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Signature: *Anand*

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**Distributions of Gastrointestinal Parasites Among the Badi
Community of Gurbhakot Municipality, Surkhet, Nepal**

Jitendra Gautam

T.U. Registrations No. 5-2-55-479-2015

T.U. Examinations Roll No. 921/077

Batch: 2077

Central Department of Zoology

Institute of Science and Technology

Tribhuvan University

Kirtipur, Kathmandu,

Nepal

A dissertation submitted

**In partial fulfillment of the requirements for the award of the degree
Of Master of Science in Zoology with special paper Parasitology**

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Signature: *Arun*

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Jitendra Gautam

TU Registration No. 5-2-55-479-2015

M.Sc. Zoology (Parasitology)

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Supervisor

Kishor Pandey, PhD

Associate Professor

Central Department of Zoology

Institute of Science and Technology

Tribhuvan University Kirtipur, Kathmandu

Nepal

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April 2024

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April 2024

E-mail: jitendragautam1232@gmail.com

Central Department of Zoology

Institute of Science and Technology

Tribhuvan University Kirtipur,

Kathmandu, Nepal

Website: <https://www.cdz.tu.edu.np/>

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त्रिभुवन विश्वविद्यालय
TRIBHUVAN UNIVERSITY

प्राणी शास्त्र केन्द्रीय विभाग

CENTRAL DEPARTMENT OF ZOOLOGY

कीर्तिपुर, काठमाडौं, नेपाल
Kirtipur, Kathmandu, Nepal



०१-४३३१८९६

01-4331896

Email: info@cdztu.edu.np

URL: www.cdztu.edu.np

पत्र संख्या :-

च.नं. Ref.No.:-

Recommendation

This is to recommend that the dissertation entitled "Distributions of gastrointestinal parasites among the Badi community of Gurbhakot Municipality, Surkhet, Nepal" has been carried out by Mr. Jitendra Gautam for the partial fulfillment of Master's Degree of Science in Zoology with special paper Parasitology. This is his original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other Degree in any institutions.

K. Pandey

Supervisor

Kishor Pandey, PhD

Associate Professor

Central Department of Zoology

Tribhuvan University

Kirtipur, Nepal

Date. 28. March. 2024



त्रिभुवन विश्वविद्यालय
TRIBHUVAN UNIVERSITY

प्राणी शास्त्र केन्द्रीय विभाग

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कीर्तिपुर, काठमाडौं, नेपाल ।
Kirtipur, Kathmandu, Nepal.

०१-४३३१८९६

01-4331896

Email: info@cdztu.edu.np

URL: www.cdztu.edu.np

पत्र संख्या :-

च.नं. Ref.No.:-

Letter of approval

On the recommendation of supervisor Dr. Kishor Pandey this dissertation submitted by Jitendra Gautam entitled "Distributions of gastrointestinal parasites among the Badi community of Gurbhakot Municipality, Surkhet, Nepal" is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for master's Degree of Science in Zoology with special paper Parasitology.

.....
Head of Department

Kumar Sapkota, PhD

Professor

Central Department of Zoology

Tribhuvan University

Kirtipur, Kathmandu, Nepal

Date: 28 March 2024



त्रिभुवन विश्वविद्यालय
TRIBHUVAN UNIVERSITY

प्राणी शास्त्र केन्द्रीय विभाग

CENTRAL DEPARTMENT OF ZOOLOGY

कीर्तिपुर, काठमाडौं, नेपाल ।
Kirtipur, Kathmandu, Nepal.

०१-४३३१८९६
01-4331896

Email: info@cdztu.edu.np
URL: www.cdztu.edu.np

पत्र संख्या :-
च.नं. Ref.No.:-



Certification of acceptance

This dissertation work submitted by Mr. Jitendra Gautam entitled "Distributions of gastrointestinal parasites among the Badi community of Gurbhakot Municipality, Surkhet, Nepal" is accepted as a partial fulfillment for the requirements of Master's Degree of Science in Zoology with special paper Parasitology.

Evaluation committee

Supervisor
Kishor Pandey, PhD
Associate Professor

Head of Department
Kumar Sapkota, PhD
Professor

External examiner
Mr. Roshan Adhikari
Assistant Professor

Internal examiner
Mr. Janak Raj Subedi
Assistant Professor

Date of examination: 9th April 2024

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Abstract

Intestinal parasitic infection causes great morbidity and mortality all over the world for people with low socioeconomic status as well as poor hygiene and sanitary conditions. This study was carried out to determine the distributions of gastrointestinal parasites among the Badi community in Gurbhakot, Municipality, and Surkhet, Nepal. 205 stool samples were randomly collected from age 18+ to 61 years and were preserved in a 2.5% potassium dichromate solution. A structured questionnaire survey was conducted. Out of 205 people, 55 (26.82%) were found to be infected with one or two intestinal parasites; among them, prevalence in females 33 (31.73%) was higher than in males 22 (21.78%). Infections were higher in the age group (18-28) years and lowest in (51-61) age groups. Protozoans 39 (19.02%) were higher than the helminths 16 (7.82%). *Giardia lamblia* (16.09%) was seen high number followed by *Ascaris lumbricoides* (5.82%), *Entamoeba histolytica* (2.94%), *Enterobius vermicularis* (0.98%) and *Hymenolepis nana* (0.98%). Distributions of parasites among the Badi people seems directly related to unsafe drinking water, occupations, lack of health education, poor sanitary conditions and low socio-economic. Local government must conduct health checkups from time to time along with mass treatment for effective control.

शोध सार

आन्द्राको परजीवी संक्रमणले कम सामाजिक आर्थिक स्थितिका साथै कमजोर सरसफाइ र सरसफाइको अवस्था भएका मानिसहरूलाई विश्वव्यापी रूपमा ठूलो रोग र मृत्युको कारण बनाउँछ । सुर्खेत जिल्लाको गुर्भाकोट नगरपालिकामा रहेको वादी समुदायमा आन्द्राका परजीवीहरूको प्रकोप पत्ता लगाउन यो अध्ययन गरिएको थियो । १८ वर्षभन्दा बढी उमेर समूहका कूल २०५ वटा स्टूल नमूनाहरू अनियमित रूपमा सङ्कलन गरी २.५% पोटासियममा सुरक्षित गरिएको थियो । डाइक्रोमेट समाधान । जोखिम कारकहरूको पहिचानको लागि एक संरचित प्रश्नावली विधि सञ्चालन गरिएको थियो। २०५ जना मध्ये ५५ (२६.८२%) एक वा दुईवटा आन्द्राको परजीवीबाट संक्रमित भएको पाइएको थियो । तिनीहरूमध्ये महिलाहरूमा परजीवी संक्रमणहरू ३३ (३१.७३%) पुरुषहरू २२ (२१.७८%) भन्दा बढी थियो, यद्यपि, भिन्नता सांख्यिकीय रूपमा महत्त्वपूर्ण थिएन। त्यस्तै, प्रोटोजोआन ३९ (१९.०२%) हेल्मिन्थ १६ (७.८२%) भन्दा बढी थिए। आन्द्राका परजीवीहरूको कुल ५ प्रजातिहरू पत्ता लगाइयो। ती मध्ये, *Giardia lamblia* (१६.०९%) सूचीमा शीर्ष स्थानमा थियो । *Ascaris lumbricoides* (५.८२%), *Entamoeba histolytica* (२.९२%), *Enterobius vermicularis* (०.९८%) र *Hymenolepis nana* (०.९८ %) थिए । तसर्थ, वादी मानिसहरूमा आन्द्राको परजीवी संक्रमणको उच्च प्रचलन असुरक्षित पिउने पानी, पेशा, स्वास्थ्य शिक्षाको अभाव, कमजोर सरसफाइको अवस्था र निम्न सामाजिक-आर्थिकतासँग प्रत्यक्ष रूपमा सम्बन्धित देखिन्छ । थप रूपमा, स्थानीय सरकारले प्रभावकारी नियन्त्रणको लागि सामूहिक उपचारको साथमा समय-समयमा स्वास्थ्य परीक्षण गराउनुपर्छ ।

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List of abbreviation

Abbreviated form	Details of abbreviations
GIPs	Gastrointestinal Parasitic Infections
IOST	Institute of Science and Technology
IPIs	Intestinal Parasitic Infections
ml	Milliliter
NaCl	Sodium chloride
SES	Socioeconomic Status
STHs	Soli-Transmitted Helminths
WHO	World Health Organizations
NTD	Neglected Tropical Disease
SPSS	Statistical Package for the Social Science

1. Introduction

1.1 Background

Gastrointestinal parasites are a significant public health concern worldwide, with a cosmopolitan distribution (Das et al., 2006). Over a half of the global population suffers from these parasites, leading to immense economic losses and widespread misery (Dhanabal et al., 2014). It is estimated that approximately one-fourth of the world's population is infected with one or more species of intestinal parasites (Ulhaq et al., 2022). Parasitism is an effective mode of life displayed by living organisms (Sehgal et al., 2010). It infects all free-living organisms and live in the digestive tract of their hosts, causing serious infections that lead to significant morbidity and mortality (Yadav., 2017). They potentially influence host health (Agrawal et al., 2012). (IPIs) are the most Neglected Tropical Diseases (NTDs) causing fatal infections among low socioeconomic status populations throughout the world (Shrestha et al., 2019).

Intestinal parasites are mainly divided into protozoan and Helminth (Tandukar et al., 2013). Helminths are categorized mainly as cestode, trematode and nematode (Pradhan et al., 2014). The major protozoan parasites are *Entamoeba histolytica*, *Giardia lamblia*, and *Cryptosporidium* transmitted mainly both contaminated food and water (Haile et al., 2017). Protozoans are mainly responsible for diarrheal diseases throughout the world (Forson et al., 2017). *G. lamblia* is the major prevalent, infecting approximately 200 million people worldwide, while *E. histolytica* infects around 50 million people worldwide (Ulhaq et al., 2022). The medically important nematodes are *Ascaris lumbricoides*, *Trichuris trichiura*, *pinworms*, and *hookworms*; they are also known as soil-transmitted Helminths (STHs). STHs are the major common NTDs, infecting 1.2 billion people (Agrawal et al., 2012). *Taenia* is the most common cestode transmitted mainly from consuming uncooked pork meats (Poudyal et al., 2017). Among the various types of IPIs, *A. lumbricoides* is the most common helminth nematode, infecting around 1.3 billion people worldwide, followed by *T. trichiura* in 650 million people and hookworms in 774 million people (Yogyata & Binita, 2011). Despite the significant progress made in sanitation, hygiene, and healthcare interventions, (IPIs) remain a global problem, primarily affecting people in developing countries with a lack of education and healthcare, low illiteracy, poor sanitation, and low socio-economic conditions (Sharma et al., 2020). Overall, IPIs continue to pose significant health problems, particularly in developing countries with inadequate sanitation and hygiene facilities. In Nepal, the

situation of intestinal parasitic infections (IPIs) remains severe, as per various studies conducted (Dhakal, 2018; Shrestha et al., 2007; Shrestha & Maharjan, 2013; Tandukar et al., 2013). The mortality and morbidity caused by parasitic infections are still high (Shrestha et al., 2019). The major risk factors for parasitic infections are poor sanitation, polluted water and land, contaminated foods, undercooked meat, lack of education and awareness, poor socio-economic conditions, overcrowding, unmanaged settlements, farming occupation, and cultural and religious practices (Shrestha et al., 2019). The common helminth causing infections in Nepal are *A. lumbricoides*, *H. nana*, and *T. trichiura* and the common protozoans causing infections are *G. lamblia* and *E. histolytica* (Poudyal et al., 2017). In Nepal, in most urban areas people have a high rate of parasitic infections (Shrestha et al., 2019). Significant cases of IPIs have been reported in major cities, with 62% of people from Kathmandu (Subedi et al., 2021) and 68.68% from Dharan (Ghimire et al., 2021) being infected by intestinal parasites. Infections are comparatively higher in rural areas of Nepal than in urban areas (Agrawal et al., 2012). The risk factors in rural areas might be illiteracy, dependency on natural waters for drinking, lack of maintained hygiene and occupation (Tandukar et al., 2013). walking barefoot, contact with animals, source of drinking water, seasonal variations, and use of unhealthy vegetables are the primary risk factors for the transmission of parasitic infections over the people (Yadav & Prakash., 2017). Children in Nepal are more susceptible to infections compared to adults, as per a study conducted by (Yadav, 2017). Malnutrition is a serious prevalent issue among school children, and there is a highly significant association between *giardiasis* and malnutrition (Tiwari et al., 2019). Malnutrition is commonly found in less than five ages of children, and it is linked to child mortality (Sharma et al., 2020).

Additionally, Nepalese women also suffer from malnutrition, as per a study conducted by (Tandukar et al., 2013). The wet season in Nepal sees higher soil contamination with helminth egg (Joshi et al., 2004). Eggs are commonly transmitted by dirty fingers and nails. According to a census report, by 2022, there are 142 castes and ethnic groups living in Nepal (National Statistics Office, 2021). In comparison to all castes, Dalits are considerably economically deprived, socially discriminated, socially stigmatized, marginalized, and treated as untouchable. Among the Dalit, Badi is a hill Dalit community in Nepal (Changing Livelihood strategies of Badi Community). The National Code 1854 categorized Badi as “impure and untouchable”, the one who plays musical

instrument in Sanskrit. Badi remain the lowest ranking untouchable caste in Western Nepal, living in the western region mainly, Surkhet, Dilekh, Jajarkot, Dang, Bake, Bardia, Kailali, Doti, Acham, and Bajura etc. The Badi people have been facing lots of problems like inadequate land ownership, poverty, and difficulty in obtaining citizenship, caste-based discrimination, illiteracy, and social-cultural discrimination (Welfare, and Province, 2022).

Traditionally Badi people used occupations such as fishing, making and repairing 'Madal, pipes, and Weaving fishing nets, especially by Badi men as They entertained the local Feudal by dancing and singing at feasts and festive. But they are now gradually involved in agriculture, livestock, foreign gain, and the service sector (Welfare, and Province, 2022). Historically Badi people came to Nepal from India and started living in Nepal's western region (Paneru, 2010). According to the National Census, in 2022 there are 44,603 badi living in Nepal (National Statistics Office, 2021).

1.2 Statement of problem

Badi is a community situated in several districts of Nepal, including Dang, Surkhet, Dilekh, Kailali, and Kanchanpur. The majority of the Badi population lives in Surkhet and Dang District, predominantly in the villages. Unfortunately, the literacy rate among the Badi community is low, and they rely on agriculture for their livelihoods. Although there is limited data available on the health status of the Badi 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.

1.3 Objectives

1.3.1 General objectives

- To study the Distributions of gastrointestinal parasites among the Badi community of Gurbhakot Municipality, Surkhet, Nepal.

1.3.2 Specific objectives

- To determine the sex-wise, age-wise parasitic infections.
- To determine the concurrency and intensity of parasites eggs.
- To find the relationship between socio-economic status and intestinal parasites among the Badi community.

1.4 Research hypothesis

- Badi communities have a higher likelihood of experiencing intestinal parasitic infections when compared to the general population. This is due to socio-economic risk factors.
- Lower socioeconomic status such as income and education level among Badi communities is associated with an increased risk of intestinal parasitic infections.

1.5 Significance of the study

Intestinal parasitic infections are a common problem in developing countries due to poor sanitation and lack of health education. There has been no research conducted on intestinal parasites infection in the Badi community of Gurbhakot Municipality, Surkhet. Therefore, it is essential to study the prevalence of parasites in this ethnic group. The present study will play a crucial role in identifying the infection rate in this community. Factors such as poor economic status, lack of health education, and unhygienic practices have contributed to the high prevalence of parasitic infections in the country. This study aims to find the relationship between socio-economic status and the prevalence of intestinal parasites among the Badi people in Gurbhakot Municipality, Surkhet, Nepal and will help minimize the risk of various intestinal parasitic diseases and improve the sanitation behavior of the community. The study will also guide researchers who wish to investigate intestinal parasites among the Badi people in Gurbhakot municipality, Surkhet, Nepal.

2. Literature review

2.1 Prevalence of intestinal parasites

Several studies have been carried out in Nepal to determine the prevalence of gastrointestinal parasites and associated risk factors in different regions. Nepal is a developing country that faces major challenges such as high poverty, malnutrition, illiteracy, and lack of health awareness. The prevalence of ethnic groups such as Magars, Sarkies, Darai, and Bote, was found to be 49.5%, 29.5%, 9.5%, and 29.5%, respectively (Joshi et al., 2004). According to a study by Dev, the prevalence of intestinal parasites was found to be 35.19% in the Badi, Tharu, and high-caste communities in Kailali. Prevalence was same in the Badi (47.97%) and Tharu (47.66%) communities, but lower in high caste communities (10.24%). In Tharu and high-caste communities, males had a higher prevalence than females, while in the Badi community, females had a higher prevalence, common helminth was *hookworm*, and a common protozoon was *Giardia*. The study detected *hookworm*, *Giardia*, *E. histolytica*, *E. coli*, *H. nana*, and *B. hominis*. Children (0-15 years) were more infected than adults (the study of Parasitic Infections in Badi, Tharu and High Caste Community of Kailali, 2010). Similarly, according to Tandukar (2013), a study conducted in Lalitpur revealed that 16.7% of school-going children were affected, with *Giardia lamblia*, followed by *Entamoeba histolytica* and *Cyclospora Cayetaenisis*. The study indicated that the prevalence of the parasites was significantly influenced by hand-washing practices and the type of drinking water (Tandukar et al., 2013b). Likewise, Prevalence in community people in Kusam Municipality Parbat district was 24.04%, Common parasites found were *Ascaris lumbricoides*, *Cryptosporidium*, *Enterobius vermicularis*, *Hymenolepis nana*, *Hookworm*, and *Taenia* and the 51-60 years' age group were observed to be highly infected (Poudel, 2013). Poor sanitation and inadequate environmental conditions were identified as major factors responsible for these infections (Shobha et al, 2013). A school-based cross-sectional study conducted in Northeast Ethiopia found that 34.2% of participants were infected with one or more intestinal parasites, The infections were higher in females than males, Common parasites were *Hymenolepis nana*, *Entamoeba histolytica*, and *Ascaris lumbricoides*, hand-washing practices was risk factors for intestinal parasitic infections (Gelaw et al, 2013). Another study conducted in Slovakia, prevalence rate was 6.81%, Protozoans were found to be more common than helminthiasis, with *Endolimax nana*, *Giardia*, and *Ascaris lumbricoides* common parasites (Dudlová et al, 2016). According

to Yadav and Prakash 2017 study, 63.35% of the Muslim community in Janakpur had been infected with at least one type of GI parasite and prevalence was higher in males, with *Giardia lamblia* being the most common parasite, study suggested that populations who did not wash their hands before and after meals, defecated in open areas, did not wash their hands and feet after defecation, did not trim their nails, and lived in large joint families with low income were more likely to have a higher prevalence of parasitic infections (Yadav & Prakash., 2017). Similarly, a study was conducted on school-going children in Rangeli Municipality, Morang and prevalence rate was found to be 83.3%; with common parasites were *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichuris trichiura*, *Enterobius vermicularis*, and *Hymenolepis nana*, study indicated that the lack of safe drinking water, food, poverty, unhygienic practices, and poor environmental conditions were the major contributing factors to the high prevalence rate of intestinal parasite infections (Yadav et al., 2017).

Another cross-sectional study was conducted from March 2016 to July 2016 in Accra, Ghana, which showed that 15% of school children had parasitic infections, common parasites found were *Giardia lamblia* and *Schistosoma mansoni*, study identified that education, personal hygiene and environmental conditions played a vital role in reducing the intestinal parasitic infections in school children in Accra (Forson et al., 2017). Furthermore, another study was conducted in the Meche community of the Jalthal Village Development Committee in the Jhapa from June to July 2017 and found that the prevalence of intestinal parasites in the Meche community was 27.33%, with a higher prevalence rate was in females than in males, the highest prevalence was found in the 21-40 age groups, five species were detected, with *Ascaris lumbricoides* being the most prevalent, followed by *Taenia solium*, *Hookworm*, *Entamoeba coli*, and *Trichuris trichiura* (Dhakal et al., 2019). A province-wide survey was conducted in Jiangsu province, in Eastern China; the survey covered two main settings - rural areas and urban areas, the results showed that 0.38% of the participants had intestinal parasitic infections, with the most common parasite being the *hookworm* (Dai et al, 2019). Another study conducted between 2015 to 2017 in Bulgaria involved both Bulgarian and foreign populations, the study revealed that 74.47% of the population was infected with intestinal parasites, with *Enterobiasis* being the most prevalent parasite identified (Harizanov et al., 2020). In addition, a study conducted in Birtamode Municipality, Jhapa found that intestinal helminth parasites were present in 28.63% of the Satar and Chaudhary

communities (Subedi., 2020). On the other hand, the prevalence of intestinal parasitic infection was 39.8% among the Chepang and 33.3% among the Musahar community, *Ascaris lumbricoides* was the most common helminth, while *Entamoeba histolytica* was the most prevalent protozoan (Adhikari et al., 2021). Parajuli and the team reported a 68.8% prevalence of parasites among certain ethnic communities in Nepal (Adhikari et al., 2021). According to recent study, the Magar Community of Nisdi Rural Municipality in Palpa had a 31.07% prevalence of intestinal helminth infection and a 2.5% prevalence of *Taeniasis* (Thapa, 2022). Another study was conducted in rural communities of district Dir Lower in Pakistan, where, 81% people were infected with intestinal parasites, with infection was higher in males compared to females. *Ascaris lumbricoides* and *hookworm* were common parasites (Ulhaq et al, 2022). In addition, a study was conducted in teaching hospitals in Zigzag district; Northeastern Egypt between 2019 to 2021, to evaluate the prevalence of intestinal parasitic infections among patients; the study revealed that 56% of the patients were infected with various types of intestinal parasites such as *Giardia lamblia*, *Entamoeba histolytica/dispar*, *Ascaris lumbricoides*, and *Hymenolepis nana* (Omar et al, 2022). Additionally, a study conducted in the Musahar community indicated that the prevalence was 81%, with 9 different species of parasites reported, Helminths were found to be more prevalent than protozoa and mixed infections were more common than single infections (Yadav, 2023). People walk barefoot, and defecate on open lands are more likely to have gastrointestinal parasitism in these populations (Yadav, 2023).

2.1 Intestinal parasitic infections with risk factor

Intestinal parasitic infections (IPIs) are caused by many factors including their habit, knowledge, social, economic, cultural and bioenvironmental condition such as Education level of the subject (Smith et al., 2001), children with less educated mother (Norhayati et al., 2003), low monthly income (Joshi et al., 2004), knowledge on intestinal parasites their biology and epidemiology (Sharma et al., 2004). Similarly, behavioral factor also responsible for transmission of parasitic infections such as Hand-washing habits can promote intestinal parasitic infections (Tandukar et al., 2013), who did not use soap to wash their hands before and after meals and after defecation had a higher risk of parasitic infection (Shrestha & Maharjan., 2013), not using shoes when outside is considered a potential risk factor (Parajuli et al., 2014). Water, Sanitation, and Hygiene conditions of children were directly related to their nutritional status and intestinal parasitic infections (Shrestha et al, 2016). Nail biting was found to be the major source of parasitic infection (Poudyal et al., 2017). Cestode infection was primarily associated with slaughtering facilities (Haile et al., 2017). The risk of acquiring IPIs is associated with the shoe-wearing habits of individuals (Yadav., 2017).

Water can be an important route for the transmission of Intestinal Parasitic Infections (IPIs) (Poudyal et al., 2017). People who did not use water while using the toilet had a higher prevalence of parasitic infection compared to those who used bucket water (Yadav, 2017). Thumb-sucking habit was significant in causing intestinal parasitic infections (Dhakal et al., 2018). Nail-biting and thumb-sucking can facilitate the fecal-oral transmission of parasites (KC et al, 2019), and finger-sucking was found to be a strong predictor of intestinal parasitic infections (Khadka et al, 2019). People who used water directly from the source had a higher prevalence of IPIs (Khadka et al., 2019). *T. trichiura* was observed in soil with a lower rate of contamination and Poor sewerage systems are also known to harbor parasites (KC et al., 2019). People who never or occasionally wear slippers have a higher risk of IPIs because parasites can penetrate the host body through the skin when one is barefoot (Shrestha et al., 2020). Open defecation, unmanaged disposal of wastes, and flood water are the primary factors that contaminate water, thereby increasing the risk of infection Furthermore, consumption of unwashed fruits and vegetables was associated with infection among vegetarians (Sharma et al., 2020). The risk of cestode infection was found to increase with the consumption of vegetables grown in soil contaminated with cestode eggs and eating of raw or improperly

cooked meat, especially pork, and beef (Kantzanou et al., 2021). A recent study by Sah estimated the prevalence of IPIs in Kaski and suggested that the infection is likely water-borne, with a prevalence rate of 24.2% (Sah et al., 2021). Using simple pit latrines were at a higher risk of infection than those who used flush toilets (Khadka et al., 2021). More members in the house or overcrowding, presence of animals, and types of house are the living condition characters for the parasitic infection (Ulhaq et al., 2022).

3. Materials and methods

3.1 Study area

This study was carried out in Gurbhakot Municipality 10&11, located in Surkhet district, Karnali province [at 28.439042°N and 81.852828°E]. Surkhet is situated about 600 kilometers west of the National capital Kathmandu and is one of the ten districts of Karnali province in mid-western Nepal. The district is divided into five urban municipalities and four rural municipalities. Gurbhakot Municipality is one of the urban municipalities in Surkhet. The population of Gurbhakot Municipality is 43,765 (National Statistics Office, 2021). The Municipality is divided into a total of 14 wards and is bordered by Salyan to the east, Bheriganga to the west, Simta and Chingad to the north, and Salyan to the south. The majority of the populations (95%) speak Nepali as their first language, while 4.3% speak Magar, 0.1% speaks Maithili, and 0.1% speaks other languages. In terms of ethnicity and caste, the population is comprised of 29.2% Chettri, 26.9% Nepali, 26.2% Magar, 5.0% Hill Brahmin, 3.4% Dami, 2.8% Thakuri, 2.2% Gurung, and 0.7% Badi etc.

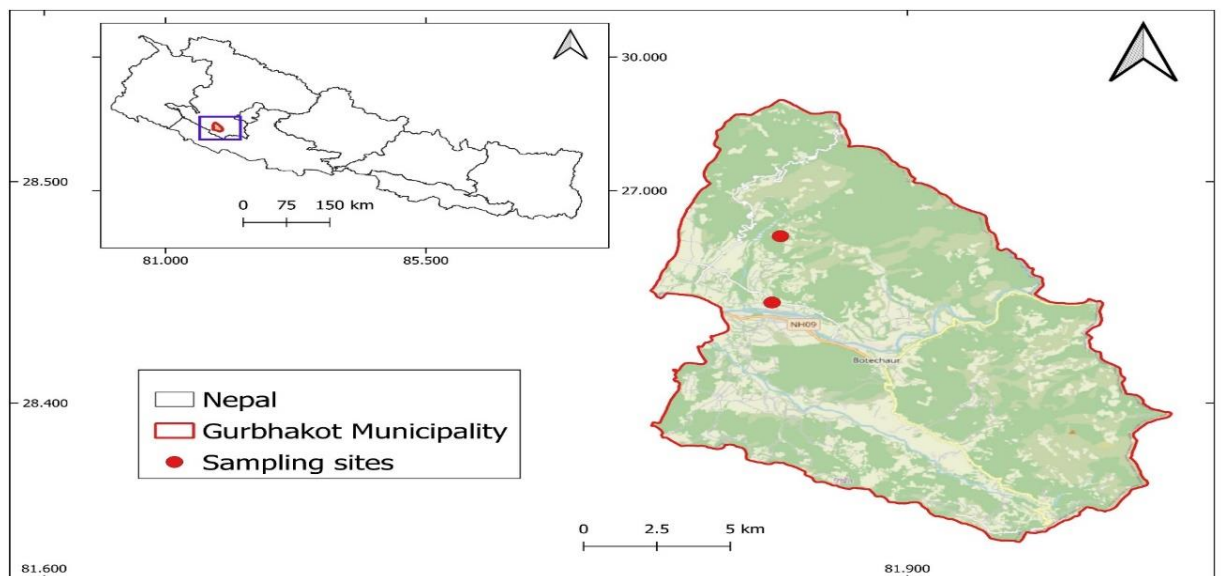


Figure 1. Map showing Gurbhakot Municipality 10&11, Surkhet, Nepal

3.2 Sampling method

An estimated house number of Badi community in Gurbhakot Municipality was 135. From the estimated house, 120 house of Badi community were randomly selected, by from various locations within the study site.

3.2.1. Selection criteria

The local government has been starting a deworming program for younger people of the Badi community across the Municipality, that's why people below the age of 18 were excluded. Participants above 18 were only included in the study.

3.2.2 Sample size

The estimated populations of Badi people in Gurbhakot Municipality were 350. Sample size of the present study was 205 from above 18+ ages of Badi people at Gurbhakot Municipality, among them; 104 were female and 101 were male. The data were collected by questionnaire survey.

3.3. Methods

The study was conducted from August 2023 to September 2023. One day before sample collection, sterile vials of 20 ml and a wooden applicator were provided to all individuals, along with clear instructions on the collection process. The 205 samples were collected early in the morning, along with a structured questionnaire. The stool samples were immediately preserved in a 2.5% $K_2Cr_2O_7$ (25gm of potassium Dichromate mixed with 1 liter of distil water) solution and transported to the Zoology Laboratory at Central Department of Zoology for microscopic examinations and further investigations.

3.3.1 Microscopic examination of stool samples

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

3.3.1.1 Direct wet mount

The stool samples were mixed with 2.5% $K_2Cr_2O_7$ solution using a glass rod. A small drop of the mixture was placed on a clean glass slide using a plastic dropper and spread out into a thin layer. A clean cover slip was then placed over the smear and any excess fluid was removed using cotton and tissue paper. Before preparing the smear, 1-2 drops of Gram's iodine were added to make the smear more visible and to aid in the study of the nuclear matter of protozoan cysts and trophozoites. This stained smear preparation will help in the identification and study of the protozoans (Satoskar et al., 2009).

3.3.1.2 Floatation technique

2 spatula of stool were taken in a beaker and about 5 ml of normal saline was added and stirred properly. The mixture was then filtered. The 1 ml filtrate was put in glass tube and

added 13ml of normal saline and centrifuged at 1000 rpm for 5 minutes. The tube was taken out without disturbing and it was poured in beaker. Eggs were concentrated at the bottom of test-tube after centrifugation. The sediment that remained in the test-tube was filled with saturated NaCl to develop a convex surface at the top of the tube. Then the cover slip was placed at the top and left for 10 minutes. After that, cover slip was placed on a clean glass slide and to the microscope for the observation (Alvarado-Villalobos et al., 2017).

3.3.1.3 Sedimentations technique

To analyze the stool samples, first, approximately 2 spatula of the sample were mixed with 5 ml of 10% normal saline solution. The mixture was filtered and 1 ml of the filtrate was added to another test tube containing 3 ml of ether and 10 ml of formal solution (10%). The final mixture was centrifuged at 1000 rpm for 5 minutes and left to settle. The supernatant fluid was discarded and the sediment was examined under the microscope using both unstained and stained smears. The preparation was first observed under low power (10X) and then high power (40X) objectives, starting from one corner of the cover slip to another corner (Panda, 2012).

3.3.2 Identification

The measurement of protozoan cysts, oocysts, trophozoites, and helminthes eggs, and larva was done comparing the obtained photographs and micrometry with the figures in published literatures (Iralu, 1972), journals (Shrestha et al., 2016), (Gyawali, 2013) books (Society, 2017), (Cox, 2002), (Satoskar et al., 2009) and CDC webpage (www.cdc.gov/parasites/).

3.3.3 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 Badi people, encompassing various age groups and genders. The entire questionnaires were checked for accuracy and completeness. (Appendix 1).

3.4 Ethical approval

The necessary permission to collect fecal samples was obtained from the ward offices and the Ethical Committee of the Institute of Science and Technology (IOST) of Tribhuvan University (See Appendix 2). Participation was voluntary and informed consent was obtained from every participant. Before the survey, the study's detailed purpose and procedures were explained verbally to the participants in Nepali language. The aim of the study and the benefits of participation were communicated to the participants beforehand. They were also informed that they had the right to withdraw at any time during the data collection.

3.5 Data analysis

The collected data from field survey and laboratory findings were statistically analyzed with the help of Microsoft excel 2013 and Pearson's Chi-squared test performed by SPSS software. The level of significance was set at $p < 0.05$.

4. Results

4.1 Overall distributions of intestinal parasitic infections over the Badi community

A study conducted among the Badi community in Gurbhakot Municipality, Surkhet, Nepal showed that 26.82% (55/205) of the population had gastrointestinal parasitic infections (Figure 2). Out of the 55 infected people, 33 were females and 22 were males. The infections were found to be caused by five different species of intestinal parasites, including two protozoans (*Entamoeba histolytica* and *Giardia lamblia*) and three helminths (*Ascaris lumbricoides*, *Hymenolepis nana*, and *Enterobius vermicularis*). The most prevalent parasite was *Giardia* (16.09%), followed by *Ascaris* (5.82%), *E. histolytica* (2.94%), *Enterobius vermicularis* (0.98%), and *Hymenolepis nana* (0.98%).

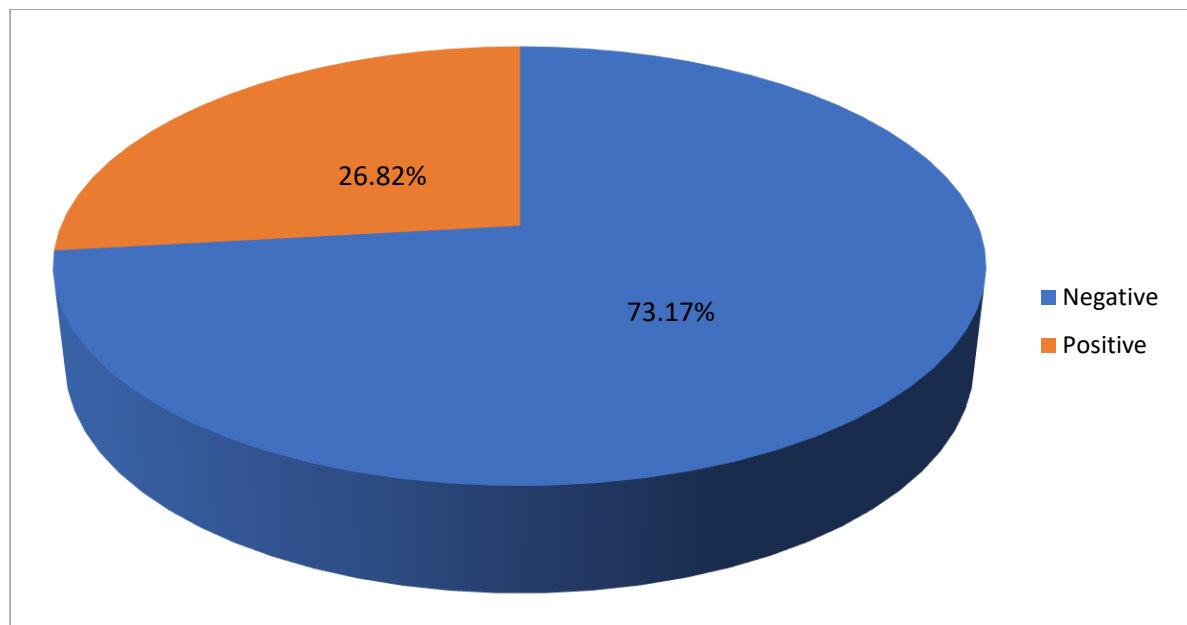


Figure 2. Overall distributions of parasitic infections over the Badi community

4.2 Species wise distributions of intestinal parasites

Examined of 205 stool samples, parasites were found to be 55 (26.82%), protozoans infections 39 (19.02%) was higher than the helminths infection 16 (7.82%) (Table1).

Table 1. Species-wise distributions of intestinal parasites.

Parasites	Number of people infected		Prevalence (%)
	Male	Female	
Protozoans			39 (19.02%)
<i>Giardia lamblia</i>	11	22	33 (16.09%)
<i>Entamoeba histolytica</i>	2	4	6 (2.92%)
Helminths			16 (7.82%)
<i>Ascaris lumbricoides</i>	7	5	12 (5.82%)
<i>Enterobius vermicularis</i>	-	2	2 (0.98%)
<i>Hymenolepis nana</i>	2	-	2 (0.98%)
Total	22	33	55 (26.82%)

4.3 Sex-wise intestinal parasitic infections

In total of 205 samples, 101 were of males and 104 were of females (Table 2). Out of 101 samples examined from male, 22 (21.7%) were found to be positive. Similarly, out of 104 samples examined from female, 33 (31.73%) 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 ($\chi^2=2.56$, $df=1$, $P=0.73$).

Table 2. Sex-wise intestinal parasitic infection.

Gender	Intestinal Parasite	
	Positive	
	n	%
Female (104)	33	31.73%
Male (101)	22	21.78%
Total (205)	55	

4.4 Age-wise distributions of intestinal parasites

The study population was divided into different age groups i.e., 18-28, 29-39, 40-50 and 51-61 years. Out of which the occurrence of intestinal parasites was maximum in 18-28 age group and minimum in above 51-61 year's age group (Table 3). Statistically, there was no significant difference in the prevalence of intestinal parasites between two different age groups ($\chi^2=4.276$, $df=1$, $P=0.63$)

Table 3. Age-wise distributions of intestinal parasites.

S.N	Ages groups	Intestinal parasites	
		Positive	
		Number	%
1	18-28	28	13.65%
2	29-39	10	4.87%
3	40-50	14	6.82%
4	51-61	3	1.46%
Total		55	26.82%

4.5 Concurrency of intestinal parasites

Out of 55 (26.82%) positive samples, 47 (22.54%) samples were found to have single infection, whereas only 8 (3.92%) samples were detected to have double infection (Figure 3).

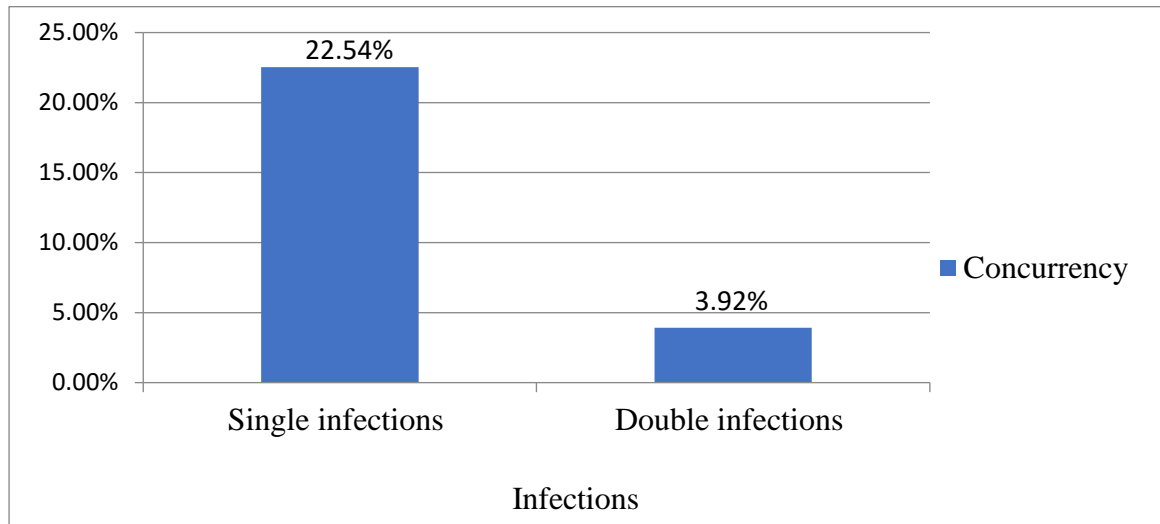


Figure 3. Concurrency of intestinal parasites.

4.6 Intensity of parasites

All positive samples had a 1-3 average eggs per slide. Highest number of eggs was (1-3) 9.8%. Similarly, lowest number of eggs was (8-11) 4.40%. It had been observed by the Direct wet mount techniques (Figure 4).

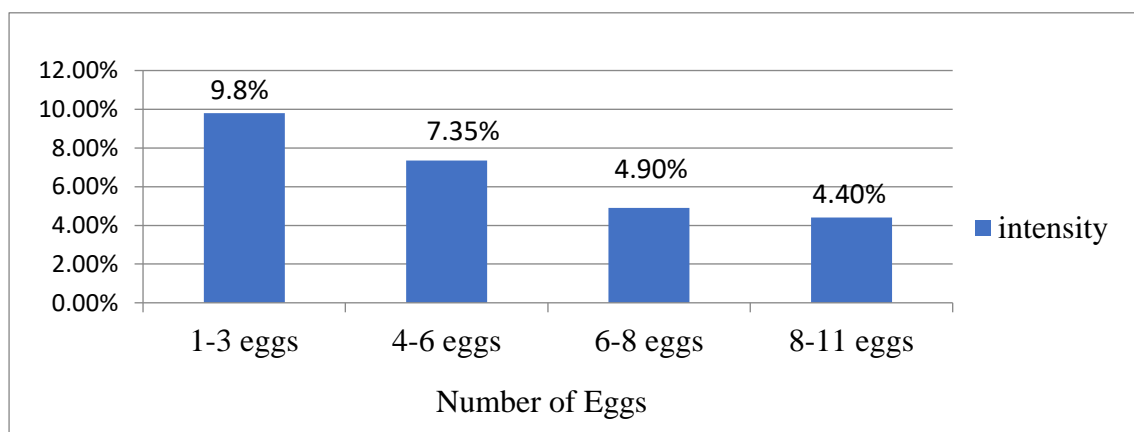


Figure 4. Intensity of egg

4.7 Assessment of the sociodemographic factor

Several demographic, socioeconomic and occupational areas among people of the Badi community of Gurbhakot Municipality were evaluated for their association with intestinal parasitic infection (Table 4). Five different factors were assessed using Chi-square test

Table 4. Assessment of sociodemographic factors with intestinal parasites.

Sociodemographic		Intestinal Parasite				χ^2	P-value
		Negative		Positive			
	Subgroups	n	%	n	%		
Gender	Female	71	68.26 %	33	31.73 %	5.45	0.73
	Male	79	78.2%	22	21.78 %		
Educations Status	Educated	79	33.4%	5	2.4%	27.76	0.00**
	Uneducated	81	39.5%	55	24.5%		
Occupations	Labor	49	23.9	24	11.4	2.11	0.99
	Farming	101	49.3	31	15.1		

**=highly significant

Chi-square test revealed that educations are highly significant of infection of intestinal parasites. Similarly, sex, age groups and occupations are no significant associations with parasitic infections in the Badi community people.

4.8 Assessment of the risk factors

Several behavioral characteristics among people of the Badi in Gurbhakot Municipality, Surkhet, were evaluated for their association with intestinal parasitic infection. 10 different Risk factors were assessed using a chi-square test (Table 5).

Table 5. Assessment of behavioral characteristics with intestinal parasites.

Intestinal parasites							
Risk factor	Sub groups	Positive		Negative		χ^2	P - value
		n	%	n	%		
Nail trimming	No	49	23.9%	73	35.6%	27.29	0.000**
	Yes	6	2.9%	77	37.6%		
Nail Biting	No	14	6.8%	77	37.3%	10.91	0.01*
	Yes	41	20.5%	73	35.2%		
Hand washing Before eating	Only water	48	23.4%	47	23.4%	50.64	0.000**
	By soap	7	3.4%	103	50.2%		
Medications during illness	No	49	23.9%	62	30.32	36.96	0.000**
	Yes	6	2.95%	88	42.9%		
Drinking water	Tap water	48	23.4%	27	13.2%	83.34	0.000**
	Boiled water	7	3.4%	160	60%		
Eat dropped food	No	27	13.2%	134	65.5%	38.66	0.000**
	Yes	28	13.7%	16	7.8%		
Maintain hygiene	Sometime	50	24.4%	23	11.2%	100.00	0.000**
	Always	5	2.4%	127	62.1%		
Play with soils	No	20	9.8%	80	39%	4.63	0.023*
	Yes	35	17.1%	70	34%		
Eat washing vegetables	No	41	20%	76	37%	9.366	0.002*
	Yes	14	6.8%	74	36%		
Knowledge about parasites	No	46	22.4%	95	46.3%	7.72	0.006*
	Yes	9	4.4%	55	26.8%		

*= significant, **= highly significant

5. Discussion

Gastrointestinal parasitic infections are a major health concern worldwide, as there is a significant variation in the types of intestinal parasites that exist across different regions, climates, communities, and ethnic groups (Ulhaq et al., 2022). In particular, these infections continue to be a significant cause of morbidity and mortality in developing countries (Omar & Abdelal, 2022). Nepal, being a developing country, is no exception and has several types of parasitic and bacterial infections that result in morbidity and mortality (Adhikari et al, 2021; Sehgal et al, 2010). To investigate whether differences in public health awareness, socioeconomic status, culture, literacy, and occupations among the Badi community affect parasitic infection, a study was conducted to determine the prevalence of intestinal parasitic infection in this population. In this study, the overall prevalence of intestinal parasitic infections in the Badi community of Gurbhakot Municipality, Surkhet, Nepal was found to be 26.8%. This result showed comparable with different previous reports published such as 27.33% among the Meche community of Jalthal Village Development Committee of Jhapa (Dhakal & Subedi, 2019), 24.1% among slum dwelling population in Kaski, Nepal (Dhanabal et al., 2014), 27.67% among school-children of Bhaktapur, Nepal (Shrestha & Maharjan, 2013), 21.4% at Ujjain, Madhya Pradesh, India (Yogyata & Binita, 2011), 28.63% among the Satar and Chaudhary Communities of Birtamode Municipality, Jhapa, Nepal (Chaudhary & Subedi, 2020), 24.04% among community people of Kushma Municipality, Parbat, Nepal (Factors et al., 2013), 29.5% among the Tharu community in Pawanagar, Dang (Prevalence of Intestinal Parasites in Tharu, 2016). Somewhat this result is slightly higher than the findings such as 17.6% among school children in Kathmandu, Nepal (Narayan & Shrestha, 2012), 15% among school children in Pokhara, Nepal (Khadka et al., 2019), 17% among the Kumal community, Chitwan (Gyawali., 2013). However, this result is lower than the finding such as 36.6% among Chepang and Musahar Community of Makwanpur and Nawalparasi, Nepal (Khadka et al., 2021), 41.1% among the Squatter community in Dharan, Sunsari (Chongbang et al., 2016), 68% among the Deula community in Kritipur (Subedi et al., 2021). This difference may be due to various factors, such as sample size, place, climate and weather, poverty, malnutrition, health awareness, and living standards of people and examination techniques and methods of stool collections. The prevalence of protozoan was found to be higher than that of the

helminth. This finding is in accordance with the results of similar studies carried in different parts of Nepal (Narayan & Shrestha, 2012; Shrestha & Maharjan, 2013; Poudyal et al, 2017; Yadav, 2017; Khadka et al, 2019). On the contrary, higher prevalence of helminthes was reported in the other studies from Nepal (Joshi et al. 2004; Chaudhary & Subedi 2020). Among the protozoan parasites, *Giardia lamblia* was the most common observed parasites. Same result was seen in the past studies (Narayan & Shrestha, 2012; Poudyal et al., 2017; Yadav & Prakash 2017; Dhakal & Subedi, 2019). This may be due to unhygienic behavior, consumption of contaminated water, and drinking unfiltered tap water. However, irregular deworming treatment also contributes to the higher prevalence of protozoan parasites compared to helminth.

Gender-wise parasitic infection rate was slightly higher in female which is comparable with studies done (Nims & Mann, 1982; Joshi et al., 2004; Tandukar et al., 2013b; Bhattachan et al., 2015; Yadav & Prakash, 2017; Sah et al., 2021). But the result contradict with (Shrestha et al., 2007; Agrawal et al., 2012; Shrestha et al., 2016; Poudyal et al., 2017; Dhakal & Subedi, 2019). All these studies showed no significant association between gender and parasitic infections. It is possible that females are at a higher risk due to their involvement in childcare, lower educational status, and greater exposure to soil while growing vegetables. Additionally, the higher number of female participants in the study may also contribute to this possibility. Based on the age of the people included in study, the infection was found higher in age group (18-28) and lowest in the (51-61) age groups years people which is slightly similar to the report (Agrawal et al., 2012; Yadav, 2017). Several studies like, age groups (51-60) was a higher infected (Factors et al., 2013), among the (40+) years people of Kumal community was higher prevalence than the below the 10 years (Gyawali, 2013), among the (40+) years people of Tharu community was a high prevalence than the (20-40) years people. Use of tap water and unfiltered water for consumption was found to be significant explanatory factor of the intestinal parasites. This result was in accordance to the result from Nepal (Tandukar et al., 2013a; Singh Khadka et al., 2019; Sharma et al., 2020). This might be due to the contamination of water by human and animal wastes. This is in agreement with the finding from India (Yogyata & Binita, 2011), and Pakistan (Ulhaq et al., 2022). Likewise, people of Badi community who did not wash their hands by soap before and after meal and after defecation were significantly infected by intestinal parasites. This finding was in accordance with the studies (Khanal et al., 2011; Shrestha & Maharjan, 2013; KC et al.,

2019) in Nepal, (Dai et al., 2019) in China, and (Norhayati et al., 2003) in Malaysia. Hand washing without soap may facilitate the fecal-oral transmission of intestinal parasites (Crompton & Savioli, 1993). Untrimmed nails of Badi community people was also highly significant factor for parasitic infections as shown by this study which is similarly these studies such as (Shrestha et al, 2016), (Chongbang et al., 2016) from Nepal; (Ulhaq et al., 2022) from Pakistan and (Sehgal et al., 2010) from India. Untrimmed nails might be site for parasites eggs residence which when come in contact to the mouth might be ingested and cause infections as discussed (Kang et al, 1998). Similarly, literacy of Badi community people was highly significant factor for IPIs as shown by this study which is similarly these studies such as (Study on Intestinal Parasitic Infections in Badi, Tharu and High Caste Community of Kailali, 2010), and (Prevalence of Intestinal Parasites in Tharu, 2016) and play with soils, eat of dropped food, maintain hygiene, medications, washing vegetable was also highly significant factor for intestinal parasitic infections, as shown by this recent study which is quite similarly these studies such as (Chongbang et al., 2016), (Dhakal, 2018), (Gyawali, 2013) and (Yadav, 2023) and the present finding was higher for single parasitic infections, 47(22.54%) followed by double parasites, 8(3.92%). The given result was in agreement with the studies in Nepal and elsewhere in the world (Adhikari et al., 2021; Dai et al., 2019; Gupta et al., 2020; Haile et al., 2017; Sehgal et al., 2010; Yogyata & Binita, 2011). In contrast, some studies were reported a higher prevalence of double infections (Agrawal et al., 2012; Dhanabal et al., 2014; Forson et al., 2017; Poudyal et al., 2017). Most of the people of the Badi community do not have any knowledge of means and modes of the parasitic disease transmission. This finding slightly matched with the result (Shrestha et al., 2007; Agrawal et al, 2012). The finding of the present study shows that knowledge of the parasitic infection is very high in this community due to lack of health awareness and education. Several socioeconomic and behavioral factors of different castes and ethnic groups are responsible for the prevalence of intestinal parasites.

6. Conclusion and Recommendations

6.1. Conclusions

Intestinal parasites are closely linked to maintaining proper hygiene and sanitary conditions. A recent study has highlighted that the health status of Badi people in Gurbhakot Municipality is still very poor. The overall prevalence of intestinal parasites was found to be 26.82%, with protozoan infections being more common than helminth infections. Among the five species of parasites identified, *Giardia lamblia* was the most prevalent. The prevalence of intestinal parasitic infections was found to be significantly influenced by various factors, including hygiene practices, such as washing vegetables, nail cutting and trimming, hand washing, and medications. However, there was no significant difference in the prevalence of IPIs based on sex, age group, or occupation. Due to poverty, inadequate sanitary practices, lack of education, poor personal hygiene maintenance, water sources, and a lack of awareness, they are more likely to get infected with intestinal parasites.

6.2. Recommendations

- The high prevalence of intestinal parasitic infections, particularly in the Badi community (26.82%), may indicate the current situation of this ethnic group. However, to obtain a clear picture, it is necessary to undertake similar studies across the country with large population's size and geography.
- The prevalence of protozoa was higher than helminth, indicating contamination in the village's water supply. Therefore, the relevant sector should consider proper management of the water supply
- Public health professionals and local government agencies should start a community-based antiprotozoal & anthelmintic chemotherapeutic program in the Badi community.
- Public health awareness programs regarding personal hygiene, proper environmental sanitation, using safe water, and continuous mass deworming programs should be launched from time to time in this community.
- Molecular studies should be conducted for the identification of parasites.

7. References

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Appendices

Appendix 1.

Baseline Questionnaires related to demographic, socioeconomic and behavioral factors

Participant Code/

Name:

Gender: Male Female

Age:

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

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

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

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?

Appendix 2.

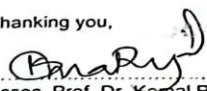
Ethical Approval of the study taken from Institute of Science and Technology, IoST, Kirtipur, Nepal



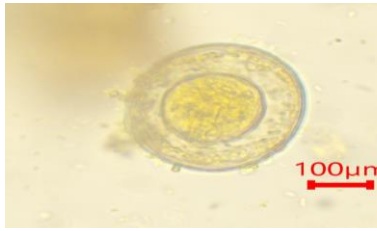
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Tribhuvan University
Institute of Science and Technology
Kirtipur, Kathmandu, Nepal

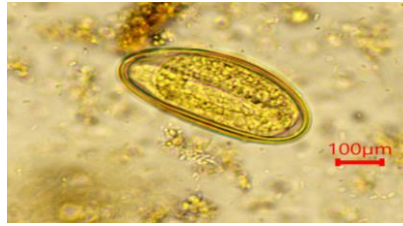
Institutional Review Committee

<p>IRC/IoST Chairperson Assoc. Prof. Dr. Surendra Gautam Asst. Dean-Academics, IoST</p> <p>IRC/IoST Members Prof. Dr. Rajani Malla Prof. Dr. Sangeeta Rajbhandary Prof. Dr. Shankar P Khanal Prof. Dr. Kumar Sapkota Prof. Dr. Amar Prasad Yadav Prof. Dr. Prakash Ghimire Assoc. Prof. Dr. Megha R Banjara Assoc. Prof. Dr. Nirmal Kumar Raut Dr. Supriya Sharma</p> <p>Member Secretary Assoc. Prof. Dr. Komal Raj Rijal</p> <p>Head, Central Department of Microbiology</p> <p>IRC/IoST Secretariat Central Department of Microbiology Phone: 4331869</p>	<p>Ref. No.: 122/079/080 Date: 02 July, 2023</p> <p>PI: Dr. Rajendra Prasad Parajuli M.Sc student: Jitendra Gautam Central Department of Zoology Tribhuvan University Kirtipur, Kathmandu</p> <p>Ref.: IRC Ethical Approval of research proposal entitled " Prevalence and associated factor of gastrointestinal parasites (GIP)s and Trichomonas vaginalis in the Badi community in Surkhet, Nepal"</p> <p>Dear Dr. Parajuli,</p> <p>It is our pleasure to inform you that the above mentioned proposal submitted on 20 June, 2023 (Regd. No IRCIOST-23-0066), following independent expert review and discussion in the IRC/IoST meeting held on 30 June, 2023 has been approved for implementation [start date 02 July, 2023 and end date 30 Dec, 2023], maintaining ethical principles, set by the Nepal Health Research Council.</p> <p>The investigators have to strictly follow the protocol stipulated in the proposal. Any change in objective(s), problem statement, research question or hypothesis, methodology, implementation procedure including deviation of the protocol, data management and budget need to be submitted in detail with justification for seeking prior approval to implement the proposed change including extension of the date, in the protocol.</p> <p>Further, the researchers are also directed to follow the national ethical guidelines published by Nepal Health Research Council during the implementation of research. You are required to submit the final report to the IRC within a month of completion of the research, as planned in the approved proposal.</p> <p>If you have any questions, please contact the Institutional Review Committee of Institute of Science and Technology, Tribhuvan University.</p> <p>Thanking you,</p> <p style="text-align: center;"> Assoc. Prof. Dr. Komal Raj Rijal Member Secretary Institutional Review Committee Institute of Science and Technology Tribhuvan University</p>
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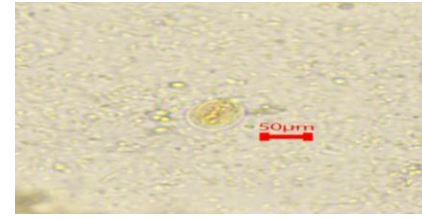
Photographs



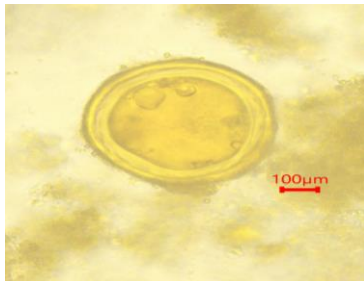
1. *Hymenolepis nana* egg
(43x36µm)



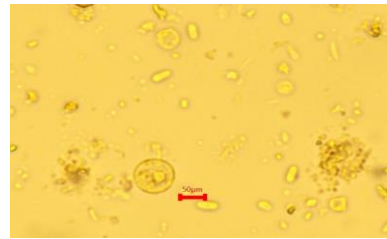
2. *Enterobius vermicularis*
egg (50x60µm)



4. *Giardia lamblia* cyst
(12x10µm) at



5. *Ascaris lumbricoides* egg (45x75µm)



6. *Entamoeba histolytica* cyst (12x15µm)