CHAPTER I

1. INTRODUCTION

Soil transmitted helminthes (STH) are those, eggs and larvae of which become infective after incubation in the soil. Soil acts as the vehicle of transmission. E.g. *Ascaris lumbricoides*, hookworm, *Trichuris trichiura*, *Strongyloides stercoralis* etc. STH are transmitted from person to person through the soil (WHO, 1964).

Intestinal parasites cause major health problem in developing countries. Intestinal parasitic infections are among the ten most common infections in the world (WHO, 1987). It is realized, however, that this morbidity rate is an underestimate, since many cases may be underreported, and new cases occur continually in conjunction with increasing urbanization in most developing countries (Crompton and Savioli, 1993).

About 3.5 billion people in the world are infected from intestinal parasitosis and 450 million are ill as the result of these infections, the majority being children (WHO, 2000). *A. lumbricoides*, hookworm and *T. trichiura* have been estimated to infect 250 million, 151 million and 45 million people, respectively (WHO, 1997). Each of these parasites has been responsible for the deaths of 65,000, 60,000 and 70,000 people, respectively (WHO, 2000). However, it is prevalent nearly one hundred percent in the rural areas of developing countries (Rai and Gurung, 1986; Reily, 1980; Estevez *et al*, 1983).

Among the helminth parasites infection, STH infections remain as the important public health problem. It is estimated that more than one billion people in the world are infected by STH, mainly *A. lumbricoides*, hookworms and *T. trichiura* (Crompton, 1999). Annually more than 2 million people die of STH infections in the world. Soil-transmitted helminthiasis remains as an important cause of morbidity and sometimes mortality in developing tropical countries, particularly among pediatric age group (WHO, 1987).

Although STH affect all age groups, the problem is predominant among the worlds' estimated 400 million school children, and is often associated with poor growth, reduced physical activity, impaired cognitive function and learning ability (Stephenson *et al*, 1998). The main cause of distribution of STH in soil is indiscriminate defecation. STH condition in soil indicates the sanitary condition of the community.

It deals with the public health awareness. Thus, studies on soil contamination are needed to gain better understanding of infection in the population.

According to WHO (2000), it has been stated that intestinal helminthes rank first in causing disease burden in children. Children are most potential group to contaminate the soil with parasites. However, most such studies were based on stool examinations and therefore they cannot directly indicate the extent to which residents are at risk of parasitic disease but simply demonstrate the parasite distribution in a population at a give time. Examination has to be made on intestinal parasite eggs in soil (Uga *et al*, 1995).

Effective control of STH infections depends on improvement in sanitation and living conditions, awareness in health and hygiene but implementation is usually hampered by lack of resources and political will. In the short term, school based deworming has been recommended as a highly cost-effective public health measure in less developed countries (Yokogawa *et al*, 1983). In addition, baseline surveys provide basis for development of control programmes at national, regional and district levels. Various school based baseline surveys have been carried out to estimate the current status of STH infections (Nock *et al*, 2003). Preventive measures include avoiding contacts with soil that may be contaminated with human faeces, proper management of disposing faeces, wastes and sewage, good personal hygiene and food or water sanitation etc. When traveling to countries where sanitation and hygiene are poor, one should be careful by avoiding water or food that may be contaminated and washing or cooking or decontaminating all raw vegetables and fruits before use.

Despite increasing commitment to the health and learning of schoolchildren, progress on these fronts can be seriously threatened by helminthes infections. Studies have shown clearly the detrimental effects of infection on educational performance and school attendance, as well as the significant improvements in language and memory development that can be realized following treatment. Helminthes infections are also associated with nutritional deficiencies, particularly of iron and vitamin A, with improvements in iron status and increases in vitamin A absorption after deworming. Adolescent girls are particularly at risk of anemia aggravated by helminthes infection and iron stress (WHO, 2002).

Nepal is a small and impoverished country located in South Asia where intestinal parasites are prevalent. Among enteric parasites, STH are highly prevalent in Nepal (Rai and Gurung, 1986; Rai *et al*, 1994a, 1994b, 1995, 1997c, 1998, 2000a, 2000b; Sherchand *et al*, 1996, 1997; Ishiyama *et al*, 2001, 2003; Ono *et al*, 2001). The main factors responsible for this are poor sanitation, poverty and lack of health education (Rai *et al*, 2000b, 2001b; Ishiyama *et al*, 2001; Matsumura *et al*, 1998).

Nepal, majority of population living on agricultural subsistence, has diverse geo-topography with diverse climatic condition. The population densities and lifestyles vary according to the region and ethnic groups, respectively (Rai *et al*, 2000a). Approximately 70% of the health problems in Nepal are infectious diseases (Rai *et al*, 2001b). Of them, STH infection alone is most important (Rai and Gurung, 1986; Rai *et al*, 1994a, 1995) and has been found significantly affect on the nutritional status of Nepalese (Rai *et al*, 1998). However, the soil contamination with STH eggs of both human and animal origin has not been well investigated. This study was done to view the condition of STH in environment as well as the health of the selected population. The study was based on the detection of STH from soil and stool samples. The present study highlights the importance of the study of STH along with the intestinal parasites. The prevalence of STH in soil of Kathmandu Valley will help to know the sanitary status and public awareness.

CHAPTER II

2 OBJECTIVES

2.1 General objective

To study the status of STH in the soil samples, school children and patients visiting the clinic of Kathmandu Valley, Nepal.

2.2 Specific objectives

a. To assess the most prevalent STH in soil.

b. To find out the parasitic prevalence in the school children.

c. To correlate the parasitic infections among the children with their socioeconomic conditions.

d. To find out the parasitic infections in the patient visiting the clinic with some gastrointestinal complaints.

e. To compare the parasitic infection especially the helminth parasite infection in school children, patients visiting in clinic and soil in Kathmandu Valley.

f. To know the sanitary status as well as the public health awareness in Kathmandu Valley.

g. Deworming the children with parasitic infestation.

CHAPTER III

3. REVIEW OF LITERATURE

STH infections are endemic in the communities where poor environmental sanitation and poor personal hygiene are prevalent, as occurs in majority of developing countries (Yodmani *et al*, 1982). Yu *et al* (1993) showed that environmental pollution, sanitary condition and human behaviour play an important role in transmittion of STH infections. Yodmani *et al* (1982) indicated that many sources of Ascariasis from the host and in the environment such as soil in the shantytowns and vegetables sold in the market resulted in the continuous active transmittion of Ascariasis in the particular area.

Soil pollution with fecal materials is instrumental in transmission of STH infection. Fertilized eggs deposited in the soil develop rapidly and, depending on environmental conditions, may reach the infective stage within a matter of weeks. Thereafter, eggs are transferred from soil to the vegetables then onto the hands and finally to the mouth (Klaas, 1987; Kobayashi, 1999).

In any host-parasite system it is necessary for certain biological conditions to be fulfilled before endemicity can be established. The parasite must produce a sufficient number of eggs or larval stages, these stages must be capable of survival until they have passed from one host to another, and there must be available a sufficient number of host individuals to acquire and to maintain the infection. In the case of the nematodes under consideration, the intermediary vehicle of transference is the soil. Consequently, it is the soil which constitutes the infective medium to the host, i.e. man.

Influencing the degree of endemicity are the host population density, the egg-laying rate of the worms, the number of female worms carried by each person, and the effectiveness of contact between faeces and soil, as well as a number of physical, chemical and biological factors which may influence development and survival of the infective stages, such as the temperature, humidity, porosity, texture, structure and consistency of the soil, wind and sunlight, and the presence or absence of particular plants and animals. As a result of these various influences, a focus of infectivity becomes established in the soil and is maintained there for a shorter or longer time depending on the prevailing conditions (WHO, 1964).

Infective stages of soil transmitted nematodes have to face many hazards. There are many animals and fungi which prey upon them. There are desiccation, flooding, frost, chemical substances, such as urine or seawater, removal of shade and direct exposure to sunlight, and ingestion by host other than natural host. It is a success of larva in the face of these hazards that is their ability to survive that determines infectivity in the particular area.

Owing to the particular requirements of its free-living stage, each species of soil-transmitted nematodes tends to occur over broad ecological situations, determined by the climatic conditions obtaining therein. It is the indirect influence of rainfall. Atmospheric temperature and vegetation exerted through the soil that affects the distribution and prevalence of STH. The environmental factors that influence the infection pressure of intestinal parasitic infections are related to the distribution pattern, the latency period, the survival time and the eventual multiplication of the infective stages of parasites.

In terms of climatic factors temperature and rainfall are of primary importance and sunlight and air movement are of secondary importance. The most favorable soil temperature for development and migration of nematode larvae lies between 20 to 30ºC. At 10ºC, development in many species is inhibited and at 45 to 50ºC, larvae are killed. For *Ascaris* the optimum temperature for development is 20 to 25ºC. On the other hand the optimum temperatures for development are 28 to 32ºC for *Necator* and for *Ancylostoma*, 5 to 8ºC lower than this. Once the infective stage has been reached both species are relatively resistant to temperature extremes.

Direct desiccation kills larvae quickly hence moisture is necessary for survival and this is usually supplied to soil by rain. Sunlight acts by direct heat and radiation on eggs and larvae that are near the surface of the soil. The effect of sunshine is greatest in sandy soils and penetrates the depth of one centimeter or more. Wind hastens desiccation but possibly may cause spread of infective *Ascaris* eggs in dust.

Soil-particle size is important, because if the particle of clay are lighter than eggs of *Ascaris* and *Trichuris*, after rain have churned up the soil and the eggs together, fine clay will be deposited above the eggs and this will in turn be deposited above the coarse and heavier particles. As the result of heavy rain, splashing may cause *Ascaris* eggs to be lifted above the surface of soil and become firmly attached to leaves.

In relation to consistency of the soil it has been observed that there is an inverse relationship between prevalence of hookworm infection and denseness of the soil. In heavy soil prevalence is low while sandy soils are more suitable for hookworm larvae. Hookworm larvae move against the flow of water, so that when water is coming downwards into the soil they are moving upwards towards the surface, and as the upper layers of the soil dry out and water is sucked from the depths, the larvae migrate downwards.

Clay soils tend to get wetter and become less well aerated in excessive rain, so that larvae would be more likely to perish in clay than in sandy soils. On the other hand, in periods of excessive dryness the surface layers of sandy soils become too dry, whereas with clay soils some moisture is retained. For this reason *Ascaris* and *Trichuris* eggs are more likely to survive in clay soils than in sandy soils. Moreover, infection is facilitated by adhesive types of soil (WHO, 1964).

Global views

Intestinal parasitosis alone has been estimated to affect some 3.5 billion people in the world and 450 million are ill as the result of these infections, the majority being children (WHO, 2000). Around the world, it is estimated that *A. lumbricoides* infect 250 million, hookworm infect 151 million and *T. trichiura* infect 45 million people, respectively (WHO, 1997). Annually, each of these parasites has been responsible for the deaths of 65,000, 60,000 and 70,000 people, respectively (WHO, 2000).

A large number of published reports provide infection on the over all prevalence of STH in various parts of the world. However, the representative data on the prevalence of STH is not available because they only give the rough indications. STH are widespread in the tropical and sub tropical countries. Reports indicate *Ascaris* and *Trichuris* infection rates are still high over most of the continents.

Ulukanligil *et al* (2001) in Turkey studied the STH in sewage farms, streams and vegetables to determine the sources and routes of STH infection in Sanliurfa. Stool samples from farmhouse inhabitants as well as soil and vegetable samples from the gardens were collected and examined. 59.5% of STH eggs were detected from the total samples.

In the industrialize countries, where STH prevalence is very low, investigators have focused their studies on zoonotic helminth parasites such as *Toxocora* eggs contamination of sandpits in public parks (Uga *et al*, 1989; Uga, 1993) including the measures to prevent their contamination and extermination of the eggs already present in the sandpits (Uga and Kataoka, 1995).

Waikagul *et al* (2001) studied soil samples around the latrine of the villages of Thailand for the presence of STH. 23.1% to 30.4% of the samples were positive with either *Ascaris* or *Trichuris* or hookworm. He again studied on the stool samples from the house holds with positive soil samples and the prevalence of STH was found to be 73.6%. *Trichuris* was predominant helminth in the village followed by hookworm and *Ascaris*.

Nazligul *et al* (1997) and Ozbilge *et al* (1998) have reported the prevalence of intestinal parasites in the population to be near 60.0% in Sanliurfa, the predominant cause of infestations being *A. lumbricoides*. These studies attributed the high incidence of intestinal parasites to the use of night soil in vegetable gardens. Fueki (1952) established that night soil was widely used as fertilizer in rural areas in Japan, and that nearly half of the vegetables sold in markets were contaminated with *Ascaris* eggs.

Many studies have reported the environmental pollution with STH. Toan (1997) made a study in similar environmental conditions in a rural area in Vietnam and found that the prevalence of STH infection was high and all of the soil samples were positive for *A. lumbricoides* eggs. In the survey of Brazilian cities by Schulz and Kroeger (1992) *A. lumbricoides* eggs were found in the soil from indoor, backyard and defecation site. They also reported that keeping of pigs was correlated with increased yard contamination.

In the study made by Nurdian (2004) in the two villages of Jember, 65.0% of soil samples were found to be contaminated with four species of intestinal parasite eggs in rainy season and only two species, 16.7%, were detected in dry season. The prevalence of parasites was significantly more in rainy season.

Imai *et al* (1985) carried out a survey on soil transmitted helminthiasis in North Sumatra, Indonesia and found extremely high prevalence, average (97.0%) in three villages and more than (70.0%) harbored three or more helminthes, especially *A. lumbricoides*, hookworm and *T. trichiura*.

The survey of the stool samples from 1,659 children aged 15 years and below in metropolitan Lagos showed 71.9% and 68.3% infection with *T. trichiura* and *A. lumbricoides* respectively while the infection rate with hookworm was (22.5%). Multiple infections were very common (Fagberno-Beyioku *et al*, 1987). Another study conducted by Egwunyenga *et al* (2005) in Nigeria, the prevalence rate of STH was found to be 54.7%. Males (60.8%) were generally more infected than female (47.3%). *A. lumbricoides* has highest overall infection rate followed by hookworm and *T. trichiura.*

YU *et al (*1993) conducted the study on STH in Hunan province in China and found the eggs of *A. lumbricoides*, *T. trichiura*, *Capillaria hepatica*, *Toxocara canis*, *T. cati*, *Hymenolepis diminuta* and *Taenia* spp. Larvae of *Strongyloides* spp. and larvae /adults of unidentified nematodes were also found. Toan (1997) found *A. lumbricoides* in 93.6% and *T. trichiura* in 79.3% rural Vietnemese. The soil contamination rate in same area was very high. All the soil samples collected were positive for *A. lumbricoides* eggs.

Uga *et al* (2005) examined the stool samples of school children, in Vietnam. Of 217 children examined, 166 (76.0%) were positive for at least one of the nine species of parasites. Among helminth parasites, *T. trichiura* (67.0%), *A. lumbricoides* (34.0%) and hookworm (3.0%) were detected. In case of protozoan parasites, *E. coli* (8.0%) and *E. histolytica* (2.0%) were detected.

In 1994, Lee *et al* examined fecal specimens of a total of 52,552 patients by formalin-ether sedimentation and direct smear method. The overall egg positive rate of helminthes was (6.5%). The egg positive rate for each species of helminthes was *Clonorchis. sinensis* (3.2%), *T. trichiura* (2.0%), *A. lumbricoides* (0.2%), *Trichostrogylous orientalis* (0.1%), *Taenia* spp. (0.05%), *H. nana* (0.03%), hookworms (0.03%), *Enterobious vermicularis* (0.02%), *S. stercoralis* (0.1%) and *Diphyllobothrium latum* (0.004%). By analysis of 9 years data, they stated that the prevalence of STH such as *A. lumbricoides* and *T. trichiura* has been decreasing remarkably, while that of snail-transmitted helminthes such as *C. sinensis* has not.

In 1994, Hassan *et al* surveyed 4 primary and 2 secondary schools at Imbaba, Egypt. Stool specimens of 791 students were examined. The results revealed *E. histolytica* (22.4%), *H. nana* (6.2%), *A. duodenale* (5.7%), *A. lumbricoides* (1.5%) and *E. vermicularis* (1.1%). There was no statistical difference in rate of infection between primary and secondary school students.

A study on parasitological examinations in stool specimens from 407 residences of Sao Paulo, Southeastern Brazil was performed. Intestinal parasites were detected in (45.7%) of the stool collected. The most prevalent parasites in this population were *A. lumbricoides* (23.8%) followed by *T. trichiura* (17.2%). The prevalence rates of infection by *A. lumbricoides* and *T. trichiura* were highest among children aged 2-12 years. The mean intensity of infection of *A. lumbricoides* was highest among children aged 6-12 years and young adults under 25 years, while in *T. trichiura* infected subjects the highest egg counts were observed in children aged 2-12 years (Ferreira *et al*, 1994).

Chandiwana *et al* (1989) surveyed to access the prevalence and intensities of hookworm and roundworm infections in 15 farm-worker communities in Zimbabwe with poor living conditions. Examinations of 1,635 fecal samples showed that hookworms were the commonest helminthes (61.7%). They were followed by *A. lumbricoides* and *T. trichiura*. Age prevalence and age intensity profiles for hookworms showed that infections increased with age, with a peak in the adult age groups. *A. lumbricoides* prevalence was relatively high in children but declined in adults.

In Nigeria an epidemiological survey of intestinal helminthiasis on 766 primary school children aged 5-16 years was conducted and found a prevalence of *A. lumbricoides* (88.5%), *T. trichiura* (84.5%), hookworm (33.1%) and *S. stercoralis* (3.0%). The influence of host age and sex on infection level was assessed. Evidence was obtained for pre-disposition of individuals to heavy and light infection with *A. lumbricoides* (Holland *et al*, 1989).

Examination of stool samples from primary school children of North Thailand was carried out by Kasuya *et al* (1989) in 491 students and revealed overall prevalence of 48.7%. The most common type of parasite was found to be STH such as hookworm (26.3%) and *S. stercoralis* (11.2%), while *A. lumbricoides* was not so prevalent (1.2%). Ophisthorchiasis is another parasitic disease with a relatively high prevalence rate of (7.5%). This disease rate was found to be increasing with age. The most common protozoan was *G. lamblia* (7.7 %).

In Cockle Province, Republic of Panama Robertson *et al* (1989) carried out a survey of intestinal helminthes in children by microscopic examinations (modified Kato-Katz technique) of stool samples from 661 children attending primary schools. The overall prevalence of *A. lumbricoides*, hookworm and *T. trichiura* infections were found (18.2%), (12.0%) and (27.5%) respectively. There were significant differences between the infection prevalence values for children attending the different schools, but not with respect to age or sex. Positive association was detected between particular pairs of infections and there were most evident with *T. trichiura.*

In Brazil, Goncalves *et al* (1990) carried out parasitological examinations on 485 inhabitants of four villages. Approximately (99.6%) of the inhabitants were infected with at least some species of intestinal parasites. A high prevalence of *S. mansoni* (82.1%), hookworm (80.2%), *T. trichiura* (69.9%), *A. lumbricoides* (61.9%) and *E. coli* (36.7%) infections were demonstrated.

Hesham *et al* (2006), studied on 281 Orang Asli children in 8 Orang Asli villages in Selangor. 26.3% of the children were infected with single parasitic infection either *A. lumbricoides*, or *T. trichiura* or hookworm and 72.6% with mixed infection. The most prevalent parasite was *T. trichiura* (98.2%) followed by *A. lumbricoides* (61.9%) and hookworm (37.0%). Jamaiah and Rohela (2005) conducted a survey in public of Malaysia. The overall infection rate was 6.9% with *T. trichiura* being the commonest parasite followed by *A. lumbricoides*, *C. sinensis*, hookworm and *E. histolytica*. The highest infection rate was among Chinese followed by Malays and Indians.

An investigation for the prevalence and intensity of STH was undertaken in four villages in Oyo state, Nigeria by Asaolu *et al* (1992). Diagnosis was based on examination of stool samples for the presence of helminthes ova in all age groups. The prevalence of *A. lumbricoides* ranged from (61.5%) to (72.2%), *T. trichiura* from (65.0%) to (74.0%) and hookworm from (52.4%) to (63.0%) depending on the village concerned.

In a survey in Indonesia, 419 stool samples were examined by using direct smear, flotation and formalin ether concentration techniques. Five nematodes and seven protozoan parasites were detected while trematodes and cestodes infections were not observed. STH infections were predominant. Among the younger inhabitants aged less than 15, positive rates of *A. lumbricoides*, *T. trichiura* and hookworm infections were almost same (45.7%), (45.3%) and (47.7%), respectively. Among the people aged 15 or more, positive rate of hookworm infection (89.4%) was much higher than *A. lumbricoides* and *T. trichiura* infections (19.3%) and (26.1%) respectively (Hasegawa *et al*, 1992).

A survey conducted by Marnell *et al* (1992) among the refugee in Juba, Sudan, involving 241 fecal samples revealed (66.0%) of the population harbored intestinal helminthes. The most commonly found infection were hookworm (36.0%), followed by *S. mansoni* (26.0%), S. *stercoralis* (20.0%), *H. nana* (11.0%), *A. lumbricoides* (1.2%), *T. trichiura* (0.8%) and *Taenia* spp. (0.4%). Among examinee 42.0% had single infection, 21.0% had double and (3.0%) had multiple infections. Parasitic prevalence and intensities were analyzed in relation to age, sex, religion and occupation. Females were more infected (70.0%) than males (64.0%). Muslims were less infected (50.0%) than Christians (68.0%) and agriculturalists (90.0%) were the most infected occupational group.

In the study made by Tadasse (2005), in Babile town of eastern Ethiopia nine species of intestinal helminthes were identified with an overall prevalence of 27.2%. The predominant parasite involved was *H. nana* which was observed in 42 (10.1%) students followed by hookworm in 28 (6.7%) and *S. mansoni* in 18 students (4.3%). The prevalence of STH was 14.2%.

Andrade *et al* (2001) studied stool samples in Ecuador. The prevalence of STH was 65%, *A. lumbricoides* being the commonest (63.0%) followed by *T. trichiura* (10.0%) and hookworm (1.4%). A significant relationship was found between the worm burden and the degree of stunting. This study suggests that the periodic administration of an anthelminthic drug should be targeted to preschool and school children to allow a normal growth spurt and prevent stunting.

A community based prospective study was conducted by Karrar and Rahim (1995) in Khartoum. The commonest infestation was giardiasis (21.1%) followed by taeniasis (10.4%) and enterobiasis (7.4%). Non pathogenic *E. coli*, *E. histolytica* and *T. saginata* were detected in (2.7%), (0.7%) and (1.7%) of stools specimens respectively.

Kightlinger *et al (*1998) surveyed 633 children, within age group 4-10 years living in Southern Madagascar. The study revealed the maximum (93.0%) prevalence rate of *A. lumbricoides* followed by *T. trichiura* and hookworm by (55.0%) and (27.0%) respectively. Mafiana *et al* (1998) conducted an investigation to determine the prevalence of STH parasites in children in Ogun state, Nigeria. Fecal examination of 1,060 children revealed the prevalence of (64.0%) for *A. lumbricoides,* (21.9%) for *T. trichiura* and (14.5%) for hookworm.

Paul and Gnanamani (1999) carried out a study to determine the prevalence and intensity of intestinal helminthes infections among the children belonging to lower socio-economic status. Stool samples collected were processed by modified formalin ethyl acetate sedimentation technique. 177 children were infected with one or more of intestinal parasites as *A. lumbricoides*, *T. trichiura* and hookworm. The overall prevalence of infection was (82.0%). *A. lumbricoides* was the most common infection with prevalence of (75.0%) followed by *T. trichiura* (66.0%) and hookworm (9.0%).

Another study was conducted by Lee *et al* (2000) in a small scale survey of intestinal parasites infection among school children and adolescents in Philippines. The overall prevalence rate was (78.1%) with *T. trichiura* topping the list (51.0%) followed by *A. lumbricoides (*40.0%), hookworm (23.4%), *Iodamoeba butschlii* (15.6%), *Endolimax nana* (14.1%), *E. coli* (9.4%) and *G. lamblia* (7.8%). The infection rate of primary school children, preschool children and adolescent were (95.5%), (64.7%) and (87.7%), respectively. The infection rate in urban area was (56.0%) and (92.3%) in rural areas.

Ascariasis was the most common parasite in China. According to nation wide survey in 1988-1992 the average infection rate was 47.0% that is around 531 million people were infected (Feng *et al*, 2001). Another study by Chai *et al* (2001a) in Jiangxi province of China has reported 72.5% prevalence rate. The positive rate of different parasite was *A. lumbricoides* (50.9%), *T. trichiura* (33.4%), hookworm (11.4%), *G. lamblia* (2.4%), *E. coli* (1.2%) and *E. histolytica* (0.8%).

In a national survey of intestinal helminthes in Korea (Chai *et al*, 2001b), the most prevalent species was *C. sinensis* (1.4%) followed by *E. vermicularis* (0.6%), *A. lumbricoides* (0.06%), *T. trichiura* (0.04%), *Taenia* spp. (0.02%) and hookworm (0.007%). The remarkable decreases in prevalence of STH are considered largely owing to successful implementation of national control activities and greatly improved sanitary conditions of Korean people.

In the SAARC nations

In Bangladesh, Muttalib *et al* (1983) reported that 80-90% of human excreta found its way into soil or water. Refuses, garden, and water sources were found to be infected predominantly by *A. lumbricoides* ova. The entire soil sample collected from different households of the village of Bangladesh was positive for *A. lumbricoides* and 13.3% - 22.2% of the soil was contaminated with the eggs of *T. trichiura*.

A study was done among the children of age below 4 years suffering from gastrointestinal problem in rural Bengal. Most common parasite was *G. lamblia* (17.2%), followed by *E. vermicularis* (12.2%) and *E. histolytica* and *A. lumbricoides* both (8.1%). A significantly lower infection rate was observed in children below one year (24.4%) than older age groups (66.4%) (Saha *et al* 1995).

Socio-economic and behavioral factors affecting the prevalence of geo-helminthes in preschool children in Sri Lanka was studied by de Silva *et al* (1996). They examined relationship between the prevalence of geo-helminthes infection in pre-school children living in the urban slum area and parental education, socio-economic status, the use of anthelminthics and beliefs regarding these helminthes. Stool sample from 307 children were examined by direct smear and concentration method. Overall prevalence was found (26.4%) and more interestingly *A. lumbricoides* (90.1%) predominated all of helminthes. The parental education level and socio-economic conditions influenced geo-helminthes infections in children.

Virk *et al* (1994) examined the stool samples in some of the villages of Utterpradesh, India. 29.2% were positive for parasitic infection. *A lumbricoides* topping the list followed hookworm, *H. nana*, tapeworm, *T. trichiura*, E. *vermicularis*, *E. histolytica*, *E. coli* and *G. lamblia*. The highest positivity was encountered in the age groups between 6-14years. The high prevalence of intestinal parasites may be due to lack of awareness about personal cleanliness and hygiene and literacy among rural women. Majority of them had helminthes infections.

A study was conducted by Awasthi and Pandey (1997) in prevalence of intestinal parasite in pre-school slum children in Lucknow. The samples were examined by direct smear technique. 17.5% children were found to be infected with parasites. *A. lumbricoides* was found in 68.1% and *G. lamblia* in 32.9% children. There was no association between weight or height and parasite positivity.

National scenario

In Nepal due to lower socio-economic and poor hygienic conditions of the people intestinal parasitosis is very much prevalent (Nepal and Palfy, 1980; Estevez *et al*, 1983; Rai and Gurung, 1986; Sherchand *et al*, 1996, 1997; Rai *et al*, 1994a, 1994b, 1995, 1997, 2000, 2001; Ishiyama *et al*, 2001; Ono *et al*, 2001). Therefore, there is no question that intestinal parasites are important causative agents of the major public health problems of the country. In some rural areas of Nepal parasitic infection rate approach one hundred percent with significant portion of parasitic infection (Reily, 1980; Estevez *et al*, 1983).

A random sample study in patients in Bhaktapur was conducted to ascertain the incidence of roundworm infection (Sharma, 1965). A total 976 stool samples were collected over a 5 years period. Among them 430 samples were from adult males, 326 were from adult females and 220 were from children of both sexes under 12 years of age. The result showed that (32.0%) of adult males, (44.0%) of adult females and (49.0%) of children were infected giving an overall incidence of (40.0%).

A microscopical examination of 80 students studying in Auxiliary Health Worker's school was carried out by Sharma and Tuladhar (1971). They found (87.4%) students were infected by different parasites like protozoa and helminthes. *A. lumbricoides* was the commonest parasites followed by hookworm, *T. trichiura*, *G. lamblia* and *E. vermicularis*. Nepal and Palfy (1980) examined 225 stools samples to find the prevalence of intestinal parasites. Only (4.4%) of the samples showed negative result. The most common helminth was *A. lumbricoides* (63.5%) followed by hookworm (55.9%) and *T. trichiura* (37.6%). Among protozoa *E. histolytica* (28.8%) and *G. lamblia* (28.8%) topped the list followed by and *E. coli* (24.4%). 55.1% samples showed the presence of more than one parasite.

Khetan (1980) examined 2,073 stool samples in the pathology laboratory of Narayani Zonal Hospital during 1977 to 1980. Among them 1,592 stool samples were found positive for parasitic infestation. (29.0%) were infected by hookworm followed by *A. lumbricoides* (21.9%), *T. trichiura* (9.9%), *G. lamblia* (8.5%) and *E. histolytica* (4.0%).

Estevez *et al* (1983) collected and examined 40 specimens of stool samples in a remote area of Western Nepal. Among them, (90.0%) were found positive for parasites as determined by direct wet mount and trichome smears. 83.3% of individuals were infected with hookworm, 52.8% with roundworm and 5.5% with whipworm. All of the positive samples contained several parasite species, averaging 4 spp. per specimen.

A study conducted in Bhaktapur district by Shrestha (1983) showed (99.0%) stools were positive for the eggs of STH, (94.0%) positive for *A. lumbricoides*, (42.0%) for *T. trichiura* and (11.0%) for hookworm. Similarly, from the Panchkhal area in Kavre District (41.0%) stools were positive for the eggs of helminthes. Of these (75.0%) were of *T. trichiura*, (37.0%) were of hookworm, (19.0%) were of *A. lumbricoides*.

A retrospective study for the evaluation of the status of STH infection in Nepal was conducted by Rai *et al* (1994a) and found that the annual prevalence for STH during the period of 1985 to 1992 range from 18.0% to 36.6% with marginal decrease in successive years. The incidence however, showed an increase rate after the year 1993. The positive rate for intestinal parasitosis was 29.1% to 44.2%. The most common helminthes was *A. lumbricoides* followed by hookworm. The incidence of *A. lumbricoides* remained constant through out the study period; while the incidence of hookworm and *T. trichiura* decreased remarkably till year 1992 followed by an increasing trend on the year 1993 and 1994.

Blangero *et al* (1993) studied the prevalence of helminthes infection for three Ethnic groups (*Jirels*, *Sherpas* and high caste *Hindus*) in Jiri region of Eastern Nepal. There was the significant difference between these groups for prevalence of hookworm with *Jirels* having the overall highest infection rate.

Another retrospective study conducted by Rai *et al* (1994b) on the prevalence of intestinal protozoan parasitic infection in Nepal showed the annual rate of protozoan parasitosis range from 3.3% in 1985 to 13.6% in 1990. The overall annual incidences of these parasites found increasing every successive calendar year. The majority of protozoan parasite found was *G. lamblia* followed by *E. histolytica*. Both of these parasites showed an increasing tendency in every successive calendar year except for the year 1989 during which *G. lamblia* showed relatively low infection.

In the study of intestinal parasitosis in rural area of southern part of Nepal, the prevalence rate of parasites recorded was 63.1%. Hookworm was the commonest parasite (11.6%) followed by *A. lumbricoides*, *E. vermicularis*, tapeworms, *H. nana*, *E. histolytica*, *G. lamblia*, *C. parvum*, *Cyc. cayetanesis*, *Opisthorchis* spp., *Schistosoma* spp. and *I. butschlii.* The incidence rate was higher in female children (58.1%) compared to male children (41.0%). High prevalence of intestinal parasitosis is an indication of human behaviour like walking bare foot, poor sanitary condition, illiteracy and lack of awareness (Sherchand *et al*, 1997).

Rai *et al* (1997b) conducted the serological study of amoebiasis among adults and found a significantly low seropositivity rate among the *Rai/Limbus* (5.0%) compared with each of the *Tamangs/Sherpas* (40.0%), *Newars* (35.0%) and *Brahmins/Chhetries* (40.0%). In the study conducted in eastern hilly region of Nepal, *A. lumbricoides* was found to be most common parasite followed by hookworm and others (Rai *et al*, 1997c). In another study conducted in a rural hilly area of Western Nepal, the overall prevalence rate of parasite was 76.4%. Parasites were almost uniformly distributed in both male and female and both in adult and children. *A. lumbricoides* was most predominant parasite (47.7%) followed by hookworm and others. Amongst the protozoan parasites, *E. coli* was the most common (Rai *et al*, 2001a).

Yong *et al* (2000) carried out a research on the status of intestinal parasite infections in two rural villages of Chitwan District in Nepal. The examination of 300 stool samples of school children were performed by formalin-ether sedimentation technique and the prevalence rate of intestinal parasite infections in female was slightly higher than that in male without statistical significance. Among the protozoan parasites, *E. coli* was the commonest parasite (21.0%) followed by *G. lamblia* (13.7%) and others (5.3%). Hookworm was the most prevalent intestinal helminth (13.0%) followed by *T. trichiura* (3.0%) and others (5.0%). Forty-three specimens (14.3%) showed mixed infections.

Among the school children of Kathmandu Valley, the parasitic prevalence of 72.4% has been reported by Ishiyama *et al* (2001). Helminthes parasites dominated the protozoan parasites with 46.9% multiple infections. *T. trichiura* (30.4%) was most frequently found helminth followed by *A. lumbricoides* (21.7%) and *G. lamblia* (17.0%) was most common protozoan followed by *B. hominis* (7.9%).

A study conducted by Rai *et al* (2002b) in rural hilly areas of Dhading District reported the overall prevalence rate of 60.0%. *A. lumbricoides* (69.6%) was most common parasite which is followed by hookworm and others. *G. lamblia* (5.2%) was only protozoa detected. Ethnically, *Dalits,* lower caste and so called untouchable people with low socio-economic status, (NPC, 2002) had significantly higher (74.1%) prevalence rate followed by *Tibeto-Burmans* (65.7%) and *Indo-Aryans* (38.5%). A marginally low prevalence was found in children having toilet compared to children who had not. Taking anthelminthic drugs in last six months had no effect on parasitic infection.

A study conducted in remote hilly village in Western Nepal revealed the highest prevalence of *A. lumbricoides* followed by hookworm and *T. trichiura.* The incidence rate of parasitosis was (27.0%) with marginally higher prevalence rate in male. The higher prevalence of intestinal parasitosis has been reported among *Dalits* as compared to *Tibeto-Burman* and *Indo-Aryans*. Majority of the subjects has single parasitic infection (Ishiyama *et al*, 2003).

In 2000b, Rai *et al* studied in the contamination of soil with helminthes parasitic eggs in Nepal. In the study, out of 156 soil samples 57 (36.5%) were contaminated with helminthes parasitic eggs. Soil contamination with helminthes eggs was uniform in both Kathmandu Valley (36.9%) and outside of valley (35.3%). The contamination rate was higher in wet season (48.3%) than during the dry season (33.3%) but insignificant statistically (P>0.05). *A. lumbricoides* eggs were detected most frequently in this study.

In a survey conducted by Bol *et al* (1981) in Lalitpur District, the high prevalence of *A. lumbricoides* was observed in soil samples. In stool samples, *A. lumbricoides* *T. trichiura* and hookworm were detected. In summer and winter seasons no significant difference was observed in parasitic prevalence rate.

In 1997, Shrestha studied nail, fingers, house dusts and stool samples for the presence of STH. In the stool samples, roundworm infection was the commonest followed by whipworm and hookworm. However, there was low prevalence of STH eggs in the soil of kitchen garden and around toilet in a village located 12 km away from Kathmandu City. About 3.0% of house dust showed the contamination with *A. lumbricoides* eggs whereas no any helminthes ova were detected in nails. Females were infected slightly higher than males.

Sharma *et al* (2004) studied the prevalence of intestinal parasitic infestation in the childen in Northeastern part Kathmandu Valley. 66.6% of the children had some kind of parasitic infections. *T. trichiura* was the commonest parasite (34.6%) among the helminthes followed by hookworm (23.7%) and *A. lumbricoides* (13.8%). Among protozoa, *E. coli* (6.45%) topped the list followed by *E. histolytica* and others. More than half of the children had mixed parasitic infections.

CHAPTER IV

4. MATERIAL AND METHODS

4.1 Materials

4.1.1 Soil

The materials, equipments, chemicals, and reagents are listed below:

Materials	**Glasswares**
Plastic bags	Beakers
Shovel	Test tubes
Loop	Conical flasks
Marker and labeling stickers	Measuring cylinder
Sieve (150µm)	Pipette
News papers	Slides and cover slips

Equipments		**Chemicals**
Centrifuge-	Remi (India)	0.05% Tween-20

Microscope-	Olympus (Japan)	Saturated sucrose solution (sp. gravity 1.200)
Refrigerator-	LG (Korea)	
Weighing machine-	Germany	

4.1.2 Stool

Materials	**Glasswares**
Questionnaire	Beakers
Stool container	Test tubes
Tissue paper	Funnel
Dropper	Measuring cylinder
Wooden stick applicator	Glass slides
Muslin gauze	Cover slips
Scissors	
Test tube stands	

Equipments	**Chemicals**
Microscope	Normal saline (0.85% NaCl)
Centrifuge	10% formal saline
Weighing machine	Lugol's Iodine (5 times diluted)

Refrigerator	Ethyl- acetate

4.2 Methods

4.2.1 Soil

4.2.1.1 Subjects and study area

Soil samples were collected from August 2005 to July 2006 in Kathmandu Valley. The samples were processed and examined in National Institute of Tropical Medicine and Public Health Research, Narayan Gopal Chowk, Shankha Marg, Kathmandu, Nepal.

4.2.1.2 Sample collection

Soil samples were collected from different sites of Kathmandu Valley (Appendix IV). About 200g of soil samples from a depth of about 2 cm in an area not exposed to direct sunlight was collected using a small shovel. The soil samples were collected in sterile polyethylene bag, labeled with sticker, and taken to the laboratory for processing.

4.2.1.3 Technique used

Modified sucrose flotation technique (Uga *et al*, 1989)

4.2.1.4 Sample processing

The soil samples were collected in the clean and sterile polyethylene bags, labeled and taken to the laboratory.

↓

The soil samples were spread over a paper and dried overnight at room temperature.

↓

The soil samples were ground and sifted through a 150µm mesh sieve.

↓

2gm of powdery soil in a test tube was suspended in 8.0 ml of (0.05%)

Tween-20 solution.

↓

It was then centrifuged at 1000rpm for 10 minutes.

↓

The supernatant was then discarded.

↓

The tube was then filled with 8.0 ml sucrose solution (1.200 sp. gravity) and again centrifuged at 2000rpm for 10 minutes.

↓

By the help of the loop, the surface layer was taken out and kept in the glass slide and microscopy was done.

For each sample, two slides were prepared.

4.2.2 Stool

4.2.2.1 Subject and study area

The study was carried out in National Institute of Tropical Medicine and Public Health Research, Maharajgunj, Nepal. The study period was from August 2005 to July 2006. The stool samples were collected from the schools of Lubhoo. Lubhoo is situated at the distance of 10 km south east of capital city Kathmandu. It is a rural region with the population about 8000. The literacy rate is 71.0% (male: 85% and female: 57%). It is inhabited by *Newars*, *Brahmins* and *Chettries*, majority being *Newars.*

4.2.2.2 Sample collection

Before the distribution of containers, the school children were given the brief description about health and hygiene, source of parasitic infection, modes and effects of infection and preventive measures as well as the importance of the stool examination. Then the questionnaire (Appendix I) was filled after the verbal consent with teachers and students.

The clean, dry and leak proof plastic container was distributed and advised to collect about 20 gm or 20 ml stool sample avoiding contamination with urine or other substances. The container was labeled with subjects name/code, class, date and time of sample collection.

Next day the samples were collected and taken to Institute of Tropical Medicine and Public Health Research, Maharajgunj, Nepal.

4.2.2.3 Sample processing

Each stool sample was processed in 2 steps as:

1. **Macroscopic examination**
2. **Microscopic examination**
   I. Concentration technique

      Saline wet mount

      Iodine wet mount

4.2.2.3.1 Macroscopic examination

- Consistency
- Blood and mucus
- Adult worm or worm segments

4.2.2.3.2 Microscopic examination

Microscopic examination was conducted to know the presence of parasites. By microscopy protozoal cysts, oocysts, trophozoites and helminthic eggs or larvae were detected based on their morphology, motility and staining characteristics. To detect parasites saline wet mount and iodine wet mount methods were performed followed by concentration method.

I. Concentration technique

Formal-ether sedimentation

a. About 1 gm of faeces was emulsified in about 4 ml of 10% formal-saline shaken well and suspension was allowed to stand for 30 minutes for fixation.
b. About 3-4 ml of 10% formal-saline was added and the tube was capped and shaken well.
c. The suspension was sieved through double gauze in a funnel into 15 ml centrifuge tube.
d. 3-4 ml of ether was added and the tube was shaken vigorously for 5 minutes.
e. The tube was then centrifuged at 1000 rpm for 10 minutes.
f. The layer of faecal debris formed between ether and formalin was removed along the side of the tube with a stick.
g. The supernatant layers of liquid were poured off.
h. The sediments were tapped with fingers and smear was made in glass slide.
i. The smear was examined by iodine and saline wet mounts under the microscope.

Saline wet mount

It was used to detect protozoan cysts and helminth ova and larvae. A drop of normal saline was taken on a clean glass slide and a drop of sediment from above process was mixed with it, covered with cover slip and observed under microscope.

Iodine wet mount

A drop of 5 times diluted Lugol's Iodine was taken on a slide. A drop processed stool was mixed with it and observed under microscope after covering with a cover slip. It was mainly used to observe the protozoal cyst. Iodine stained cysts showed pale reflectile nuclei, yellowish cytoplasm and brown glycerol material.

4.2.3 Deworming of students.

Those students who had parasitic infections were given a full course of anti-parasite drugs.

4.2.4 Statistical analysis

Statistical significance was analyzed by using Chi-Square (χ^2) test. The results were considered significant if the P-values were less than 0.05. The Chi-Square test is shown in (Appendix III).

CHAPTER V

5. RESULTS

5.1 Soil

Within the study period from August 2005 to July 2006, a total of 200 soil samples and 1,504 stool samples were collected from Kathmandu Valley. Soil samples were collected from different urban and sub-urban areas of the valley. Out of total stool samples 188 were collected from two schools of Lubhoo V.D.C. and 1,316 stool samples were collected from patients visiting Shi-Gan Health Foundation.

Out of 200 soil samples, 57 (28.5%) were found to be positive for helminthes parasite eggs and larvae. In dry season (November-April), 67 samples and in wet season (June-September), 133 samples were collected. 17 (25.3%) samples collected in dry season and 40 (30.0%) samples collected in wet season were contaminated with the helminth parasitic eggs and larvae. But the difference was not statistically significant (P>0.05) (Table 1).

Out of 57 positive samples, 32 (56.1%) were contaminated with *Ascaris* eggs, 10 (17.5%) with *Trichuris* eggs, 9 (15.8%) with hookworm and 6 (10.5%) with *Strongyloides* larvae (Table 2).

Table 1 Soil contamination in different seasons in Kathmandu Valley

Seasons	**No. of samples collected**	**Positive**	**Percentage**	**P-value**
Dry	67	17	25.3	**P>0.05**
Wet	133	40	30.0	
Total	**200**	**57**	**28.5**	

The samples were collected from different sites. According to the sites of collection the highest prevalence (45.7%) was observed in samples collected from river sides followed by vegetable gardens

(38.5%), vegetable markets (35.3%) and low contamination was observed in soil samples collected under the shaded tree (13.3%) (Table 3).

Table 2 Prevalence and frequency of parasite in two different seasons

Parasites detected	**Dry season n= (67), (%)**	**Wet season n= (133), (%)**	**Total n= (200), (%)**
A. lumbricoides	10 (58.8)	22 (55.0)	32 (56.1)
T. trichiura	2 (11.8)	8 (20.0)	10 (17.5)
Hookworm	3 (17.6)	6 (15.0)	9 (15.8)
S. stercoralis	2 (11.8)	4 (10.0)	6 (10.5)
Total	**17 (100.0)**	**40 (100.0)**	**57 (100.0)**

Table 3 Soil contamination rate in different sites

Sites	**Total**	**Positive**	**Percentage**
Banks of rivers	35	16	45.7
Vegetable gardens	26	10	38.5
Vegetable markets	17	6	35.3
Play grounds	20	5	25.0
Roadsides	50	12	24.0
In front of houses	16	3	18.8
Near the taps	21	3	14.3
Under the shaded trees	15	2	13.3
Total	**200**	**57**	**28.5**

5.2 Stool samples of school children

Out of total 188 school children, 91 (48.4%) children were found to be positive for parasitic infection. Of 91 positive samples, 46 (45.5%) male and 45 (51.7%) female were infected with parasites but the difference was not statistically significant ($P>0.05$) (Table 4).

Table 4 Gender wise distribution of parasitic infection

Gender	Total	Positive	Percentage	P-value
Male	101	46	45.5	**P>0.05**
Female	87	45	51.7	
Total	**188**	**91**	**48.4**	

Table 5 Frequency of parasites detected in school children

Types of parasites	Total (n=188)	Percentage
T. trichiura	66	53.7
A. lumbricoides	37	30.0
Hookworm	2	1.6
H. nana	1	0.8
H. diminuta	1	0.8
Total helminthes	**107**	**87.0**
E. histolytica	8	6.5
E. coli	5	4.0
G. lamblia	3	2.4
Total protozoa	**16**	**13.0**

Out of 123 parasites obtained from 188 stool samples (91 positive samples), 87.0% were helminthes and 13.0% were protozoan parasites. Among the helminthes, *T. trichiura* was the most common (53.7%) followed by *A. lumbricoides* (30.0%), hookworm (1.6%), *H. nana* (0.8%) and *H. diminuta* (0.8%). Among protozoa, *E. histolytica* (6.5%) topped the list followed by *E. coli* (4.0%) and *G. lamblia* (2.4%) (Table 5).

Out of 91 positive cases, 68.1% school children were infected with single type of infection either protozoan or helminthic. Of single parasitic infection, 16.2% children were infected with protozoan and 83.9% were infected with helminth parasites. 31.8% students had mixed infection out of which 3.4% had mixed protozoan infection, 82.6% had mixed helminthic infection and 13.8% had both protozoan and helminthic infection (Table 6).

Table 6 Types of intestinal parasitic infection in school children

Types of infections	**Total**	**Percentage**
Single	**62**	**68.1**
Protozoa	10	16.2
Helminthes	52	83.9
Mixed	**29**	**31.8**
Protozoa	1	3.4
Helminthes	24	82.6
Protozoa + Helminthes	4	13.8
Total	**91**	**100.0**

Fig 1 Age wise distribution of parasites in school children

Of 188 study population, 130 were of age group above 10 and 58 were age group below 10. Among age group above 10, 34 (58.6%) were found to be infected with parasite and among age group below or equals to 10, 57 (43.8%) were found to be infected with parasite, however not significant statistically (Fig 1).

Of different ethnic groups, 18 were *Dalits*, 103 were *Tibeto-Burmans* and 67 were *Indo-Aryans*. 16 (88.9%) *Dalits*, 50 (48.5%) *Tibeto-Burmans* and 25 (37.3%) *Indo-Aryans* were found to be infected with parasites. The difference was statistically significant (P<0.05) (Table 7).

Table 7 Prevalence of parasites in different ethnic groups

Ethnic group	Total	Positive	Percentage	P-value
Dalit	18	16	88.9	**P<0.05**
Tibeto-Burman	103	50	48.5	
Indo-Aryan	67	25	37.3	
Total	**188**	**91**	**48.4**	

The higher (53.4%) prevalence of parasitic infection was observed in family size ≤ 5 than in family size > 6 (42.3%) with no such significant difference (p>0.05) (Fig 2).

Fig 2 Prevalence of parasites according to family size

The children without toilet were found to be significantly more infected than those having toilet (P<0.05). Out of 163 children having toilet, 73 (44.8%) were infected whereas out of 25 children not having toilet, 18 (72.0%) were infected with parasitic infection (Table 8).

Table 8 Parasitic prevalence according to the availability of toilet at their houses

Toilet	Total	Positive	Percentage	P-value

Yes	163	73	44.8	**P<0.05**
No	25	18	72.0	
Total	**188**	**91**	**48.4**	

The highest prevalence rate of parasitic infection was found in children having parent occupation agriculture (71.4%), followed by parent occupation other than mentioned (54.2%), business (50.0%), service (35.3%) and lowest (35.0%) in children whose fathers were working abroad. The difference was statistically significant (P<0.05) (Fig 3).

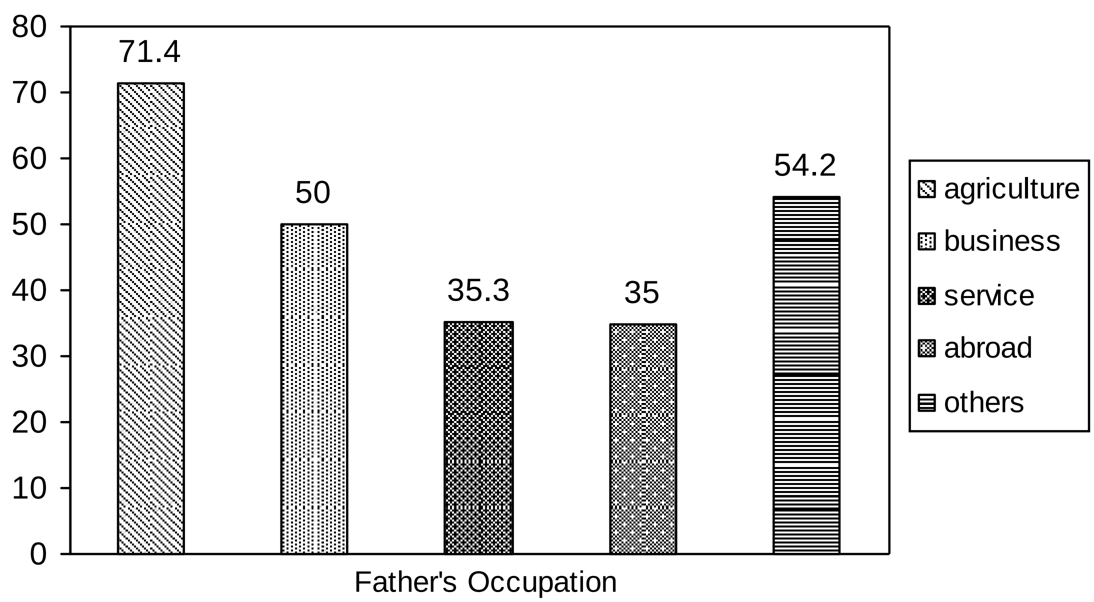

Fig 3 Prevalence of parasites according father's occupation

Table 9 Prevalence of parasites among those taking of anthelminthic drug in the past 6 months

Anthelminthic	Total	Positive	Percentage	P-value
Yes	105	43	40.9	
No	83	48	57.8	

Total	188	91	48.4	P<0.05

In relation to the use of anthelminthic, out of 105 students who had used anthelminthic 43 (40.9%) were found to be infected with parasites where as out of 83 students who had not used anthelminthic 48 (57.8%) were found to be infected with significant difference (P<0.05) (Table 9).

The parasitic infections were also observed according to the schools from where the stool samples were collected. Two schools were selected for the study of stool samples of the children. From the public school 82 samples were collected and from private school 106 samples were collected. 36 (33.9%) school children studying in private school were positive for parasites whereas 55 (67.0%) children studying in public schools were infected with parasites with statistical significance (P<0.05) (Table 10).

Table 10 Parasitic infection among the children according to school type

School children	Total	Positive	Percentage	P-value
Private school	106	36	33.9	**P<0.05**
Public school	82	55	67.0	
Total	**188**	**91**	**48.4**	

5.3 Stool samples of patients

During the research period, from August 2005 to July 2006, the stool samples of patients having the complaints of gastrointestinal disorder visiting the Shi-Gan Health Foundation were collected. Out of 1316 patients, 395 (30.0%) had some kind of parasitic infections (helminthes, protozoa or both). Of 1316 patients, 817 were male and 499 were female. Of 817 male, 225 (27.5%) and among 499 female, 170 (34.0%) were positive for parasitic infection with statistical significance (p<0.05) (Table 11).

Table 11 Prevalence of intestinal parasite in the patients visiting clinic

Gender	Total	Positive	Percentage	P-value
Male	817	225	27.5	**P<0.05**
Female	499	170	34.0	
Total	**1316**	**395**	**30.0**	

The prevalence rate of parasitic infection was found highest in age group 16-30 (32.3%), followed by age group 31-45 (30.8%) and least in age group > 60 (24.0%) ($P>0.05$) (Fig 4).

Age

Fig 4 Age wise distribution of parasitic infections

Out of 395 positive cases, (89.9%) patients were infected by the single type of parasite either protozoa or helminthes. Of single parasitic infection (8.7%) were helminthic infection and (91.3%) were protozoan infection. (10.1%) cases had mixed infection, (17.5%) had protozoan and helminthic infections and (82.5%) cases had mixed protozoan infection (Table 12).

Among helminthes, *A. lumbricoides* was most common (3.3%) followed by hookworm (2.6%), *H. nana* (1.6%) and *T. trichiura* (0.9%). Among protozoan parasite *E. histolytica* was most common

(38.3%), followed by *B. hominis* (13.0%), *G. lamblia* (11.0%), *E. nana* (10.3%), *I. butschlii* (9.6%), *E. coli* (4.0%), *E. hartmani* (2.8%) and others (2.8%). Others include *C. mesnili* (1.9%), *Cyclospora* spp. (0.7%) and *T. hominis* (0.2%). The prevalence of protozoan parasites was higher (91.6%) than helminthes (8.4%) (Table 13).

Table 12 Types of intestinal parasitic infection in patients

Types of infection	Total	Percentage
Single	**355**	**89.9**
Helminthes	31	8.7
Protozoa	324	91.3
Mixed	**40**	**10.1**
Protozoa +Helminthes	7	17.5
Protozoa	33	82.5
Total	**395**	**100.0**

Table 13 Types of intestinal parasites detected in the patients

Parasite	Total	Percentage
Helminthes	**36**	**8.4**
A. lumbricoides	14	3.3
Hookworm	11	2.6
H. nana	7	1.6
T. trichiura	4	0.9

Protozoa	**392**	**91.6**
E. histolytica	164	38.3
B. hominis	56	13.0
G. lamblia	47	11.0
E. nana	43	10.0
I. butschlii	41	9.6
E. coli	17	4.0
E. hartmani	12	2.8
Others	12	2.8

CHAPTER VI

6. DISCUSSION AND CONCLUSION

6.1 Discussion

Present study showed 28.5% soil contamination rate with helminth parasitic eggs and larvae. However, this finding was lower than that reported earlier (Rai *et al*, 2000b; Bol *et al*, 1981). This might be due to the difference on parasite eggs recovery technique. Furthermore, this could be due to improvement in living standards, literacy rate, health awareness, use of toilet, deworming program during National Vitamin A Programme or else.

The most common soil contaminant in this study was found to be *Ascaris* eggs. This finding was in agreement with others (Schulz *et al*, 1992; Yu *et al*, 1993; Muttalib, 1983; Toan, 1997). *Ascaris* eggs were also the most common contaminants in Kathmandu Valley. The finding was in agreement with previous findings of Nepal (Rai *et al*, 2000b; Bol *et al*, 1981; Chettri, 1997). This indicated that *Ascaris* is still the predominant helminth parasite. Further, the *Ascaris* eggs are able to survive in adverse environmental conditions due to their protective shell which helps the parasite to persist (WHO, 1987) and embryonated eggs can survive for upto fifteen years in environment (Rai and Rai, 1999). It might also be due to the dispersion of many *Ascaris* eggs through stool of infected individual in the soil as reported earlier (Rai and Rai, 1999). A single female *Ascaris* can liberate about 240,000 eggs daily. This had been associated with indiscriminate open defecation, poor and non-existence sanitation, poverty, unmanaged and unhygienic street vegetable markets etc. Besides, irrigation of the cultivable field with sewage and sewage mixed water had added eggs of parasite in soil. This might be the cause behind contamination of soil with the helminth parasite eggs.

This was in agreement with the higher prevalence of *Ascaris* infection among Nepalese range from 8.5% to over 94.0% (Shrestha, 1983). Soil contamination with *Ascaris* eggs can be taken as an indicator of environmental hygiene (Schulz *et al*, 1992). *Ascaris* and *Trichuris* eggs were found even in the archaeological excavation dating from 2000 BC - 1900 AD. It indicated that these helminthes were prevalent since historic periods (Han *et al*, 2003). However, the contamination rate has been decreasing in different parts of the world. In Korea the prevalence of *Ascaris* eggs had been decreased from 80.0%

in 1950s to 0.3% and 0.06% by 1997 (Chai *et al*, 2001b). In Japan, STHs declined markedly (Yokogawa, 1983) and had come down to less than 1.0%. In Taiwan, the infection rate of *Ascaris*, hookworm and *Trichuris* had been decreased to less than 1.0% (Chen *et al*, 2001).

The low prevalence of *Trichuris* eggs observed in the study was in agreement with the earlier reports from Nepal (Rai *et al*, 2000b; Shrestha, 1997) and elsewhere (Muttalib *et al*, 1983; Toan, 1993; Yu *et al*, 1993). This could be due to the easy destruction of *Trichuris* eggs in dry condition. The detection of larvae of hookworm and *Strongyloides* in this study was not in agreement with previous study (Rai *et al*, 2000b). This might be due to the difference in the technique of detection of parasitic eggs. This was also in contrast to the improvement of the sanitation and living standards of the population mentioned above. One very possible reason could be due to the high influx of people in the valley due to conflict in the country since one decade back. However, there was no explanation for such difference.

Though sample size was small, Rai *et al* (2000b) reported 35.3% prevalence of helminth parasitic eggs outside the valley. In another study (Rai *et al*, 2001a), half of the soil samples collected from household yards showed helminth eggs in a so called unknown disease out break hit rural hilly area in Western Nepal. This high prevalence of contamination appeared to be associated with extremely poor sanitary condition and low socio-economic status of local people.

In this study, the prevalence rate of parasite was found to be higher in wet season (30.0%) than that in dry season (25.3%) which was in agreement with earlier finding (Rai *et al*, 2000b). However, the difference was not significant. As reported earlier, this could be due to the relative high humidity in the valley even in dry season (Rai *et al*, 2000b). The parasitic eggs of animal origin were not detected in this study. This could be due to the difference in technique used for the detection of parasites. Another reason behind it might be the fact that the pet animal keeping and animal husbandry are not common in the valley. On the other hand, *Toxocara* eggs could not be found in this study despite of large number of stray dogs. In contrast to this finding earlier investigators have reported 22.8% prevalence of *Toxocara* eggs. However, no explanation was available for such discrepancy.

Soil samples were selected from different sites of valley. The highest contamination was seen in soil samples collected from banks of river. This was in agreement with improper disposal of sewages in river and the bad conditions of rivers in valley. Further, rivers are good sites of defecation. Next to the river bank, the vegetable gardens were found to be more contaminated. The vegetable gardens are irrigated with sewage and sewage mixed water. Consequently, eggs are dispersed in soil of gardens and onto the vegetables. Moreover, once the vegetables are collected from garden, these are washed in highly contaminated river water, from where the vegetables are again contaminated. The play grounds were other sites which were relatively more contaminated. This might be due to the dispersal of contaminated dust from defecation sites to the whole community and play ground by children feet, animals etc.

In stool samples, eight species of intestinal parasites were detected, five helminthes and three protozoa. Among them, *T. trichiura* was found to be the most common parasite. *T. trichiura* topping the list of parasites have also been reported from Nepal (Ishiyama *et al*, 2001; Uga *et al*, 2004; Rai *et al*, 2005; Sharma *et al*, 2004) and elsewhere (Rajeswari *et al*, 1994; Lee *et al*, 2000; Kabatereine *et al*, 1997; Kan 1983; Uga *et al*, 2005). It could be due to ineffective deworming with single doze of anthelminthic drug particularly in case of heavy infections. In Nepal the prevalence of *T. trichiura* ranges from 5.0% (Houston and Schwarz, 1990) to as high to 94.5% in a backward community in Bhaktapur District (Sahu *et al*, 1983). The high prevalence of *Trichuris* is because of its special mode of attachment to cecal mucosa, longer lifespan of parasites as well as its refractory reaction to most anthelminthic and remains in intestine causing chronic infection. The higher prevalence of *Trichuris* in this study and other studies showed that *Trichuris* is the most common intestinal helminth. Therefore, effective deworming of the parasites should be done.

In this study, *Ascaris* prevalence rate in children was greatly reduced than that of *Trichuris.* This was in disagreement with the prevalence of *Ascaris* in soil. However, this might be due to the twice-yearly single doze deworming program. Furthermore, *Ascaris* eggs can survive in environment for longer period due to the presence of chitin protein layer in their shell (Rai and Rai, 1999).

In this study, among the school children hookworm was detected in very low prevalence (1.6%). This was lower than the year-to-year incidence ranging from 3.8% to 10.7% as reported earlier (Rai *et al*, 1997). However, the higher rate of finding of hookworm reported (Rai *et al*, 1997) could be due to difference in the study population in which they have included hospital-attending people having some kinds of abdominal ailments. On the other hand, in part, this also could be due to the use of shoes/slippers by school children even in rural areas, which prevent skin penetration by larvae. In one study from Nepal hookworm topping the list has also been reported (Sherchand *et al*, 1997).

In this study, single case of *H. nana* (0.8%) was detected from the school children. *H. nana* is most common tapeworm infecting man in Nepal. It was reported to be 3.3% in southern Nepal (Sherchand *et* *al*, 1997) and 4.9% in Kathmandu Valley (Sharma *et al*, 2004). Again, *H. nana* was also reported as commonest tapeworm in the Kathmandu Valley (Sherchand *et al*, 1996). This might be due to the low socio-economic condition of people. However, the single finding may be accidental in this study.

Very low prevalence of *H. diminuta* has been reported earlier from Nepal (Uga *et al*, 2004) and Vietnam (Uga *et al*, 2005). Similar finding was observed in this study. *H. diminuta* is the cestode of rodent and completes its life cycle between rodents and fleas. Infection takes place by ingestion of fleas containing infective larva. Therefore, is associated with the poor sanitation and low socio-economic status in the community.

Among protozoa, *E. histolytica* was found to be the commonest parasite in this study. This was in agreement with the report from Nepal (Nepal and Palfy, 1980) and elsewhere (Ali *et al*, 2005; Hassan, 1994). However, this finding was inconsistent with some of the reports from Nepal (Rai *et al*, 2001a; Rai *et al*, 2005; Sharma *et al*, 2004; Yong *et al*, 2000) and other countries in Asia like Vietnam (Uga *et al*, 2005). Some have reported *E. coli* as the commonest protozoan parasite. This might be due to its commensal nature. As reviewed by Rai (2005), the incidences of *E. histolytica* infection in Nepal range from 3.0% to 28.8%. Nepal and Palfy (1980) reported the highest incidence rate of *E. histolytica* (28.8%) in Nepal. The decrease in the prevalence rate might be due to the difference in the study population as well as the site of study.

Most of the studies from Nepal have shown *G. lamblia* as the commonest intestinal parasite (Khetan, 1980; Rai *et al*, 1995; Rai *et al*, 2002b; Sherchand *et al*, 1997) and similar findings have also been reported by other investigators (Okyay *et al*, 2004; Saha *et al*, 1995). In contrast, the prevalence of *G. lamblia* was the lowest in this study. This was in agreement with the previous findings of (Ishiyama *et al*, 2003) from Nepal and (Virk *et al*, 1995) from India. In part, this might be due to improvement of water quality and awareness among the people during recent years. Further, the secretary IgA and IgM might have played some role in these findings as these two antibodies have been reported to play a role in the clearance of intestinal parasites (Oda and Sherchand, 2002).

More than half (51.7%) of the female schoolchildren were infected by the intestinal parasites. Similar findings has also been reported from Nepal (Sherchand *et al*, 1997; Yong *et al*, 2000; Uga *et al*, 2004) and elsewhere (Kightlinger *et al*, 1995); Rajeswari *et al*, 1994; Jamaiah and Rohela, 2005). Marnell *et al*, 1992 has also reported the high prevalence of infection (70.0%) among female. But these appeared to be in contrast to the earlier reports from Nepal (Rai and Gurung, 1986; Ishiyama *et al*, 2001).This indicated that both boys and girls are equally exposed to infections in this area.

More than two-third (68.1%) of the children were infected with single parasite and the majority of which (83.9%) were infected with the helminth parasite. Helminthes dominating the protozoan parasite were in agreement with the earlier reports from Nepal (Rai *et al*, 1995, 2000a, 2001a; Estevez *et al*, 1983; Rai and Gurung 1986; Sherchand *et al*, 1996; Nepal and Palfy 1980; Uga *et al* 2004) and else where in the world (Hasegawa *et al*, 1992, Kasuya *et al*, 1989). It can be due to the consumption of the vegetables washed in contaminated river water and raw vegetables being sold in the market. Besides, unhygienic and unmanaged street vegetable market may be the cause behind it. This was also in the agreement with the considerably high soil contamination rate in Kathmandu Valley with helminth parasite eggs (Rai *et al*, 2000b). Inspite of the regular twice-yearly deworming under the National vitamin A Program, helminth parasitic infection was higher (87.0%) among the children. This result indicated that deworming alone is not effective to eliminate the helminth parasites and effort should be placed in the improvement of sanitary condition.

More than half of the children of age group >10 were infected with intestinal parasites. It was in agreement with the findings from Nepal (Rai *et al*, 2005; Rai *et al*, 1994 ; Sharma *et al*, 2004) but inconsistent with other report (Rai *et al*, 2002b). This could be due to the increment of their childish activity with their age and move around frequently increasing the possibility of acquiring infections from sleazy environment.

In this study, the significantly higher incidence of parasite was found in *Dalits* followed by *Tibeto-Burmans* and *Indo-Aryans*. Similar type of the result had also been reported (Rai *et al*, 2002b; Ishiyama *et al*, 2003). This result appears to be associated with poor hygienic, cultural and behavioral practice, low socioeconomic status, illiteracy and lack of health awareness in *Dalits* compared to their counter social groups. This could also be due to the small sampling size as has been explained by other investigations (Rai *et al*, 2002b; NPC, 2002). Interestingly, in one study (Sharma *et al*, 2004), low prevalence of parasitic infection in *Dalits* compared with *Tibeto-Burmans* and *Indo-Aryans* has also been reported.

In general, it is presumed that children of larger and socio-economically under privileged family are infected with various infective pathogens including intestinal parasites. However, more than half of the children living in small (≤5) family size compared with those children coming from larger family size.

Similarly finding has also been reported (Rai *et al*, 2005). This finding however was inconsistent with the finding of others (Karrar and Rahim, 1995).

However, parasitic infection rate can also be correlated well with unavailability of toilet at their houses and the difference was statistically significant. This finding was consistent with the previous findings from Nepal (Rai *et al*, 2002b; Rai *et al* 2005) and elsewhere (Sorensen *et al*, 1994; Toma *et al*, 1999). Lack of or inadequate toilet affects the environmental sanitation on prevalence of STH. Due to lack of proper toilet, indiscriminate defecation around the houses, fields, road, playgrounds increase the chance of parasitic infection.

The significantly higher infection rate (71.4%) has been observed in children belonging to farming family. Farmers and their family members are more at risk of infection with the soil contaminated with parasites as they are more exposed to soil and environment. They usually eat raw and unwashed vegetables. Further while working in the field, they are likely to be infected by the infective hookworm larvae. Elsewhere, similar trends of infection have been reported (Habbari *et al*, 1999; Ishiyama *et al*, 2003; Marnell *et al*, 1992) but without significance. Rai *et al* (2005) reported lowest rate of infection in children with father's occupation as business. But in this study it was lowest in children whose fathers were working abroad. However, the education levels of parents influence the prevalence of parasitic infection in children as reported by other researchers (de Silva *et al*, 1996; Ishiyama *et al*, 2003). High parental literacy directly results in better employment potential, which leads to higher family income and therefore better life standard and in turn lowers parasitic infection.

More than half (57.8%) of the children who had not taken anthelminthic drug in past 6 months had significantly higher parasitic infection than those who doing so. Similar findings were also reported by (Bundy *et al*, 1990; Albonico *et al*, 1999; Rai *et al*, 2005). This clearly indicates the importance of deworming. WHO (2002) had reported that the prevalence of helminth infection was reduced remarkably and there was dramatic reduction in infection intensity after deworming programmes. However, insignificant difference in the prevalence has also been reported earlier (Rai *et al*, 2002b).

The prevalence of parasites was higher in children studying in public school than those studying in private school. The difference was significant indicating that private school children are in better health condition. This was in agreement with earlier report from Nepal (Chettri, 1997). Uga *et al*, (2004) has also reported high prevalence in public school children compared with general people both in and outside Kathmandu Valley. Low prevalence in private school children might be due to the better socio-economic status and education of their parents.

Those children who were infected were treated with antiparasitic drugs (albendazole and metronidazole). As to avoid infection in future all the subjects were explained about the source of infections, mode of infections, preventive measures and hygienic habits.

In the patients sample, fourteen species of parasites were detected, four helminth parasites and ten protozoan parasites. The protozoan prevalence was higher in this study unlike reported by others (Uga, 2004; Rai *et al*, 2004). This might be due to the poor sanitation and contamination of water in the city. Due to the unplanned urbanization, the sewerage and water pipe lines system are unmanaged leading to over dispersion of parasites in the environment. *E. histolytica* topped the list in contrast to the different reports from Nepal (Yong *et al*, 2000; Rai *et al*, 2001a; Rai *et al*, 1994; 1995; 1997; Ishiyama *et al*, 2001).

In this study, the prevalence rate of *B. hominis* was recorded second to *E. histolytica*. *B. hominis* has been reported earlier in people with abdominal complaints (Sherchand *et al*, 1996) and in general population (Gianotti, 1990; Rai *et al*, 2001a). The reported incidence ranged from less than 1.0% to 24.9% (Gianotti, 1990; Rai *et al*, 2001a; Ishiyama *et al*, 2001). However, *B. hominis* was not reported by other workers (Uga *et al*, 2004) in similar types of study. It may be due to the autolysis of *B. hominis* cysts during the time lapsed between sample collection and examination (Uga *et al*, 2004).

G. lamblia was not the commonest parasite detected in this study as reported by (Rai *et al*, 2001a; Yong *et al*, 2000). Most of the investigators have reported *G. lamblia* as the commonest protozoan parasite (Rai *et al*, 1995; Khetan, 1980; Rai *et al*, 2002b; Sherchand *et al*, 1997; Sharma *et al*, 2004; Rai *et al*, 1994). Besides, these protozoan parasites *E. nana* (10.3%), *I. butschlii* (9.6%), *E. coli* (4.0%), *E. hartmani* (2.8%), *C. mesnili* (1.9%), *Cyclospora* spp. (0.7%) and *T. hominis* (0.2%) were also detected. The majority of parasites detected being protozoa. These indicate the fecal contamination of drinking water and poor sewerage system in valley (Adhikari *et al* 1986; Ono *et al* 2001).

The marginally high parasitic prevalence was seen in female than in male as reported earlier in Nepal (Sherchand *et al*, 1997; Uga *et al*, 2004) and elsewhere (Jamaiah and Rohela, 2005; Kightlinger *et al*, 1995; Marnell *et al*, 1992) with significant difference. It indicated the wide dispersion of parasites in the environment. The high prevalence of parasites in female can be correlated with the prevalence of parasite in children. As female are directly associated with health, hygiene and nutritional care of their children, they are supposed to be infected more likely than their male counterparts. Further, this could also be due to the sample size.

All the helminthes detected in the patients' samples were STH; however, the prevalence rate was lower than protozoa. In contrast similar type of study (Uga *et al*, 2004) showed very high prevalence of helminthes especially STH than protozoa. This may be due to the difference in technique used for detection of parasites. The prevalence rate of helminth parasites in these samples was also lower than that in school children. The difference in result might be due to the difference in study population. In clinic, most people come along with the abdominal discomfort including diarrhea. As reported earlier parasitic diarrhea is mainly caused by protozoan parasites (Uga *et al*, 2004). This might be the cause behind the high prevalence of protozoal parasites in patients.

The adult of age group 16-30 years had higher positive rate, which was consistent with the result of (Jamaiah and Rohela, 2005). This might be due to the fact that this is the age group of active and working people who are most likely to be exposed to infection. This was in contrast with most of the reports from Nepal, which have shown higher positive rate in children (Rai *et al*, 1986; Rai *et al*, 2002b; Rai *et al*, 1980). The prevalence rate of infection was lowest in age group >60.

The prevalence of parasites in patients visiting clinic was lower (30.0%) than that reported (49.0%) earlier (Uga *et al*, 2004). This was also relatively lower than the year-to-year range from 29.1% to 44.2% (Rai *et al*, 1995). This discrepancy may be due to difference in parasite detection technique since they followed concentration technique unlike direct method used in this study for clinical samples. However, Rai *et al* (2004) reported similar prevalence (30.6%) indicating that method used can alter the result.

Overall prevalence of parasites in soil seemed to be decreasing in this study than previous studies. However, in the stool sample from rural region of valley showed the higher prevalence of helminth parasites (87.0%) however the prevalence rate of helminth parasites in patients was lower (8.4%). Despite of increase in the health awareness and knowledge of sanitation in people, there is still the presence of different kinds of parasites. This reveals that the health status of Nepalese people is still poor. It shows the poor hygiene and sanitary conditions, wide dispersion of parasites, influx of parasitic infected people from rural area, unplanned urbanization, direct disposal of sewage into stream, use of sewage water in irrigating vegetable fields, improper water supply etc in the valley. As health of citizens' play the crucial role in development of socio-economic status of the country, these problems must be solved as soon as possible.

The result in this study, however, does not show the whole picture of STH prevalence in the valley. Detection of parasite in environmental samples like soil, dust, water, vegetables etc is quite difficult task. The parasite could not be detected easily in these samples as in stool due to the dispersion of parasite in wide range. Moreover, large number of samples should be examined.

Many factors are involved in the failure of the parasite control program such as human behavior (eating habits, occupation), their beliefs (religion and culture), natural phenomena (climate, rain, flooding) and the most serious problem was partial co-operation of the people in mass treatment. However, intestinal parasites have been decreased sharply in the developed countries like Japan (Yokogawa *et al*, 1983), Korea (Chai *et al*, 2001b) and Taiwan (Chen *et al*, 1993).

Health and environment are such an important part of human existence that no one can ignore. The maintenance of health and hygiene and sound environment are the needs of human beings. For this, health education should be made accessible to the community either through the education program, media, information or else. Moreover, the parasitic infections can also be controlled when the socio-economic status of community is improved like better living status, proper sanitation, accessibility towards deworming, improvement in nutritional status etc. Further, for this, it requires not only the financial change but also the conceptual change in both individual and community.

Considerable efforts have been put for the expansion of health system to provide basic health services to the citizens. Nowadays the private sectors are equally interested to promote the health of people. Many medical colleges, health care centers established by their own investments (Rai *et al*, 2001b) are the good examples of it. The public should be provided with the appropriate healthy environment like good system for water supply, safe disposal of excreta as well as well managed sewerage system.

6.2 Conclusion

Hence it is concluded that STH are still prevalent in the community causing the public health problems. *A. lumbricoides* eggs in soil account for the indicator in environmental hygiene. *A. lumbricoides* eggs were found to be most prevalent parasitic eggs in soil which is associated with the poor sanitation, lack of health awareness and education etc in the community. *T. trichiura* was found to be the commonest helminth parasite in the children indicating the need of more effective and accessible regular deworming programmes. The patients visiting the clinic were found to be highly infected with protozoan parasites rather than helminth parasites suggesting the requirement of well managed and safe water supply. The programmes focusing in general education as well as health/sanitary education, environmental health, community interventions directed to vulnerable groups and poverty alleviation should be conducted.

CHAPTER VII

7. SUMMARY AND RECOMMENDATION

7.1 Summary

- A total of 200 soil samples, 188 school children stool and 1316 stool samples of patients were included in the study. Of all samples, 28.5% soil samples were contaminated with parasite eggs whereas 48.4% school children and 30.0% patients were found to be infected.
- The eggs of *A. lumbricoides* were found most frequently (56.1%) in soil samples of the valley followed by *T. trichiura* (17.5%), hookworm (15.8%) and *S. stercoralis* (10.5%). Soil contamination rate in valley during wet season was 30.0% and dry season was 25.3% ($P>0.05$).
- In school children, *T. trichiura* (53.7%) was the commonest helminth parasite followed by *A. lumbricoides*, hookworm, *H. nana* and *H. diminuta*.
- Parasitic prevalence rate in age group above 10 was higher (58.6%) than that below 10 (43.8%). According to the ethnicity, parasitic infestation was highest in *Dalits* (88.9%) followed by *Tibeto-Burmans* (48.5%) and *Indo-Aryans* (37.3%) ($P<0.05$).
- Higher prevalence of parasite was seen in family size below 5 (53.4%) than family size above 6. The study showed the higher prevalence rate in female (51.7%) children than male children (45.5%) ($P>0.05$).
- The children without toilet in their houses had higher (72.0%) infection rate than those who had (44.8%). The prevalence rate was found highest (71.4%) in children from farming family and lowest (35.0%) in those whose fathers were working abroad ($P<0.05$).
- The children who had used antihelminthic drug within past 6 months had significantly lower prevalence rate (40.9%) than those who had not (57.8%). The parasitic infestation rate was significantly higher (67.0%) in children studying in public school than those studying in private school (33.9%) ($P<0.05$).

- 30.0% of the patients visiting the clinic were found to be positive for parasitic infestation. In this case protozoan parasites dominated (91.6%) the helminth parasites (8.4%). Among the protozoa, *E. histolytica* (38.3%) was commonest parasite and among helminthes *A. lumbricoides* topped the list (3.3%) followed by hookworm, *H. nana* and *T. trichiura*.

7.2 Recommendation

1. The prevalence rate of STH has been found lower than previous studies in Kathmandu Valley. However, this may not represent the situation of different part of country so this type of study should be undertaken throughout the country to obtain the accurate data. More environmental samples should be studied to access the real sanitary status of environment.

2. High prevalence of STH has been observed in school children in the study conducted in rural area of the valley. So this type of study should be conducted throughout the country to obtain the real picture helminth parasites infection.

3. Periodic as well as mass treatment in both urban and rural region of the nation must be continued to reduce the dispersion of the parasite in the community. Among the STH, *T. trichiura* was found to be most prevalent parasite in children. So single dose is insufficient and proper course of drugs should be administered.

4. In the case of patients, the prevalence rate of STH was lower than that of protozoa. This indicates the contamination in water supply in the city. So concerned sector should think about the proper management of water supply.

5. STH in soil indicates the sanitary and public health status. So use of toilet, maintaining hygienic conditions, no walking bare foots, hand washings before and after meal, use of treated water are recommended.

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