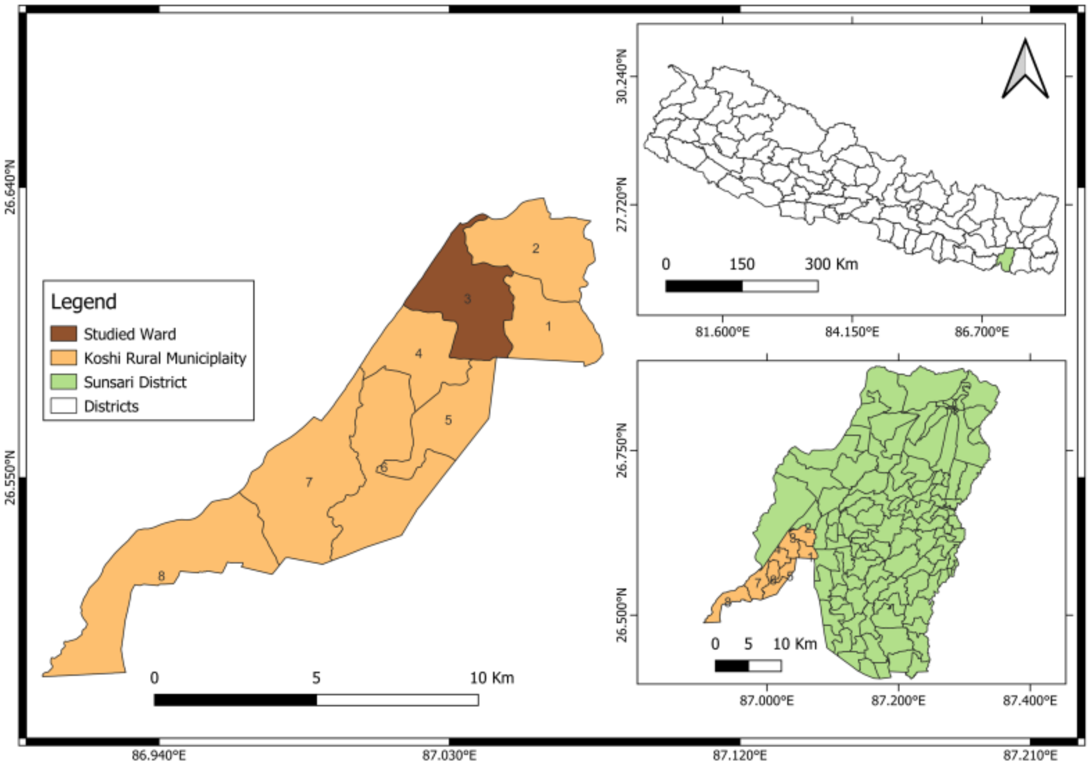


Figure 1: Map of Koshi Rural Muncipality-3

3.2 Sampling method

The Bantar community in Koshi Rural Municipality was estimated to have 212 households. From this estimate, 130 households were randomly selected based on their locations within the study area**.**

3.3 Sample size

The estimated population of the Bantar community in Koshi Rural Municipality was 635. For this study, a sample of 150 individuals was selected, comprising 75 females and 75 males. Data collection was conducted through a questionnaire survey.

3.4 Methods

The study was carried out from June to July 2022. A day before sample collection, participants were provided with sterile 20 ml vials and wooden applicators, along with detailed instructions on the proper collection procedure. A total of 150 samples were collected early in the morning, accompanied by a structured questionnaire. The stool samples were immediately preserved in a 2.5% potassium dichromate ($K_2Cr_2O_7$) solution, prepared by dissolving 25 grams of potassium dichromate in one liter of distilled water. The preserved samples were then transported to the Zoology Laboratory at the Central Department of Zoology for microscopic examination and further analysis.

3.4.1 Microscopic examination of stool samples

Microscopic examination was carried out using direct wet mount and Concentration techniques based on the procedure explain below.

Direct wet mount

The stool samples were mixed with a 2.5% potassium dichromate ($K_2Cr_2O_7$) solution using a glass rod. A small drop of the mixture was then transferred onto a clean glass slide with a plastic dropper and spread into a thin layer. A clean cover slip was placed over the smear, and any excess fluid was carefully removed using cotton and tissue paper. Before preparing the smear, 1–2 drops of Gram's iodine were added to enhance visibility and facilitate the examination of the nuclear material in protozoan cysts and trophozoites. This stained smear preparation aids in the identification and study of protozoan organisms(Tang & Luo, 2003).

Floatation technique

Two spatulas of stool were placed in a beaker, and approximately 5 ml of normal saline was added and stirred thoroughly. The mixture was then filtered, and 1 ml of the filtrate was transferred into a glass tube. Subsequently, 13 ml of normal saline was added, and the sample was centrifuged at 1000 rpm for 5 minutes. After centrifugation, the tube was carefully removed without disturbance, and the supernatant was discarded into a beaker. The eggs were concentrated at the bottom of the test tube. The remaining sediment in the tube was then mixed with saturated sodium chloride (NaCl) to form a convex surface at the top. A cover slip was placed over the tube and left undisturbed for 10 minutes. Finally, the cover slip was carefully transferred onto a clean glass slide and examined under a microscope for observation(Villalobos et al., 2017).

Sedimentation's technique

To analyze the stool samples, approximately two spatulas of the sample were mixed with 5 ml of a 10% normal saline solution. The mixture was then filtered, and 1 ml of the filtrate was transferred into a separate test tube containing 3 ml of ether and 10 ml of a 10% formal solution. This final mixture was centrifuged at 1000 rpm for 5 minutes and allowed to settle. The supernatant was carefully discarded, and the sediment was examined under a microscope using both unstained and stained smear preparations. The sample was first observed under low power (10X) and then under high power (40X) objectives, systematically scanning from one corner of the cover slip to the other(Villalobos et al., 2017).

3.4.2 Identification

The identification and measurement of protozoan cysts, oocysts, trophozoites, helminth eggs, and larvae were carried out by comparing the obtained photographs with reference images from published literature (Article, 2002; Dudlová et al., 2016; Narayan Yadav, 2017; Pradhan et al., 2014)**.**

3.4.3 Questionnaires

A questionnaire consisting of a set of questions was used both Nepali and English languages to gather information on the knowledge, attitudes, and practices of the Bantar people, encompassing various age groups and genders. The entire questionnaires were checked for accuracy and completeness. (Appendix 1)

3.5 Ethical approval

Approval for fecal sample collection was obtained from the ward offices and the Ethical Committee of the Nepal Health Research Council (NHRC) (Appendix). Participation in the study was entirely voluntary, and informed consent was secured from each participant. Before the survey, the purpose and procedures of the study were clearly explained to the participants in Nepali. The objectives and potential benefits of participation were communicated in advance, and participants were informed of their right to withdraw from the study at any stage during data collection (Appendix)

3.6 Data analysis

The data gathered from the field survey and laboratory analysis were statistically examined using Microsoft Excel 2013. Additionally, Pearson's Chi-squared test was conducted in SPSS software, with the significance level set at $p<0.05$

4 Results

4.1 Overall prevalence

A study conducted among the Bantar Community in Koshi Municipality, Sunsari, Nepal showed that 63.3% (95/150) of the population had gastrointestinal parasitic infections. Out of the 95 infected people, 51 were females and 44 were males. The infections were found to be caused by six different species of intestinal parasites, including two protozoans (*Entamoeba histolytica* and *Giardia lamblia*) and three helminthes (*Ascaris lumbricoides*, *Hymenolepsis nana*, and *Strongyloidesstercoralis*, *Trichuris trichuria*). The most prevalent parasite was *Ascaris* (18.8%), followed by *Giardia lamblia* (14.6%), *E. histolytica* (10%), *Strongyloidesstercoralis* (8.8%), *Hymenolepsis nana* (8%) and *Trichuris trichuria (3%).*

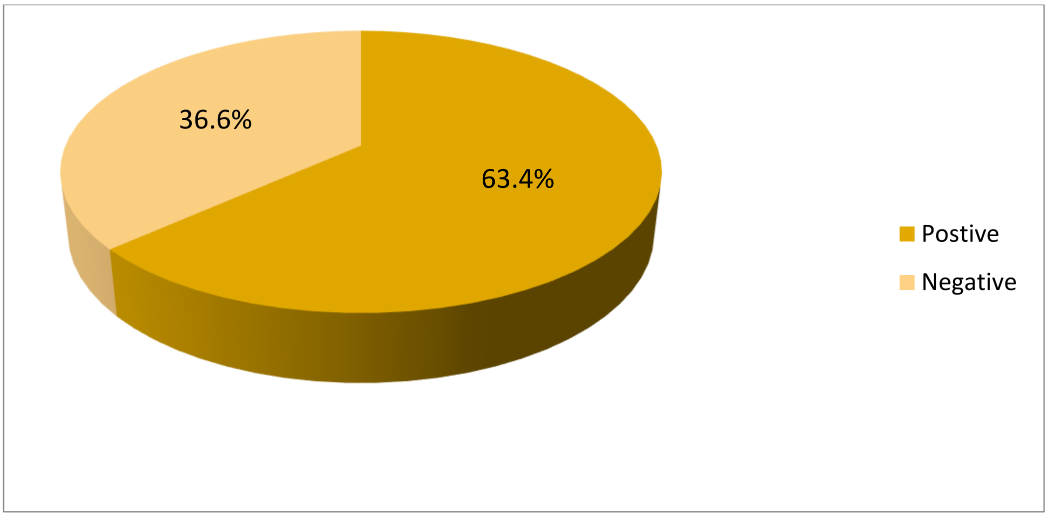


Figure 2: Overall prevalence

4.2 Species wise prevalence of intestinal parasites

On examination of 150 stool samples, the general prevalence of the intestinal parasites was found to be 95 (63.3%). Among total positive samples, the prevalence of protozoan infections 37 (24.6%) were lower than the helmimthes infection 58 (38.6%).

Table 1: Species wise prevalence of intestinal parasite

4.3 Sex-wise intestinal parasitic infections

Parasites	**Number of people infected**		**Prevalence (N=150)**
Protozoans	Male	Female	
Giardia lamblia	8	14	22(14.6%)
Entamoebia histolytica	4	11	15(10%)
helminthes			
Ascaris lumbricoides	10	18	28(18.8%)
Strongyloidesstercoralis	5	8	13(8.6%)
Hymenolepsis nana	3	9	12(8%)
Trichuris trichuria	2	3	5(3%)
Total	42	53	95(63.3%)

In total of 150 samples, 75 were of males and 75 were of females. Out of 75 samples examined from male, 44 (29.3%) were found to be positive. Similarly, out of 75samples examined from female, 51 (34%) were found to be positive. Hence, infection rate was found higher in female than in male. Statistically, there was no significant difference in the prevalence of intestinal parasites between male and female (χ^2=2.36, df=4, p=0.72).

Table 2:Sex-wise intestinal parasitic infections

	Intestinal Parasite	
	Positive	
Gender	n	%
Female	51(75)	34%
Male	44(75)	29.3%
Total	95(150)	63.3%

4.4 Age-wise prevalence of intestinal parasites

The study population was divided into two different age groups. Out of which the occurrence of intestinal parasites were maximum in 10-20 age group of and minimum in above 51-60 year's age group. Statistically, there was no significant difference in the prevalence of intestinal parasites between two different age groups (χ^2=4.36, df=1, P=0.73).

Table 3: Age-wise prevalence of intestinal parasites

		Intestinal parasites	
		Positive	
S.N	Ages(years)	n	Prevalence
1	10-20	35	23.3%
2	21-30	15	10%
3	31-40	20	13.3%
4	41-50	18	12%
5	51-60	7	4.6%

4.5 Concurrency of intestinal parasites

Out of 95 (63.3%) positive samples, 70 (46.6%) samples were found to have single infection (*Ascaris*, *Hymenolepsis*, *Strongyloides*, *Giardia*, *Entamoebia*, *Trichuris*), whereas only 25 (16.6%) samples were detected to mixed infection (*Giardia,Entamoebia, and Ascaris*).

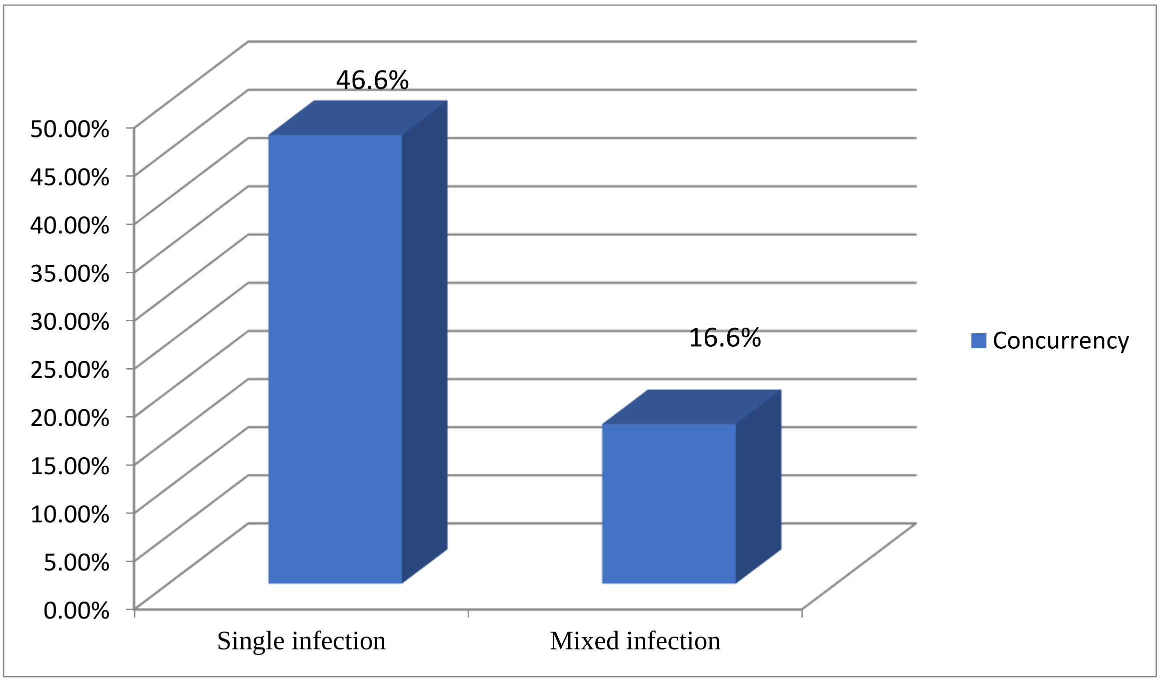


Figure 3: Concurrency of intestinal parasites

4.6 Assessment of the sociodemographic factor associated with intestinal parasitic infection

Various behavioral characteristics of the Bantar community in Koshi rural Municipality-3, Sunsari, were analyzed to determine their association with intestinal parasitic infections. A total of five risk factors were evaluated using a chi-square test

Table 4: Assessment of risk factor with intestinal parasitic infections

	Intestinal Parasites infections				
Risk factors	**Sub-groups**	**Positive**		**χ^2**	**P - value**
		n	%		
Drinking Water	By filtration	15	10%	2.45	0.001
	Non-filtration	80	53.3%		
Habit of hand washing	Only by water	85	56.6%	3.56	0.000
	With soap	10	6.6%		
Literacy	Yes	35	23.3%	4.56	0.0002
	NO	60	40%		
Nail trimming and biting habit	Yes	68	45.3%	3.56	0.0001
	No	27	18%		

5 Discussions

This study highlights the widespread presence of gastrointestinal parasites within the Bantar community in eastern Nepal, with a recorded prevalence of 63.3%. To my knowledge, this is the first study in the country to report such a high prevalence and diverse range of intestinal parasites in Bantar communities. Therefore, this research can serve as a reference model for studying parasitic diseases in indigenous communities both in Nepal and beyond. In this study, parasitic infections were detected in 63.3% of the 150 stool samples collected from the ethnic Bantarpopulation. However, this prevalence rate is lower compared to findings reported from India (97.4%) (Kang et al., 1998) and Nepal 81%(Yadav, 2023).Somewhat this result is slightly higher than the finding such as such as 27.33% among the Meche community of Jalthal Village Development Committee of Jhapa(Dhakal, 2018) , 24.1% among slum dwelling population in Kaski(Khadka et al., 2019) in Nepal, 27.67% among school-children of Bhaktapur in Nepal(Sharma et al., 2020), 21.4% at Ujjain, Madhya Pradesh in India(Yogyata & Binita, 2011), 28.63% among the Satar and Chaudhary Communities of Birtamode Municipality, Jhapa in Nepal(Chaudhary&Subedi, 2020), 24.04% among community people of Kushma Municipality, Parbat in Nepal(Factors et al., 2013), 29.5% among the Tharu community in Pawanagar in Dang (*Prevalence of Intestinal Parasites in Tharu*, 2016), 17.6% among school children in Kathmandu, Nepal(KC et al., 2019), 15% among school childrean in Pokhara in Nepal(Tiwari et al., 2019), 17% among the Kumal community in Chitwan(Gyawali, 2013), 36.6% among Chepang and Musahar Community of Makwanpur and Nawalparasi in Nepal(Adhikari et al., 2021), 41.1% among the Squatter community in Dharan in Sunsari(Chongbang et al., 2016), 28% among the Badi community in Surkhet(Gautam et al., 2024). This difference might be due to sample size, place, climate and weather, poverty, malnutrition, health awareness, and living standards of people and examination techniques.The prevalence of helminth was found to be higher than that of the protozoan. This finding is in accordance with the results of similar studies carried in different parts of Nepal(Bhattachan B et al., 2015; KC et al., 2019; Khadka et al., 2021; Narayan Yadav, 2017; Shrestha et al., 2007; Tandukar et al., 2013b).On the contrary, higher prevalence of helmimthes was reported in the other studies from Nepal (Amin, 2002; Chandrashekhar et al., 2009; Das et al., 2006; Norhayati et al., 2003)Among the helminth parasites, *Ascaris* was the most common observed parasites. Same result was seen in the past studies (Dudlová et al., 2016; A. Shrestha et al., 2007;

Tang & Luo, 2003; Tiwari et al., 2019).This might be due to the unhygienic behavior, using of contaminated water resources, drinking of tape water without filtered. However, not taking deworming tablets in regular basis was also playing the supportive role for higher prevalence of protozoan over helminthes.Gender-wise parasitic infection rate was slightly higher in female which is comparable with studies done by (Article, 2002; Dudlová et al., 2016; Forson et al., 2017; Kumar Sah et al., 2021; A. Shrestha et al., 2007; Tandukar et al., 2013b).All these studies showed no significant association between gender and parasitic infections(KC et al., 2019; Narayan Yadav, 2017; Tandukar et al., 2013b). This might be due to the Involvement of female in childcare, their lower educational status, more soil contact during growing vegetables more often than males is responsible for increased risk in them. Moreover, this possibility could be due to higher number of female respondents involved in the study.Based on the age of the people included in study, the infection was found higher in the age group 10-20 and lowest among the elder people which is slightly similar to the report of(Forson et al., 2017; Khadka et al., 2021; Omar & Abdelal, 2022; K. Yadav & Prakash, 2017). Several studies like, age groups (50-60) was a higher infected(Bhattachan B et al., 2015; Khadka et al., 2021; Narayan Yadav, 2017), among the (45+) years people of Kumal community was higher prevalence than the below the 10 years(Gyawali, 2013), among the (50+) years people of Tharu community was a high prevalence than the (20-40) years people (*Prevalence of Intestinal Parasites in Tharu*, 2016). This might be due to the sample size.The prevalence of helminth infections was higher than that of protozoan infections. This finding are similar with the results of research conducted in various regions of Nepal (Bhattachan B et al., 2015; Dai et al., 2019; K. Yadav & Prakash, 2017). In contrast, other studies from Nepal have reported a higher prevalence of protozoan infections (Chaudhary & Raj Subedi, 2020; Haile et al., 2017; Kang et al., 1998; Shrestha & Maharjan, 2013; Tandukar et al., 2013a; Yogyata & Binita, 2011). Among the helminth parasites, *Ascaris* was the most commonly observed species, consistent with findings from previous studies (Crompton & Savioli, 1993; Das et al., 2006; Jamaiah & Rohela, 2005; Khanal et al., 2011; A. Shrestha et al., 2007). This might be attributed to poor hygiene practices, consumption of contaminated water, and drinking unfiltered tap water. Additionally, irregular deworming treatment may also contribute to the higher prevalence of helminth parasites compared to protozoan.The use of filtered or unfiltered drinking water was identified as a significant factor influencing intestinal parasite infections. This finding is consistent with a study conducted in Nepal by (Agrawal et al., 2012;

Bhattachan et al., 2015; Panda, 2012; Tandukar et al., 2013b). The contamination of water sources by human and animal waste may be a contributing factor, aligning with findings from a study in India by (Jamaiah & Rohela, 2005),(Kang et al., 1998; Sehgal et al., 2010).Similarly, individuals from the Bantar community who did not wash their hands with soap before and after meals or after defecation had a significantly higher rate of intestinal parasite infections. This finding aligns with studies conducted in Nepal(Gautam et al., 2024), in China (Tang & Luo, 2003), and in Malaysia (Jamaiah & Rohela, 2005).Untrimmed nails among individuals in the Bantar community were identified as a highly significant factor for intestinal parasitic infections (IPIs) in this study. This finding is consistent with research conducted in Nepal (Gyawali, 2013), in Pakistan (Ulhaq et al., 2022), and in India by(Sehgal et al., 2010). Untrimmed nails may serve as a reservoir for parasite eggs, which can be ingested upon hand-to-mouth contact, leading to IPIs, as discussed (Das et al., 2006; Norhayati et al., 2003; Shrestha & Maharjan, 2013).The literacy level of individuals in the Bantar community was found to be a highly significant factor influencing intestinal parasitic infections (IPIs), as demonstrated in this study. This finding aligns with previous studies such as(Crompton & Savioli, 1993; Jamaiah & Rohela, 2005; Malla B , Ghimire P, 2004; Shrestha & Maharjan, 2013). Additionally, hygiene maintenance, medication use, and were also significant factors associated with IPIs, similar to findings from studies such as (Parajuli et al., 2014; Sehgal et al., 2010;).Most individuals in the Bantar community lack awareness regarding the transmission of parasitic diseases, a finding that partially aligns with the results of (Das et al., 2006; Dhakal & Subedi, 2019; Haile et al., 2017; Pradhan et al., 2014; Satoskar et al., 2009). The present study indicates that knowledge of parasitic infections is significantly low in this community due to inadequate public health awareness and limited health education. Various socioeconomic and behavioral factors among different castes and ethnic groups contribute to the prevalence of intestinal parasites.The high prevalence of intestinal parasites among the Bantar community in Koshi Rural Municipality, Sunsari District, highlights the urgent need for public health awareness programs focusing on personal hygiene, proper environmental sanitation, and the use of safe drinking water. Additionally, regular mass deworming programs should be implemented periodically to control infections effectively.

6 Conclusion and Recommendations

6.1 Conclusion

Intestinal parasite infections are strongly associated with hygiene and sanitation practices. A recent study revealed that the health conditions of the Bantar people in Koshi rural Municipality remain poor, with an overall intestinal parasite prevalence of 63.3%. Helminth infections were more common than protozoan infections, with *Ascaris* being the most frequently detected parasite among the six identified species. The highest prevalence of intestinal parasitic infections (IPIs) was observed in individuals aged 10-20, with females being more vulnerable than males. The study also found that single infections were more prevalent than double infections. Several factors significantly influenced the occurrence of IPIs, including hygiene habits such as washing vegetables, trimming nails, handwashing, medication use. However, no significant differences were noted in infection rates based on sex, age group. The findings suggest that the Bantar community has limited awareness of health education. Factors such as poverty, inadequate sanitation, lack of education, poor personal hygiene, unclean water sources, and low awareness levels contribute to their increased risk of intestinal parasite infections.

6.2. Recommendations

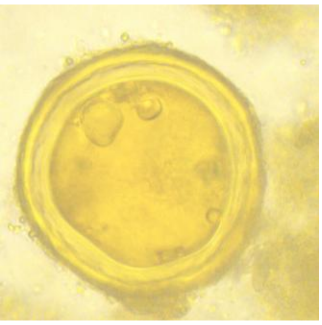
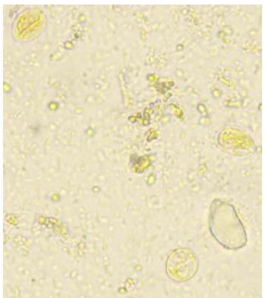
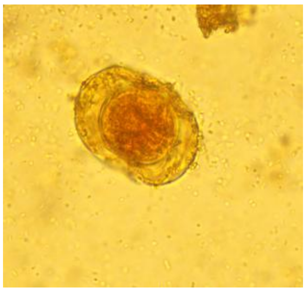
1. The high prevalence of intestinal parasitic infections, particularly among the Bantar community (63.3%), reflects the current health status of this ethnic group. However, to gain a comprehensive understanding, similar studies should be conducted nationwide.

2. The higher prevalence of helminth infections compared to protozoan infections suggests contamination in the village's water supply. Therefore, appropriate measures should be taken to ensure proper water management.

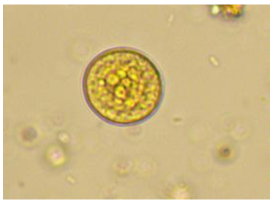
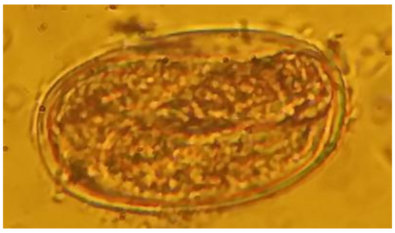
3. Several significant predisposing factors were identified, including handwashing before meals, regular nail trimming, and type of drinking water, nail-biting, walking barefoot and vegetable consumption. Implementing proper sanitation practices is essential to address these issues.

4. Regular administration of anti-parasitic medication is recommended, along with awareness campaigns to educate communities on controlling intestinal parasitic infection.

Photographs

(a) ***) Ascaris lumbricoides (b) Giardia lamblia (c) Hymenolepsis nana***

(d) ***Trichuris trichiura*** **(e)** ***Entamoeba histolytica*** **(f)*****StrongyloidesStercoralis***

References

Adhikari, R. B., Parajuli, R. P., Maharjan, M., & Ghimire, T. R. (2021). Prevalence and risk factors of gastrointestinal parasites in the Chepangs in Nepal. *Annals of Parasitology, 67*(3), 387–405. https://doi.org/10.17420/ap6703.353

Agrawal, P. K., Rai, S. K., Khanal, L. K., Ghimire, G., Banjara, M. R., & Singh, A. (2012). Intestinal parasitic infections among patients attending Nepal Medical College Teaching Hospital, Kathmandu, Nepal. *Nepal Medical College Journal : NMCJ*, *14*(2), 80–83.

Alvarado-Villalobos, M. A., Cringoli, G., Maurelli, M. P., Cambou, A., Rinaldi, L., Barbachano-Guerrero, A., Guevara, R., Chapman, C. A., & Serio-Silva, J. C. (2017). Flotation techniques (FLOTAC and mini-FLOTAC) for detecting gastrointestinal parasites in howler monkeys. *Parasites and Vectors*, *10*(1), 4–11. https://doi.org/10.1186/s13071-017-2532-7

Amin, O. M. (2002). Seasonal prevalence of intestinal parasites in the United States during 2000. *American Journal of Tropical Medicine and Hygiene*, *66*(6), 799–803. https://doi.org/10.4269/ajtmh.2002.66.799

Armenda, S., Rusmawatiningtyas, D., Makrufardi, F., & Arguni, E. (2021). Factors associated with clinical outcomes of pediatric dengue shock syndrome admitted to pediatric intensive care unit : A retrospective cohort study. *Annals of Medicine and Surgery*, *66*(May), 102472. https://doi.org/10.1016/j.amsu.2021.102472

Article, O. (2002). *Intestinal Parasitic Infestation in Healthy School*. 266–270.

Bhattachan B, Panta YB, Tiwari S, Thapa Magar D, Sherchand JB, Rai G, & Rai SK. (2015). Intestinal Parasitic Infection among School children in Chitwan district of Nepal. *Journal of Institute of Medicine*, *37*(2), 79–84.

National Statistics Of fi ce, 1 National report on caste/ethnicity, language &religion 1 (2021). www.nsonepal.gov.np, www.censusnepal.cbs.gov.np

Chandrashekhar, T., Joshi, H., Gurung, M., Subba, S., Rana, M., & Shivananda, P. (2009). Prevalence and distribution of intestinal parasitic infestations among school children in Kaski District, Western Nepal. *Journal of Medicine and Biomedical Research*, *4*(1), 78–82. https://doi.org/10.4314/jmbr.v4i1.10672

Chaudhary, S., & Raj Subedi, J. (2020). Comparative Prevalence of Intestinal Helminths in Satar and Chaudhary Communities of Birtamode Municipality, Jhapa, Nepal. *National Journal of Health Sciences*, *5*(1), 4–12. https://doi.org/10.21089/njhs.51.0004

Chongbang, R., Dongol, P., Chakrawarti, A., & Khanal, H. (2016). Parasitic Infections among Children of Squatter Community in Dharan Municipality, Sunsari, Nepal. *International Journal of Applied Sciences and Biotechnology*, *4*(2), 203–206. https://doi.org/10.3126/ijasbt.v4i2.15099

Crompton, D. W. T., & Savioli, L. (1993). Intestinal parasitic infections and urbanization. *Bulletin of the World Health Organization*, *71*(1), 1–7.

Dai, Y., Xu, X., Liu, J., Jin, X., Shen, M., Wang, X., Cao, J., & Yang, H. (2019). Prevalence of intestinal helminth infections in Jiangsu Province, eastern China; A cross-sectional survey conducted in 2015. *BMC Infectious Diseases*, *19*(1), 1–9. https://doi.org/10.1186/s12879-019-4264-0

Das, R., Kumar, P. S., & Biswas, R. (2006). “Prevalence of intestinal-parasites and its association with sociodemographic, environmental and behavioral factors in children in Pokhara valley, Nepal.” In *African Journal of Clinical and Experimental Microbiology* (Vol. 7, Issue 2). https://doi.org/10.4314/ajcem.v7i2.7439

Dhakal, N. (2018). *Prevalence of Intestinal Parasites in Meche Community of Jalthal VDC, Jhapa, Nepal in Relation To Their Socio-Economic Status*. http://107.170.122.150:8080/xmlui/handle/123456789/1418

Dhakal, N., & Subedi, J. R. (2019). Intestinal parasites in Meche community in relation to their socio-economic status. *Janaki Medical College Journal of Medical Science*, *7*(1), 14–24. https://doi.org/10.3126/jmcjms.v7i1.29920

Dhanabal, J., Selvadoss, P. P., & Muthuswamy, K. (2014). Comparative study of the prevalence of intestinal parasites in low socioeconomic areas from South Chennai, India. *Journal of Parasitology Research*, *2014*. https://doi.org/10.1155/2014/630968

Dudlová, A., Juriš, P., Jurišová, S., Uška, P. J. A. R. Č., & Méry, V. K. R. Č. (2016). *Epidemiology and geographical distribution of gastrointestinal parasitic infection in humans in Slovakia*. 309–317. https://doi.org/10.1515/helmin-2016-0035

Factors, A. R., Parasitic, I., Of, P., & Municipality, K. (2013). *PREVALENCE AND ASSOCIATED RISK FACTORS OF INTESTINAL PARASITIC INFECTION AMONG COMMUNIry 7 : y : ht , g*.

Forson, A. O., Arthur, I., Olu-Taiwo, M., Glover, K. K., Pappoe-Ashong, P. J., & Ayeh-Kumi, P. F. (2017). Intestinal parasitic infections and risk factors: A cross-sectional survey of some school children in a suburb in Accra, Ghana. *BMC Research Notes*, *10*(1), 4–8. https://doi.org/10.1186/s13104-017-2802-7

Gautam, J., Parajuli, R. P. P., & Pandey, K. (2024). Prevalence and associated factors of intestinal parasitic infections in the Badi indigenous communities of Western Nepal. *Journal of Health, Population and Nutrition*, 1–11. https://doi.org/10.1186/s41043-024-00694-1

Gupta, R., Rayamajhee, B., Sherchan, S. P., Rai, G., Mukhiya, R. K., Khanal, B., & Rai, S. K. (2020). Prevalence of intestinal parasitosis and associated risk factors among school children of Saptari district, Nepal: A cross-sectional study. *Tropical Medicine and Health*, *48*(1). https://doi.org/10.1186/s41182-020-00261-4

Gurung, B., Subedi, J. R., & Chhetri, B. (2019). Prevalence of Intestinal Parasites among Public and Private School Children below 10 years' at Tarakeswor-10 Manamaiju, Kathmandu, Nepal. *National Journal of Health Sciences, 4*(3), 97–102. https://doi.org/10.21089/njhs.43.0097

Gyawali, P. (2013). Parasitic Diseases of Indigenous Community (Kumal) in Nepal. *Nepal Journal of Science and Technology*, *13*(2), 175–178. https://doi.org/10.3126/njst.v13i2.7731

Haile, A., Abera, T., & Dana, D. (2017). The prevalence of intestinal parasitic infection and associated factors among primary school children in Gurage Zone, South Ethiopia. *Journal of Pharmacy and Alternative Medicine*, *15*(2017), 8–15. www.iiste.org

Harizanov, R., Rainova, I., Tsvetkova, N., Kaftandjiev, I., Borisova, R., Ivanova, A., & Videnova, M. (2020). Prevalence of intestinal parasitic infections among the Bulgarian population over a three year period (2015-2017). *Helminthologia (Poland)*, *57*(1), 12–18. https://doi.org/10.2478/helm-2020-0002

Jamaiah, I., & Rohela, M. (2005). Prevalence of intestinal parasites among members of the public in Kuala Lumpur, Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health*, *36*(1), 68–71.

Joshi, D. D., Maharjan, M., Johnsen, M. V., Willingham, A. L., Gaihr, Y., & Sharma, M. (2004). Taeniasis/cysticercosis situation in Nepal. *Southeast Asian Journal of Tropical Medicine and Public Health*, *35*(SUPPL. 1), 252–258.

Kang, G., Mathew, M. S., Rajan, D. P., Daniel, J. D., Mathan, M. M., Mathan, V. I., & Muliyil, J. P. (1998). Prevalence of intestinal parasites in rural Southern Indians. *Tropical Medicine and International Health*, *3*(1), 70–75. https://doi.org/10.1046/j.1365-3156.1998.00175.x

Kantzanou, M., Karalexi, M. A., Vrioni, G., & Tsakris, A. (2021). Prevalence of intestinal parasitic infections among children in europe over the last five years. *Tropical Medicine and Infectious Disease*, *6*(3). https://doi.org/10.3390/TROPICALMED6030160

KC, U., Rai, S. K., Basnyat, S., & Upreti, M. (2019). Prevalence of Intestinal Parasitic Infections among Schoolchildren of Kapan VDC, Kathmandu. *International Journal of Applied Sciences and Biotechnology*, *7*(1), 22–26. https://doi.org/10.3126/ijasbt.v7i1.21637

Khadka, S., Sapkota, S., Adhikari, S., Dubey, A. K., Thapa, A., Bashyal, R., & Bhusal, H. (2021). Intestinal Parasitoses among Chepang and Musahar Community People of Makwanpur and Nawalparasi Districts of Nepal. *Acta Parasitologica*, *66*(1), 146–154. https://doi.org/10.1007/s11686-020-00269-0

Khanal, L. K., Choudhury, D. R., Rai, S. K., Sapkota, J., Barakoti, A., Amatya, R., & Hada, S. (2011). Prevalence of intestinal worm infestations among school children in Kathmandu, Nepal. *Nepal Medical College Journal : NMCJ*, *13*(4), 272–274.

Kumar Sah, R., Jha, A., Nandan Sah, S., & Kumar Sah, P. (2021). Prevalence of intestinal parasites among school children of Janakpurdham, Nepal. *IP International Journal of Medical Microbiology and Tropical Diseases*, *7*(2), 94–99. https://doi.org/10.18231/j.ijmmtd.2021.021

Kunwar, R., Acharya, L., & Karki, S. (2016). Trends in prevalence of soil-transmitted helminth and major intestinal protozoan infections among school-aged children in Nepal. *Tropical Medicine and International Health*, *21*(6), 703–719. https://doi.org/10.1111/tmi.12700

Malla B , Sherchand JB, Ghimire P, B. R. K. and G. P. (2004). Prevalence of Intestinal Parasitic Infections and Malnutrition among Children in a Rural Community of Sarlahi , Nepal. *Journal of Nepal Health Research Council*, *2*(1), 2–4.

Narayan, K., & Shrestha, A. (2012). Prevalence of Intestinal Parasitosis Among School Children in Baglung District of Western Nepal Corresponding Author. *Kathmandu Univ Med J*, *10*(1), 3–6.

Narayan Yadav, S. (2017). Study on Intestinal Helminth Parasites in School Children of Rangeli Municipality of Morang District in Eastern Nepal. *American Journal of Health Research*, *5*(2), 50. https://doi.org/10.11648/j.ajhr.20170502.15

Norhayati, M., Fatmah, M. S., Yusof, S., & Edariah, A. B. (2003). Intestinal parasitic infections in man: A review. *Medical Journal of Malaysia*, *58*(2), 296–306.

Omar, M., & Abdelal, H. O. (2022). Current status of intestinal parasitosis among patients attending teaching hospitals in Zagazig district, Northeastern Egypt. *Parasitology Research*, *121*(6), 1651–1662. https://doi.org/10.1007/s00436-022-07500-z

Panda, D. S. (2012). Prevalence of Intestinal Parasitic Infections among School Children in Rural Area of Vizianagaram. *IOSR Journal of Pharmacy and Biological Sciences*, *3*(3), 42–44. https://doi.org/10.9790/3008-0334244

Parajuli, R. P., Fujiwara, T., Umezaki, M., Konishi, S., Takane, E., Maharjan, M., Tachibana, K., Jiang, H. W., Pahari, K., & Watanabe, C. (2014). Prevalence and risk factors of soil-transmitted helminth infection in Nepal. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *108*(4), 228–236. https://doi.org/10.1093/trstmh/tru013

Poudyal, N., Lb, S., Gautam, S., Dk, Y., Baral, R., & Gurung, R. (2017). *Prevalence of intestinal parasitic infection / infestation in differently abled people of Dharan , Nepal*. *8*(09), 538–540.

Pradhan, P., Bhandary, S., Shakya, P. R., Acharya, T., & Shrestha, A. (2014). Prevalence of intestinal parasitic infections among public school children in a rural village of Kathmandu Valley. *Nepal Medical College Journal : NMCJ*, *16*(1), 50–53.

Prasad, B., Janak, Y., & Subedi, R. (2024). *Gastrointestinal parasites among Musahar Community in Balan-Bihul , Saptari ,*. *8*(2).

Prevalence of Intestinal Parasites in Tharu. (2016).

Prov-, K., Welfare, S., & Provinces, K. (2022). *The Issue of Children ' s*.

Satoskar, A. R., Simon, G. L., Hotez, P. J., & Tsuji, M. (2009). Medical parasitology. *Medical Parasitology*, 1–298. https://doi.org/10.1201/9781498713672

Saud, B. (2017). Prevalence of Intestinal Parasitic Infection among Rural Area School Children of Lokhim VDC, Nepal. *Journal of Microbiology & Experimentation*, *4*(1), 12–14. https://doi.org/10.15406/jmen.2017.04.00102

Sehgal, R., Reddy, G. V, Verweij, J. J., & Subba, A. V. (2010). *Prevalence of intestinal parasitic infections among school children and pregnant women in a low socio-economic area , Chandigarh , North India*. *1*(2), 100–103.

Sharma, M., Sapkota, J., Jha, B., Mishra, B., & Bhatt, C. P. (2020). Prevalence of intestinal parasitic infestation among public school children of a community. *Journal of the Nepal Medical Association*, *58*(225), 293–296. https://doi.org/10.31729/jnma.4892

Shrestha, A., Rai, S. K., Basnyat, S. R., Rai, C. K., & Shakya, B. (2007). Soil transmitted helminthiasis in Kathmandu, Nepal. *Nepal Medical College Journal : NMCJ*, *9*(3), 166–169.

Shrestha, J., Bhattachan, B., Rai, G., Park, E. Y., & Rai, S. K. (2019). Intestinal parasitic infections among public and private schoolchildren of Kathmandu, Nepal: Prevalence and associated risk factors. *BMC Research Notes*, *12*(1), 0–7. https://doi.org/10.1186/s13104-019-4225-0

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

Shrestha, S., Laluwa, S., Ranamagar, B., Thapa, P., Pradhan, M., Adhikari, N., & Thapa Shrestha, U. (2016). Intestinal Parasitosis among School Going Children in Bhaktapur, Nepal. *International Journal of Medicine and Biomedical Sciences*, *1*(2), 1–6. https://doi.org/10.55530/ijmbiosnepal.v1i2.9

Singh Khadka, K., Prasad Kaphle, H., Gurung, K., Shah, Y., & Sigdel, M. (2019). Study of Intestinal Parasitosis among School Going Children in Pokhara, Nepal. *Journal of Health and Allied Sciences*, *3*(1), 47–50. https://doi.org/10.37107/jhas.54

Study on Intestinal Parasitic Infections in Badi , Tharu and High Caste Community of Kailali and Kanchanpur Districts Dissertation Presented To Central Department of Microbiology Tribhuvan University in Partial Fulfillment of the Requirement for the Award. (2010).

Tandukar, S., Ansari, S., Adhikari, N., Shrestha, A., Gautam, J., Sharma, B., Rajbhandari, D., Gautam, S., Nepal, H. P., & Sherchand, J. B. (2013a). Intestinal parasitosis in school children of Lalitpur district of Nepal. *BMC Research Notes*, *6*(1). https://doi.org/10.1186/1756-0500-6-449

Tandukar, S., Ansari, S., Adhikari, N., Shrestha, A., Gautam, J., Sharma, B., Rajbhandari, D., Gautam, S., Nepal, H. P., & Sherchand, J. B. (2013b). Intestinal parasitosis in school children of Lalitpur district of Nepal. *BMC Research Notes*, *6*, 449. https://doi.org/10.1186/1756-0500-6-449

Tang, N., & Luo, N. J. (2003). A cross-sectional study of intestinal parasitic infections in a rural district of west China. *Canadian Journal of Infectious Diseases*, *14*(3), 159–162. https://doi.org/10.1155/2003/721930

Thapa, S. (2022). *Magar community* (pp. 1–68). https://elibrary.tucl.edu.np/bitstream/123456789/18918/1/Full Thesis.pdf

Tim May, Malcolm Williams, Richard Wiggins, and P. A. B. (2021). *Chepang Community and their Occupational Shift: A case study of Bhimphedi Rural Municipality-1, Nayagau Makwanpur District*. *1996*, 6.

Tiwari, B. R., Chaudhary, R., Adhikari, N., Jayaswal, S. K., Poudel, T. P., & Rijal, K. R. (2019). Prevalence of Intestinal Parasitic Infections among School Children of Dadeldhura District, Nepal. *Journal of Health and Allied Sciences*, *3*(1), 14–16. https://doi.org/10.37107/jhas.44

Ulhaq, Z., Khan, W., Khan, M. F., Kabir, M., Ujjan, A. A., Ullah, W., Masood, Z., Khan, S., & De los Ríos Escalante, P. (2022). Prevalence of intestinal parasitic diseases in school children of rural areas of district lower dir, pakistan. *Brazilian Journal of Biology*, *82*, 8–15. https://doi.org/10.1590/1519-6984.243150

Yadav, B. P. (2023). *GASTROINTESTINAL PARASITES IN MUSAHAR COMMUNITY IN BALAN BIHUL , SAPTARI , NEPAL*. *558*.

Yadav, K., & Prakash, S. (2017). Study on Intestinal Parasitic Infections in Muslim community of Janakpurdham, Nepal. *Janaki Medical College Journal of Medical Science*, *4*(1), 36–45. https://doi.org/10.3126/jmcjms.v4i1.16383

Yogyata, M., & Binita, S. (2011). Prevalence of intestinal parasites at Ujjain, Madhya Pradesh, India: Five-year study. In *African Journal of Microbiology Research* (Vol. 5, Issue 18, pp. 2711–2714). https://doi.org/10.5897/ajmr11.459

Appendices

Appendix .1

<u>Baseline Questionnaires related to demographic, socioeconomic and behavioral factors</u>

Participant Code/ Name:

Gender: ☐Male ☐Female Age:

1. In general, how would you rate your health on a scale of 1 to 5?

☐1 ☐2 ☐3 ☐4 ☐5

2. What type of drinking water do you prefer?

☐Tap water ☐Jar water ☐Boiled water ☐Filtered water

3. How frequently do you maintain your hygiene?

☐Always ☐Nearly always ☐Nearly never ☐Never

4. What is your Occupation?

☐Govt. Employee ☐Business ☐Farmer ☐other specify

5. Do you use soap to wash your hands before eating?

☐Yes ☐No, but with water ☐sometimes ☐Spoon

6. Do you cut and clean your nails once a week?

☐ Yes ☐No ☐sometimes

7. Do you eat any fruits or green vegetables without washing?

☐Yes ☐No ☐sometimes

8. Do you wear foot ware while outdoors?

☐Yes ☐No ☐sometimes not

9. How many family members are in House?

10. Do you cover food from flies?

☐Yes ☐No ☐sometimes

11. Do you bite fingernails?

☐Yes ☐ No ☐sometimes

12. Do you play with Soils?

☐Yes ☐No ☐sometimes

13. Do you eat food (any) dropped on the floor?

☐Yes ☐No ☐sometimes

14. Do you drink Boiled water?

☐Yes ☐No ☐sometimes

15. Do you know at least a way to prevent intestinal helminthiasis?

16. Did you consume any medication for intestinal helminths parasites in the last 6 months?

☐Yes ☐ No

17. Do you have free-ranging pig or poultry in the house?

☐Yes ☐ No

18. Did you notice any worm in your stool?

☐Yes ☐ No

19. How frequently have you experienced diarrhea or abdominal discomfort in a month?

20. Do you ever consumed raw meat?

☐Yes ☐No ☐Maybe

Ethical Approval (Appendix2)

Government of Nepal
Nepal Health Research Council (NHRC)
Estd. 1991

Ref. No.: 1004

1 November 2021

Dr. Kishor Pandey
Principal Investigator
Central Department of Zoology, Kirtipur
Kathmandu

Ref: Approval of research proposal

Dear Dr. Pandey,

This is to certify that the following protocol and related documents have been reviewed and granted approval through the expedite review process by the Expedited Review Sub-Committee meeting for it's implementation.

Protocol Registration No/ Submitted Date	586/2021 P 19 October 2021		**Sponsor Protocol No**	NA	
Principal Investigator/s	Dr. Kishor Pandey		**Sponsor Institution**	NHRC Grant	
Title	Molecular surveillance of Schistosoma species in Sunsari District of Nepal				
Protocol Version No	NA		**Version Date**	NA	
Other Documents	1. Data collection tools 2. Informed Consent Form 3. Support letter 4. Assent form		**Risk Category**	Minimal risk	
Co-Investigator/s	NA				
Study Site	1. Sunsari District				
Type of Review	√	**Expedited**	**Duration of Approval** 1 November 2021 to 1 November 2022		**Frequency of continuing review** NA
	☐	Full Board			
	Meeting Date: 28 October 2021				

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