PREVALENCE OF INTESTINAL HELMINTHS PARASITES AMONG THE CHILDREN IN PRIVATE AND PUBLIC SCHOOLS IN DEVDAHA MUNICIPALITY OF RUPANDEHI DISTRICT, NEPAL

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Submitted to

Central Department of Zoology

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Tribhuvan University

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Nepal

August, 2019

DECLARATION

I hereby declare that the work present in this thesis entitled" **PREVALENCE OF INTESTINAL HELMINTHS PARASITE AMONG THE CHILDREN IN PRIVATE AND PUBLIC SCHOOL IN DEVDAHA MUNICIPALITY OF RUPANDEHI DISTRICT OF NEPAL"** has been done by myself and has not been submitted elsewhere for the award of any degree. All the sources of information have been specifically acknowledged by references to all the author(s) or institution(s).

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RECOMMENDATION

This is to recommend that the thesis entitled **"Prevalence of Intestinal Helminths Parasite among the children in Private and Public schools in Devdaha municipality of Rupandehi district, Nepal."** has been carried out by Krishna Prasad Gaire 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.

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LETTER OF APPROVAL

On the recommendation of supervisor **"Mr. Janak Raj Subedi"** this thesis submitted by Krishna Prasad Gaire entitled **"Prevalence of Intestinal Helminths Parasite among the children in Private and Public schools in Devdaha municipality of Rupandehi district, 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.

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This thesis work submitted by Krishna Prasad Gaire entitled **"Prevalence of Intestinal Helminths Parasite among the Children in Private and Public Schools in Devdaha municipality of Rupandehi district, Nepal** has been accepted as a partial fulfillment for the requirements of Master's Degree of Science in Zoology with special paper Parasitology.

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LIST OF ABBREVIATIONS

Abbreviate form	Details of abbreviation
µm	Micrometer
A.D	Amino Domino
B.C.	Before Christ
CBS	Central Bureau of Statistics
CDC	Centers for Disease Control and Prevention
CDZ	Central Department of Zoology
Cm	Centimeter
et al.	And his associates
gm	Gram
IPI	Intestinal Parasitic Infection
KAP	Knowledge, Attitude and Practices
m	Meter
mm	Millimeter
No.	Number
P-value	Probability value
STH	Soil Transmitted Helminthes
TU	Tribhuvan University
VDC	Village Development Committee
WHO	World Health Organization

ABSTRACT

The intestinal parasitic infection is more common in developing countries living under low socio-economic profile, with poor hygiene and sanitary condition. This study was carried out to measure the prevalence of intestinal parasitosis among the children of Public and Private schools of Devdaha Rupandehi. Total 150 stool sample were collected randomly from different public school (n=75) and private schools (n=75) and examined by direct smear method. Out of 150 samples of children 28 (18.667%) were found to be infected with one or more intestinal parasites. Among them *A. lumbricoides* (42.10% vs. 41.66%), *Trichuris trichiura* (26.31% vs. 25%) Hookworm (17.14% vs. 15.38%) and *Taenia* sp. (15.78% vs. 8.33%) were identified. The prevalence of infection were found higher in public school children (22.667%) as compared to private school (14.667%) where public school boys were (24.24%) were slightly more infected than girls (21.42%) while in private school girls (15.38%) were slightly more infected than boys (13.88%). The prevalence of parasite on the basis of age group (3-7) years in both public (25%) and private (18.42%) school is more than other age groups. The observed data were statistically analyzed with the help of Ms. Excel 2007, Chai square test was performed for the analysis of data, statistically no significant difference ($P>0.05$) was noticed in prevalence of intestinal parasitic infection among children of both public and private schools children. Children should be discouraged from activities such as finger sucking defecating on open place, nail biting habits, walking by bare foot, use of dirty drinking water etc. Basic health education program about intestinal parasitic infections should be conducted time to time, proper management of toilet, Pure and safe drinking water should be made easily accessible, which is important to overcome parasitic infection in school children.

1. Introduction

1.1 Background of the Study:

Health is an integral part of development. Healthy adults make the nation strong, but when they are unhealthy a country has to face invalid manpower. In evolutionary biology, parasitism is a relationship between species. Parasite are those living organism that live in a host organisms and gets food from the expense of its host (CDC, 2014).Parasite may cause mechanical injury such a boring a hole into the host or digging into the other tissue, stimulate damaging inflammatory or immune response (Taliaferro, 2009).There are different type of parasites such as ectoparasites, endoparasites, facultative parasites, obligatory parasite etc. that can cause disease in humans. They bring serious health problems in humans (CDC, 2014). Intestinal parasites are cosmopolitan in distribution. Intestinal parasite still establishes one of the main causes of health problem in world especially in developing country like Nepal. Around 3.5 billion people globally are estimated to be affected by intestinal parasite and 450 million are sick as a result of these infections, the majority being children (WHO, 2000). Parasitic infections are a big problem mainly in low-income and middle-income setting tropical and subtropical regions worldwide (Kinman, 2013). Gastrointestinal parasites are the organism that inhabit in the gastrointestinal region of human or other animals (Ajayi, 2017). The common intestinal parasite which are reported from human are *Trichuris trichiura*, *Ascaris lumbricoides*, Hookworm (*Ancyclostoma duodenale* and *Nector americans*) and *Strongyloides stercoralis* (Williams, 2005).Tapeworm, Roundworm and protozoa are three common intestinal parasite of small and large intestine of human. However helminthes and protozoa are the two major parasite of gastro-intestinal tract which cause a serious health problem (Emmanuel, 2017).

Intestinal parasite infection is still being a major health problem in developing country like Nepal having warm or hot and relatively humid climate, that is associated with poverty, malnutrition, high population density, unavailability of portable water, low health status, inadequate sanitation and hygiene, lack of access to facilities for safe disposal of human wastes, improperly cooked or washed food material (Ziegelbauer, 2012; Freeman, 2015) People of all ages are affected by parasitic infections but children with age group 3-12 years old are the most affected due to compromised sanitary habits.

Due to soil transmitted helminthes, more than 610 million children of school age are at risk of morbidity (WHO, 2011). It is reported that the prevalence of the intestinal parasites in Nepal varies considerably from one study to another study and researches nearby 100% in some tropical areas (Estevez, 1983; Rai, 1986). In Nepal children are more commonly infected than adult (Rai, 1986). The effects of parasite infections in children are adverse alarming. Intestinal parasitic worms have detrimental effects on the survival, growth, general infections are known to trigger immune response in man,

present problems for the body's ability to fight diseases, thus making affected individuals more prone to co-infection was rooted (WHO, 2005; Suresh *et al*., 2014).

1.2 Intestinal Parasites:

The intestinal parasites are those parasites which inhabit the intestinal region of the host and get nourishment from there. The intestinal parasites are generally helminthes and protozoan.

1.2.1 Intestinal Helminthes Parasites:

Helminthology, the study of parasitic worms and their effects (helminthiasis / helminthes infection) on their host (CDC, 2014). Helminthes are the parasitic worms which are multicellular , bilaterally symmetrical, elongated , round or flat animals (Arora and Arora, 2016). Helminthes have one or more intermediate host. They are classified into two phylum: Platyhelminthes and Nemathelminthes. Platyhelminthes are dorsoventrally flattened, leaf like or tape like whose alimentary canal is incomplete or entirely lacking. They are mostly hermaphrodites which divided into two classes- Cestoda and Trematoda where as Nemathelminthes are unsegmented diecious worms having body cavity with a high hydrostatic pressure having only one class Nematoda. Many parasite helminthes require one or more intermediate host.

Many route of infection of helminth parasites is ingestion of egg with contaminated food, or consumption of the infected intermediate host; Percutaneous route is also an important mode of invasion in case of helminthes parasite. Common symptoms are related with digestive system but effect can be more pronounced like anemia, loss of appetite, abdominal discomfort irregular bowel habit emaciation sometime epilepsy like symptoms are also evident. It has been estimated that, two million peoples are infected with helminthes worldwide, which are endemic in most tropical countries which may be underestimate of the true global distribution (Albonico *et al*.,, 1999; Zani, 2004). Five species are responsible for causing diseases in human which are *Ascaris lumbricoides, Trichuris trichiura* , Hookworm (*Ancylostoma duodenale* and *Nectar americans*) and *Strongyloides stercoralis* (Williams, 2005). Some of the intestinal helminthes infections are:

Ascariasis

Ascaris lumbricoides commonly known round worm is the largest intestinal nematode. It was discovered by Linnaeus in 1758. It is cosmopolitan in distribution being especially prevalent in tropical countries like India and China. These are large, stout and tapering at both ends. It has separate sex, females are longer and luger (200-400× 3.6mm) than males (150-300×2.4mm) (Oli, 2016).The worm does not require any intermediate host to complete its lifecycle. Infection with the *Ascaris lumbricoides* is acquired by the ingestion of the embryonated eggs containing 2^{nd} stage infective larva through the contaminated food, drinks and vegetables. The main features of the diseases are diarrhea,

fever, cough dyspnoea, body sputum etc. The adult worm causes edema of face, fever, rashes, conjunctivitis, hemorrhagic pancreatitis meningitis and other (Chatterjee, 1976).

Ancylostomiasis:

Ancyclostoma duodenale was discovered by Dubini in 1843 in Italy. It is commonly known as old world Hook Worm. It is cosmopolitan in tropical and sub-tropical countries. This worm is mostly common in an unmanaged area of sanitation where walk with bare foot. The adults are small and grayish-white in color. The male is smaller (8-11mm×0.45mm) than female (10-13mm×0.66mm). Single female can lay 15,000-20,000 eggs per day (Chakraborty, 2004). The taronomic features of Ancyclostoma dudanale are presence of copulatory bursa and mouth with teeth. The characteristics symptoms of Ancylostomiasis include nervous disorder, gastrointestinal disturbance. Heart defect, circulatory failure iron deficiency, anemia, bone marrow defect may cause due to adult from, while larva form may cause lesions in the lungs, ground itching, bronchitis erythema and oedema of the area (Arora and Arora,2016).

Trichuriasis:

The disease caused by *Trichuris* is Trichusiasis or whipworm infection. It was first discovered by Linnaeus in 1771. It occurs worldwide but mostly prevalent where the sanitation is poor and warm moist climates. The adult worm lives in large intestine of man especially in the caecum and vermiform appendix. The adult worms are characteristically whip shaped (Oli, 2016). The male worm measures 30-45mm in length and have coiled posterior end is comma or arc shaped. The infection is caused by the ingestion of embryonated eggs with contaminated food or water. The characteristic symptoms of Trichuriasis include abdominal pain and distension, bloody diarrhea, medicinal damage to the intestinal mucosa etc (Arora and Arora, 2016).

Strongyloidiasis:

The disease caused by *strongyloides* is srongyloidiasis. The different stages of S*trongyloides stercoralis* are adult, eggs and larvae. Only female worms are seen in the intestine and are partherogenetics i.e. they can produce offspring without being fertilized by male. Female are broader than male worms. It was first identified by Normend in 1876 (Yadav *et al*., 2017). It is worldwide in distribution however it is more common in tropical and sub-tropical area of Asia, Africa and South America. Adult fertilized female lives under the mucosa of small intestine especially in the duodenum and jejunum. It exists in two forms they are parasite and free living forms. Parasite males are not reported yet. Both free living males and females are reported. Parasitic females measures 2-3mm in length and 30-50mm in width. The characteristic symptoms of strongyloidiasis include skin lesions, pulmonary lesions, intestinal lesion etc (Arora and Arora, 2016).

Taeniasis:

Taeniasis is referred as the human infection with *Taenia solium* and *Taenia saginata*. The description of *Taenia saginata* was given by the hippocrates and Goeze differentiated it from the *Taenia solium*. They are Cosmopolitan in distribution. It is estimated that as many as 100 million people are infected with *Taenia saginata* (beef tapeworm) and *Taenia solium* (pork tapeworm) (Arora and Arora, 2016).

Taenia solium was identified by the Linnaeus in 1758. The adult worm consists of scolex, neck and strobilus which are made up of large number of proglottids. T.saginata measure 4-6m or more achieve as *Taenia solium* measures 2-4m in length. The eggs of both species are indistinguishable which are brown spherical in color and measures (31-43)µm in diameter. Man acquires infection by eating raw or under cooked beef or pork containing encysted larval stage. The adult worm lives in gut causing taeniasis. Taeniasis is generally asymptomatic but severe infection cause weight loss, dizziness, abdominal pain, diarrhea, headache, nausea, loss of appetite etc (Arora and Arora, 2016).

***Hymenolepis* and Hymenolepiasis :**

The disease caused by *Hymenolepis nana* is hymenolepiasis. The species nana meaning small is derived from the small size of the adult worm. The worm is first discovered by Bilharz in 1857. It is cosmopolitan and more common in warm climates. The adult are found in the lumen of the ileum with diameter of 1mm and hence is called a "dwarf tapeworm" (Ichhpujani, 2002). The infection is more common in children .The infection is symptomatic in malnourished and immuno-compromised children. Abdominal pain, diarrhea, weight loss and weakness are the major clinical features.

1.3 Objectives

1.3.1 General objectives:

To determined the prevalence of intestinal helminthes parasites among the children in private and public schools of Devdaha municipalities Rupandehi, Nepal.

1.3.2. Specific objectives:

- To determine the prevalence of parasites according to age and sex.
- To access the knowledge, attitude and practices (KAP) regarding intestinal parasitic infection of the study area.

1.4 Significance of the study

Intestinal Parasites are widely prevalent in developing countries probably due to the poor sanitation and inadequate personal hygiene. The study of intestinal parasites in school's children in Rupandehi district of Devdaha municipalities has been done to find out the prevalence of the infection on the basis of age, sex, source of drinking water, defecation place etc. The study is concerned to develop knowledge about intestinal parasite found in children of private and public school. So, this survey helps to create the awareness related

to the intestinal parasite infection, determine the present health status and possible cause of demise by the prevalence of helminthes parasites in school age children as well as this study will also help to find out the relationship between socio-economic status among children. The findings of the study will be helpful for future action plan.

1.5 Limitation of the study:

- Samples from more than two schools could not be collected due to time boundary and budget problem. From both Private and public school only some of the age, sex, wise representative sample was taken.
- This study was focused on children only of age (3 to 15) that are not sufficient for total description of possible infections.
- Due to time constraint the samples were collected only for one time hence seasonal impact could not be studied.

2. LITERATURE REVIEW

2.1 History of Parasitology:

The knowledge of parasitology was Limited to recognition of the existences of a few common external parasite such as like, lice fleas and few internal parasites like tapeworms, *Ascaris*, Pinworms and guinea worms up to the middle of 17th century (Chandler, 1961). In Earth human act as a host to about 300 species of helminthes worms and over 70 species of protozoa which was observed from our primate ancestors and some from the domesticated animals (Ashford and Crewe, 1998). Many of these are rare and accidental parasites but there are still 90 common species of parasites which can cause some of the most important diseases in the world by the presence of their small proportion. Intestinal parasite infection marked as a major public health issue and still considered as the most prevalent infections of humankind, more common among children and have been termed as "The cancer of developing nations" (Egger, 1990). Evidence had shown the infections have been closely associated with human over 10,000 years (Alum *et al*., 2010). Intestinal parasite infections are endemic in most tropical countries where the conditions are associated with poverty, lack of hygiene and sanitation, overpopulation (Crompton, 1999) and its distribution closely related to soil and climatic features which can be easily tracked by geographical information systems and remote sensing (Brooker *et al*., 2000).

The first written records about parasitic infections cause from a period of Egyptian medicine from 3000 to 400 BC. Later on there were description of various diseases may or may not caused by parasites, especially fevers. In Linnaeus time people thought that internal parasites were originated from accidentally swallowed free living organisms (Chandler, 1961). About a hundred species of helminthes have been reported from the human gastrointestinal tract, of these the nematodes- *Ascaris lumbricoides*, Hookworms and *Trichuris trichiura* are the most common parasites (Crompton, 1986). Similarly, the protozoan- *Entamoeba histolytica* infections are prevalent mostly in tropical and sub-tropical nations where by children especially those suffered from malnutrition are more frequently infected as compare to adult (Gilman, 1985). Both helminthes and protozoan infection is cosmopolitan in distribution but according associated risk factors, prevalence level differ with area and duration.

2.1.1. Global context:

Hook worms was discovered by Dubini in 1782. The penetration of the human skin by the hookworm larvae was discovered by Leoss in 1898 Gros found the 1st human amoeba *Entamoeba gingivalis*. Lambl discoverd *Entamoeba histolytica* in 1859 Kuchemeister and Leukart studied the life history of the *Taenia solium* in 1855 and 1856 respectively. In 1865 Leukart workout the life cycle of *Enterobius vermicularis* and latter in 1875 Losch proved its pathogenic nature. *Strongyloides stercoralis* was observed by Normand in 1876 (Arora and Arora, 2012). In 1903, Schoudinn differentiated pathogenic and non-

pathogenic types of amoeba (Oli, 2016). Stewart experimentally provided tissue migration of Ascaris in 1961 (Niyizurugero, 2013) had reported more than 50% positivity for intestinal protozoan infection with high prevalence of *Entamoeba histolytica* (54%) followed by *Trichomonas intestinalis* and *Ascaris lumbricoides* (20%) *Giardia duodenalis* (3.6%) and *Ancylostoma duedenale* (1.8%) in Rwanda where the study carried out in same year, (Gelaw, 2013) had reported higher prevalence of helminthic infection having predominant parasite *Hymenolepis nana*(13.8%) and *Entamoeba histolytica* (9.2%) , *Ascaris lumbricoides* (5.9%) respectively in Ethiopia. Many researches have been carried out on the intestinal parasites of the human by different workers. Some of the studies on human parasites and their infection are as follows:

The main three soil-transmitted infections like ascariasis, trichuriasis and hookworm cause clinical disorder in man (Bethony, 2006). Parasitic infection is considered as single worldwide cause of illness and disease (Keiser, 2008). The major neglected infections of helminthes infection are toxocoriasis, Strongyloidiasis, ascariasis, and cysticerusis where as in case of protozoan infection trichomoniasis, bacterial infections and vector borne infection including chagas disease in United States of America (Hotez, 2008) .

(Patel and Khandekar, 2006) carried out the study on intestinal parasitic infections among school children of the Dhahira region of Oman. Stool samples of 436 students were taken, out of which 65 children were undernourished. The prevalence of intestinal parasitic infections was 38.7% where the prevalence of protozoan infection was 36% while helminths infection was 9.4%. The overall prevalence was higher as Compared to other studies carried in Turkey (Kuman, 2001; Okyay, 2004). The prevalence of *E. histolytica* was 24%, *Giardia* species 10.5% and *Eschesichia coli* 1.4%. The infection of hookworm (*A. duodenale, N.americanus*), *A. lumbricoids, T.trichiura, H. nana, Taenia* sp., *E. vermicularis* and *strongyloids* were found very low 29(6.4%) students are infected with more than one parasites. It has been concluded that Dhahira region could be classified as low prevalence and low intensity area for soil transmitted helminthes infection where the protozoan infections were high. The school health program should be done in parasitic infection treatment and addressing the underlying causes of this problem. Several researches have been carried out in the Asian continent is the home of the most of the developing countries. Poverty, illiteracy, ignorance etc are common among the people of developing countries. Many researches have been done in different countries of the Asia. It was claimed that overall prevalence of IPI has been found very high (75.18%) in India (Wani, 2010). Similarly study by (Alyousefi, 2011) revealed comparatively less prevalence (30.9%) in the Yemon where as 28.5% of prevalence was revealed in Joardan (Ammoura, 2010). Research done in Indonesia showed variety of result regarding IPI. It was reported that *Ascaris lumbricoides* was the major helminth parasite infecting the people of the muslim community (Hasegawa, 1992). While some argued *Ansyclostoma duodenale* as the predominant intestinal parasite (Bangs *et al*., 1996). Some study revealed *Trichuris trichiura* as most frequently encounterd parasite in the muslim population of Indonesia (Hadju *et al*., 1995; Toma *et al*., 1999; Uga *et al*., 2004) . Diverse species of parasites have been recorded from the different countries of the Asia. *Ascaris*

lumbricoides has been ranked as most prevalent helminth parasite in India (Wani, 2010) i.e. 68.3%. and korea (Kyong-Rock *et al*., 2010). *Blastocystis hominis* and *Giardia limblia* have been reported as most common intestinal parasites (Arani *et al*., 2008) while in national scale *Giardia lamblia* alone was ranked as most encountered intestinal parasites in Islamic Republic or Iran (Sayyari *et al*., 2005). In Pakistan, *Ascaris lumbricoides* was reported as most frequent intestinal parasite in Muslim Population contributing over 60% of total intestinal parasitic infection (Hiroshi *et al*., 2002) Regarding the sex-wise distribution of IPI, male are more victimized then females but statistically not explained in United Arab Emirtes (Dash *et al*., 2010).

Similarly, (Manir *et al*., 2017) conducted the survey on prevalence of intestinal parasites associated with some primary school aged children in Dutsinma area, katsina state, Nigeria. A stool sample of 252.children was taken, out of which 63.49% positive for parasite infections. Five different parasites were observed in the study area including *Ascaris lumbricoides* (21.42%), *T. trichiura* (4.76%), hookworm (13.10%), *Strongyloides stercoralis* (3.97%) and *Schistosoma mansoni* (1.98%). This report is consistent with work of (Alemu *et al*., 2011; Utzinger *et al*., 2010; Charanchrashekhar *et al*., 2005) which states that the public health importance of soil-transmitted helminthic infection ranked highest in morbidity rate among the school-aged children which is due to nutritional deficiency. Intestinal parasitic infestations are highly prevalent in developing countries especially in the tropic region which bears serious medical and public health problems (WHO, 2013). It was found that there is a higher prevalence *Ascaris lumbricoides* (20%) followed by *Trichuris trichiura* (12.9%) *Enterobius vermicularis* (17.18%) and *Ancylostoma duodenale* (6.5%) in Nigeria (Akinbo *et al*., 2010). Similarly, the researches carried out in pupils of private and public primary schools in an urban centre, Nigeria to find the prevalence and pattern of intestinal parasites. 420 stool samples of pupils were taken, out of which 210 pupils from each school type prevalence of 78.1% and 17.1% were recorded in private and public school's pupil who agree with the findings of previous studies (Ogwurike *et al*., 2010; Emmanuel, 2017) carried out the study on prevalence of gastrointestinal parasitic infection among the school children in Port Haecourt city local government area, Nigeria. A total of 250 children were examined among them 24.8% (62 out of 250) Carried intestinal parasites. The most prevalent intestinal parasites were *Ascaris lumbricoides* (12.4%) *Trichuris trichiura* (6.8%) and hookworm (5.6%) which is similar to the previous study conducted in Nigeria (Ozumba, 2002). This study observed that the prevalence of intestinal parasites is associated with drinking untreated well/spring water and due to less educated parents who do not practice their hand washing before meal.

Parasitic infection in children reflect social inequalities throughout the world especially in urban and rural territories (Barra *et al*., 2016) and a regression analysis showed that the difference between rural and urban children disappear when the result are adjusted by family income and quality of sewage disposal.

2.1.2 National Context:

In the developing world, intestinal parasitic infection plays a significant role in high morbidity and mortality among the general population in a developing country like Nepal burden of parasitic infection appears in all ages mainly due to factors like lack of education, low socio-economic status, poor sanitation, consumption of unhealthy food and water.

In the contest of Nepal, many researches have been carried out by different researcher regarding IPI and reported the different species of helminth and protozoan parasites among. *Ascaris* has remained as leading human parasites among helminth where as *Entamoeba* sp. has been found higher among different species of the protozoan parasites (Rai, 1999). The study carried out by (Suresh, 2014) which was done to determine the presence of the Intestinal parasite among school children of Bhratpokhari VDC of Kaski District. Total 163 stool samples were collected out of which overall prevalence was 18(11%). The prevalence of *E. histolytica* had 61% followed by *Trichuris trichiura* 22% Hookworm: *Ascaris/Giardia* 6% each.

(Pradhan *et al.*, 2014) carried out the study to determine the prevalence of intestinal parasitic infection in rural public school children of Kathmandu. A total 194 stool sample of children was taken out of which overall prevalence of intestinal parasitic infection was found to be 23.7%, (28.2% for boys and 20.2% for girls). Among the infected children single or double parasitic infection was found in 44(93.5%) and 3(6.5%) children respectively. Among prorozoan parasites, *G. lamblia* was the most common (58.6%) where as *H. nana* was the most common (21.7%) among the helminths statistically, prevalence of different intestinal parasite infection was observed among children age group 6 years to 10 years. Gender wise, there is no statistical difference in prevalence of intestinal parasitic infection. This study suggests that there should be launched health education program in school along with regular screening of intestinal parasite and treatment for effective management of the intestinal parasites among school children in Nepal. (Saud *et al*., 2017) did the study on prevalence of intestinal parasitic infection among rural area school children of Lokhim VDC. A cross sectional study was conducted on 359 student attending Janata secondary school where the prevalence was 30.92% (111/359). Highest prevalence rate was seen in *G. lamblia* (13%) which is followed by *E. histolytica* 6.68%, *H. nana* 2.79% hookworm 2.5%, *A. lumbricoides* 2.30%, *T. trichiura* 0.84% and *E. vermicularis* 0.28%. The prevalence of parasite was found to be higher in female children than in the male children and highest prevalence was found between age group of 6-10 years, but the difference was statistically insignificant (p value>0.05) in both categories (Shrestha *et al*., 2019). Collected 508 stool sample from public and private schools children of Kathmanadu valley, an overall IPI prevalence of 19.9% (101/508) was found,where dominance of protozoan's (78.4%) over helminths (21.6%). *G. doudenalis* (32.7%) and *Ascaris lumbricoides* (21.8%) were the most common detected protozoan and helminth species respectively. Prevalence of intestinal parasitic

infections was higher among children from public school (26.1%) than private school (12.1%) and Dalit children (36.2%). These finding reveal the different prevalence of IPIs among public and private school children. (Yadav, 2017) study was accomplished on school children with the objective to define the prevalence of intestinal helminth parasite. A total 3000 of stool sample wear infected with helminth parasites. The prevalence rate of intestinal parasite was *Ascaris lumbricoides* (50.92%), *Ancyclostoma duodenale* (44.56%), *Trichuris trichiura* (1.96%), *Enterobius vermicularis* (1.44%), *Hymenolepis nana* (1.12%). The lack of safe drinking water, food, poverty unhygienic practices and poor environmental condition were found to be contributing factor in the maintenance of high prevalence rate of intestinal parasites infection. Parasite control program with hygienic practice and improvement of environmental conditions along with the treatment of infected peoples may be helpful in reducing the burden of helminth parasite in children. Hygienic conditions benefit people at personal and community level and ultimately contribute to promoting the health status of people.

Based on available earlier and recent reports review, it can be analyze that prevalence of intestinal parasite infection is still hanging up and down in many areas that are creating major issue in health sector of our country. Each and every studies or survey had reported their result and associated terms with conclusion and suggestion of the needs of health education program along with frequent screening of these parasites mainly among school children, awareness, on infectious diseases, improving hygiene and application of supportive programs for parents to elevate socioeconomic status etc. (Pradhan *et al*., 2014; Shakya *et al.*, 2012).

3. MATERIALS AND METHODS

3.1. Study area

The study area is in Devdaha municipality, Rupandehi district. The district lies on the southern and western part of Nepal. On the east it shares border with Nawalparasi District, on the west with kapilvastu district on North with Palpa district and on South with India. The elevation of the district lies between 100m to 1229m from sea level. The total area of district is 1360 km^2 with 16.1% in Churia Range and rest in the Terai region.

3.2. Introduction of Devdaha municipality:

Devdaha is a municipality in Rupandehi District of Nepal, the ancient capital of Koliya Kingdom, located 7 km east from Lumbini and east of Butwal and shares a border with Nawalparasi district on the east side. It is identified as the maternal home of Queen Mayadevi, Prajapati Gautami and Princess Yosodhara. There are many place to visit in Devdaha . It is believed that Prince Siddhartha had spent some years of his childhood with his step-mother/aunt Prajapati Gautami in Devdaha.

Devdaha was a township of the Koliyan in what is now the Rupandehi District of Nepal. The Buddha stayed there during his tours and preached to the monks on various topics. According to the commentaries it was the city of birth of the Buddha's mother (Mayadevi) and of Prajapati Gautami and their companions (Koliyans), who married the sakiyans of Kapilvasthu.

In Sanskrit language Deva means God and Daha means a Pond hence the literal meanings of Devdaha is "Pond of a God". It is believed that the gods and goddesses and saints bathed in this pond. Prince Siddhartha himself is believed to have bathed in this holy pond during his visit here in Devdaha. Because of it came into existence without human intervention and the water of this holy pond was supplied in the Koliya Palace. The ancient Koliya Kingdom and present Devdaha received it's name Devdaha from this holy pond.

Fig 1. Map of Study Area Devdaha

3.3. Materials Required

3.3.1. Equipments

a) Compound microscope
b) Sampling vials
c) Gloves and Mask
d) Toothpicks
e) Slides and Cover Slips
f) Forceps
g) Beaker
h) Filter paper
i) Ocular and stage micrometer
j) Dropper etc.

3.3.2. Chemicals

a) 2.5% potassium dichromate
b) Iodine Solution
c) Distilled water
d) Glycerin
e) 70% alcohol

3.3.3. Preparation of Solution

3.3.3.1. Preparation of potassium dichromate solution:

Accurately 2.5gm of potassium dichromate ($K_2Cr_2O_7$) was weighted with the help of electric balance and dissolve in 100ml of distilled water. The prepared solution was used for the preservation of stool samples (Chatterjee, 2017).

3.3.3.2. Preparation of Normal saline:

The solution was used for unstained observation of the characteristics movement of parasites; helminthes eggs which was prepared by dissolving 8.5 gm. of sodium chloride (NaCl) with 1000ml of distilled water (Chatterjee, 2017).

3.3.3.3. Preparation of Iodine Solution:

It was prepared by dissolving 10gm of potassium iodide in 100ml distilled water and slowly adding 5gm of iodine crystals in it. The mixture was filtered and kept in bottle which was mainly used for the detection of eggs of helminthes (Chatterjee, 2017).

3.4. Methods

3.4.1. Field Survey:

As there are many schools in Devdaha, Rupandehi and is impossible to include all of them so, pilot survey was done in different schools of some selected areas. Questionnaire is the important part during survey so it was filled by the interviewer to get more information regarding risk factors such as food habits, living conditions, defection places, drinking water and other factors.

3.4.2. Study Design:

This study was designed to find the prevalence of intestinal helminths parasites among the children in public and private school of Devdaha, municipality, Rupandehi. The design includes selection of individuals from study area from 5 to 16 years aged children stool collection and preservation, examination and recording of the obtained results. It also includes questionnaire survey to assess the KAP of the respondents given in Annex-I.

3.4.3. Sample Size:

A total 150 samples from both public and private schools were randomly collected. 75 sample from public school and 75 from private, orientation as focus on avoidance of urine in stool.

3.4.4. Stool Collection:

Random sampling technique was applied in selection of children for the sample and data collection from both private and public schools of selected area. Collections of samples were carried out at the first hour of the day when schools were in session. The children were taught in brief about the importance of the examination of stool to detect the parasite and how to collect stool sample with the help of their teachers and parents. A short questionnaires was designed which include **a)** Socio demographic data; address, age, gender **b)**behavioral data; hand washing habits, types of drinking water **c)** participant's present medical history. All the questionnaires were checked for accuracy. Each of the specimens was cheeked for its labeling. The portion of stool samples was preserved in 2.5% potassium dichromate solution and transported to the laboratory then processed immediately to detect eggs of intestinal parasites.

3.5. Laboratory processing of samples:

Lab work was carried out at Aryans pathology at Devdaha – Khaireni ,Rupandehi Nepal.

3.5.1. Microscopic examination of stool samples:

Photograph 1: Microscopic examination of stool sample slides

3.5.1.1. Direct method of observation:

This examination was done for the detection and identification of helminths egg or larva and protozoal cysts, oocysts, tropozoites by wet preparation i.e. unstained smear preparation and stained smear preparation (Arora and Arora, 2016).

3.5.1.2. Unstained smear preparation of sample:

In a clean glass slide a drop of normal saline was taken and with the help of toothpick 1-2 drops of stool sample was mixed over it making its consistency thin and clear then observed under microscope after covering it with a cover slip (Arora and Arora, 2016).

3.5.1.3. Stained smear preparation of sample:

With the help of dropper, a drop of 5 times diluted Lugol's iodine solution was taken on a glass slide and mixed 1-2 drops of stool sample with it then the preparation was covered with a cover slip and observed under microscope (Arora and Arora, 2016).

3.6. Methods of observation:

Both stained and unstained preparations were first examined under the low power 10x of microscope. Observation was starting from one end of the slide to another. When the parasites eggs were seen then the objects were centered and focused under 40X for the clear vision and also for detailed diagnosis. Micrometry was done for the conformation of egg of helminthes parasites.

3.7. Calibration of eggs, cysts and larva:

Calibrating process was done by using ocular and stage micrometer. The length, breadth and diameter of parasites eggs, cysts and larva were measured with the calibration factors.

Calibration factor (CF) for 10X= 10.37 micrometer

Calibration factor (CF) for 40X= 2.588 micrometer

3.8. Identification of the eggs, cysts and larva:

The identification and confirmation of the eggs, cysts and larva were made by comparing the structure, color size of eggs, cysts and larva from published books, literature and journals (WHO, 2004).

3.9. Data analysis, Interpretation and presentation:

The collected data from the field survey and laboratory reports were statistically analyzed with the help of excel 2007. Chi square test was performed for the analysis of data, and $p<0.05$ was considered for the statistically significance difference. The obtained data were also presented in the tabulated, bar diagram forms according to the model of collected data and information by using Microsoft Excel 2007.

4. RESULTS

The study was conducted among the children of private and public schools at Devdaha, Rupandehi district. A total of 150 stool samples of different sex and age groups were collected and examined. The result of the present study is divided into two categories.

1) Result of stool examination
2) Result of questionnaire survey

4.1. Result of stool examination:

4.1.1. General prevalence of intestinal parasites:

Out of 150 stool samples examined, (75 from private school and 75 from public school) four intestinal parasite were identified with overall prevalence was 18.66% where as in case of public school 22.66% and in case of private school 14.66%, was found positive for the intestinal parasites. There was no significant difference between the gastrointestinal parasite among the children in public and private schools.

Table 1: General prevalence of intestinal parasites:

Types of school	Total no. of examined Samples.	Positive Case	Positive %	Overall prevalence	P-value
Public	75	17	22.66%	18.67%	0.812239
Private	75	11	14.66%		

4.1.2. Age wise prevalence of intestinal parasites:

From both public and private schools the distribution of intestinal parasite were maximum in (3-7) year's age group of children compared to (8-12) age group and (13-16) age group as shown in table. Statistically, the difference in prevalence of parasites with age group in public school and in private school was found to be insignificant.

Table 2: Age wise prevalence of intestinal parasites:

Types of Schools	Age	Total no. of samples	+ve case	Positive %	p-value
Public School	(3-7)	36	9	25%	0.999141
	(8-12)	27	6	22.22%	
	(13-16)	12	2	16.66%	
Private School	(3-7)	38	7	18.42%	0.989416
	(8-12)	29	3	10.34%	
	(13-16)	8	1	12.5%	
Total		150	28	18.66%	

4.1.3. Gender –wise prevalence of intestinal parasite:

Among the public school children and private school children the prevalence of infection rate is similar where prevalence of infection in male (24.42%) is more than female (21.42%) in public school where prevalence rate of infection in female (15.38%) is more than male (13.88%) in private school.

Statistically, there was no significant difference in the prevalence of intestinal parasite between male and female of school children (P>0.05).

Table 3: Prevalence of gender-wise prevalence of intestinal parasite:

S.N.	School	Gender	Total no. of sample	+ve case	+ ve %	P- value
1	Public School	Male	33	8	24.24%	0.999153
		Female	42	9	21.42%	
2	Private School	Male	36	5	13.88%	0.999862
		Female	39	6	15.38%	

4.1.4. Prevalence of individual intestinal parasites:

Out of 150 stool samples examined, four intestinal parasites were identified with list of *A. lumbricoides*, Hookworms, *Trichuris trichiura*, *Taenia* sp. The children of public school have maximum distribution of parasites in comparison to private school.

Table 4: Prevalence of Specific intestinal parasite:

S.N.	Parasites	Types of school			
		Public school		Private school	
		+ve cases	Infected	+ve cases	Infected
1.	*A.lumbricoides*	8	42.10%	5	41.66%
2.	*Trichuris trichiura*	5	26.31%	3	25%
3.	Hookworm	3	15.78%	3	25%
4.	*Taenia* sp.	3	15.78%	1	8.33%

4.1.5. Intensity of single and double infections:

Altogether, 88.23% children of public school 81.81% of private school were found to be single parasite infected where as 11.77% and 18.18% reported as double parasite infected case with *A .lumbricoides* as most common single parasite infection as shown in table.

Table 5: Intensity of single infection:

S.N.	**Parasites**	**Types of school**			
		Public school		**Private school**	
		+ve case	**% of+ve Case**	**+ve case**	**% of +ve Case**
1.	*A.lumbricoides*	6	40%	4	40%
2.	*Trichuris trichiura*	4	26.66%	3	30%
3.	Hookworm	2	13.33%	2	20%
4.	*Taenia* sp.	3	20%	1	10%
	Total	N=15		N=10	

Table 6: Intensity of double infection

S.N.	**Parasites**	**Types of school**			
		Public school		**Private school**	
		+ve case	**%+ve Case**	**+ve case**	**of +ve case**
1.	*A. lumbricoides* + Hookworm	1	50%	1	100%
2.	*A. lumbricoides* + *T. trichiura*	1	50%	-	
3.	*T.trichiura* + Hookworm	-		-	
4.	Hookworm+ *Taenia* sp.	-		-	
		N=2		N=1	

4.2. Result of Questionnaires Survey Analysis:

Interviewers was carried out to the same public and private school children whose stool samples were collected and examined and those who could not answer themselves, taken help from their parents. For this survey a set of questionnaires were prepared and asked them about the knowledge of parasite infections and associated risk factors such as behavior, economic status, occupation, eating, drinking and sanitary habits etc. the results from the questionnaires survey analysis are as follows.

Knowledge, Attitude and Practice (KAP) of school children in relation to intestinal parasitic infection:

Proper knowledge, good attitude and practice (KAP) towards intestinal parasite can significantly mitigate the spreading of intestinal parasitic infection. Interview was carried out to the some public and private school children's whose stool samples were collected and examined and those who could not answer themselves was taken help from their parents. For this survey, a set of questionnaires were prepared and asked them about the knowledge of parasitic infections and associated risk factors such as behavior, eating, drinking and sanitary habits etc.

The knowledge related risk factors were their education level, knowledge about the parasites and their transmission. Most of the parent had either seen parasites particularly *Ascaris lumbricoides* commonly called as 'juka' or had heard about it. Similarly, in relation to mode of transmission very few people had knowledge as "water" contamination with faecal matter is major source, while most of them were aware about preventive practice. The children who use open place for defecation had higher infection as compared to the children using toilet and very few of them defecate on open place. The result revealed that defecation was significantly associated with parasitic infection. Most of the children wash their hand with soap and water and few of them do not wash their hands before meal and after defecation. Those students who do not wash their hand before meal and after defecation had higher infection rate in both public and private school as compared to the students using soap and water.

The attitude towards drinking water, walking on barefoot and defecating on open place were assessed. Most of them know about drinking dirty water and walking on barefoot is one of the causes of intestinal parasitic. In case of defecation on open place, most of the parents know its causes as transmission of various diseases like Diarrhea, Cholera. Most of the children wash their hands with soap and water and few of them do not wash their hands before meal and after deification. Those students who do not wash their hand before meal and after defecation had higher infections rate in both public and private school as compared to the students using soap and water. There was not significant association of hand washing habits with parasitic infection.

Table 7: Assessment of Knowledge Attitude and Practice of School Children in relation to intestinal parasitic infections:

KAP Indicators	Public			Private		
	Total	Infected	Infection	Total	Infected	Infection
Knowledge on IP						
Yes	12	3	25%	24	2	8.3%
No	63	14	22.22%	51	9	17.64%
Mode of transmission of IP						
Know	16	2	12.5%	23	1	4.3%
Don't know	59	15	25.42%	52	9	17.3%
Walking on barefoot can cause IPI						
Yes	34	6	17.64%	48	4	8.33%
No	41	11	26.82%	27	7	25.92%
Dirty water can cause IPI						
Yes	47	8	17.02%	58	6	10.34%
No	28	9	32.14%	17	5	29.41%
Defecating on open place can cause IPI						
Yes	51	7	13.72%	62	4	6.45%
No	24	10	41.66%	13	7	53.84%
Hand washing before meal and after defecation	23	1	4.34%	29	1	3.4%
1) With soap water	36	9	25%	38	7	18.42%
2) With water only	16	7	43.76%	8	3	37.5%
3) No hand wash						
Defecation sites						
Toilet	64	8	12.5%	66	6	9.09%
Open place	11	9	81.8%	9	5	55.55%
Using of anti-helminthes drugs						
• Before 3 month	12	1	8.33%	9	1	11.11%
• Before 6 month	16	3	18.75%	14	3	21.4%
• Before 1 year or above	47	13	27.65%	52	7	13.4%

5. DISCUSSION

Intestinal parasites are present throughout the world in various degree of prevalence and are the major health problems in areas where there is overcrowding, poor environmental sanitation and personal hygiene practice especially in developing countries (WHO, 2010). The study revealed that intestinal parasite infection was higher among children who did not usually wash their hands after playing or defecation and before eating. Other similar studies reported about poor hand washing practice of children and risk of intestinal parasite infections. This can be due to the fact that children catch germs when they touch contaminated objected or surface or soil which increases the risk of hand contaminated with diseases causing pathogens. Hand washing is the single most effective way to prevent the spread of infection.

The present study reveals that out of 150 children of Devdaha municipality 28(18.67%) was infected by different *kinds of intestinal parasites like Ascaris lumbricoides,* Hookworm*, Trichuris trichiura*, *Tainia* sp. which showed agreement with previously published reports by (Khanal *et al*., 2011; Shrestha *et al.,* 2012; Pardhan *et al*., 2014; Tandukar *et al*., 2013; Sah *et al.,* 2016; Emmanuel, 2017; Belachew *et al*., 2017). However this result was somehow lower than the (Dhital *et al.*, 2016; Regmi, 2014; Sah *et al*., 2013; Saud *et al*., 2017).

The prevalence of *A. lumbricoides* was found higher in both private and public schools which is followed by *T.trichiura*, Hookworm and *Taenia* sp. In both school, *A. limbricoides* was most common parasite same result was showed by the previous studies (Rai *et al*., 2004; Shrestha *et al*., 2001; Khanal *et al*., 2011; Khadka *et al*, 2013; Belachew *et al*., 2017; Esiet *et al*., 2017). This might be due to over dispersion of *Ascaris* egg in the environmental as relatively large number of eggs is laid by single female worm and as well as poor hygienic habits 7 improper washed or cooked food materials also have highly influenced in prevalence of those parasitic infections.

In the present study the prevalence of intestinal parasitic was found to be higher in male (24.24%) than in female (21.42%) in public school where as private school it was found higher in female (15.38%) than male (13.88%). But overall prevalence rate is higher in male 18.84% than in female 18.51%. which is similar to finding with other studies like (Chandra shekhar *et al*.,2005; Khanal *et al*., 2011; Tandulkar *et al*.,2013; Pardhan *et al*., 2014; Regmi, 2014; Singh *et al*., 2014; Pandey *et al*., 2015; Esiet *et al*., 2017; Gurung, 2018; Regmi, 2019).Whereas, (Shrestha *et al*., 2007; Mukhiya *et al* ., 2012; Sherchand *et al*., 1997; Shakya, 2012) had showed high prevalence of infection in girls.

Based on the age of children in the study, parasitic infection was found to be highest to the children of age group (3-7) years both in public and private school. From Nepal (Rai *et al*., 2017; Yadav, 2016; Gurung, 2018; Regmi, 2019) had also presented prevalence of infection among same age group of children. As the children of this age group have only the think of playing (outside the house) with mass of their friends wherever they gets.

They use to get everything they found without knowing good or bad sense etc, which may lead the higher chance of infection. While, the studies by Poudyal *et al*.,(2006), Shrestha (2009), Regmi (2019), Shakya *et al*., (2012), Khanal *et al*., (2011) with elsewere Gelaw *et al*., (2013) reported higher prevalence of infection among school children of other age groups.

The present study showed that overall 92.85% had single infection showed that overall 92.85% had single infection where as 7.14% had double infection. In double species infection *Ascaris lumbricoides* was seen in all cases. This shows that *Ascaris lumbricoides* highly influence the low socio-economic and resembles the study conducted by Yanai *et al*., (1996), that showed the annual rate of positive for soil transmitted helminthes i.e. *A. lumbricoides* had the highest prevalence than *H.nana, T. solium* and *A. duodenalae*.

When we analyzed public and private school data, knowledge on IPI, mode of transmission of IPI, shows association between intestinal parasitic infections. However in some cases like age group (3-7) having habit of playing in open area sand ,soil and they are unable to care themselves having more victim of this type of infection. Personal hygiene and attitude of parents and children seem improve due to education. Defecation in toilet and hand washing before meal and after defecation, nail cutting habits, drinking pure water (filtrate or boil water) are very important hygiene practices to avoid IPI transmission. Intestinal parasitic infection is found more common in children who are not following the hand washing practice. Its common knowledge that lack of using toilet facilities affects environmental hygiene since, children defecates around the houses, fields, playgrounds and nearby water sources which ultimately might have increased the chances of intestinal parasitic infection by contaminating the food and drink materials (Regmi, 2012).

Pokhrel (2005) reported higher positive rate of infection among respondents who don't know about the use of dewormng drugs and least prevalence was found who used deworming drugs 3 months before. Therefore, positive rates of parasitic infection were significantly low in children taking anti-parasitic drugs before 3 months. The present study showed maximum prevalence of infection among those children who having deworming tablets before 1 year than having regular interval of time (before 3 month/ before 6 months).

6. Conclusion and Recommendations

The study was carried out to observe the prevalence of intestinal parasitic of Public and Private School of Devdaha Municipality of Rupandehi district. The overall prevalence of intestinal helminth infections was found to be 18.67%. Altogether four species of parasite were encountered with most common parasite *A. lumbricoides*. The prevalence rate of infection was found higher in children of public school as compared to the children of private school. The infection rate was found marginally higher in boys than in girls. Socially and economically deprived groups seem more victim of parasitic infection. Children of age group of (3-7) year's old school children of both public and private were observed more infected with intestinal parasites. There was significant difference in the prevalence of intestinal parasitic infections regarding knowledge, attitude and practices of respondents where, insignificant difference was observed with use of drugs, drinking water wise.

This shows that intestinal parasitic infections are still prevalent as major health problem among school children. Transmission of infections were generally due to poor sanitary habits, using of direct tap water , defecation on open place and somewhat lack of knowledge and awareness about the infection. Awareness program related to intestinal parasitic infection and improving hygiene, health education and improvement of personal as well as environmental hygiene on protect from intestinal helminthes infection. Therefore the public health interventions and control program including treatment of infected individuals, education on personal and environmental hygiene, school-based awareness program, development of the health care facilities and other are required to minimize the risk of intestinal parasitic infections in such communities.

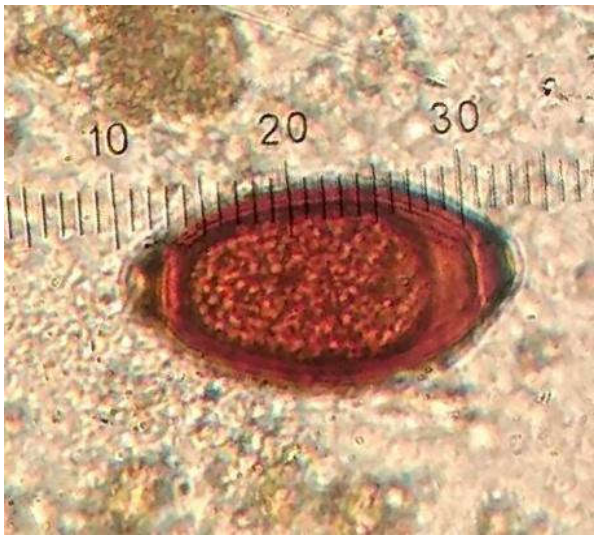
Recommendations:

This study reflects the poor hygiene status of school age children so, some recommendation are as follows:

- Basic health education programs about intestinal parasitic infections should be conducted time to time.
- Well established sanitary toilet should be build up in each and every house.
- Pure and safe drinking water facility should be made easily accessible for the tribal communities.
- Awareness program related to intestinal parasitic infections and interventions repeated albendazole mass treatment can protect from intestinal helminthes infections.

Figure of identified species of Helminths Parasite:

Photograph 2: *Ascaris lumbricoides*



Photograph 3: *Trichuris trichiura*

Photograph 4: Hook worm

Photograph 5: *Taenia* sp.

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ANNEX – I

QUESTIONAIRES

Name :

(a) Age ……..(b) sex …… (c) Ethnic group ……..……

(d) Occupation ……. (e) Gender …….

1. Do you have knowledge about gastro-intestinal parasites ?

i) Yes ii) No

2. Have you ever suffered from any intestinal diseases ?

i) Frequently ii) Rarely iii) Often

3. Do you know about health sanitary practices ?

i) Yes ii) Little iii) No

4. What types of water do you prefer to drink ?

i) Direct water ii) Filtered water

5. Do you think walking with bare foot can cause IPI ?

i) Yes ii) No

6. Do you parents take you for checkup in regular interval of time ?

i) Yes ii) No iii) Often

7. Do you have taken anti-helminthic drugs ? If yes, then when

i) Before 3 month ii) Before 6 months iii) Before I yr or abovr

8. Where do you defecate ?

i) Toilet ii) Open place

9. Do you wash your hands before meal and after defecation ?

i) Yes ii) No

If yes, how ?

i) With soap water ii) with water only iii) no hand washing

10.Do you have habit of cutting your nail ? If yes, then when

i) Once a week ii) once a two weeks iii) Sometimes

ANNEX – II

Keys for the Identification of Helminth eggs and Protozoan cysts (Arora and Arora , 2015).

Helminthes	Measurement	Appearance
Ascaris lumbricodes (Unfertilized)	90 μm in length and 55 μm in breadth	Yellow, elongated mammillated, thinner capsule and packed with refractile yolk globules.
Ascaris lumbricoides (fertilized)	60-75 μm in length and 40-50 μm in breadth	Yellow, oval (fertilized ova with thick mammillated capsule.
Trichuris trichitura	50-54 μm in length and 22-23 μm in width.	Brown, thick-shelledm barrel-shaped with a knob at either end.
Enterbius vermicularis	60 μm in length and 30 μm in width	Oval, planoconvex, thin-shelled
Hookworms	6 μm in length and 40 μm in width.	Oval, thin shelled
Taenia sp.	31-43 μm in diameter	Oval, pale yellow with a thick radically striated embryophore with 6 hooklets.

Protozoan	Measurement	Appearance
Entamoeba coli	20-50 μm in diameter	Oval, Nucleus visible when stained.