PREVALENCE OF INTESTINAL PARASITOSIS AMONG SCHOOL CHILDREN OF JALESHWAR, MAHOTTARI, NEPAL

A

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BY

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RECOMMENDATION

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ABSTRACT

Present study was conducted among the school children of Jaleshwar, Mahottari, Nepal to determine the prevalence of intestinal parasitic infections. The study reflects the present scenario of intestinal parasitic infection and some of its pre-disposing factors among school children of this region. The study was conducted from May to November 2010. A total of 320 (212 from public school and 108 from private school) stool samples were collected, formalin fixed and brought to Kathmandu. The laboratory examination was done at employing direct smear and formal-ether concentration technique. Overall prevalence of infection was found to be 42.2% (135/320). Infection rate was marginally higher in public school children (45.3%) compared to the private school children (36.1%) ($P>0.05$). No significance difference in infection rate among male (41.7%) and female (42.9%) was observed ($P>0.05$). Infection rate was significantly higher in the children not having toilet at home (48.9%) compared to the children having toilet facility at home (32.3%) ($P<0.05$). Significantly higher prevalence was observed in children washing their hands with mud after defecation (50.8%) compared to the children using soap (37.1%) ($P<0.05$). Significantly higher infection was observed in children who have not taken anti-parasitic drugs in previous one month (47.9%). Altogether ten species of parasite were detected in the study. *Giardia lamblia* (31.79%) was the most common protozoan parasite detected whereas *Ascaris lumbricoides* (12.58%) topped among the list of helminthes. The result indicated the need for school health programmes that will involve periodic deworming, health education and improvement of sanitation.

Key words: School children, Intestinal parasite, Terai, Nepal, Factors

CONTENTS

LIST OF TABLES

Page No.

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF APPENDICES

LIST OF ABBREVATIONS

STH	Soil transmitted helminthes
A. lumbricoides	*Ascaris lumbricoides*
S. sterocoralis	*Strongyloides sterocoralis*
H. nana	*Hymenolepsis nana*
E. histolytica	*Entamoeba histolytica*
E. coli	*Entamoeba coli*
I. butschlii	*Iodamoeba butschlii*
E. nana	*Endolimax nana*
E. hartmanni	*Entamoeba hartmanni*
B. hominis	*Blastocystis hominis*
C. cayetanensis	*Cyclospora cayetanensis*
T. trichiura	*Trichuris trichiura*
C. mesnili	*Chilomastix mesnili*
C. sinensis	*Clonorchis sinensis*
S. mansoni	*Schistosomiasis mansoni*
N. americanus	*Necator americanus*
WHO	World Health Organization

CHAPTER- I

1. INTRODUCTION

Intestinal parasitic infection is the infection of gastrointestinal tract caused mainly by two groups of parasites namely protozoan and helminthic. It has created a great nuisance since early past to present globally. Though it has affected both developing and developed countries, developing countries are affected severly.

Intestinal parasitosis is one of the major causes of public health and in turn socio-economic problem particularly in developing countries (Rai et al; 2002). An estimated 3.5 billion people are affected globally and 450 million are ill, majority being the children (WHO, 2000). In some tropical areas, the prevalence reaches nearly 100% (Estevez et al; 1983; Rai and Gurung, 1986).

More than half of the human population in the world live in misery pain and suffer vast economic loss due to intestinal parasites. About one fourth of the world population is infected by one or more species of intestinal parasites. *Ascaris lumbricoides*, hookworm and *Trichuris trichiura* have been estimated to infect 250 million, 151 million and 45 million people respectively. Each of these parasites has been responsible for the death of 65,000, 60,000 and 70,000 people respectively (Ishiyama et al; 2001). Thus the intestinal parasitic infection has created constant health hazards globally.

Over the last 100 years there has been a dramatic fall in the incidence and prevalence of parasitic diseases in the developed countries. Unfortunately in the developing countries like Nepal, parasitic diseases remain significant health problem (Kunwar et al; 2004). The disease has caused a great economic loss and human health hazards from in developing countries. Thus the public health importance of intestinal parasitosis continues because of its

high prevalence, virtually global distribution and effects on both nutritional and immune status of individuals (Rai et al; 1995).

Nepal is a small impoverished country with infectious diseases including intestinal parasitosis, being highly prevalent (Rai et al; 2001; 2002). Over 85% of the population are engaged in agriculture, live in village setting and have the low human development indexes (Rai et al; 1998). Being a developing country intestinal parasitosis is common in Nepal. The reported prevalence varies considerably from one study to another with over 90% in some areas. On an average over 60% people are infected with some kinds of intestinal parasites. Intestinal worm infections alone rank fourth in "top ten disease" in Nepal (Shrestha et al; 2009).

Although, they target all age groups children are more commonly affected than adults and suffer from malnutrition associated morbidity and mortality (Shrestha et al; 2009). It has been attributed to poor sanitation, poverty and lack of health education (Matsumura et al; 1998; Rai et al; 2002) and water contamination (Adhikari et al; 1986; Ono et al; 2001). In addition emerging parasites have also been reported (Sherchand et al; 1996; Ono et al; 2001). Polyparasitism is common in some areas (Estevez et al; 1983; Rai et al; 2001).

Intestinal parasitosis even in low or moderate level, affect on host nutritional status by causing reduction in apetite, digestion, absorption and acute phase status and increasing intestinal nutrient losses which in turn leads to various mortality and morbidity (Rai et al; 2004). Intestinal parasitosis contributes greatly to malnutrition in Nepal. A significant negative effect of intestinal parasitosis on some nutritional parameters in school children, pregnant women and general population in Nepal have been reported (Rai et al; 2004).

High prevalence rate of intestinal parasitic infection is associated with intake of contaminated water, open defecation habit, poor hygiene and poor sanitary conditions etc.

Directly measurable effects of the infection includes increased fecal nitrogen and fecal fat and impaired carbohydrate absorption all of which return to normal after eradication of the infection (Kunwar et al; 2004). Some of the common clinical manifestations of the infection are diarrhea, dysentery, abdominal pain, anaemia, vomiting, vitamin A deficiency, intestinal obstruction etc. Chronic infection impairs physical and mental development. Furthermore it increases susceptibility to infections with other pathogens (Rawat et al; 2002).

The host factors associated with predispotion of disease are age, level of immunity, co-existing disease which reduces immunity eg. Pregnancy, under nutrition etc. (Rai et al; 2002). Children are more susceptible to infection than adults due to low immune status, unhygienic habits and the activities like playing outside in the soil, eating the streets food etc.

Safe and efficacious broad spectrum anti-parasitic drugs has been developed, however, their availability for treatment programs can be limited by economic resources, distribution network and national regulations. Increasing population density, environmental pollution, unmanaged urbanization and migration pattern will continue to promote transmission and re-infection of parasite.

BACKGROUND INFORMATION OF THE STUDY POPULATION

Jaleshwor is the Headquarter of Mahottari District which lies in the Terai region of Nepal. This study was carried among the school children of Jaleshwor and some nearby villages. There is a vast cultural and religious difference between the people living in this region. Although the ethinicity of this area varies among

different groups of people they live peacefully and enjoy the culture, tradition and festivals of each other.

The major Castes residing in this region includes, Bramhin, Rajput, Bhumihar, Teli, Sundi, Mushar, Yadavas, Dusadh, Hajam, Chamar, representing Hindu community. Besides, different castes of Muslim community also belong to this region. The occupation of the people depends on their caste though majority are involved in agriculture and animal rearing. Their literacy rate is low since most children of this region help their parents in the farming activities rather than going to school. Open defecation habit is practiced in the most part of this region. Most of the children of this region do not follow the simple rules of sanitary practices, especially the children belonging to the lower caste and low income group family. Due to low income of the parents most of the children are devoid proper nutrition, education, housing, proper hygiene practices etc. which all lead to a considerable level of intestinal parasitic infection among the children of this area.

This study is carried with a view to determine the prevalence of intestinal parasitic infection among the school children of this region. The study will help the national regulatory bodies to formulate plans and policies and to implement them for the effective control of the infection in this region. It will also help the researchers to carry out further studies in the related areas.

CHAPTER- II

2. OBJECTIVES OF THE STUDY

2.1) General objective:

To determine the prevalence of parasitic infections among school children of Jaleshwor, Mahottari

2.2) Specific objectives:

1. To assess the prevalence of parasitic infections among school children.
2. To correlate the parasitic infection and sanitary practices between private school and public school children.
3. To assess the prevalence of parasitic infection in relation to socio-economic condition.
4. To compare the parasitic infection among different ethnic groups.
5. To estimate the prevalence of intestinal parasite in relation to age, sex, education status.

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CHAPTER - III

3. LITERATURE REVIEW

3.1 Global Scenario

Intestinal parasitic infection is one of the major public health problems in the world particularly in the developing countries approaching the prevalence of 100% in some areas (Ishiyama et al, 2003). About 80% of all illness and disease in the world is caused by inadequate sanitation, unsafe water and unavailability of water (WHO, 2002), intestinal parasitosis being one of them.

The global burden of the disease caused by the three major intestinal nematodes *A. lumbricoides*, hookworm and *T. trichiura* have been estimated to be 250 million, 151 million and 45 million respectively. The death associated with these disease are 65,000, 60,000 and 70,000 respectively (Ishiyama et al, 2001). Similarly the incidence rate of two protozoan parasites *G. lamblia* and *E. histolytica* vary from one study to another. The reported incidence of *G. lamblia* varies from 0.2% in Thai labourers working in Taiwan to as high as 61 to 69% in rural village children.

A significant relation between income level and parasitic prevalence was found when parasitic distribution was evaluated in association with demographic features in Turkey. *Blastocystis hominis* was most commonly detected parasite followed by *Enterobius vermicularis* and *G. intestinalis.* Multiple parasitic infection was most common in crowded families. High prevalence of parasitic infection in Izmir, Turkey is a serious problem and could be decreased by improving sanitary practices by urbanization and quality of life Aksoy et al (2007).

The occurrence of various intestinal parasites and high prevalence of *Ascaris lumbricoides* among school children in Maragondon, Cavite, Southern Luzon, Philippines, necessitates the immediate action of the proper health authorities in the area, coupled with public health education on prevention of infection with *Ascaris lumbricoides*. *A. lumbricoides* was most common parasite followed by hookworms, *T. trichiura*, *Taenia* spp, *E. histolytica/dispar* , *G. lamblia* and *Strongyloides stercoralis* and *E. vermicularis* (Cauyan et al; 2008). Organization of education seminars including the topics such as prevention of infectious disease, improving general hygienic condition and application of supportive programmes for the parents must be done not only to reduce intestinal parasitic infections but also to elevate the saocio-cultural levels. *B. hominis* and *G. lamblia* were the most frequent intestinal parasite detected in a retrospective cross-sectional study conducted in Tehran to describe the epidemiologic characteristics of intestinal parasites. Practicing good hygiene and avoiding using contaminated water and food are the main preventive measures to prevent these infections Arani et al (2008).

Chomotherapy using albendazole was found most effective against intestinal helminthic infection in Nigeria. The 77% prevalence of intestinal geohelminthiasis before deworming the children with albendazole was reduced to 34% after deworming (Oyewole et al; 2007). Regular deworming of members of this community was assumed to be effective to reduce the helminthic infection to a considerable level. Though the relation between hygienic and sanitation practices were not properly investigated, provision of toilet facilities, hand washing after using the toilet and before eating will be useful. In addition, the availability of potable water and mobilization with health education message on good hygienic practices will be useful. A two dose of 200mg regimen of albendazole is likely to eliminate the worm completely.

Intestinal parasitic infection remains a public health problem in Gaza Strip, Khan Younis governorate because of poor sanitation, population crowding, bad hygienic habits and poor health education. *A. lumbricoides* was found to be the most common parasite (12.8%), followed by *G. lamblia* (8%), *E. histolytica* (7%), *E. coli* (3.6%), *T. trichiura* (1.6%) and *H. nana* (1%), *E. vermicularis* (20.9%) (Astal et al; 2005). A high prevalence of intestinal parasitic infection was reported from Metro Manila, Philippines. The prevalence of intestinal parasites among children housed in institutions managed by government and NGOs remains high. Multiple infection was common, *T. trichiura* was the most common helminthic parasite found whereas *B. hominis* was the most prevalent protozoan parasite Baldo et al (2004). Periodic treatment with anti-parasitic drugs were found effective to control the parasitic infections. Geophagia is one of the most important factors causing intestinal parasitic infection was reported from Guinea. A high prevalence of nematode infection was observed in children having goephagic habit. The most common parasites identified were hookworm, *A. lumbricoides*, *T. trichiura*, *S. stercoralis.* Multiparasitic infection was found more common than single parasite infection. Parasite pairs *A. lumbricoides* and hookworm and *A. lumbricoides* and *T. trichiura* showed a positive association (Glickman et al; 1999).

Intestinal parasitic infection has a strong association with allergic diseases. Among helminthes *S. stercoralis*, *Anisakis simplex*, *T. trichiura* and *A. lumbricoides* have been reported to exihibit a direct relation with chronic urticaria and atopic dermatitis. Similarly *G. lamblia* and *B. hominis* was reported to be associated with cutaneous allergy. An increase in total IgE levels is commonly detected because parasites can stimulate the production of high levels of specific IgE antibodies against their own antigens, which sensitizes mast cells of the host and also the parasites cause polyclonal stimulation of IgE synthesis which may result in enhanced allergic reactivity toward environmental antigens. *B. hominis* was the most frequently recovered protozoa whereas *E. vermicularis* and *T.*

trichiura were the most frequently recovered helminthes in individuals with allergic skin diseases from Italy (Giacometti et al; 2003).

Demographic factors such as young age, wet season female gender all correlated positively with increased rates of parasitic infection among young children in Guatemala. Malnutrition was associated with increased rates of infection for *G. lamblia* and *E. histolytica* only while infection during wet season was higher for *H.* nana and *E. histolytica* only. Age was significant only in infections due to *G. lamblia* and *E. histolyti*ca, and infection infection in females was only greater for *H.* nana. The prevalence of gastrointestinal parasites among young Guatemalan children is highly dependent on the specific species of the parasite (Cook et al; 2009). Nitazoxanide, 5-nitrothiazole derivative was found to be highly effective broad spectrum antiparasitic drugs. The drug was found to be effective against infections with *A. lumbricoides*, *T. trichiura*, *T. saginata*, *H. nana* and *Fasciola hepatica* as well as infections with common protozoa such as *Cryptosporidium parvum, B. hominis, E. histolytica*, *G. lamblia* and *Isospora belli*. The drug is well tolerated with only minor clinical side effects such as abdominal pain. The efficacy of this drug was tested in Mexico and was found to be effective against parasitic infections by eliminating 84% of protozoa and 95% of helminthes from the patients (Diaz et al; 2003). The drug was reported to be very effective to treat patients having mixed infections.

A significant seasonal fluctuation was observed in the rate of common intestinal parasitic infection in Khan Younes governorate in patients attending Nasser Hospital. Peak incidence of intestinal parasites occurred during the summer season (June to August) and lowest during winter season (December to February). The overall commonly prevalent species were *E. histolytica, G. lamblia* and *A. lumbricoides* (Sharif, 2002). Intestinal parasitic infection is also a major public health problem in Sivas, Turkey. The prevalence of intestinal parasitic infection in this region ranges from 11.6% to 79.2%. The total prevalence of parasitic

infection was found to be 37.2% as reported in a study conducted (Celiksoz et al; 2005) in Turkey. *G. lamblia* and *E. vermicularis* was found to be the most frequent parasites. The highest parasitic prevalence was determined in the age group of 7-15 years. It has also been reported that the most accurate method of diagnosis for Taeniasis was the combined usage of cellophane tape technique and direct preparation method and the cellophane tape technique was the best method for the diagnosis of Enterobiasis. Similarly intestinal parasitic infections are still public health problem in Thailand. During past decades *F. buski* was the most prevalent parasite in central region of Thailand as this area is low and flat and contains rice and water chestnut fields and small rivers. But *F. buski* was not reported in the study conducted by Saksirisampant et al, (2006). *E. coli* was reported as the most prevalent parasite followed by *G. lamblia, E. vermicularis, T. trichiura* and others in the study. At present the invasion with urban culture, health education and other conditions could have made the prophylaxis of the intestinal parasitic infections quite different from what it was in the past.

Intestinal parasitic infection causes serious public health problems in Ethiopia. They are more prevalent in the poor segments of the population with low household income, poor handling of personal and environmental sanitation, overcrowding and limited access to clean water for drinking and household use. A very high prevalence of 83% was reported in a study (Mengistu et al; 2007). *G. lamblia* was identified as the most common protozoan parasite whereas *T. trichiura, A. lumbricoides* and *S. mansoni* was the most common helminthes found. Polyparasitism was found to be more common than monoparasitism. Taeniasis was found dominant in teenagers. Intestinal parasitic infection was observed in relative decreasing trend at present compared to the previous decades among rural inhabitants of Mazandaran Province, Iran. Nevertheless, the overall prevalence of infections was still high and people of both sexes and from different occupations and age groups are exposed to the infectious agents. Involvement of people in agricultural activities is the main reason of infection in this region. *G.*

lamblia and *B. hominis* are the leading intestinal parasites in this area followed by other parasites (Kia et al; 2008). *B. hominis* and *G. lamblia* were also determined to be the most frequent intestinal protozoan parasites in Tehran (Niyatti et al; 2009). Most of the people infected with the above two parasites presented with the gastrointestinal symptoms and are referred to the hospital. Helminthic infections were found less common than protozoan infection in this region.

Prevalence of intestinal parasitic infections was also found high among school children of Kampongcham, Cambodia. Helminthic infections are more common than protozoan infections in this region. *A. lumbricoides*, *Echinostoma* spp, hookworm, *Opisthorchis* spp, *Rhabditis* spp and *T. trichiura* are common helminthic parasites whereas *E. coli*, *G. lamblia*, *I. butschlii* and *E. histolytica* are the common protozoan parasites (Lee et al; 2002). Polyparasitism was found common but less often than monoparasitism. Trematodes such as *Echinostoma* spp and *Opisthorchis* spp remain endemic parasite of this region. Similarly intestinal helminth infection rate of school children of the Roxas City, Philippines was found considerably high. The highest infected helminth was *A. lumbricoides* followed by *T. trichiura*, hookworm and *E. vermicularis*. The most common protozoan parasites detected was *E. coli* followed by *Iodoamoeba butschlii* and *E. histolytica*. The overall parasite positive rate was found to be 64.5% and that of male and female were 56.6% and 72.5% respectively (Kim et al; 2003). Multiple infections with more than two parasites was common and double infection with *A. lumbricoides* and *T. trichiura* was most frequent. So that mass treatment with wide spectrum antihelminthic drugs should be carried out.

Prevalence of intestinal parasites and impact of annul anthelminthic treatment in rural and urban schools in Narathiwat Province, Thailand was assessed and found an overall prevalence of 75.1% of intestinal parasitic infection (Jiraamonninit et al; 2006). Multiple infections were found common in infected individuals. *A. lumbricoides* and *T. trichiura* were the most frequently observed helminthes

whereas *B. hominis* was the most common protozoan found. Annual mass deworming with albendazole was found inadequate for the control of parasitic infections due to high re-infection rates found. For the control of infection a half-yearly repeated anthelminthic treatment was recommended for schoolchildren to reduce re-infection rates. Intestinal parasites remain endemic among children from East Africa. An overall prevalence of 50% was reported in a screening study for intestinal parasites in children arrived from East Africa to Australia (Rice et al; 2003). *B. hominis* was the most common intestinal parasites followed by *E. coli, E. nana* and others. Helminthic infection was low compared to protozoan infection. The infected children were also found to have moderate levels of anaemia and iron deficiency.

Parasitic infections in Equatorial Guinea represent a major public health problem the average prevalence of most common protozoa and helminthic intestinal infections in rural and urban areas respectively are as follows *E. histolytica/E. dispar* (14.9% and 32.7%), *G. lamblia* (7.2% and 8.6%), *A. lumbricoides* (45.8% and 31.4%) and *T. trichiura* (25.7% and 36.4%) (Roche et al; 1999). *E. histolytica* was found most commonly associated with acute diarrhea in this region. Prevalance of *E. histolytica/E. dispar* was found to increase with increasing age while *G. lamblia* decrease after aldolescence. Diarrheal disease was found to be associated mainly with poverty and environmental and educational conditions that accompany deprivation. Prevalence of intestinal parasites was found low (6.9%) in the public who participated in a Medical Fair held at the University of Malaya Medical Centre, Kuala Lumpur, Malaysia (Jamaiah et al; 2005). Among the infected persons, the highest infection was found in the age groups 16-30 years which was 9%. The highest infection rate was among the Chinese 7.7% followed by Malays 7% and Indians 3.3%. *T. trichiura* was found to be the most common parasite followed by *A. lumbricoides, Clonorchis sinensis,* hookworm and *E. histolytica*. The two cases of Clonorchiasis were found from two Chinese women both of whom came to seek medication as the parasite remain endemic in certain

region of china. Relatively higher infection rate (41%) of intestinal parasitic infection was reported in a similar study conducted among five interior communities in Sarawak, Malaysia. A higher infection rate was found among the settled Kayans (56%) than the Semi-nomadic Penans (29%). Infection rate was found higher (68%) among children less than 14 years old compared to the adults. *T. trichiura* accounted for more than 90% of the infection and other parasites such as *A. lumbricoides,* hookworm and *S. stercoralis* was found less common. Polyparasitism was found less often than monoparasitism and dual infection with *T. trichiura* and *A. lumbricoides* are more common than dual infection with *T. trichiura* and hookworm. Women had higher infection rates than men (Sagin et al; 2002). The prevalence of infection was found higher in villages with high population density compared to villages with low population density. Suggested population density was a significant factor in intestinal parasitic infection and re-infection.

Intestinal parasitic infection remains a public health problem especially among children in Chiang, Mai Province, Thailand. The overall prevalence of 42.6% was reported among children of the Karen Hill-Tribe in Mae Chame District (saksirisampant et al; 2004) by using concentration technique and 22.7% by using Scotch-tape technique. Protozoan infection was found to be more common over helminthic infection. Among helminthes *E. vermicularis* found at the highest prevalence (15.49%). Other common infections were Ascariasis (9.78%), Trichuriasis (5.90%), hookworm infection (2.20%), Strongyloidiasis (0.92%). For protozoan infection, the major cause is the non-pathogenic species *E. coli* (27.68%). The other non-pathogenic protozoa (*E. nana, Chilommastix mesnili and I. butschlii*) had a low prevalence from ranged 0.18%-4.97%, *G. lamblia* (2.21%). Based on two techniques used the results from Scotch-tape technique provided a higher sensitivity for the detection of *Taenia* spp and *E. vermicularis* eggs. Parasite egg contamination of water and air was reported to be a major cause of intestinal helminthic infection in a suburban area of Hanoi, Vietnam (Noda et al;

2009). Water from pond and ditches used for drinking purposes in rainy season was found to be contaminated by helminthic eggs. Similarly few filtered and non-filtered water samples were also found to be contaminated by parasites eggs which indicated that filtering mechanism was not working effectively and should be improved. The major parasites contaminating the water bodies in this area include *Toxocara* spp, *Trichuris* spp, *Taenia* spp, *Ascaridia galli* hookworm and *Fasciola* spp. Similarly *Trichuris* spp, *Ascaridia galli* and *Taenia* spp found to be associated with air contamination. A very high prevalence of intestinal parasitic infection (88%) was reported in a similar study carried (Verle et al; 2003) in mountainous Province of Hoa Binh, North-west Vietnam. The study was conducted among six ethnic groups: Muong, Kinh, Dao, Thai, Tay and Hmong. Prevalence of nematodes such as hookworm, *T. trichiura* and *A. lumbricoides* was found high among all ethnic groups. Infection rate was found lower in households owning a latrine and was highest among children and decreased with the age. Chlonorchiasis was found increased with increasing age and was highest among adult men. Similarly hookworm infection was highest among adult women. *G. lamblia* was found in all districts and among all ethnic groups having a lower infection rate. Taeniasis was also found in few individuals.

Prevalence of intestinal parasitic infection among Southeast Asian laborers in North Taiwan decreased from 33.3% in 1992-1993 to 4.6% in 1995-1996 (Wang LC, 2004). Females laborers had significantly higher prevalence than male laborers. There was no significant difference in infection rates between Thais, Filipinos and Indonesian laborers. The prevalence of soil transmitted helminthes was extremely low. The epidemiological pattern of the disease has decreased from previous reports which could be attributed to the application of control measures by limiting the entry of infected persons, carrying out periodic follow-ups and treating the sporadic cases. Prevalence of gastrointestinal parasite was also found higher in children from a home for mentally handicapped in a similar study from Lublin (Bidun et al; 2001). A higher number of children were infected from

countryside compared to those from towns. The infection pattern was found to be similar in boys and girls. *E. vermiculris* was found to be the most common parasite followed by *T. trichiura, A. lumbricoides, G. lamblia* and others. Helminthic infection causes a considerable level of morbidity and mortality in the children of this region. Intestinal parasitic infection also causes a considerable morbidity and mortality in people of Riyadh District, Saudi Arabia. Children are more commonly infected than adults and highest infection with protozoan parasites, *E. histolytica* and *G. lamblia* was observed in the age groups of 1-15 years. Males are found more commonly infected than females by these protozoan parasites. Other parasites infecting the people of this region include *A. lumbricoides, T. trichiura, Schistosoma mansoni, H. nana, A. duodenale, E. vermicularis, T. saginata and S. haematobium* (Abdel-Hafez et al; 1986).

Intestinal parasitic infections are major public health problems in Islamic republic of Iran affecting one-fifth of the population. Infections are more common in rural than urban areas (Sayyari et al; 2005). People living in rural areas may lack sanitary water supplies and live close to sources of parasites in social and environmental conditions that predispose to intestinal parasitic infections. The infections are found more common in children aged 2-14 years. *G. lamblia* was found to be the most common parasite followed by *A. lumbricoides, E. histolytica* and *E. vermicularis.* Seasonal variation in the pattern of intestinal parasitic infection was observed in the West Bank of Jordan. Lower prevalence of intestinal parasitic infection generally occurred during winter and early spring while peak incidence occurred during summer and early autumn (Ali-Shtayeh et al; 1989). The most frequently found parasites were *E. histolytica, G. lamblia* and *A. lumbricoides* whereas the less frequent parasites include *H. nana, T. hominis, T. trichiura, T. saginata, E. vermicularis* and *S. stercoralis.* Very high prevalence of intestinal parasitic infection was reported in a similar study conducted in Maracaibo, Venezuela. The overall prevalence was reported to be 80.4% (Chacin-Bonilla et al; 1992). Multiple infections were reported to be high compared to

single infection which was attributed to the low socio-economic status of the community studied. Helminthic infection was found dominating over protozoan infection. Among protozoan *E. coli* was found to be the most frequent parasite followed by pathogenic *E. histolytica, G. lamblia* and others. *T. trichiura* and *A. lumbricoides* were the most frequent helminthes found. Infection was more common in pre-school and school visiting children compared to adult and older age people and was also common in females compared to males. *Entamoeba polecki* was also found to cause few infections.

A positive association between intestinal parasitic infection and environmental factors such as cardboard tin or wooden house, dirt floor, home or communal water pump, faucet outside the house or public faucet and cesspool or latrine was reported in rural population from Argentina (Basuldo et al; 2007). Parasitic forms were found in highest number in soil and water samples. In both samples the parasites found are prevalent in human intestines. Most prevalent protozoan parasites determined were *B. homonis* and *G. lamblia* whereas *A. lumbricoides* was the most frequent helminthic parasites. The study evidenced that contaminated soil and water are the sources of heavy infection with these parasites. Displacement and refugee camps are ideal grounds for the transmission of intestinal parasites and increases the risk of acute respiratory infections, diarrhoel diseases and intestinal parasitic infections. *C. parvum, G. lamblia, E. histolytica, A. lumbricoides,* hookworm infection, *S. haematobium, S. mansoni* and *S. stercoralis* are important cosmopolitan intestinal parasites that are common among children, the immunocompromised and displaced populations as reported among camp residents from Sierra Leone (Gbakima et al; 2007). *G. lamblia* was found the commonest parasite in children followed by *C. parvum* and a few children harbours these both parasites in combination. Prevalence of hookworm was highest at Parade Ground camp followed by *S. mansoni* and *A. lumbricoides.* Prevalence of *E. histolytica* was found to affect a considerable number of people.

Preschool children are at a considerable risk of morbidity and mortality with intestinal parasitic infections. A very high prevalence of intestinal parasitic infection was reported among preschool children at a daycare centre in Alexandria, Egypt (Abolfotouh et al; 1995). Gastrointestinal symptoms such as vomiting and diarrhea was strongly associated with *G. lamblia* infection. Social children were most commonly infected with *G. lamblia* than unsocial ones. Giardiasis was the most common infection followed by Ascariasis and Trichuriasis. Infection was found to be more common in boys than in girls. So that the sanitary conditions in the daycare centres in this region should be monitored and improved to reduce the burden of intestinal parasitic infection in children visiting daycare centres. Intestinal parasitic infection was also a major public health problem in Lao People Democratic Republic. Approximately one-third of school children in Vientiane Capital City were infested with intestinal parasites (Phathammavong et al; 2007). The persistent parasitic infestation seemed to be associated with growth rate pattern among those children. *Opisthorchis viverrini* and *Ascaris lumbricoides* were found the commonest parasites infecting the children. School based parasite control programme and health promotion are essential for the elimination of this public health problem in children.

Intestinal parasitic infection was also common problem of preschool children in Riyadh, Saudi Arabia. Diarrhea, loss of appetite, underweight and failure to thrive are presenting symptoms of infection in this region. *G. lamblia* and *E. vermicularis* were the commonest parasite found followed by *A. lumbricoides, E. histolytica* and *H. nana* (Bolbol et al; 1989). A high prevalence of infection was observed in a similar study among Sudanese children and the risk factors associated with the infections are determined to be illiteracy, overcrowding and large sized families. Children aged 3 years and older are the most affected groups (Karrar et al; 1995). Giardiasis, Taeniasis and Enterobiasis are the commonest infestations whereas *E. coli, E. histolytica* and *T. saginata* were found to cause

few infections. Malnutrition and growth retardation among children are the major consequences of infection in this region and *G. lamblia* was found in significant association with undernourished group. Helminthic infections were found more common compared to protozoan infection among children in a similar study conducted in Southern Sudan (Magambo et al; 1998). Overall 15 different species of parasite are found infecting the children of this area. Hookworm infection was found most common followed by *S. stercoralis, Trichostrongylus, S. mansoni* and *T. trichiura.* Common intestinal protozoan parasites detected are *E. coli, E. histolytica* and *G. lamblia.* Children aged 6-10 years are more commonly infected followed by 11-15 year age group. Intestinal parasitic infection was seen more frequently in children with malignancy compared with healthy children as reported from Turkey (Aksoy et al; 2003). The infection was most common in age group 13-16 years. *B. hominis* and *G. intestinalis* were found to be associated most commonly with the children having neoplasms.

3.2 SAARC SCENARIO

Intestinal parasitic infections are one of the major health problems in Saarc region. The infection causes a considerable morbidity and mortality in this region and the infection remain endemic in Saarc countries infecting mainly preschool and school level children. High prevalence of undernutrition in terms of underweight (61.7%), stunting (51.7%) and wasting (32.8%) was reported among tribal aldolescents of Madhya Pradesh, India (Rao et al; 2003). A high prevalence of intestinal parasitic infection and anaemia associated with the infection was reported. Infection rate was found to be higher in males compared to females. Similarly 67.6% underweight, 62.8% stunted and 26.5% wasted was observed in preschool slum children in Lucknow as the consequences of intestinal parasitic infection. Mean haemoglobin levels was found to be reduced in the children who are infected compared to those who are not infected (Awasthi et al; 1997). No association between weight or height and parasite positivity was observed in

children from Lucknow whereas malnutrition was found strongly associated with parasite positivity in both aldolescents from Madhya Pradesh and children from Lucknow. Helminthic infection was found common in both places compared to protozoan infection. *A. duodenale* and *H. nana* were the most common parasites observed in Madhya Pradesh whereas *A. lumbricoides* and *G. lamblia* are the common parasites found in Lucknow. Overall infection rate was found higher in aldolescents of Madhya Pradesh compared to the children from Lucknow.

Intestinal parasitic infections cause a considerable morbidity and mortality in Bhutan. Children bear the major burden of various parasitic infections in the country. Malnutrition is a major consequence of the parasitic infections among the children in Bhutan. Tapeworm infection was reported to be a major parasitic infection among children in Bhutan (Allen et al; 2004) followed by other soil-transmitted helminthes. The high prevalence of Tapeworm infection in Bhutan could be attributed to beef eating habit of the people of Bhutan. A significant association was observed in the decrease of worm infestation rate among Nepali children from Darjeeling, India with the increasing educational status of their mothers. An overall prevalence of 51.4% of intestinal parasitic was reported among children from Darjeeling (Ram et al; 2008). The children whose mother was educated has less burden of infection compared to the children whose mothers are uneducated or less educated. Health education of mothers was essential to maintain sanitary condition in home environment which ultimately reduces the rate of intestinal parasitic infection. Helminthic infections were found more common than protozoan infection and multiparasitic infection was common among the children. *A. lumbricoides* and *T. trichiura* are the major helminthes causing infections among them.

The frequency of intestinal parasitic infection was high in Sukkur, Sindh, Pakistan possibly due to low socio-economic status, lack of health education and warm climate in this area. Warm and rainy season is the peak time of intestinal parasitic

infection. An overall prevalence of 35% was intestinal pathogenic parasites were reported from Sukkur, Sindh (Shaikh et al; 2009). Protozoan parasites were found to be dominating over helminthic parasites and could be attributed to the contamination of drinking water with fecal matter. *G. lamblia* and *E. histolytica* were found to be the common protozoan parasites whereas *H. nana* and *A. lumbricoides* were the commonest helminthes followed by *A. duodenale, E. vermicularis, T. trichiura* and *T. saginata.* Intestinal parasitic infection is also a major public health problem in India. About 50% of the urban and 68% of rural populations are affected with different species of intestinal parasites. Slum dwellers have high rates of infestations due to poor sanitation, contaminated water supply and high population density. Malnutrition was a major consequence of the infection in them. Malnutrition is thought to potentiate the polyclonal stimulation of IgE by parasites. A twenty-fold elevation in total serum IgE level was reported among an urban slum males in India (Nagaraj et al; 2004) which explains their undernourished state and having intestinal parasitic infection. Albendazole and tinidazole were found to be effective against intestinal parasites whereas no effect on total serum IgE was observed by the use of these anti-parasitic drugs.

Intestinal parasitic infections are serious problems in developing countries like Bangladesh. This is due to poor hygienic habits and living conditions of the majority of populations of these countries. The high prevalence of the parasites was correlated with poverty, poor sanitation and impoverished health services in Bangladesh. Soil-transmitted helminthes are common parasites found in Bangladesh especially among children. The common nematodes found in Bangladesh are *A. lumbricoides, T. trichiura, A. duodenale* etc. Helminthic infection cause decreased body resistance, retardation of physical and mental development of children, indigestion, diarrhea, anorexia and lack of memory, increased morbidity rate, greater incidence of abortion, sterility, stillbirth and impaired lactation, anaemia, pneumonia, bronchitis, appendicitis and increased susceptibility to various non-helminthic diseases. A number of studies have been

conducted throughout Bangladesh during the past half century regarding to the infestation of intestinal nematodes. A small prevalence of overall helminthic infection was reported (Muznebin et al; 2007) among the children of high socio-economic status community in Bangladesh. *A. lumbricoides* was found to be the most common helminth followed by *T. trichiura*. A significant improvement in the pattern of parasitic was reported by providing regular health education among rural area from Bangladesh (Taylor-Mascie et al; 2003).

Parasitic infestation was a common cause of morbidity and mortality in paediatric population of rural and urban areas of Pakistan. The common intestinal parasites causing abdominal discomfort among children of Quetta, Pakistan were *H. nana, G. lamblia, E. histolytica, A. lumbricoides* and *A. duodenale* (Wadood et al; 2005). Malabsorption and anaemia are the major consequences of intestinal parasitic infection among children of Quetta, Pakistan. Intestinal parasites are important and common cause of diarrhea in children of Delhi, India. These parasites may increase the susceptibility to infection with other pathogens. An overall infection rate of 46.5% of intestinal parasites was in diarrhoeic children from Delhi (Kaur et al; 2002). *Cryptosporidium parvum* was found the most common parasite causing diarrhea followed by *G. lamblia* and *E. histolytica* in them. The common helminthes found the patients are *A. lumbricoides* and *T. trichiura.* Mixed infection with parasites was not found in any of the cases. An immunodeficient state, age, malnutrition, contact with animals and crowded living conditions have been reported as the possible risk factors of the infection because most of the children included in the study came from families of low socio-economic status living in urban slums.

Intestinal helminthic infections are more prevalent compared to protozoan infections among children in rural areas of District Shahjahanpur, Uttar Pradesh, India (Virk et al; 1987). *A. lumbricoides* superseded all other parasites by showing a high positivity followed by hookworm, *H. nana,* Tapeworm, *T. trichiura, E.*

vermicularis, E. histolytica and *G. lamblia.* Parasite load was higher in females compared to males. The highest positivity was reported in age group 6 to 14 years. Illiteracy among rural women was found to be the major contributing factor of high parasitic infection. Water source, defecation site, personal hygiene and the extent of maternal education are the most frequently associated conditions with the infection rate. Among them maternal education has been reported to be the most important risk factor associated with the degree of intestinal parasitic infection (Wani et al; 2007) among school children in Srinagar, Kashmir, India. *A. lumbricoides* was the most common parasite followed by *G. lamblia, T. trichiura* and others. Installation of latrines together with provision of safe drinking water and the construction of cement floors would probably reduce community prevalence of *T. trichiura* effectively. Open field defecation, large family size and three or more children in the house were found independently associated with *Trichuris* infection in rural Assam, India (Narain et al; 2000). Gender specific analysis revealed that in females the age was also independently associated with increased risk of infection. Earth flooring was the most significant risk factor independently associated with the risk of *Trichuris* infection.

Socio-cultural and behavioral activities are most commonly associated with the intensity of parasitic infection in a community. A very high prevalence (91%) of *A. lumbricoides* infection among rural children of Northern Area, Pakistan was reported (Nishiura et al; 2002). The heavy infection with *A. lumbricoides* was found to be associated with age, location of household, defecation practice, soil eating habit, hand washing after defecation and living under 5 years of age. The most intense *A. lumbricoides* infection was found in children aged 5-8 years. Household located in Surngo, Askole and Stakchun where health services are not appropriate were reported to have heavy infection. Intestinal parasitic infection was also a major public health burden among children in Afghanistan. Low blood haemoglobin and anaemia are the major consequences of the infection in children of Afghanistan (Gabrielli et al; 2005). In recent years there have been major

socio-economic changes within Afghanistan such that the present public health burden of soil-transmitted helminthes especially that within school aged children has considerably changed. *A. lumbricoides* was reported to be the major helminthic parasite among the children and was found most commonly in the urban environment of Afghanistan. A considerable level of infection with *T. trichiura* and hookworm was reported which was not previously encountered in Afghanistan. The infection was most common in age group 8-15 years and anaemia was a major presenting symptom in them.

Intestinal helminthic infestation bears a considerable burden among tribal population of Kottoor and Anchankovil areas of Kerala, India. Among environmental factors studied in relation to helminthic infestation, the practice of hand washing alone was found to be significant in reducing the risk of helminthic infestation. Among the tribal population of two area, Anchankovil showed a high rate of infestation compared to Kottoor area (Farook et al; 2002). Hookworm was found the most predominant helminth in Anchankovil area whereas roundworm predominated in Kottoor area. Anaemia was found a major consequence of infection in both areas. Parasitic infections are also a major cause of morbidity and mortality among HIV infected patients. HIV patients in India also bears a considerable burden of intestinal parasitic infection. Diarrhea is one of the major consequences of parasitic infection among HIV patients. *Isospora belli* was reported to be a major intestinal parasite infecting HIV patients in Chennai, India (Kumar et al; 2002). *Cryptosporidium* was found to be the second common parasite in these patients and infection with *Microsporidia* and *Cyclospora* was reported to be very low. Overall prevalence of parasitic infection was determined 39% among patients with diarrhea.

3.3 NATIONAL SCENARIO

Nepal is a small and impoverished land locked country located in south Asia. Like other developing countries intestinal parasitic infection is a major public health problem in Nepal. Helminthic infections alone rank fourth in top ten lists of disease in Nepal (Adhikari et al; 2007). The reported prevalence rates of enteric parasitosis in Nepal vary from considerably low (Rai et al; 2002) to nearly one hundred percent (Estevez et al; 1983) and have been associated with contamination of soil and water. Some emerging diarrheagenic enteric parasites have also been reported recently (Ono et al; 2001).

Intestinal parasitic infection was a common public health problem among school children in Thimi area, Kathmandu valley. Thimi municipality is a small semi-agricultural area in Kathmandu valley, mostly inhabited by ethnic Newars depended on traditional agriculture. An overall prevalence of 35.6% of intestinal parasitic infection was reported among school children of this area (Shrestha et al; 2009). Infection rate was found higher in children attending public school compared to the children attending private school. Boys and girls have the equal chances of acquiring infection but the boys attending private school were reported to have higher infection rate. Altogether seven species of parasites were detected and *G. lamblia* was found to be the most common parasite followed by *A. lumbricoides, E. histolytica* and others. The infection was also found higher in children drinking untreated water and those living in bigger family size.

Intestinal helminthic infection was reported to be highly endemic in the capital city due to poor sanitary conditions and unplanned urbanization. An overall prevalence of 31% of intestinal helminthic infection was reported among school children in Kathmandu valley (Adhikari et al; 2007). A significant difference in having helminthic infections with the gastrointestinal tract symptoms was observed and the rate of infection was determined to differ in different ethnic

groups. *T. trichiura* was determined to be the most common parasite followed by *A. lumbricoides*, Hookworms, *H. nana* and *S. stercoralis.* Interestingly, the prevalence of infections among the dewormed children was not significantly higher in comparison to non dewormed children. Therefore effective deworming program should be administered to minimize the infections among children in Nepal. Parasitic infection was found common among school children in Kaski district, Western Nepal. An overall Prevalance of 21.3% of intestinal parasitic infection was reported among school children of this area (Chandrashekhar et al; 2005). The study indicated the infection to be mainly water-borne. The children from school in rural area of the District was found to have greater burden of the disease compared to the children from school in urban area. No difference in infection rate was found according to age and gender of the children. The prevalence of protozoal infection was higher than that of helminthes and *G. lamblia* was the commonest parasite isolated.

Geohelminthic and protozoal infections are fairly common among young children in rural community in Eastern Nepal. Infection rate and pattern of parasitic infection varies according to the season and time of year. Prevalence of *A. lumbricoides* was found to be highest from September to November and lowest from December to February. Similarly prevalence of *G. lamblia* and *E. histolytica* also varied according to the time of year (Kunwar et al; 2004). Vast majority of cases of infection were observed in infants aged from 1-3years but no geohelminthic or protozoal infections were detected in infants aged less than 11 months. Similarly none of the children were found to be infected with hookworm or whipworm. Very high prevalence of (71.2%) of intestinal parasitic infection was reported among school children in rural area of Kathmandu valley (Rai et al; 2005). Highest infection was observed in children drinking water from shallow well compared to natural spout, piped water and river water. Higher infection rate was found among *Dalits* compared to *Tibeto-Burmans* and *Indo-Aryans.* Helminthic infections dominated protozoan infections and *T. trichiura* was found

to be the most dominating parasite followed by hookworm and *A. lumbricoides* whereas *E. coli* was found as the most common protozoan followed by *E. histolytica, G. lamblia* and others. Anti-parasitic treatment was found effective in reducing the burden of parasitic infection whereas availability of toilet was not found associated with the infection.

Newer opportunistic intestinal pathogens like *Cyclospora cayetanensis* and *Cryptosporidium* spp. were reported from immunocompromised children below 2 years of age as a result of vertical transmission in Western Nepal (Easow et al; 2005). Parasites other than these emerging oppurtinistic infections include *G. lamblia* and *E. histolytica.* Active infection of *E. histolytica* was less common in winter and spring whereas active infection of *G. lamblia* was observed in all four seasons. Low temperature all throughout the year and ambient humidity in this region were favorable environment for the acquisition and dissemination of intestinal protozoal parasitic infestation. Similarly intestinal protozoan parasitic infection is common health problem in HIV infected patients in Nepal. *E. histolytica* was the commonest protozoan infection in HIV seropositive subjects in Nepal (Adhikari et al; 2007). Other parasites most commonly found in HIV patients are *G. lamblia* and *B. hominis.* The opportunistic protozoan parasite most commonly found was *C. parvum.* The prevalence of infection was found significantly lower among subjects dwelling at different rehabilitation centres of the Kathmandu Valley in comparison to those who did not. Infection rate was also found similar between males and females indicating an equal opportunity for acquiring parasitic infections. *C. parvum* was reported to be the most common parasite associated with low CD4 counts and chronic diarrhea.

Children in remote hilly area of Nepal are at high risk of intestinal parasitic infection. A high prevalence of infection was reported among school children of hilly area. Helminthic infections were found more common than protozoan infections in these children and polyparasitic infection was also found low in them

(Rai et al; 2004). *A. lumbricoides* was the most common parasite detected followed by hookworm and others. No difference was found in the levels of various nutritional factors studied between parasite positive and negative children of different ethnic groups. But a low prevalence of intestinal parasitic infection was reported in a similar setting in another study (Ishiyama et al; 2003). Higher positivity was observed in people who drink raw water and those who do not have toilet at their home. Similarly higher infection rate was observed in people who are engaged in agricultural activities compared to those who are involved in office works or teaching. Adults had relatively higher positive rate with the highest positive rate in the age group of 31-45 years which was contrasting with the most of reports from Nepal and elsewhere which have shown higher positive rate in children. Helminthic infections are higher compared to protozoan and *A. lumbricoides* was found to be the most common parasite followed by others.

Influx of parasites infected people in Kathmandu valley from rural area coupled with unplanned urbanization was reported to be associated with a high prevalence of intestinal parasitic infection among public school children in a sub-urban area of Kathmandu (Ishiyama et al; 2001). The poor sewerage system and bad smelling street flood during and after rainy season provides additional conditions for heavy infection. Helminthic infections were more common than protozoan infection and male children had a greater burden of disease compared to female children. *T. trichiura* was the most common parasite followed by *A. lumbricoides* and others. Among protozoan infection *G. lamblia* was commonest followed by *B. hominis* and *E. coli*. Haemoglobin level also did not differ significantly in children with and without parasitosis. A high parasitic burden was observed during an unknown disease outbreak in rural hilly area of Western Nepal due to low environmental sanitation (Rai et al; 2001). Helminthic parasites especially *A. lumbricoides* was found to be the major cause of outbreak of the infection and could be attributed to the fact that half of the soil samples examined from household yard showed helminthic eggs. The environmental and sanitary

condition was found extremely sleazy as over 80% of household had no latrine and practices open defecation. Parasites were almost uniformly distributed in males and females, and in adults and children. Polyparasitism was found in approximately two-third of the population and was more common in males than in females which indicate the extremely sleazy hygienic and environmental conditions in the area.

Intestinal parasitic infection was also reported to be high among school children in rural area of Dhading District. An overall prevalence of 60% of intestinal parasites was observed and was attributed to the low personal and environmental sanitary practices especially among children and lack of health education among them (Rai et al; 2002). As reported from other places also *A. lumbricoides* was the most common parasite among helminthes followed by hookworm and others whereas *G. lamblia* was the only protozoa detected. The infection rate was found to decrease with the increasing age and infection was common among children drinking piped water compared to the children drinking natural source water. Higher infection was observed in children practicing open defecation and no effect of anti-parasitic drugs was observed in children having taken the drug in last six months.

Boiling of drinking water is one of the best methods to reduce infection with intestinal parasites and other enteric pathogens. A considerable decrease in the infection with intestinal parasites by the practice of boiling drinking water was reported from Kathmandu (Oda et al; 2002). The boiled water consumers showed less prevalence of helminthic parasites compared to non-boiled water consumers. Factors affecting to the boiling practice were found be lack of awareness toward water quality and preference of non-boiled cold water coupled with lack of time. Though some protozoan infections were observed but overall reduction of infection was considerable.

Intestinal helminthic infection is a major health problem in various areas of Nepal and could be attributed to soil contamination with helminthic eggs due to open defecation practice especially in rural area of Nepal. A high prevalence of intestinal helminthic infection among rural villagers was reported which caused reduction in blood haemoglobin and total serum protein (Rai et al; 1998). Poor sanitary practices were found a major contributing factor of high helminthic infection in them. *A. lumbricoides* was found to be the most common parasite followed by *T. trichiura* and others. Similarly a high prevalence of intestinal parasitic infection was reported from other rural village (Yong et al; 2000). Prevalence in female was slightly higher than in male without statistically significant difference. *E. coli* was the most commonly found protozoan parasite (21%) followed by *G. lamblia* (13%) and others. Hookworm was the most prevalent intestinal helminth (13%) followed by *T. trichiura* (3%) and others (5%). Mixed infection was observed in 14.3% specimens.

CHAPTER- IV

4. MATERIALS AND METHODS

A list of materials, chemicals, equipments, reagents for the study is presented in Appendix

4.1 Subject and site of study

The laboratory examination of dissertation was carried in Shi-Gan Health Foundation/ National Institute of Tropical Medicine and Public health Research, Maharajgunj, Sankhmarg, Kathmandu. The study was carried during April to October 2010. The stool samples were collected from school children of public and private school of Jaleshwor, Mahottari, Nepal.

4.2 Sample collection

Students in a class were given a brief description about the importance of examination of stool and the impact of intestinal parasite upon health. The plastic containers were labelled with children's name and roll number, date and time of collection and distributed to the students. During the distribution of containers questionnaire accompanying the queries about name, age, family size, clinical history and hygienic practices were filled. They were advised not to contaminate the stool with water and urine and asked to bring about half the container of stool samples.

4.3 Transportation of the samples

The collected samples were fixed using 10% formalin solution and transported to Kathmandu for laboratory processing in Shi-Gan Health Foundation.

4.4 Laboratory processing of the samples

Each stool samples was processed in two steps as:

Macroscopic examination

Microscopic examination

4.4.1 Macroscopic examination

A direct visualization of each sample was done for the color, consistency, presence of mucus, blood and adult worm or worm segment.

Color

Based on the color, the stool specimens were categorized into groups i.e. yellowish brown (normal color), muddy, black, pale etc (abnormal color).

Consistency

Based on consistency stool specimen were classified as formed, semi-formed, semi-solid and loose. The trophozoites were usually found in the soft or loose stools whereas the protozoal cysts are found in formed and semi-formed stool. Helminthic eggs and larva can be found in the any type of stool specimen.

Blood and mucus

The stool specimens were observed whether it contains blood and mucus or not. Blood and mucus may be found in stool from patients with amoebic dysentery, intestinal taeniasis, intestinal schistosomiasis, invasive balantidiasis and severe *T. trichiura* infections. In other non parasitic conditions like bacillary dysentery, *Campylobacter enteritis*, ulcerative colitis, intestinal tumor and hemorrhoids, blood and mucus could be found in stool.

Adult worms and segments

The stool specimens were also observed for adult worms and segment of *A. lumbricoides* and *E. vermicularis*. Tapeworm segments may be occasionally seen in stool specimen.

4.4.2 Microscopic examination

Microscopic examination is done for the detection and identification of protozoal cysts, oocysts, trophozoites and helminthic eggs or larva. Microscopic examination was done by saline wet mount and modified acid fast stain. The slides were observed first under low power (10x) and followed by high power (40x) of the microscope. Parasites cysts and trophozoites were identified by their morphology, motility and staining characteristics.

Samples were concentrated by centrifugation before performing wet mount. Centrifugation concentrates the eggs, larva and cysts when they are present in low intensity and increases the sensitivity of microscopic examination. Trophozoites are destroyed in the process. There are various flotation and sedimentation techniques of concentration. Formal-ether technique was used for concentration in the process.

Formal-ether sedimentation method leading to saline/Iodine wet mounts

This is the most sensitive method for concentrating cysts, eggs, larva without distorting their morphology. It is a less time consuming process and the chances of error are minimum.

1. About one gram of stool sample was emulsified in about 4ml of 10% formal saline solution, shaken well and was allowed to stand for 30 minutes for adequate fixation.

2. Further 3-4ml of 10% formal saline was added shaken well.

3. The suspension was sieved through cotton gauge in a funnel into a 15 ml centrifuge tube.

4. After filtration 3-4 ml of ether was added and shaken vigorously for 5 minutes.

5. The tube was immediately centrifuged at 2000 rpm for 4 minutes.

6. Four layers of suspension were obtained in the tube after centrifugation.

    a. A small amount of sediment at the bottom of the tube containing the parasite.

    b. A layer of formalin on the top of sediment.

    c. A plug of fecal debris on the top of formalin layer.

    d. A layer of diethyl ether at the top.

    e. The plug of debris formed between diethyl ether and formalin was removed by rotating the tip of the applicator along the inner wall of the tube.

7. The supernatant layer of suspension were discarded and the sediment was examined by saline and iodine mount.

Saline wet mount

It was used to detect helminthic egg, larvae and the protozoal cysts. A drop of normal saline was taken on a clean glass slide; a drop of sediment from the above process was mixed with it and observed under microscope after covering with a cover slip.

Iodine wet mount

This was mainly used for detecting protozoan cysts, however, helminthic eggs were also stained and could be detected. Iodine stained cysts showed pale refractile nuclei, yellowish cytoplasm and brown glycogen material. A drop of five times diluted Lugol's iodine was taken on a slide and a drop of sediment from above process was mixed with it. The preparation was covered with cover slip and observed under microscope.

4.4.3 Recording of the result

After laboratory processing of the samples, the result obtained was recorded in the log book and later recorded in the computer.

4.4.4 Report and medicine distribution

The report distribution was done as the result was obtained after laboratory processing of the samples. Every student with positive cases was given anti-parasitic drug along with the report. The complete dose of anti-parasitic drug distributed were Albendazole and Metronidazole according to the parasites detected.

4.4.5 Statistical analysis

Data were entered into computer and analyzed using SPSS version 10.5. The chi-squre test of significance was applied. Significance was determined on a 5% significance level ($p\text{-value}<0.05$).

CHAPTER-V

5. RESULTS

A total of 320 students (133 female and 187male) stool sample were examined for detection of intestinal parasites and out of these 135 (42.2%, 57 females and 78 males) were found infected. Gender wise prevalence was almost similar (male 41.7% and female 42.9%) with no statistical significance difference (p>0.05) (Table-1).

Table-1: Prevalence of parasitic infection in relation to gender difference

Gender	Total n	Positive n	Positive %	P-value
Male	187	78	41.7	P>0.05
Female	133	57	42.9	
Total	320	135	42.2	

For the prevalence of parasitic infection according to the type of school of students, it was found higher in students studying in public school (45.3%) compared to private school students (36.1%) with no statistical significance difference (P>0.05) (Table-2).

Table-2: Prevalence of infection according to the type of school

Type of school	Total n	Positive n	Positive %	P-value
Private	108	39	36.1	P>0.05
Public	212	96	45.3	
Total	320	135	42.2	

The prevalence of infection was almost similar (42.3% and 42.1%) among the children aged 10 or less and children more than 10 years. The difference was statistically not significant (p>0.05) (Table-3).

Table-3: Prevalence of parasitic infection in different age groups

Age	Total n	Positive n	Positive %	P-value
≤ 10	137	58	42.3	P>0.05
>10	183	77	42.1	
Total	320	135	42.2	

The prevalence of parasitic infection according to the family size was found little higher in students living in a family having more than seven members (45.2%) than students living in a family having members of seven or less than seven (38.1%), though the result was statistically not significant (p>0.05) (Table-4).

Table-4: Prevalence of parasitic infection according to the family size of students

Family size	Total n	Positive n	Positive %	P-value
≤ 7	134	51	38.1	P>0.05
>7	186	84	45.2	
Total	320	135	42.2	

Prevalence of infection according to caste of the students was found higher in Paswam, Mushar, Chamar, Hajam, Yadavs and Teli (47.8%) as compared to Brahmin, Rajput, Bhumihar and Caist (31.5%) and the difference was statistically significant (p<0.05) (Table-5).

Table-5: Prevalence of parasitic infection according to the caste of the students

Caste	Total n	Positive n	Positive %	P-value
Brahmin, Bhumihar, Rajput, Caist	111	35	31.5	
Paswan, Mushar, Chamar, Hajam, Yadavs, Teli	209	100	47.8	P<0.05
Total	320	135	42.2	

The rate of infection was higher in students having the habit of defecation in field (48.9%) compared with students having toilet facility at their homes (32.3%) with significant difference statistically ($p<0.05$) (Table-6).

Table-6: Prevalence of parasitic infection according to the toilet facility of students

Toilet facility	Total n	Positive n	Positive %	P-value
Home	130	42	32.3	
Open Field	190	93	48.9	P<0.05
Total	320	135	42.2	

The prevalence of infection according to hand washing habit after defecation was higher in students having a practice of hand washing with mud (50.8%) as compared with soap users (37.1%) with statistically significant difference ($p<0.05$) (Fig.1).

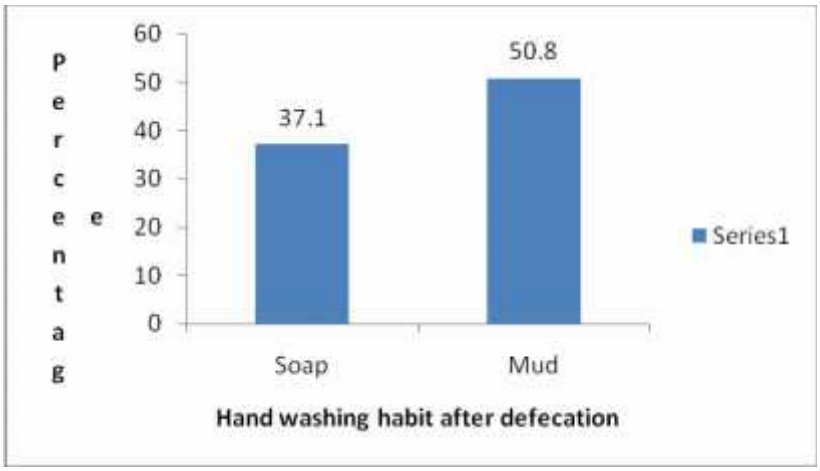

Fig-1: Parasite positive rate according to hand washing habit

The prevalence of infection was lower in students having taken anti-parasitic drugs in previous one month (25%) compared with students having not taken drugs (47.9%), the result was significant ($p<0.05$) (Table-7).

Table-7: Prevalence of parasitic infection in relation to anti-parasitic drugs taken

Anti-parasitic drugs taken	Total n	Positive n	Positive %	P-value
Yes	80	20	25	P<0.05
No	240	115	47.9	
Total	320	135	42.2	

Prevalence of infection according to parents occupation was higher in students whose parents are involved in farming (47.1%) compared to students whose parents are involved in job and business (36% and 34%). The difference was statistically not significant (P>0.05) (Table-8).

Table-8: Prevalence of parasitic infection in relation to parent's occupation

Parent's occupation	Total n	Positive n	Positive %	P-value
Job	89	32	36	P>0.05
Business	44	15	34.1	
Farming	187	88	47.1	
Total	320	135	42.2	

Prevalence of protozoan parasites was found higher (58.28%) compared to helminthic parasites (41.72%). The most common protozoan parasite detected was *G. lamblia* (31.79%), followed by *E. histolytica* (14.57%), *E. coli* (6.62%), *B. hominis* (5.30%). Among helminthic parasites the most common was *A. lumbricoides* (12.58%), followed by *Hymenolepis nana* (11.92%), Hookworm (8.60%), *T. trichiura* (4.63%), *E. vermicularis* (2.65%) and *S. stercoralis* (1.32%) (Table-9).

Table-9: Different types of parasite detected in students

Parasites	Total n	%
G. lamblia	48	31.79
E. histolytica	22	14.57
B. hominis	8	5.30
E. coli	10	6.62
Total protozoans	88	58.28
A. lumbricoides	19	12.58
H. nana	18	11.92
T. trichiura	7	4.63
Hookworm	13	8.60
S. stercoralis	2	1.32
E. vermicularis	4	2.65
Total helminthes	63	41.72
Total parasites	151	100

Pattern of parasitic infection showed maximum infection with single parasites (88.89%) compared with multiparasitism (11.11). Among multiparasitism, combination of protozoa and helminthes caused maximum infection (5.92%) followed by protozoans (3.70%) and helminthes (1.48%). Among 15 cases of multiparasitism, 14 cases had combination of two parasites whereas only one had three parasites in combination (Table-10).

Table-10: Pattern of parasitic infection among students

Type of infection	Total n	%
Single parasite	120	88.9
Protozoan	69	51.11
Helminthes	51	37.77
Multiparasites	15	11.11
Protozoan	5	3.70
Helminthes	2	1.48
Protozoa +Helminthes	8	5.92
Total	135	100

Chapter-VI

6. Discussion and conclusion

6.1 Discussion

Public health importance of intestinal parasitosis continues because of its high morbidity and mortality in developing countries (Rai et al, 2005). Nepal is a small impoverished country where intestinal parasitosis being highly prevalent and varies considerably from one study to another (Rai et al 2001, 2002). The present study is conducted to know the prevalence of intestinal parasitic infection among school children which reflects the sanitary condition, socio-economic impact, environmental impact, consiousness about the factors causing the disease and health education among the school children.

The present study showed the prevalence of 42.2% of intestinal parasite among the school children of Jaleshwor, Mahottari. The result was in close finding with the previous study (Malla et al, 2004; Sherchand et al, 2002; Ghimire et al, 2005; Shrestha et al, 2009; Oda et al, 2002) from Nepal. However, Ishiyama et al (2001), Sharma et al (2001), Rai et al (2005), Shrestha et al (2002), Rai et al (2004), Rai et al (2002) have reported the higher prevalence of the parasite than the present findings. On the other hand Easow et al (2005), Chandrashekhar et al (2005) have reported a lower prevalence of parasitic infection among school children. In Terai region Malla et al (2004) have nearly equal prevalence with the present finding from Sarlahi whereas Rai and Gurung (1986) have reported a higher prevalence (69%) from Birgunj City. A great fluctuation have been observed in the pattern of parasitic infection from low 19.7% (Easow et al, 2003) to high 81.94% (Shrestha , 2002). The analysis of recent reports have shown a decreasing rate of parasitic infection (44.6% Shrestha et al, 2002; 42% Ghimire et al, 2005; 35.6% Shrestha et al, 2009) compared to the past reports (69% Rai and

Gurung, 1986; 60.1% Sherchand et al, 1997; 72.4% Ishiyama et al, 2001). The decrease in prevalence of parasitic infection in recent years could be due to increased health education of the people, increased standard of living of people, access to health services provided by government and private organizations, public awareness towards the prevention and control of disease.

The difference in the prevalence of parasite also depends on the environmental condition, geographical condition, climatic condition of the study place and the technique used for identification. The prevalence reported from western Nepal (Easow et al, 2003) as 19.7%, from Lamjung (Ishiyama et al, 2003) as 27%, Chandrashekhar et al (2005) from Kaski as 21.3%, Rai et al (2004) from remote hilly area as 61.8%.

The prevalence of parasitic infection also vary countrywide as reported (Kaur et al, 2002) 46.5% in India, 31% in Pakistan (Wadood et al, 2005), 33.4% in Turkey (Aksoy et al, 2007), 83.8% in Phillipines (Cauyan et al, 2008) and 63% in Saudi Arabia (Bello et al, 2008). The difference in the prevalence of parasitic infection in different areas of a country and from country to country could be due to the over dispersion of the parasite, sanitary condition of the people, life style of the people, geographical and environmental fluctuations, access to safe drinking water, behavioral and cultural habits and health education of the people.

The present study revealed the higher prevalence of protozoal infection compared to helminthic infection which was in agreement with the previous report from Nepal (Oda and Sherchand, 2002; Chandrashekhar et al, 2005; Shrestha et al, 2009). Similar finding was also reported from other countries as from India (Kaur et al, 2002), Turkey (Aksoy et al, 2007), Iran (Arani et al, 2008), Thailand (Saksirisampant et al, 2006). However, studies from Nepal (Rai et al, 2005; Sharma et al, 2004; Uga et al, 2003; Ishiyama et al, 2002; Rai et al, 2004) have reported a higher prevalence of helminthic infection over protozoan infection.

Prevalence of protozoan parasite was higher which could be due to the fecal contamination of drinking water, poor sanitary practices and poor health hygiene. Also in Terai region the water used for irrigation for improvement of crops and vegetables may be fecally contaminated which caused the higher infection. Defecation outside in the field and near water source is practiced in most part of the Terai region which could be a cause of water contamination and higher infection rate.

Distribution of anti-helminthic drugs through different health programmes conducted by government and private organizations may be a cause of preponderance of protozoan over helminthic infection. Besides, the study was conducted during rainy season when protozoan infections are high (Rai et al, 2001).

The present study revealed the preponderance of monoparasitism over multiparasitism and it was in agreement with the previous report (Ishiyama et al, 2001; Sharma et al, 2004) from Nepal. In similar studies carried in Saudi Arabia (Bello et al, 2008), Cambodia (Lee et al, 2002), Turkey (Aksoy et al, 2007) it was reported a high prevalence of monoparasitism. In contrast Rai et al (2001), Sharma et al (2004) have reported the preponderance of multiparasitism over monoparasitism in Nepal. Multiparasitic infection may be due to very poor health-hygeine and sanitary practices.

Prevalence of the infection was found slightly higher in females compared to males though the difference was not significant statistically. The finding was in agreement with the previous studies conducted in Nepal (Uga et al, 2002; Adhikari et al, 2007; Rai et al, 2004) whereas Ishiyama et al (2001), Sharma et al (2004), Rai et al (2001) have reported a higher prevalence of in males. The even distribution of parasite in the environment may be responsible for close infection rate among boys and girls. But slightly higher infection in females could be due to

their behavior as they are mostly involved in household works that make them frequently exposed with water. Besides, also they have to take care of babies which increases the chance of transmission of the parasites. In Terai region girls from lower caste helps their parents in agricultural activity more often as compared to boys which may also be a reason of higher infection among them.

Prevalence of infection was found equal in the children aged ten or less than ten years and the children aged more than ten years which was in agreement with Arani et al (2008) from Iran and Ishiyama et al (2003) Nepal. Whereas Rai et al (2002) reported a decrease in prevalence of infection significantly with the increase of age. Chandrashekhar et al (2005) have reported higher prevalence among children aged 6-10 years whereas Rai et al (2005) have reported an increasing prevalence with increasing age of children. In this study the equal infection between two groups could be due to the over dispersion of parasite in the environment. Besides, it could due to similar behavior, cultural habits and genetic factors of the children of different age groups.

The prevalence of infection was found higher in children belonging to family size more than seven compared to those belonging to seven or less than seven which was in agreement with the previous report from Nepal (Oda and Sherchand, 2002; Rai et al, 2005). Overcrowding and poor sanitary practices in large family may be associated with the higher infection rate.

The present study revealed the higher prevalence of infection among children belonging to caste Paswan, Mushar, Chamar, Yadavs, Teli (Group I) compared to the children belongin to caste Brahmin, Bhumihar, Rajput and Caist (Group II). The finding was in agreement with previous studies (Rai et al, 2002; Ishiyama et al, 2003; Adhikari et al, 2007) from Nepal. Poor hygiene practices, lower socio-economic status, lower literacy rate, higher involvement in agricultural activities of first group people could be associated with the high rate of infection among

them compared to second group. Prevalence of infection was found higher in the children studying in government school compared to those studying in boarding school. The finding was in agreement with previous reports from Nepal (Shrestha et al, 2009). Children studying in government school are from low socio-economic status family, the drinking water provided by school are handled and consumed haphazardly which increases the chance of contamination and poor sanitary practices among children in public school may have caused higher infection rate.

Infection rate was found higher in students washing hands with mud (50.8%) after defecation compared to the students using soap (37.1%). Mud is the main source of soil transmitted helminth and use of mud to wash hands after defecation causes the people to be infected again with parasites.

The parasitic prevalence was higher in students having toilet compared with students not having toilet facility. The result is consistent with previous report by Rai et al (2002), Rai et al (2005) from Nepal. However the finding was inconsistent with the finding of Ishiyama et al (2001). Lack of toilet affects the environmental sanitation since the students defecate around houses, fields, roads and playgrounds which may increase the chances of infection. Furthermore, flies and other insect sitting on faeces when reaches the food by chance increase the rate of infection.

The significant difference in the prevalence of parasite was found in children who have taken anti-parasitic drug in previous one month compared to those who have not taken the drug. The finding was consistent with the previous report from Nepal (Rai et al, 2005) whereas it was inconsistent with the finding by Adhikari et al (2007).

The prevalence of infection was found higher in children of farmers followed by the children of businessman and jobholders. The finding was consistent with previous finding from Nepal (Ishiyama et al, 2003). The children of farmers belong to low socio-economic status, they help their parents in farming activities, have poor hygiene practices, they take care of pet animals which all leads the greater chances of infection among them.

A. lumbricoides is the most predominant helminth found in the present study which is in agreement with the previous report from Nepal (Rai et al, 1986, 2000, 2001, 2004; Sherchand et al, 1996; Ishiyama et al, 2003). Similar finding was also reported from India (Awasti et al, 1997; Wani et al, 2007), Malaysia (Atiya et al, 2007), Pakistan (Hussain et al, 2009). The variation in the prevalence of *A. lumbricoides* in different studies conducted at different places could be due to the geographical variation, hygienic practices, sanitary condition followed by the people. This must have been attributed to survival instinct since, *Ascaris* egg survive longer time in the environment due to chitin present in their shell (Rai et al, 1999). However, distribution of anti-helminthic drug by government and private organizations has decreased the prevalence nowadays.

In the present study *H. nana* (12.58%) was found to be the second most prevalent helminth which was in agreement with the previous study (Chandrashekhar et al, 2005) from Nepal. Rai et al (2005) have reported its prevalence of 5.3%, Sharma et al (2004) as 4.9% whereas Shrestha et al (2009) have reported 1% and 1.9% in public and private school children respectively. Workers from Mexico (Diaz et al, 2003), Pakistan (Hussain et al, 2009), Sudan (Mohamed et al, 2009) reported *H. nana* as the most prevalent helminth. Once this helminth localizes in the human intestine it remain endemic due to its internal auto-infection nature and it is difficult to deworm as the cysticercoids larvae living inside the villi remain unaffected by drug which increase the prevalence of parasite. Higher prevalence

in the study could be due to faeco-oral route of transmission, poor personal hygiene and poor environmental sanitation.

Prevalence of *T. trichiura* was found to be 4.63% in the present study which was in agreement with Ishiyama et al (2003), Rai et al (2004) from Nepal. Rai et al (2005), Adhikari et al (2007), Ishiyama et al (2001) from Nepal have reported *T. trichiura* to be the most prevalent helminth. Longer life span, blood sucking nature and difficulty in deworming
during the heavy infection (Rai et al, 2001) could be associated with a higher prevalence of infection of this parasite.

Hookworm was found to be the third most common helminth (8.60%) in this study. The finding agreed with the previous report from Nepal (Ishiyama et al, 2001; Adhikari et al, 2007; Rai et al, 1997). Ishiyama et al (2003), Rai et al (2005), Sharma et al (2004) have reported high prevalence of hookworm infection in Nepal. However, Shrestha et al (2009), Chandrashekhar et al (2005) have reported very low prevalence. This variation in the hookworm infection may be due to geographical variation of study place, occupation of the people, cultural habits of the people, health hygiene, poor sanitary practices. A higher prevalence of hookworm (*A. duodenale*) appears to be due to its ability to undergo arrested development and to infect through oral and transplacental routes other than skin (Rai et al, 1997).

In the study low prevalence of *S. stercoralis* (1.32%) and *E. vermicularis* (2.65%) was in agreement with the previous report from Nepal (Chandrashekhar et al, 2005; Shrestha et al, 2009; Adhikari et al, 2007; Uga et al, 2004). Astal ZE (2005) from Palestine reported *E. vermicularis* to be the most common helminth. Low prevalence of *Strongyloides* may be due difficulty in diagnosing which may lead to delay in diagnosis and frequently results in death, despite vigorous treatment.

In the present study *G. lamblia* was found to be the most common protozoa infecting nearly one third of the total infected children. The finding was consistent with the previous report from Nepal (Oda et al, 2002; Chandrashekhar et al, 2005; Uga et al, 2004; Rai et al, 2002; Shrestha et al, 2009). It was also consistent with the report from India (Kaur et al, 2002), Mexico (Diaz et al, 2003), Thailand (Saksirisampant et al, 2006), Pakistan (Shaikh et al, 2009). The high prevalence of *G. lamblia* could be due to its transmission through drinking water (Ishiyama et al, 2001). In this study the highest prevalence could be due to the drinking of unboiled water by the people, use of fecally contaminated water for irrigating vegetables and crops, open defecation habits. Furthermore flies and other insects sitting on faeces may be a vector in disease transmission. Also the cysts of *G. lamblia* are more resistant to osmotic lysis compared to *E. histolytica* (Rai et al, 1994) could be a reason of its high prevalence.

E. histolytica was found to be the second most prevalent species in this study infecting nearly one fifth of the infected children. The finding was consistent with the previous reports from Nepal (Rai et al, 1994; Oda et al, 2002; Sharma et al, 2004; Easow et al, 2005; Chandrashekhar et al, 2005). The finding was also consistent with reports from Iran (Kia et al, 2008), Sudan (Mohamed et al, 2009). The high prevalence of *E. histolytica* in the study population could be due to their low socio-economic status, poor sanitation, poor health hygiene, drinking of unsafe and focally contaminated water. The organism causes amoebiasis and is more severe in children, during pregnancy and lactation, HIV infected, homosexuals, travellers and its extraintestinal dissemination is fatal.

Prevalence of *E. coli* was found to be 6.62% in the present study and is the third most common protozoan parasite detected. The finding was in agreement with the previous report from Nepal (Oda and Sherchand, 2002; Uga et al, 2004; Ishiyama et al, 2001). In contrast Ishiyama et al (2003), Rai et al (2001), Sharma et al

(2004) have reported *E. coli* to be the most prevalent protozoan parasites from different part of the country. Its high prevalence have also been reported from Sudan (Mohamed et al, 2009), Cambodia (Lee et al, 2002). *E. coli* is generally non-pathogenic but sometimes it causes diarrhea and its high prevalence could be due to the fecal contamination of drinking water which in turn shows poor sanitary practices.

B. hominis have the lowest prevalence (5.30%) among protozoan parasites in this study. The result was close to the finding of Oda and Sherchand (2002) from Nepal. The finding was inconsistent with finding of Aksoy et al (2007) from Turkey, Rice et al (2003) from Australia who reported its highest prevalence. *B. hominis* has been reported earlier in people with abdominal complain (Sherchand et al, 1996). Some researchers have not reported its presence which could be due to autolysis of *B. hominis* cyst during the time lapsed between sample collection and examination (Uga et al, 2004).

The present study revealed the high prevalence of protozoa compared to helminthes which could be due to the climatic factors as the study was carried in the beginning of rainy season when the number of flies and insects increase and may be a possible vector of disease transmission and also due to active protozoal infection during rainy season (Rai et al, 2001).

The high prevalence of parasitic infection in the present study indicates that the health status of Nepalese children is still poor and infection could be associated with consumption of contaminated water and food, open defecation practice in most of the study region and lack of practice in drinking boiled water.

Though safe and efficacious broad spectrum anti-parasitic drug have been developed, their use in mass treatment programme and individual treatment has

been limited by economic resources, existing manufacturing and distribution networks and national regulations.

Despite the government of Nepal and other private organizations are functioning for the promotion of health services through different programmes no significant progress has been achieved in controlling the intestinal parasitic infection in Nepal. Many factors are involved in the failure of parasitic control programme such as human behavior, their religion and culture, natural phenomena (climate, rain, flooding), educational factors, political factors. Therefore more effort should be made and applicable plans and policies should be formulated and implemented to get the satisfactory achievement in control of parasitic infection. The present study will help the government regulatory bodies and other private and social organizations to formulate effective plans and policies regarding control of parasitic infection and it will also help to conduct further researches in related areas to other researchers.

Although the study provides lots of information regarding the health status and parasitic prevalence among children, there are some limitations of the above study.

1. Due to the limitation of time factor, manpower and economic resources, the study had to be confined over limited sample size.
2. Limited age range of the study population as the target population was school children aged 3-18years.
3. Result would be more reliable when stool samples from each individual on three consecutive days were taken.

6.2 Conclusion

The parasitic infection among school children are closely related to their health hygiene, sanitary condition, socio-economic status, behavior and cultural beliefs as indicated by this study. The parasitic prevalence determined in this study was 42.2%. *G. lamblia* (31.7%) and *A. lumbricoides* (12.5%) are the commonest protozoan and helminthes found respectively. The prevalence of infection was nearly equal in male and female. The infection rate was found higher among the children visiting government school compared to children visiting private school. The infection was found marginally higher in children belonging to family size more than seven compared to seven or less than seven members. The children having toilet at home were found less infected compared to children not having toilet. Prevalence was found to be higher in children washing their hands with mud compared to children using soap after defecation. The infection rate was found lower among children who have taken anti-parasitic drugs in previous 1 month compared to them who have not taken. Parasitic prevalence was found higher in children belonging to caste Paswan, Mushar, Chamar, Yadavs, Hajam and Teli compared to those belonging to Brahmin, Bhumihar, Rajput and Caist. Monoparasitism was common than polyparasitism among infected subjects.

Chapter-VII

7. Summary and Recommendations

7.1 Summary

1. Stool samples were collected from 320 school children from Jaleshwor, Mahottari and transported to Kathmandu and analysis was done here at Shi-Gan laboratory.

2. The overall prevalence was determined to be 42.2% and among infected 88.9% had monoparasitism and 11.11% had multiparasitism.

3. *G. lamblia* (31.79%) and *A. lumbricoides* (12.58%) was the commonest protozoa and helminthes found respectively. Females (42.9%) and males (41.7%) were found almost equally infected.

4. The children visiting government school (45.3%) had marginally higher infection than private (36.1%). Prevalence was almost similar in age groups equal to or less than 10 years compared to age groups more than 10 years.

5. Prevalence of parasitic infection was found higher (47.8%) in children belonging to caste Paswan, Mushar, Chamar, Hajam, Teli and Yadavs and lower (31.5%) in children belonging to caste Brahmin, Bhumihar, Rajput and Caist.

6. Infection rate was lower in students having toilet at home (32.3%) compared to students not having toilet at home (48.9%). Similarly prevalence was higher in students washing their hands with mud (50.8%) after defecation compared to those using soap (37.1%).

7. The rate of infection was found lower (25%) in children who have taken anti-parasitic drugs in previous 1 month compared to those who have not taken (47.9%).

8. Prevalence of infection was found higher in children whose parents are involved in farming (47.1%) compared to those whose parents are involved in business (34.1%) and job (36%).

7.2 Recommendations

1. Relatively higher prevalence of intestinal parasitic infection (42.2%) in this study reflects the poor personal hygiene of children and poor sanitary condition. The study also reflects the lack of health education among children and their parents. So this type of study should be conducted regularly to make them conscious about their health status.

2. Periodic distribution of anti-parasitic drug and deworming programme should be conducted among school children as the study indicated very low prevalence among children who have taken drug in previous 1-2 months.

3. Health improvement programmes regarding health hygiene and sanitary improvement should be conducted regularly in school and village settings. The parents and children must be educated about health hygiene and sanitary practices.

4. As the study indicated the higher prevalence of protozoal infection, appropriate surveillance and monitoring system of drinking water and other possible sources of infection should be conducted.

5. The sanitary condition of government school was not found good as the study also indicated relatively higher rate of infection among the children of government school. So the government and community should be involved in the proper management of government schools.

6. Though no significance impact of various predisposing factors were studied, maintaining personal hygiene, drinking boiled water, washing hands with soap after defecation, avoidance of defecating in open places and periodic check-up of stool is recommended.

CHAPTER-VIII

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APPENDIX – 1

Materials and chemicals used

1. Chemicals and reagent used

Sodium chloride	Qualigens, India
Basic Fushin	Qualigens, India
Ethanol	Bengal, India
Diethyl ether	Qualigens, India
Formaldhyde	Qualigens, India
Iodine crystals	Loba chemic, India
Sulphuric acid	Qualigens, India
Methanol	Loba chemic, India
Malachite Green	Qualigens, India
Sucrose crystal	Qualigens, India
2.5% Potassium Dichromate	Qualigens, India

2. Materials

Test tube	Borosil, India
Conical flask	Borosil, India
Beaker	Borosil, India
Measuring cylinder	Borosil, India
Glass slide and cover slips	Borosil, India
Droppers	Borosil, India
Pipettes	Borosil, India
Glass tube	Borosil, India
Test tubes stand	Borosil, India

3. Equipments

Microscope	Olympus (Japan)
Refrigerator	LG, Korea
Centrifuge	Remi, India

APPENDIX-2

Microbiological Profile

Serial No: Date:

Name: Age:

Gender: Educational Status:

Height: Weight:

Patient's Clinical

History:……
……

Questionnaire:

1. How many members are there in your family?.....
2. Do you wash your hand after toilet? I. Yes II. No
3. Have you taken anti-parasitic drug recently? I. Yes II. No
4. Do you have toilet in home? I. Yes II. No
5. What is your parent's occupation? ----------

6. Report of Stool Examination:

Macroscopic examination:	**Microscopic Examination(Findings):**
Color: Consistency: Blood and Mucus:	Saline mount/Iodine mount: Concentration technique
Treatment:	

Authorized

Signature……...