CHAPTER - 1

INTRODUCTION

1.1 Background

Nepal, located in the northeastern border of India and southwestern border of China is a small rugged, land-locked country with developing economy, nestled beneath the Himalayan mountain range. Nepal varies topographic, social and cultural characteristics. Poverty ignorance and diseases characterize life in Nepal like in most of the Third world countries. The Health status is also dominated and badly affected by parasitic diseases.

Intestinal parasitic diseases are ranked among twenty most fatal infections in tropical countries of Asia, Africa and Latin America in 1977-1978 (Davis 1980). Fifty different species of intestinal parasites can infect human being. The five important groups of intestinal parasites are roundworm, hookworm, tapeworm, *Amoeba* and *Giardia*. Roundworm infects $1x10^8$ people and killed 20000 people per year, Hookworm infect 9x108 people killing 60000 people per year $4x10^8$ people get infected by *Amoeba* killing 30000 per year and $9x10^7$ people get infected by tapeworm and kill 50000 per year (WHO, 1981).

Fan Ping Ching and Wen-cheng in 1997 reported loss of billions of dollars due to intestinal parasites in Taiwan, Cheju Island of Korea and Sama sir Island of Indonesia (Thapa, 2000). The importance of intestinal parasites thus can be judged by great surveillance rate among the populations of world and amount of money spent for curative and preventive measures against these parasites.

Intestinal parasites caused 5119 mortality (death) of people due to symptomatic diarrhea and cholera in Nepal during 12 months (2001/2002) of period (National Population Census, 2001).

Children are future of country. The children of today are pillar of country for the future. So every parent must try their best to improve hygiene and education of their children.

Health is our wealth. With out good health no one can do well in his life. But only few parents think deeply about their children. Those parents who don't care their children carefully, their children are mostly infected with diseases mainly with parasitic diseases. Mainly parents are careless due to lack of knowledge. If they are uneducated and poor, They may have no idea about the diseases and have no plenty of money to feed balanced diet to their children. They only think how to fill up their bowl but not which food is best for them.

Intestinal parasitic infection rate incase of school children was found to be decreased in the past few years according to data from Family Planning Association, School Health Program, Nepal (Maharjan K., 2004). But the falling rate of infection is not satisfactory, since the program conductors are giving interest only stool examination and curative measures. The program could be effective if the children are given awareness about the preventive measures of such parasites.

1.2 Introduction to intestinal parasites

The intestinal parasites are these, which inhabit the intestinal region of the foot and get nourishment from there. The intestinal parasites are generally the protozoan and helminthes.

1.2.1 Intestinal protozoan parasites

Protozoan parasites consist of a single cell like unit, which is morphologically, and functionally complete they cause serious health problem for human. Some common intestinal protozoan parasites are *Entamoeba histolytica, Giardia lamblia, Entamoeba coli, Isospora, Trichomomas hominis, Balantidium, Cyclospora* and *Cryptosporidium* etc.

1.2.1.1 *Entamoeba histolytica*

Lamb in 1859 first discovered the parasite. Losch (1875) proved its pathogenic nature. They are world wide in distribution but more common in tropics and sub tropics.

Habitat: Trophozoite of *Entamoeba histolytica* live in the mucous and sub mucous layers of the large intestine of human.

Morphology: *Entamoeba histolytica* has 3 stages in its life cycle.

a) Trophozoite: It is regular and not fix in shape and size ranges 18-40 μm in diameter. It is feeding stage.

b) Pre-cystic stage: It is smaller in size varying from 10-20 μm in diameter. It is round or slightly ovoid in shape. It is a transitory stage.

c) Cystic stage: It is round and surrounded by highly retractile membrane. Cystic wall size varies from 5 to 20 μm. Initially the cyst is uninucleate but the mature cyst is quadrinucleate, which is infective stage.

Mode of Infection: - Faeco-oral route transmission of *Entamoeba histolytica* from human to human is through ingestion of food or drinks contaminated with quadrinucleated cysts.

Amoebiasis: - Infection of *Entamoeba histolytica* commonly results in amoebiasis. Amoebiasis is two types:

a) Invasive Amoebiasis - When clinical symptoms result, the disease is referred to as invasive amoebiasis. Possibly only about 10% of infection result in invasive amoebiasis (Smyth 1996).

b) Non-invasive Amoebiasis - A high percentage of individuals infection with *Entamoeba* show no symptoms of disease. This condition is referred as non-invasive amoebiasis and sometimes also called luminal amoebiasis.

Amoebiasis is second leading cause of death from parasitic disease worldwide (Stanly 2003). In developing world, amoebiasis causes some 450 million infections per annum, about 50 million incidents and about 100000 deaths (Smyth 1996). *Entamoeba histolytica* is potent pathogens that secretes proteolytic enzymes that dissolve host tissues and host cells and engulfs RBCs. The presence of low Haemoglobin both in males and females infected with *Entamoeba histolytica* proves that this is the causative agent of low Hb concentration in Nepalese people (Ghimire *et al.,*

2005). *Entamoeba histolytica* trophozoite invades the intestinal mucosa causing amoebic colitis. In some cases, it breaches the mucous barrier and travels through the portal circulation to the liver where they cause abscesses (Stanley, 2003). Intestinal amoebiasis is characterized by abdominal pain, mucous in stool, weakness, dehydration along with malaise, loss of appetite etc.

1.2.1.2 *Giardia lamblia*

History- Leeuwenhock first discovered *Giardia lamblia* in 1681 while examining own stool.

Geographical Distribution- It is worldwide distribution.

Habitat - It is confined in its distribution to the small intestine particularly the duodenum and upper part of jejunum occasionally invading the bile ducts.

Morphology- It exists in two forms; trophozoite and cyst.

Trophozoite- It is a `tear drop' shaped with convex dorsal surface and concave ventral one (Smyth 1996). The ventral surface processes two depressions called adhesive discs, which make contact with the intestinal cells of the host. Its size is 14 µm long by 7 µm broad. It is feeding phase.

Cyst - The fully formed cyst is oval in shape with thick wall and measures 12 µm broad. It is infective phase.

Mode of infection - Cysts are passed in the faeces. Transmission is through faecal-oral route i.e. *Giardia* cysts passed in the faeces of a person result into a new infection when swallowed by another person.

Giardiasis: - The resulting infection of *Giardia lamblia* is usually referred to as giardiasis. It is recognized as one of the most common agents for diarrhea worldwide. Giardiasis is also known as flagellate diarrhea. *Giardia lamblia* has worldwide distribution with an incidence of 1-30%. In the USA it is now considered to be the most common intestinal parasite of man and the leading cause

of diarrhea due to protozoan infection in human (Smyth 1996). Children seem especially susceptible and mass infections occasionally break out in kindergartens or day care centers (Smyth 1996). It is also the most frequently reported intestinal parasite in Britain (Knight & Wright, 1978). Giardiasis is characterized by disturbance in intestinal functions, leading to malabsorption of fats, persistent looseness of bowels and mild steatorrhoea. Toxin produced by the parasites can cause allergic manifestation, fever, anemia as well as enteritities and some time chronic cholecytopathy.

The intermittence of the *Giardia* cycle and medications may cause temporary disappearance of cysts from stools, thus giving false and negative results (Boghdadi *et. al*, 1996).

1.2.2 Intestinal helminthes parasites

The World Health Organization (WHO) estimated that more then one billion people are chronically infected with intestinal helminthes (WHO, 1998).

The helminthes parasites are multicellular, bilaterally symmetrical, and triploblastic animals. They belong to the phyla Platyhelminthes and Nemathelminthes. They are endoparasites of intestine and blood of human body and cause different diseases. Most helminthes parasites come under the heading of intestinal infection. Many parasitic helminthes require one or more intermediate hosts.

The relative importance of the major groups of helminthes may be roughly judged by Stool's (1947) estimation that 'there exist in the world today among some 2200 million people, 72 million nematode infections' (Chandler, 1961). These numbers have decreased in the successive decades; as a matter of fact they are probably too low now.

1.2.2.1 *Hymenolepis nana*

History: - This helminthes species was discovered by Bilharz in 1851 in the small intestine of a native boy in Cairo Grassi and Rovelli (1887, 1892) first worked on the life cycle and demonstrated that no intermediate host was required (Craig & Faust, 1943).

Geographical Distribution: - The worm is practically cosmopolitan in its distribution but is more common in warmer than in colder climate.

Habitat: - The abode of the adult worm is the small intestine of human.

Morphology: - *Hymenolepis nana* is also known as dwarf tapeworm, as the entire worm is small, measuring up to 25 mm in length by a maximum of 1 mm diameter. Scolex is rhomboidal with four hemispherical suckers and a short rostellum armed with 20-30 spines in one ring. Proglottids are 200 in numbers. Eggs are oval or spherical in shape with two distinct membranes. The outer membrane is thin and colorless and inner embryophore encloses an oncosphere with three pains of lancet-shaped hook lets.

Mode of Infection: - The first infection occurs through ingestion of food contaminated with eggs of *Hymenolepis nana.*

Hymenolepiasis: - The clinical symptoms are restless, irritability, abdominal pain and diarrhea.

1.2.2.2 *Ascaris lumbricoides*

History: - This worm was observed and reported as a parasite of man by many ancient people (Craig &Faust, 1943). It has undoubtedly been one of men most faithful and constant companion form time immemorial (Chandler, 1961).

Geographical Distribution: - *Ascaris lumbricoides* is the most cosmopolitan and most common of all helminthes. It flourishes is warm moist climates or in moist

temperate regions where personal hygiene and environmental conditions combine to favor embryo nation of the eggs in polluted soil.

Habitat: - The adult worm lives in the small intestine of the human beings.

Morphology: - It is elongated, cylindrical nematode, tapering bluntly at the anterior end and somewhat more attenuated at the posterior end. Lateral lines can easily be seen. The head is provided with conspicuous lips. Sexes are separate. The size of male is 15-25 cm in length with a maximum diameter of 3-4 mm and female is 25-40 cm in length with diameter of 5 mm.

Mode of Infection: - Faecal-oral route infection occurs by the ingestion of food or water contaminated with embryonated eggs of the parasite.

Ascariasis: - *Ascaris lumbricoides* is an important parasite of human, it often occurs in high levels in population living under conditions of poor hygiene (Smyth, 1996). It has been estimated that there are about 1000 million cases of ascariasis worldwide; with average prevalence in the range of 32-60 percent (Crompton et al, 1989). In some surveys of children between the ages of 6 & 12 years, the infection rate was as high as 90 %. The infection results in malnutrition and relation of growth in children but other symptoms associated with both the larval (Tissue) and adult (Intestinal) stages include pneumonitis, asthma, diarrhea, nausea, abdominal pain and anorexia.

1.2.2.3 *Trichuris trichiura*

History: - Linnaeus first described this worm in 1771. Its life cycle was first studied by Grassi (1887) and later by Full born (1923) and Hagegawa (1924). It is also known as whipworm.

Geographical Distribution: - It is cosmopolitan in distribution but is more common in the warm moist regions of world. The whipworm infection is more or less co-extensive with ascariasis.

Habitat: - The adult worm lives in the large intestine particularly the caecum and also found in the vermiform appendix.

Morphology: - They are so called whipworm, a term derived from the whip like form of the body. The anterior three- fifth of body is very thin and hair like and the posterior two-fifth are thick and stout. Male measures 3-4 cm in length by 25 µm in breath, bassel shaped with mucous plug at each pole.

Mode of Infection: - Human is infected by swallowing embryonated eggs with food or water.

Trichiuriasis: - This species is a much more common human parasite than is generally appreciated and it is reported to infect up to 800 millions people throughout the tropical and temperate areas (Smyth, 1996). There is now evidence that children are especially prone to intestinal disorder like loss of appetite, abdominal pain, nausea, vomiting emaciation and dysentery with blood tinged mucous, acute appendicitis and prolepses of rectum. *Trichuris* dysentery, rectal prolapx, anemia, poor growth and clubbing of the fingers constitute an important public health problem (Stephenson et al., 2000)

1.2.2.4 *Ancylostoma duodenale*

History: - The parasite was discovered in 1838 by an Italian physician Angelo Dubini. The pathogenesis and mode of entrance of the larvae into human was worked out by looss in 1898.

Geographical Distribution: - It is widely distributed in all tropical and sub tropical countries extending from parallel 36^0 North to parallel 30^0 South.

Habitat: - The adult worm lives in the small intestine of human, particularly in the jejunum, less often in the duodenum and rarely in the ileum.

Morphology: - It is commonly known as hookworm. The adult worms are somewhat cylindrical in shape, are slightly constricted anteriorly and have a

cervical curvature. The large conspicuous buccal capsule is lined with a hard substance provided with six teeth, four hooks on ventral side and two knobs like on dorsal side. A male measure 8-11 mm x 0.4 mm while female is 10-12 mm x 0.6 mm (Craig and Faust, 1943). Male bears copulatory bursa at posterior end.

Mode of Infection: - Infection occurred by the entry of filariform larva, the infective stage through the penetration of skin. *Ancylostoma duodenale* can infect man successfully by oral, transmammery and (probably) transplacental routes (Smyth, 1996).

Ancylostomiasis: - Hookworm must be classified as one of the most destructive of human helminthes parasites with estimates of some 900 million cases world wide (Crompton et al, 1969). Hookworms were essentially bloodsuckers and can cause severe blood loss (i.e. hookworm anemia). They insidiously undermine the health of their hosts causing stunting of growth and general laziness accompanied by acute mental distress (Smyth, 1996).

1.2.2.5 *Strongyloides stercoralis*

History: - Normand (1876) first found *Strongyloides stercoralis* in the faces of French colonial troops.

Geographical Distribution: - It is world wide in distributed. It is adapted to warm climate but it has reported sporadically in temperate regions (Craig & Faust, 1943).

Habitat: - Adult *Strongyloides stercoralis* are largely localized in the duodeno-jejunal region.

Morphology: - In the parasitic phase, the females are readily discovered but not the male. The parasitic female measures 2.5 mm in length and 40-50 µm in diameter. Males are shorter and broader than females. Eggs are thin shelled, transparent and oval and measures 50 µm x 30 µm.

Mode of Infection: - Infection occurs by the entry of filariform larvae, which penetrate directly through skin coming in contact with soil. it can undergo 'auto infection'; this infection has been reported to last more than 30 years in untreated human. Also, infection with these parasites can be transmitted via breast milk (Stephenson *et al.,* 2000)

Strongyloidiosis: - *Strongyloides stercoralis* is the fourth most important intestinal nematode infection, but its impact is much less widely appreciated than those of *Ascaris*, *Trichuris* or Hookworm infections. *Strongyloides stercoralis* is symptomatic in around 50 % of cases, with diarrhea, abdominal pain, nausea and vomiting being the common gastrointestinal symptoms (Milder *et al.,* 1981, Nonaka *et al.,* 1998).

1.2.2.6 *Enterobius vermicularis*

History:- The pin worm, *Enterobius vermicularis*, has been known since ancient time. It was first described by Linnaeus in 1758. The disease caused by the parasite is known as oxyuriasis, pinworm infection, *Enterobiasis.*

Geographic distribution: - It is cosmopolitan in distribution, but less common in warm climate. This disease is more common in temperate and cold region.

Habitat:- It is specially common in children and women. The adult worm live in the caecum, appendix vermiform, colon and small intestine, with their head attached to the mucosa.

Morphology: - The worms are slender and cream-coloured. Male measures 2 mm to 5 mm in length and 0.1 to 0.2 in diameter, while female 8 to 13 mm in length and 0.3 to 0.5 mm in diameter respectively. Anterior end is provided with three small lips and a pair of cephalic expansions. Posterior end or tale of female is straight, long and pointed while that of male is blunt, curved with bursa-like expansion and a single spicule. The gubernaculum is absent. Tail

end of female is pointed. There is no buccal cavity but double bulb esophagus is a characteristic feature of this nematode. Male has a single testis (monorchic), while the female has two ovaries (diadelphic). Uteri are very much coiled and filled with eggs.

Eggs are colorless, asymmetrical being plano-convex measuring 60 μm **x**30 μm and surrounded by transparent shell containing coiled tadpole like larvae and float in saturated salt solution.

Mode of infection:- The infective agent is the ova that contain tadpole like larvae. The ova from the perianal region are transferred to night clothes and bedding, dust and air. The hand of the patient, particularly beneath the fingernails become contaminated with the ova through scratching the perianal region or handling the clothing and bed linen. Thus infective ova may be readily transferred to the same or another host either by hand to mouth or indirectly through food and drink. Likewise infection may be transmitted through inhalation of ova from bed clothing or from the dust of rooms. Infection of less intensity may be produced by retroinfection in which the larvae after hatching in the perianal regions enter the anus and migrate to the caecum.

Enterobiasis: - Irritation of perianal and perineal regions with exeoriation eczema and pyogenic infection from scratching occurs during hatching of eggs and migration of larvae. In females vaginitis may take place due to invasion of worm from perianal region. Internally parasites may cause mild acute or chronic catarrhal inflammation of the multiple focal types from the attachment irritation of the worms. The early symptoms of this parasites are inflammation of colon mucosa with abdominal pain and irregular bowel habit, loss of appetite, appendicitis. Migration of gravid female cause intense irritation and itching towards perianal and perineal region. Insomnia, restlessness, nervousness, even sexual disorders to hysteria, vaginitis and salphangitis is also evident.

CHAPTER - 2
AIMS AND OBJECTIVES

2.1 General Objectives

The general objective of the study is to find the status of the intestinal parasites along with awareness in children.

2.2 Specific objectives

- To determine the prevalence rate of intestinal parasites in the children of age group 1-14 years.

- To determine the prevalence rate of intestinal parasitic (helminthes and protozoan) infections sex wise, age wise, ethnic wise, feeding habit wise and rate of concurrent infection (i.e. single double and multiple species infections) of the children.

- To assess the knowledge, attitudes and practices in study population in relation to transmission of intestinal parasites.

- To obtained possibility of conducting awareness.

CHAPTER - 3
LITERATURE REVIEW

3.1 History of parasitology

Up to the middle of the seventeenth century knowledge of parasitology was limited to recognition of the existence of a few common external parasites such as lice, fleas and few internal parasites like tapeworms, *Ascaris*, pinworms and guinea worms. However, they ware considered as natural products of human bodies. Even Rudolphi and Bremser also supported this idea (Chandler and Read, 1961).

In Linnaeus' time, people thought that internal parasites were originated from accidentally swallowed free-living organisms (Chandler and Read, 1961).

During the later half of 17^{th} century Francesco Redi, grandfather of parasitology stated that maggots developed from eggs of flies. At the same time, Leeuwenhock perfected microscopes and discovered *Giardia* in his own stool and other protozoan in rainwater, salvia etc. (Chandler and Read, 1961).

Rudolphi (Linnaeus of Parasitology) classified all the parasites known up to his time. In 1773, Muller discovered cercaria larvae but as protozoan.

In 1782, Dubini discovered human hookworm. Similarly, leoss (1898) made the discovery of penetration of the skin by hookworm larvae.

Lambl, in 1859, first discovered the parasite *Entamoeba histolytica*.

In 1865, Leuckart first worked out the life cycle of *Enterobius vermicularis*. Later,
Losch, in 1875 proved its pathogenic nature.

In 1876, Normand first reported *Strongyloides stercoralis*. Schoudinn, in 1903, differentiated pathogenic and non-pathogenic types of amoebae.

In 1916, Stewart experimentally proved tissue migration of *Ascaris* where as Ranson 1920, Stewart 1921 and Vokogawa 1923 conclusively demonstrated that only one host is required for *Ascaris.*

From the middle of twentieth century, the works on parasites regarding different aspects; i.e. distribution, life cycle, pathogenesis, treatments and controls became fast and went wide spread. For this especially World War I and II were responsible, that accelerated interest in parasitology, especially the therapeutic aspects (Parajuli, 2003).

Many workers have studied human intestinal parasites; some recent studies on human intestinal parasites are as follows:

3.2 Literature review in the context of world

Chong-Hwan *et al.*, (1971) studied prevalence of intestinal parasites in Korea. A survey of intestinal parasitic infection among Korean people had been carried out during July 1961 to Dec.1970. A total of 2250 stool sample were collected from all the provinces and Seoul city in Korea, out of 2250 sample examined, 1803 (i.e. 80.1%)were positive for intestinal parasites. Among them, 46% for *A. lumbricoides*, 6.8% for hookworm, 1.6% for E. vermicularis, 0.78% for *H.nana*, 0.3% for *Taenia* spp was recorded. Among protozoan parasite, 6.4% of *E. histolytica* and 5.1% *G. lamblia* were also recorded. In context of sexual distribution, female showed higher prevalence than male.

Kyung *et al.*, (1972) worked on prevalence of intestinal parasites in Roka soldier during the period from April 1970 to Dec.1971. Stool samples were collected from Army troops, 1755 from recruits during basic training and 245 stool specimens from student of (Republic of Korea Army) Roka Nursing school of Taegu area. Overall prevalence rate for intestinal parasites found to be 88%. Specific prevalence was recorded 28.1% *A. lumbricoides*, 79.3% of *T. trichiura*, and 14.2% of hookworm. The incidence of *E. vermicularis*, out of

822 samples was 19.8% from anal swab and *E. histolytica* was recorded in 4.2% among 541 samples.

Rao *et al.*, (1973) worked on prevalence of intestinal parasites in two villages of Bhograi block Balasere district, Orissa. A total of 256 stool samples were collected from healthy rural community of Orissa and analyzed. The overall prevalence for intestinal parasite was 83.9% where as specific prevalence recovered was 58.2% of *A. lumbricoides*, 47.7% of Hookworm, 3.5% of *E. vermicularis*, 0.4% of *T. trichiura*, 0.4% of *H. nana*, 5.8% of *E. histolytica* and 8.2% of *G. lamblia*.

Cutting JW (1975) carried a survey of intestinal parasitism in a Yaviza community on the pan American Highway route in eastern Panama. A total of 202 stool samples were examined 90% of samples were found to be positive for any one intestinal parasite. Specific prevalence found was 80% of *T. trichiura*, 62% of *A. lumbricoides*, 41% of Hookworm, 7% of *S. stercoralis*, 0.5% of *H. diminata*, 16% of *E. histolytica*, and 5% of *G. lamblia*.

Arora *et al.*, (1976) studied on prevalence of intestinal parasites in rural community in Jammu Kashmir. A total of 436 stool samples were collected from healthy person and analyzed. Specific prevalence was recovered as 16.5% *Giardia* (i.e. maximum prevalence) followed by 8.3% of *E. histolytica*, 6% of *A. lumbricoides*, 4.6% of Hookworm, 2.8% of *E. vermicularis*, 1.8% of *H. nana* 0.5% of *T. trichiura* from this study.

Chiu *et al.*,(1979) studied on prevalence of intestinal parasitic infections among in habitants of Tan ran village, Nantov County, Taiwan. Out of 417 stool samples collected, maximum prevalence rate was shown by *A. lumbricoides* i.e. 81.5% followed by 73.6% of *T. trichiura*, 30.9% Hookworm, 4.5% of *G. lamblia*, 3.1% of *E. histolytica*, 0.7% of *S. stercoralis*, 0.2% of *T. solium* and 0.2% of *T. saginata*.

Massound *et al.*, (1980) worked on prevalence of intestinal helminthes in Khuzestan, southern Iran. Examination of a total of 16361 stools sample from people in 105 villages and 14 small towns revealed high prevalence of Roundworm, Hookworm, *T. trichiura* and *H. nana*. Hookworm was twice prevalent in rural area than in urban areas.

Datta *et al.*, (1981) worked on prevalence of intestinal parasites in urban areas of Alwar, Rajasthan. Stool specimens collected from 489 individuals, were examined for intestinal parasites during 1978-1979. 50.10% of the samples were positive for one or more intestinal parasites. *E. histolytica* and *E. coli* affected 46.49 % of examined population. 3.3% of *G. lamblia*, 7.8% of *A. lumbricoides* and 0.4% of Hookworm were detected. 43.79% of sanitary latrine users 52.98% of unsanitary latrine users were found to be infected as a proof of the importance of sanitary use of latrine.

Datta BND (1981) worked on intestinal parasitic infections in preschool children in lower socio-economic community in Delhi. A total of 2493 stool specimens were collected from them January to December 1975. 17.4% of Giardiasis, 9.6% Ascariasis, 7.9% of *H. nana*, 2.9% of Amoebiasis, 2.7% of Ancylostomiasis, 2.6% of *E. vermicularis*, 1.4% of Trichiuriasis and 8.9% of Taeniasis was found. 68.1% of artificially fed infants and 34.3% of breast fed infants were found to be infected which proved the significance of breast–feeding.

Bidinger *et al.*, (1981) carried out a study on aspects of intestinal parasitism in villagers from rural peninsular India. Stool samples from 355 people of 5 villages of Peninsular India were collected during 1977. Labrotary examination revealed highest 70% i.e. prevalence of *A. lumbricoides* was followed by *Entamoeba* cyst, egg of Hookworm and *H. nana*. It was concluded that such high prevalence was due to contaminated drinking water supply supported by dry, windy, dusty environment and without covering.

Ralna *et al.*, (1984) worked on prevalence of intestinal parasitic infection in some urban localities of Solon district of Himachal Pradesh. Out of 156 stool samples examined 54.5% were positive for one or more intestinal parasitic infection. Specific prevalence recovered was 12.8% of *G. lamblia*, 5.8% of Hookworm, 3.8% of *E. histolytica* 4.5% of *A. lumbricoides*, 1.9% of *H. nana* and 0.6% of *T. trichiura*.

Lall R (1985) worked on intestinal parasitic infection in a section of population of Port Blair, Andaman and Nicobar islands. A total of 1109 stool samples were collected from OPD patient attending G.B. Pant Hospital. Out of 1109 sample 668(i.e.60.2%) were found to be positive for one or more parasites, 63% of single, 3.8% of multiple infection were detected. Specific prevalence was recovered as 18.6% of *A. lumbricoides*, 5.4% of *T. trichiura*, 4.3% of *E. histolytica*, 3.4% of Hookworm, 3% of *G. intestinalis*, 1.2% of *S. stercoralis*, 0.7% of *E. vermicularis*, 0.2% of *H.nana* and 0.1% of *Taenia* sps.

Develoux *et al.*, (1986) worked on intestinal parasitic disease of school children in Republic of Niger. Coprologic survey revealed strong prevalence of Amoebiasis in all the studied area; Giardiasis is more frequent in dry areas. As for helminthes *H. nana* was met everywhere. The prevalence of *Ancylostoma* found to be decreasing gradually from south to north.

Mishra *et al.*, (1987) worked on a pattern of intestinal parasitic infestation in Diarrhoeal subjects in rural community. The overall isolation of intestinal parasites from the stool sample was 79.9%. The most common parasite isolated from the Diarrhoeal stool was *Ascaris lumbricoides* i.e.55.6% followed by 23.5% of *E. histolytica*, 19.2% of *G. lamblia* and 3.4% of Hookworm.

Ludwig *et al.*, (1999) worked on correlation between sanitation condition and intestinal parasitosis in the population of Assis, State of Sao Paulo. A total of 18366 stool samples were collected from six sanitary centers of Assis during

1990 to 1992. The general prevalence of entroparasites was 25.3 %. The most frequently found entroparasites were *G. lamblia* 3.7 %, *A. lumbricoides* 5.5 % *T. trichiura* 2.07 % and *H. nana* 1.97%. In Marialues, a low-income neighborhood, the prevalence was 17 %, 13.1 %, 5.9 % and 4.2 % respectively. The age group 3-12 years showed the largest number of infected individuals.

Macpherson *et al.*, (1999) carried out a cross sectional point prevalence study of intestinal protozoan and helminthes in school children aged 6-12 years of age in three schools in St. George's Parish, Gronada. A total of 315 samples were collected and examined. The specific prevalence was 36 % of *G. lamblia*, 12 % of *E. histolytica*, 0.41% Hookworm, 1.3 % of *E. vermicularis*, 5.3 % of *T. trichiura* and 1.4 % of *A. lumbricoides*. Protozoa was found to be common than helminthes, due to easy availability of wide spectrum of antihelminthics than antiprotozoal.

Paul *et al.*, (1999) carried out a study to determine the prevalence of intensity of intestinal helminthes infections. The children were between 7 to 13 years of age and belonged 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 the intestinal parasites viz., *A. lumbricoides, T. trichiura* and Hookworm. The overall prevalence of infection was 82 %. *A. Lumbricoides* was the most common infection with a prevalence of 75 % followed by *T. trichiura* of 66 % and hookworm of 9 %.

Needham *et al.*, (1999) studied the epidemiology of soil transmitted nematode infection in Ha Nam province, Vietnam. Altogether 177 households were visited and stool samples of 543 individuals with aged 1-33 years, were examined. The prevalent helminthes found were *A. lumbricoides, T. trichiura* and Hookworms.

Zhang *et al.*, (2000) investigated the prevalence and intensity of geohelminthes infections caused by hookworm, *Ascaris* and *Trichuris* in two rural Yunnan villages. In Liuku, a village of Lisu indigenous people in Lushui Country, there was an overall geohelminth prevalence of 72% (48%, 43%, and 16% for hookworm infection, Ascariasis and trichiuriasis respectively). The prevalence of ascariasis was greatest among pre-school and school aged children where as prevalence of was greatest among the teenagers and prevalence of Hookworm increased until the age of 10-15 and then remained high throughout adulthood. In Linger, a village of Han Chinese, located in Puer country, there was an overall geohelminth prevalence of 77%, (33%, 60%, and 36% for hookworm infection, ascariasis and trichiuriasis respectively). The difference in prevalence for hookworm and ascariasis were statically significant.

Habbari *et al.*, (2000) worked on the association between the geohelminthic infection and raw wastewater reuse for agricultural purposes in Beni-Mellal, Morocco. In a randomly selected sample of 1343 children, 740 of them were from five communities using raw wastewater for agriculture and 603 were from control communities that do not practice wastewater irrigation. Ascariasis prevalence was found to be approximately five times higher among children in wastewater-impacted regions compared to control regions. Contact with wastewater and contact with wastewater irrigated land and public water supply were found to be associated with higher infection rates. *Trichiuris* rates did not show a statically significant difference between the wastewater impacted and control regions.

Chukiat *et al.*, (2000) studied on *H. nana* infection in Thai children. Stool examination was performed on 2,803 children from orphanages and primary school. *H. nana* infection was found only in children from orphanages with a prevalence of 13.12%. Males had statically significant higher prevalence of infections than females.

Lee *et al.*, (2000) examined stool and cello tape anal swab carried out in August 1997 on handicapped people at an institution located in Chorwongun, Kangwon-do, Korea. A total of 112 stool samples (78 males and 34 females) revealed 3 cases of *T. trichiura* and 1 case of *E. vermicularis* infection. The overall prevalence rate was 35.7%. More than two different kinds of parasites were found in 42% of the positive stool samples (17 cases). The infection rates for protozoan cysts were as follows; *E. coli* (25%), *E. histolytica* (1.8%), *Endolimax nana* (21.4%), *I. butschlii* (1.8%) and *G. lamblia* (0.9%). In cello tape and anal swab examinations (165 samples), the prevalence ratio of *E. vermicularis* was 20.6%.

Lee *et al.*, (2000) carried out a survey on the intestinal parasites of the school children Kaohsiung Country. This study was conducted among school children from September to December 1999.The overall infection rate in 305 children was 17%. The most common intestinal parasites detected were *A. lumbricodes*, Hookworm, *T.trichiura*, *H. nana* and *G. lamblia*. The male had highest infection rate than females (11%). The infection rate of aboriginal and non-aboriginal children was 17% and 14% respectively. Grade 1 and Grade 6 had highest infection rate (21%) out of 302 tape perianal examination revealed 25% prevalence.

Janakiram *et al.*, (2001) investigated on prevalence of intestinal parasitic infections among patients attending Adichumchanagiri Hospital and research Center. G. Nagar, Monday, Karnataka. Total of 4133 stool samples were collected from OPD patients suffering from diarrhea and other gastro intestinal disturbance during August 1994 to July 1999. Out of 4133 stool samples examined 599(14.49%) were positive for either protozoan (7.79%) or helminthes (6.7%) parasite. Majority of them, 97.98%was detected with single type pathogen and rest 2.02% with more than one pathogen.

Toma *et al.*, (2001) studied on *Strongyloides* infection conducted by faecal examination and subsequent treatment of the population on a model Island (KumeIsland) in Okinawa, Japan for 5 years from 1993 to 1997. More than 1200 persons, accounting for 17% to 20% of the persons and subjected, received faecal examinations each year. The positive rate in 1993 was found to be 9.7%.

Sofia *et al.*, (2001) worked on intestinal parasitic infection in the University Campus of Aligarh. Faecal samples of 3695 persons complaining for diarrhea, dysentery, abdominal pain and other bowl disturbances were examined. Out of total samples, 2152 samples (58.24%) were found to be positive for *E. histolytica A. lumbricoides*, *G. lamblia*. Among them, *E. histolytica* showed highest prevalence rate (37.95%), while *A. lumbricoides* showed least infections rate (5.71%).

Uchoa *et al.*, (2001) conducted a parasitological survey of children from five-community day –care centers from Nieterio City, Rio de Janerio, Brazil in 1999. Of 218 stool samples of children surveyed, 120 (55%) had positive samples for intestinal parasites. The most prevalence protozoan parasites were *G. lamblia* (38.3%) followed by *E. coli* (26.6%), *H. nana* (0.8%) and *E. vermicularis* (0.8%). Monoparasitism was found in 57.5% of positive cases.

Smith *et al.*, (2001) conducted a cross sectional survey between January and March 1998 in four rural community in Honduras, Central America. He examined prevalence and intensity of *Ascaris lumbricoides* and *Trichiuris trichiura* infections among 240 faecal samples of 62 households. The overall prevalence of *A. lumbricoides* and *T. trichiura* was 45% and 38% respectively. The most intense infections of *A. lumbricoides* and *T. trichiura* were found in children aged 2-12 years old.

Xia *et al.*, (2002) across sectional study was performed to assess the prevalence and soil transmitted nematode infection in school children Mafia Island. Hookworm infection was widespread (72.5%) where as *T. trichiura* was less prevalent (39.7%) and *A. lumbricoides* was present at a low prevalence (4.2%), mainly in urban area. In a sub sample of the study population both *Nectar americanus* and *Ancylostoma duodenale* were found, although *N. americanus* was more present. This survey was followed by a parasitological evaluation of Mebendazole treatment using a single (500 mg) dose. A higher efficiency of Mebendazole against hookworm infection was found in Mafia Island when compared with that observed in Pamba Island, possibly indicating that hookworm may be developing mebendazole resistance on Pamba Island as a result of intense exposure to the drug there.

Fernandez *et al.*, (2002) carried out a comparative study of the intestinal parasites prevalent among children living in rural and urban setting in and around Chennai. A total of 324 stool sample were collected and examined .Out of 125 specimens tested from the rural location, the overall prevalence of intestinal parasite was 91%. *A. lumbricoides* was the most common helminthes parasite detected 52.8% followed by *T. trichiura* 45.6% *A. duodenale* 37.6% where as *G. lamblia* (16%) was the most common parasite detected followed by E. histolytica (4%). In contrast under urban setting out of 199 stool samples tested the positively rate was 33%. *G. lamblia* was the most common parasite detected (22.6%) followed by *E. histolytica* (10.6%). Other intestinal parasites, such as *T. trichiura* (2.01%), *H. nana* (1.01%), *E. vermicularis* (0.5%) and *A. lumbricoides* (0.5%) were found have much lower prevalence in comparison to rural area.

Nishiura *et al.*, (2002) carried out a study on prevalence, intensity and associated socio-cultural and behavioral risk factors of Ascaris lumbricoides among children in rural communities in the Northern area of Pakistan. Prevalence and intensity of *A. lumbricoides* in 492 children from five rural

villages in northern area of Pakistan was examined. The overall prevalence of *A. lumbricoides* was 91% with geometric mean egg count intensities of 3985 eggs per g. The most intense *A. lumbricoides* infections were found in children aged 5-8 years. Univariate analysis associated *A. lumbricoides* intensity with age ($p=0.004$), location of household ($p<0.01$), defecation practices ($p=0.02$), soil eating habit ($p<0.01$), had washing after defecation ($p<0.01$), had and living with children under 5 years old ($p=0.02$). Multivariate analysis identified the children's age 5-8 ($p<0.01$). The result indicated that there were certain clear risk factor in *A. lumbricoides* transmission and its intensity was influenced by age related behavioral and environmental factors that contribute to exposure.

Martha *et al.*, (2002) studied on *Hymenolepis nana* a common cause of pediatric diarrhea in urban slum dwellers in India. The prevalence of intestinal parasitic infection was studied for 5 years (April 1996, April 2001). Among urban slum dwellers, parasitological examinations were performed on 931 faecal specimens, collected on a household bases. The total prevalence of pathogenic parasite was 33.6%. The most common intestinal were recovered on following prevalence rate *H. nana* 9.9%, *A. lumbricoides* 3.5%, *G. lamblia* 3.4% and *E. histolytica* 3.7%.

Crame *et al.*, (2002) carried out a study on intestinal parasites among wayampi Indians from French Guiana. A total of 138 wayamp from an isolated Amerindian population from upper Oyopock with traditional social and cultural specificities below the age of 15 years were collected and examined. It was revealed 92% of overall prevalence. The most common parasites were 50% of hookworm, 17% of *E. histolytica*, 16% of *S. stercoralis* and 13% of *H. nana* and very few *A. lumbricoides* and *T. trichiura* were also recovered. *H. nana* was frequent in children.

Sirvichayakul *et al.*, (2003) studied the prevalence of intestinal parasitic infection by stool examination in institutionalized and non-institutionalized

Thai people with mental handicapped. It was found that the prevalence of infection was much higher in institutionalized (57. 06%) than in non-institutionalized people were *T. trichiura* (29.7%), *E. coli* (32.1%), *G. intestinalis* (8.0%), *H. nana* (7.8%) and *E. histolytica* (7.1%).

Alakpa *et al.* (2002) conducted a cross sectional laboratory based study in Lagos Metropolis state in South Western Nigeria during March 1999 to April 2000. In total 1109 stool samples were collected during the period of study. 11 (0.99%) were conformed positive *Cyclospora cayetanensis*. Other parasites were also detected; they were *Entamoeba, Ascaris, Trichiuris, Strongyloides* sp. and hookworm.

Bong-Jin *et al.*, (2003) carried out a small state survey to investigate the status of intestinal protozoa and helminthes infection of inhabitants in Roxus City, Mindoro, Philippines. A total 301 stool samples were collected. The overall positive rate was 64.5% and that of male and female were 56.6% and 72.5% respectively. The highest infected helminthes was *A. lumbricoides* (51.2%) followed by *T. trichiura* (27.6%) hookworm (8.0%) *E. vermicularis* (0.3%). The protozoan infection status revealed that E. coli was the most frequent (15.0%). *Iodomoeba buetschlii* and *E. histolytica* were found but few. The multiple infections more then two parasites was 29.6% and double infection with *A. lumbricoides* and *T. trichiura* was common. The intestinal helminthes infections were highly prevalent in this area.

Miller *et al.*, (2003) examined the presence of intestinal protozoan and helminthes infections and their associations with clinical signs and symptoms in children in Trujillo, Venezuela. The point prevalence of protozoan infection was 21% for *G. lamblia*, 1.0% for *E. histolytica* / disper, 4% for *E. coli*, 16% for *Blastocystis hominis* and 89% for *Crytosporidium*. Prevalence of helminthes infection was 11% for *Ascaris* 11% for *T. trichiura* 0.0% for *S. stercoralis* and 2% for *H. nana*.

Chukiet *et al.*, (2003) studied the prevalence of intestinal parasitic infection by stool examination in institutionalized and non-institutionalized Thai people with mental handicaps. It was found that prevalence of infection was much higher in institutionalized (57.6%) than in non-institutionalized people (7.5%). The common parasites found in institutionalized people were *T. trichiura* (29.7%), *E. coli*,(23.1%), *G. lamblia* (3.0%), *H. nana* (7.8%) and *E. histolytica* / disper(7.1%).

Belzario *et al.*, (2003) determined the efficiency of single dose of albendazole, ivermeetin and diethyl carbamazine and of the combination of albendazole + ivermeetin and also albendazole + diethyl carbamazine against common intestinal helminthes caused by *Ascaris* and *Trichiuris* spp. In a randomized, placebo + controlled trial, infected children were randomly assigned to treatment with albendazole + placebo, ivermeetin + placebo, diethyl carbamazine + placebo, albendazole + ivermeetin, or albendazole + diethyl carbamazine. The kato-katz method was used for qualitative and quantitative parasitological diagnosis. The test was used to determine the significance of care rates. Albendazole, ivermeetin and the drug combination gave significantly higher care and egg reduction rates for ascariasis and Trichiuriasis than diethyl carbamazine and other treatment. The infection rates were lower 180 and 360 days after treatment.

3.3 Literature review in national context

Sharma BP (1965) was the pioneer of such works in Nepal who conducted study of patients in Bhaktapur by random sampling method in order to ascertain the incidence of roundworm infection. He studied 976 stool samples and found 40% roundworm infestation in that area.

Sharma *et al.*, (1971) carried out a study on intestinal parasites among auxiliary health worker in Kathmandu. They examined 80 stool samples, of which 10 did not show any infestations. The rest 70 i.e. 87.5% respondents were suffered from different types of protozoan and helminthic infection. The commonest infestation

found was roundworm (*Ascaris lumbricoides*). Among them 61 i.e. 78.5% of them were suffered from single infection and 7 i. e. 7.5% suffered from multiple infection. Among them 41.25% of roundworm, 27.5% hookworm, 10% of *Trichiuris trichiura*, 5% of *E. histolytica* and 3.75% of *G. lamblia* were recorded.

Dongol (1972) studied a case of roundworm infestation in gall bladder.

Soulsa (1975) carried out a survey of the prevalence of intestinal parasites in Pokhara and found very high incidence. He observed that dirty finger nails might play an important role in the transmission of intestinal parasites.

Lynch *et al.*, (1978) worked on prevalence of hookworm and other helminthes in British Gorkha recruits reported 89% of healthy appearing individuals were infected with hookworm, 49% with roundworm and 36% with whipworm.

Acharya (1979) reported that the intestinal infestations like giardiasis, amoebiasis, ascariasis, ancylostomiasis, fascioliasis and taeniasis were common in Nepal.

FPAN/IP (1979) studied the parasitic infection rate in Paanchkhal village community and found 89% parasitic infection rate in 4056 sample size.

Khetan (1980) carried out the study of the incidence of parasitic infection on Narayani Zone. Stool sample of 2073 patients were examined between the years 1977-1980. Out of total samples 1522 stool sample had worm infection, of which 458 sample had *Ascaris*, 591 had hookworm, 203 had *Trichiuris*, 175 had *G. lamblia* and 83 had other infection.

Gurbacharya (1981) observed that the infection by soil transmitted helminthes. Bhaktapur and Paanchkhal area were higher than in these types of parasites than any other type of parasite.

Bol *et al.*, (1981) reported the soil-transmitted nematodes in Lalitpur district. They observed *A. lumbricoides, N. americanus, A. duodenale, T. trichiura* and *S. stercoralis* are the soil-transmitted nematodes.

Estevez *et al.*, (1983) studied intestinal parasites in remote western village of Nepal and reported 83.3% of individuals positive for hookworms, 52.8% for roundworm and 5.5% for whipworm infection.

Integrated Family Planning and Parasite Control Project, IFPPCP (1985) examined 25260 stool samples of students from 46 schools of Kathmandu valley out of which 22626 (86%) were found positive. The infection by *A. lumbricoides* was 15423 (68.16%) followed by *T. trichiura* 8104 (35.8%), *G. lamblia* 2491 (11%), hookworm 6.7% and tapeworm 0.97%.

Sugari *et al.*, (1985) conducted to find the helminthes infections, in 737 Nepalese people living in Gandaki, Dhaulagiri, Lumbini and Sagarmatha Zone of Nepal and in 26 Japanese living in Kathmandu. The overall helminthes infection rate was found 36.8% including roundworm (50.3%), hookworm (44.1%), whipworm (47.6%), pinworm (1.2%) and *Taenia sp.* (0.1%).

Morel AM (1986) studied specification of human hookworm in Eastern hills of Nepal. A total of 757 human faecal samples from 1982 to 1985 were examined and found 17% positive for hookworm. 10 samples were for *strongyloides.*

Rai *et al.*, (1986) collected 2000 stool samples and examined by direct smear technique over a period of 16 days. The incidence of roundworm was highest (35%) followed by hookworm (14%). The overall infection rate was 69% and result showed that the infection was most common in girls than the boys.

Geollman R (1988) carried out an extensive disease survey in Patan hospital's general out patient's clinic from December 1986 to November 1987. A total of 79,404 people were diagnosed during this year, and the incidence of related

intestinal parasites was found to be 1.7% of *E. histolytica* 2.7% of *G. lamblia* and 8.5% of *G. lamblia* and 8.5 of Hookworm.

Gupta *et al.*, (1988) collected 285 stool samples. Among them 192 i.e. 67.36% was found to be positive for intestinal parasite. Out of these 192 positive stool samples, 49 cases were infected with protozoan parasite, 9.12% by *G. lamblia* and 9.47% *by E. histolytica* out of 155 samples. Out of 285 stool samples, 54.38% were positive for helminthes highest prevalence was exhibited by *A. lumbricoides* i.e. by 25.65% of *T. trichiura*, 4.56% of *A. duodenale*, 2.46% of *H.nana* and 0.55% of *T. solium*.

Houston *et al.*, (1990) studied about helminthes infections among Peace Corps volunteers station in rural regions of Nepal indicated 14% were positive for Hookworm, 3% for Whipworm, and 82% for Roundworm.

Blangero *et al.*, (1993) studied helminthes infection in Jiri, concluded that roundworm, Whipworm and hookworm were endemic in Nepal and are the major health problem for the population.

Rai *et al.*, (1993) carried out a work on status of intestinal parasitosis in Nepal during 1985-1992 at TUTH parasitology lab. An average 6537 faecal samples were examined each year for the presence of various intestinal parasites. The positive rate of intestinal parasites was seen to be varying from 29.1% to 43%. Children below 15 years were found to be more infested than that of above 15 years. Among the helminthes *A. lumbricoides* had highest prevalence rate i.e. 18% followed by Hookworm and Taenia and among protozoan parasites *G. lamblia* had the highest prevalence rate, followed by *E. histolytica.*

Sherchand *et al.*, (1994) studied the intestinal parasites in Kathmandu valley and reported 28.1% of parasitic load among subjectively healthy children and 38.8% parasitic load among healthy adults, where as 62.7% total parasitic load was recorded among children with abdominal discomfort. *H. nana* was recorded most common tapeworms associated with patients having abdominal discomfort.

Among protozoan parasites prevalence of G. lambia was highest among the sick children. In healthy children the prevalence of mixed parasitic infection was 2.1% and 7% in healthy adults, while 13.3% prevalence was found in sick children and 11.5% in sick adults.

Sherchand *et al.*, (1997) carried out stool survey on intestinal parasites in rural village of Dhanusha district, southern Nepal. Out of 604 children of aged 0-9 years, examined 63.1% were found positive for at least one intestinal parasite. Hookworm infection superseded all the parasites by showing a positivity of 11.6%. Other parasites found were *A. lumbricoides, T. trichiura, E. vermicularis, S. stercoralis H. nana, E. histolytica, E.coli, G. lamblia, Cryptosporidium* and *Cyclospora* etc.

Chettri MK (1997) analyzed the parasitic infection scenario of Nepal and concluded that 50% of people were infested by helminthes. Among them *Ascaris lumbricoides* was found to be top in the list of helminth and *Giardia* in protozoan from 4, 00,000 stool samples report studied by different organization at different places and period (from 1979 to 1995 i.e. 16 years).

Navisky *et al.*, (1998) examined faecal specimens from 292 pregnant women (age 15 to 40 years) and 129 infants (age 70-140) days for helminthes eggs by the Kato- Katz method. These stool specimens were collected from Sarlahi district in Southern Nepal among pregnant woman was found to be 78.8% hookworm, 52% *A. lumbricoides* and 7.9% *T.trichiura*.

Rai *et al.*, (1999) had suggested *Ascaris* as leading human parasite and also reported as major causes of public health problem. The study reported that over 75% people were infested by *A. lumbricoides* in rural areas, where as hospital-based study in Kathmandu over a period of one decade also shown a static annual prevalence with mean of approximately 35%.

Rai *et al.*, (2000) worked on contamination of soil with helminth parasitic eggs in Nepal. A total of 156 samples were collected from different part of Nepal (i.e. 122

from Kathmandu valley and 34 from outside valley). Among 156 samples, the overall contamination rate was 36.5% (57/156). In Kathmandu valley, soil contamination rate was higher i.e. 48.3% during wet seasons compared with that of dry season i. e. 33.3%. *Ascaris lumbricoides, Toxocara sp., Trichiuris trichiura, capillaria sp., Trichostrongylus* sp. and two sp. of cestoda (i.e. *H. nana* and *H. diminuta*) were also recovered. *A. lumbricoides* was predominant in Kathmandu valley while Trichostrongylus was the commonest out side of the valley.

Shrestha B (2001) studied on intestinal parasitic infestations in healthy school children of Lalitpur district. Stool samples of 515 healthy urban and rural school children of 7-12 year age group were collected. Among them 81.94% of children found to be infected with parasites. Among them prevalence of *Ascaris lumbricoides* was found to be highest i.e. 73.45% in rural and 71.66% in urban children. Like this way prevalence of *Trichiuris trichiura* was found to be higher among children of urban of i.e. 37.91% where as that of rural was 27.27%. 78.36% and 84.07% of male and 92.45% and 73.72% of female children from the urban and rural respectively were found infested with the protozoan and parasites.

Rai *et al.*, (2002) studied intestinal parasites among school children in rural hilly area of Dhading district Nepal. A total of 423 school children were included and 254 i.e. 60% of them were found be positive for intestinal parasite. *Ascaris lumbricoides* was the most common (i.e.69.6%) parasite detected followed by Hookworm i.e. 19.2% and Whipworm 5.9% *Giardia lamblia* was only protozoal parasite detected in this study i.e. 5.2% where as Dalit had significantly higher prevalence i.e. 74.1%.

Parajuli R (2004) studied on the prevalence rate of intestinal parasite in Mushar community in Chitwan district. A total of 183 stool samples were examined of which 77.05% were positive. Female had higher prevalence (79.2%) than male (74.4%). *A. lumbricoides* had higher prevalence (48.08%) followed by *A. duodenale* (34.94%), *T. trichiura* (22.4 %), *E. histolytica* (15.3%), *S. stercoralis*

(8.19%), *G. lamblia* (7.65%), *H. diminuta* (4.37%), *H. nana* (2.73%) and *Taenia spp* (1.63%).

Karki (2004) conducted a study among Magars Barangdi VDC of Palpa from July 002 to June 2003. A total of 157 samples were examined, and the total prevalence was 66.88%. The highest prevalence rate was found to be due to A. *lumbricoides* (50.32%), followed by hookworm (24.2%), *T. trichiura* (17.2%), *Taenia sp.* (828%), *H.nana* (6.37%) and *S. stercoralis* (1.91%).

Chaudhari (2004) carried out a study in Machchhegaun VDC from February 2002 to January 2003. A total of 306 samples were examined, among which 76.6% positive with at least one kind of parasite. The prevalence of parasite was higher in male (86.5%) than female (70.0%). Highest prevalence rate was for *A. lumbricoides* (43.4%) followed by *T. trichiura* (22.5%), *G. lamblia* (16.1%), *C. cayetanensis* (7.2%), *E. histolytica* (2.5%), *C.parvum* (1.7%), hookworm (1.7%), *E. coli (*1.7*%), I. butschlii (*1.2%),*H. nana* (0.8%), *E. vermicularis* (0.4%) and *E. nana* (0.4%).

Ghimire *et al.*, (2005) conducted a study to determine the prevalence of the intestinal parasites and to evaluate the types of intestinal parasites and haemoglobin concentrations in the people of two areas of Nepal. The cross-sectional descriptive type of study was conducted from April 2005 to October 2005 in Kirtipur, Kathmandu and Gunjanagar VDC, Chitwan, Nepal. A total of 400 stools were processed by using a standard formalin-ethyl acetate concentration method, direct light microscopy, modified acid fast stain, oculo-micrometer and bisporulation assay. The blood was collected from the 59 solitary parasite positive persons, one concomitantly infected person and 17 parasite non-infected persons and examined by colorimeter. The total prevalence of intestinal parasites was 42.0% in which the prevalence of males and females was 35.2% (58/165) and 46.8% (110/235) respectively with statistically significant ($P<0.05$, 95% CI).

There was statistically significant of low concentration of haemoglobin in the helminths and protozoa infected males and females with different age groups ($P<0.05$, 95% CI).

Ghimire *et al.*, (2006) conducted a study to highlight the intestinal parasites in the role of diarrhea in Human Immunodeficiency Virus infected patients who attended in Sukra Raj Tropical and Infectious Disease Hospital of Kathmandu, Nepal from May 1, 2003 to April 30, 2004. The totals of 86 stool samples were collected from86 HIV patients once and they were examined by direct smear methods and modified Kinyoun acid-fast stain. Here, 18 females (78.3%) out of 23 HIV patients and 40 males (63.4%) out of 63 patients were found to be infected with intestinal parasites with the prevalence of 67.4%. Though in August and October 2003, 100% samples were positive, there was statistically no significant difference with months ($\chi^2=18.83$, $P>0.05$). In this study, *Cyclospora* (19.8%), *Cryptosporidium* (14.0%), *Isospora* (3.5%), *Strongyloides* (10.5%), *Ascaris* (4.7%), *Giardia* (3.5%), *Hymenolepis nana* (2.3%), *Trichuris trichiura* (2.3%), *Entamoeba histolytica* (2.3%), Hookworm (2.3%) and *Enterobius* (2.3%) were reported with statistically significant ($\chi^2 =18.3$, $P<0.05$). The total prevalence of coccidian and non-coccidian parasites was 37.0% and 30.2% respectively with statistically significant ($\chi^2=15.51$, $P<0.05$). The prevalence was found 100% in drivers, 80% in farmers, 100% in housewives and 48.9% in sex workers. Among 48 diarrheic patients, 36 (75.0%) showed infection. 17 (35.4%) was acute diarrheic among which 11(64.7%) was positive. Among 31 (64.6%) chronic diarrheic, 25 (80.6%) was positive. They conclude that the control of intestinal parasite involves adequate treatment and proper health education, provision of adequate toilet facilities and pipe borne water.

CHAPTER - 4
MATERILS AND METHOD

4.1 Study area

Kanti Children's Hospital is situated in the about centre part of Kathmandu valley. It was established in 2019 Poush 22 (7 January 1963). This hospital was started from 50 beds. It was supported by Soviet Sangh. For 7-8 years all aged group people were treated. Since 2027-shrawan-4 (July -1970) it is changed to Kanti Children Hospital.

Tulsi Giri was the first chairman of this hospital. The first chairman of the development committee was Ram Shankar Shrestha. There are 304 beds and 20 beds are provided in Emergency ward. The services of X-ray, Ultrasound, E-ces, pathology, Physiotherapy, Echocardiography are available.

Emergency ward gives services every time. OPD gives services 6 days in a week. Services of cardiology, Nephrology, Oncology are given in fix days. In Tuesday and Friday doctors from Teaching Hospital come there to check up the patient. One consultant gives service one day OPD and one day flow up in a week. In other days his duty is only rounding.

Daily 250-400 patients come there to check up, among them about 40-50 patients are related to intestinal parasitic diseases. The indoor services are medical, paying, neonlogy, oncology/ cardiology, surgical, NICU, PICU, SICU. The charge of OPD is Rs.10/- Poor children are treated freely. These patients are admitted who are suffering from Acute respiration infection, diarrhea, Enteric fever, Meningitis, skin infection. Since two years ago study of mediatric has been started.

4.2 Sample Size

Stool samples were collected from 278 children (single sample from each). These samples were examined with in two months of rainy season. This season was prevalent time for parasite to transmit due to appropriate condition for them, from Asadh to Bhadra. The samples were collected from all ethnic backgrounds such as Brahman, Chettri, Gurung, Newar, Magar, Rai, Limbu, and Dalit etc.

4.3 Materials and Method

The whole study was divided into two parts. First part is surveillance study and second part is stool sample collection and examination. In first part children of different castes were selected. Base line health survey was conducted in the Kanti Hospital with prepared questionnaire during second week of Asadh to second week of Bhadra. They (selected patient and their guardians) were interviewed with the help of prepared questionnaire.

4.3.1 Materials

4.3.1.1 Equipments

1. Compound Microscope
2. Refrigerator
3. Hot air oven
4. Sample vials
5. Gloves
6. Trays
7. Needles and sticks
8. Glass slides
9. Cover slip
10. Dust bin

4.3.1.2 Chemicals

1. Normal saline (0.85% Nacl)
2. Potassium dichromate (2.5 % wt. by volume)
3. Iodine solution (1% wt by volume)
4. Glycerin
5. Soap

Normal saline

It helps to observe characteristics movement of the parasites. It is used in unstained preparation. This solution was prepared by dissolving 8.5 gm. of sodium chloride in 1000 ml. of distilled water.

2.5 % Potassium dichromate

This solution is useful for preservation of parasite, which is found in the stool. 2.5 gm. of Potassium dichromate was weighted accurately by the help of electric balance and dissolved in distilled water.

Iodine Solution

It is used to study the internal characters for identification of the species of protozoan parasites. It also helps to identify the egg of helminth. Dissolving 10 gm Potassium iodide in 100ml of distilled water and slowly adding 5 gm of iodide crystals in it prepared the solution used in the present study. The solution was filtered and kept in a stoppered bottle of amber colour.

4.3.2 Methods

4.3.2.1 Macroscopic examination

Examination of stool was carried out by naked eye for studying physical appearance of as well as helminthic segments and larvae present in stool sample. Macroscopic examination was performed to observe following:

Color of stool

Odor of stool

Soliditary or consistency

Presence of mucus or blood

Presence of gravid/ worm

Microscopic examination

4.3.2.2 Microscopic examination

In this study, 278 stained and unstained stool smears were prepared to observe the various intestinal protozoan as well as helminth parasites. Some of the methods are as follows:

4.3.2.2.1 Unstained preparation

Very small portion of stool sample was picked up with a wooden applicator and diluted with freshly prepared normal saline on a clean glass slide. A clear cover slip was placed over it .For prevention of desiccation glycerin was applied on cover slip and excess of fluid was removed with the help of filter paper. The resulting mixture was so transparent that it was possible to read newspaper through it.

4.3.2.2.2 Stained preparation

Stained preparation was required for identification and the study of internal nuclear characters for identification of the species. The iodine stained preparation was used for this purpose. It was prepared by adding a drop of Iodine on saline emulsion and then covered by cover slip. Vaseline or Glycerin was kept there to prevent desiccation before the cover slip was kept there. The excess of fluid was removed with the help of filter paper. Both stained and unstained preparation was kept on the same glass slide one on each half. (Chattarjee KD, 1967).

4.3.3 Method of observation

Both of the preparations that are unstained and stained were first examined under the low power (10x) objective and (4x) ocular. It was started from one corner of the cover slip, the whole slide was examined. It was carefully wached on shape, size and color, marking on the surface of the egg shell during the identification of egg of helminth and cyst of protozoa. With the help of Standard books and references, the presence or absence of yolk granules, ovum or differentiated embryos, the existence of operculum, polar filament or knob in specific case of

cestodes and in case of protozoa, cyst, remains of flagella, nucleus characters and position of nucleolus were considered. Larval stages of hook worm (*Strongyloide stercoralis*) were also observed.

4.3.4 Data processing and analysis

4.3.4.1 Data collection

Data obtained from stool sample examination collected in pathology lab of Kanti Children Hospital from the age group of 1-14 were collected. Using questionnaire collected the knowledge, attitude and behaviour of patients and their parents. These data were primary data.

4.3.4.2 Data analysis and Interpretation

The data obtained from laboratory as well as survey were edited, coded, classified, tabulated and analyzed. Data were analyzed by applying various method of analysis. It was done on the basis of age, sex, feeding group and infection rate (single, double and triple infection) of the children.

CHAPTER – 5
RESULTS

Surveillance study and stool samples collection and examination (single sample from each) were done in 278 children of Kathmandu valley from OPD of Kanti children's Hospital.

The result of present study is divided in two categories;

i. Results of stool examination.
ii. Results of stool examination and Survey analysis.

5.1 Results of stool examination:- Out of 278 children 126 were found to be positive. Prevalence of intestinal parasite in male was 45.91% and 45.32% in female.

Table No. 1: Age and sex-wise population of interviewed respondents

Age Group (in years)	Male		Female		Total	
	Total no of respondent	Percentage (%)	Total no of respondent	Percentage (%)	Total no of respondent	Percentage (%)
1-3	35	22	25	21	60	**21.59**
4-6	34	21.39	30	25.21	64	**23.02**
7-9	48	30.19	23	19.33	71	**25.54**
10-12	19	11.95	25	21	44	**15.83**
13-15	23	14.46	16	13.45	39	**14.02**
Total	**159**		**119**		**278**	

During the study period 278 children and their guardians were interviewed. Among them 159 (57.2%) were males and 119(42.80%) were females. Maximum numbers of respondents were from age group 7-9 years and least were from 13-14 age group.
Hence, the population of patient was found higher male than female.

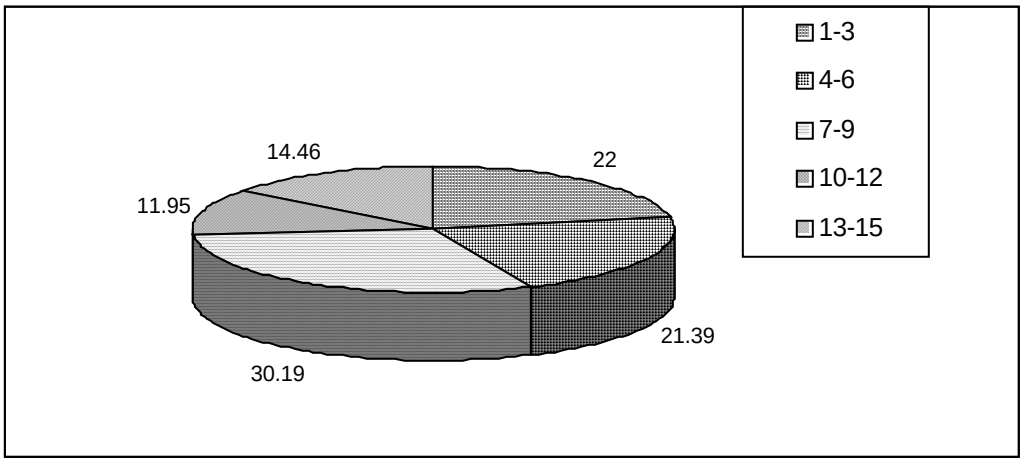

Figure 1: Age wise population of interviewed respondents

Table No. 2: Age and sex wise prevalence of intestinal parasites

	Male	Female	Total

Age Group	Total no of samples examined	No of positive samples	Per. (%)	Total no of samples examined	No of positive samples	Per. (%)	Total no of samples examined	No of positive samples	Per. (%)
1-3	35	8	22.85	25	8	32.00	60	16	26.66
4-6	34	18	52.95	30	15	50.00	64	33	51.57
7-9	48	26	54.16	23	9	39.1	71	35	49.29
10-12	19	13	68.42	25	14	56.00	44	28	63.63
13-15	23	8	37.78	16	7	43.75	39	15	38.46
Total	**159**	**73**	**45.91**	**119**	**53**	**44.53**	**278**	**126**	**45.32**

Age wise study for prevalence of intestinal parasites revealed that males and females of age 10-12 were found to be highest (63.63%)and minimum in 1-3 years age group (26.66%). Statistically the prevalence of intestinal parasites according to the age was significant ($\chi 2 = 5.21$)

From above table we can see that the male and female of age 10-12 yrs were found to be highest prevalence than other age groups. Similarly the age group of 1-3 years had least prevalence in both males as well as females.

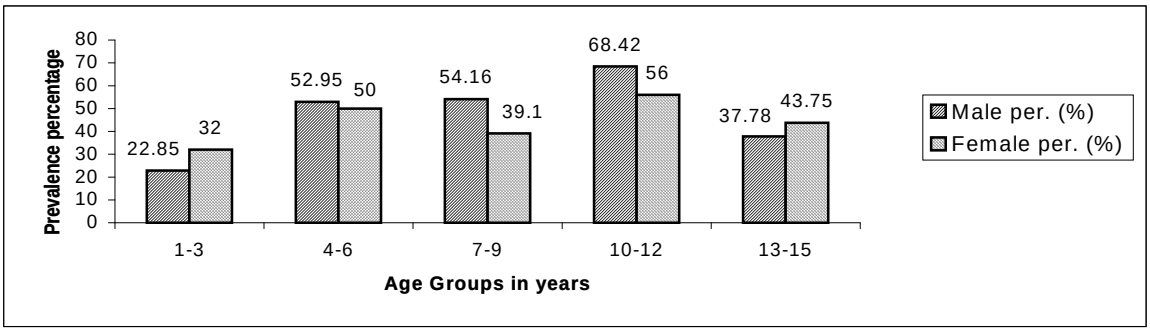

Figure 2a: Age and sex wise prevalence percentage of intestinal parasites

Sex wise study for prevalence of intestinal parasite revealed that 73 of males (45.91%) and 53 of females (44.53%) were found to be infected with the intestinal parasite.

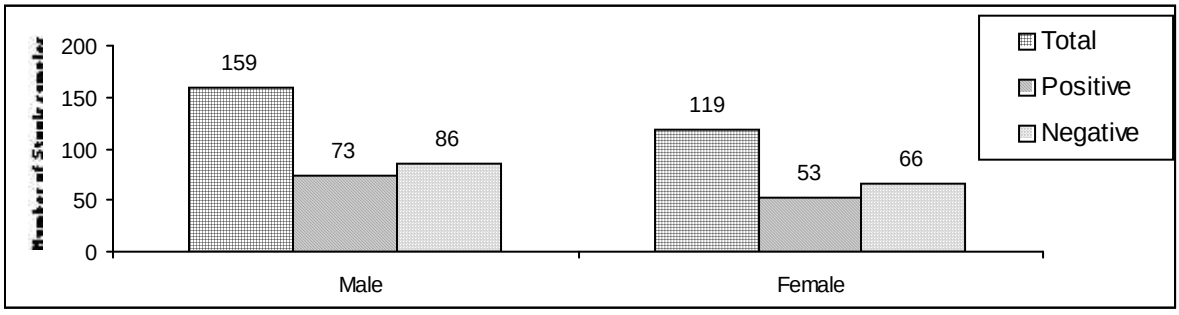

Figure 2b: Sex wise prevalence of intestinal parasites

Statistically, different in the prevalence of intestinal parasites according to the sex group was found to be significant (**$\chi 2 = 0.06$).**

Table No. 3: Sex wise prevalence percentage of single species intestinal parasites

Name of parasites	Male		Female		Total	
	No of positive cases	Percentage (%)	No of positive cases	Percentage (%)	No of positive cases	Percentage (%)
Entamoeba histolytica	7	4.40	15	12.60	22	**7.91**
Giardia lamblia	39	24.53	20	16.8	59	**21.23**
Ascaris lumbricoides	31	19.50	19	7.57	50	**17.99**
Ancylostoma duodenale	4	2.52	2	1.69	6	**2.15**
Trichiuris trichiura	3	1.89	0	0	3	**1.08**
Strongyloides stercoralis	1	0.62	3	2.52	4	**1.43**
Hymenolepis nana	1	0.62	4	3.37	5	**1.79**
E. vermicularis	3	1.89	0	0	3	**1.08**
Total	**89**		**63**		**152**	

The above table revealed that, incase of single species of parasitic infection, *Giardia lamblia* is most prevalent protozoan parasites with 24.53% and 16.8% in males and females respectively. Similarly *Ascaris lumbricoides* is most prevalent helminth parasites with 19.50% and 7.57% out of 159 and 119 stool samples in male and female children respectively.

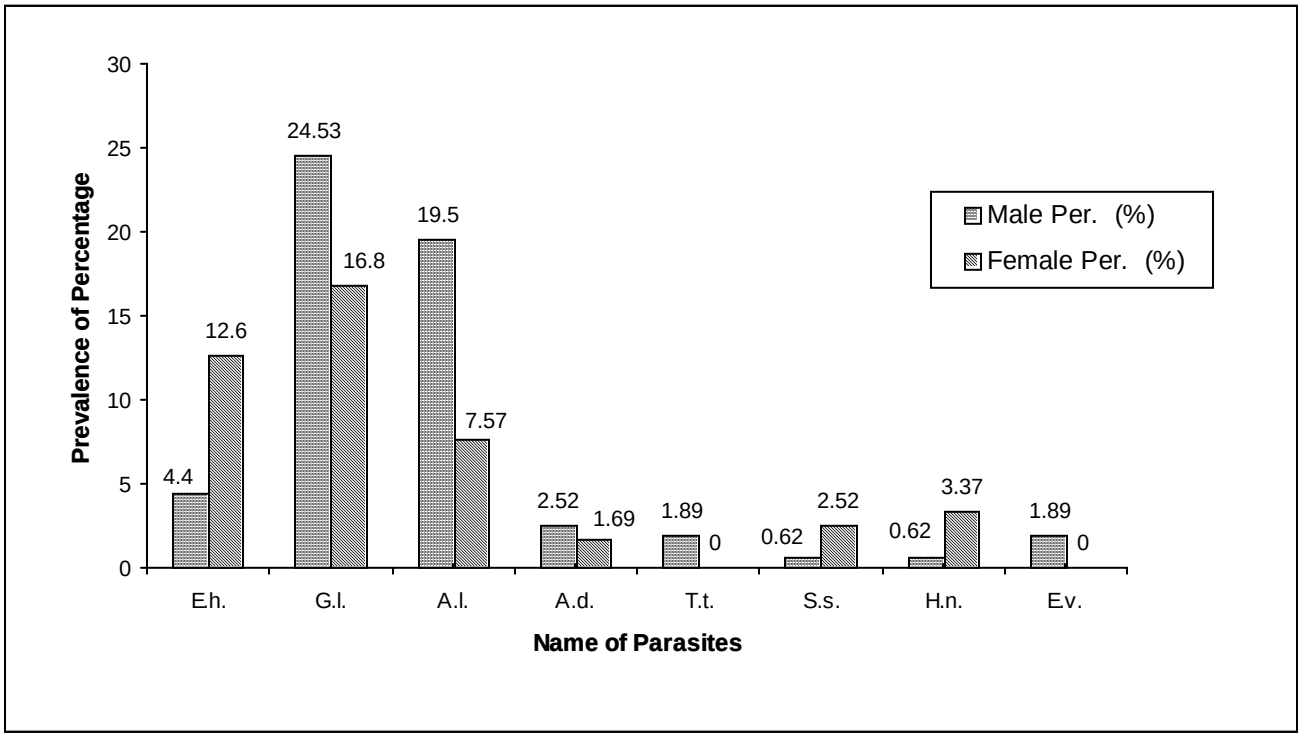

Figure 3: Sex wise prevalence percentage of single species intestinal parasites

5.2 Results of stool examination and survey analysis:- Interview was also carried out in same population of children whose stool examination was done. The children who could not answer themselves, their interview was taken with the help of parents or guardians. The results from the survey analysis and stool examination are as follows:

Table No. 4: People's way of defecation

S. No	Category	No. of respondents	Percentage (%)	No of positive samples	Prevalence %
1	Toilet	247	88.85	106	42.5
2	Pot toilet	27	9.72	12	44.44
3	Open place	14	5.03	8	57.19
	Total	**278**	**100 %**	**126**	

Out of 278 respondents, maximum 88.85% use toilet, 9.72% use pot toilet, mainly the children under age 3 years use this type of pot. Remaining children used other open places such as fields, roads etc. From the above table, maximum prevalence 57.19% is recorded in the persons who used outside for defecation.

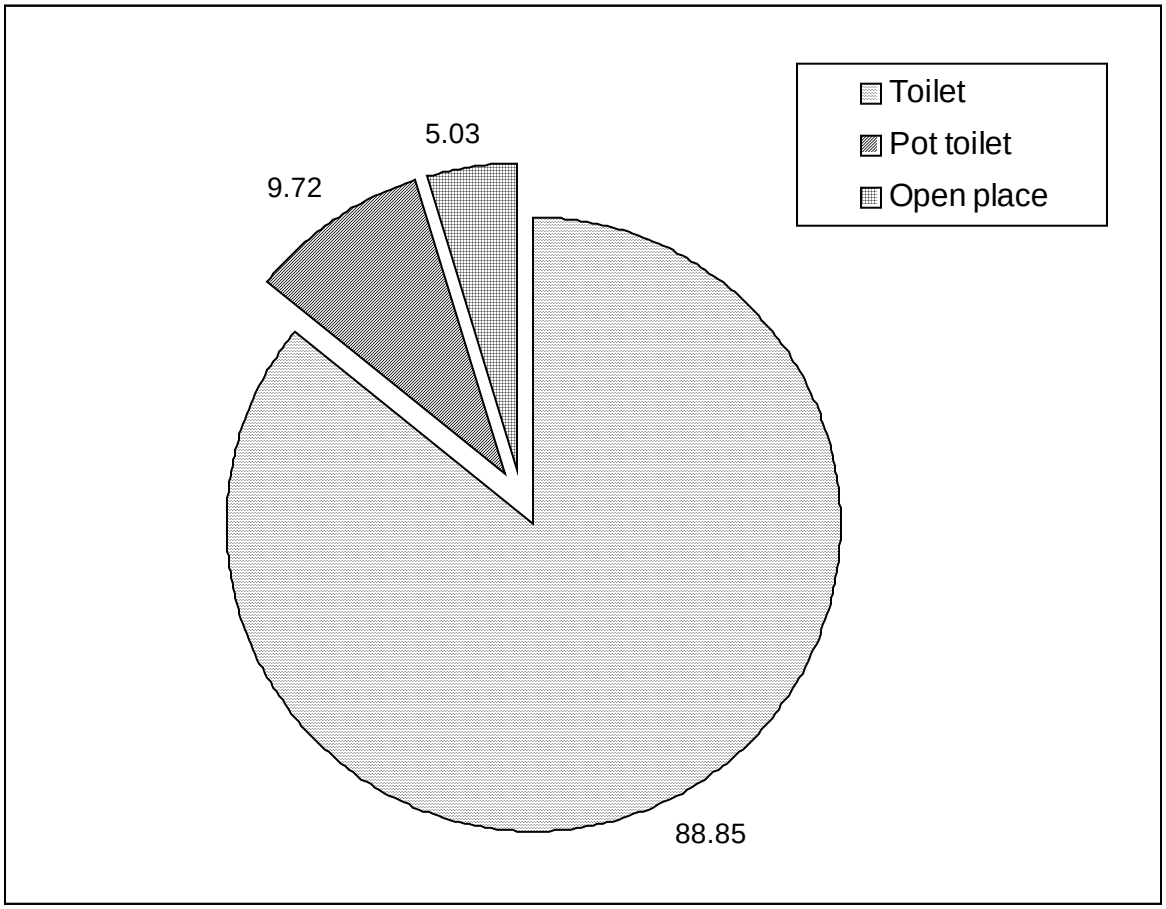

Figure 4: People's way of Defecation

Table No. 5: Drinking water used by respondents

S. No	Category	No of respondents	Percentage (%)	No of positive samples	Prevalence %
1	Direct	40	14.39	28	70.00
2	Boiled	123	44.25	37	30.89
3	Filtered	47	16.90	43	91.49
4	Boiled & Filtered	13	4.68	2	15.39
5	Chemically treated (water guard)	55	19.79	16	29.09
		278	100%	126	

Regarding the type of drinking water 14.39% respondent drink water directly with out treating. 44.25% children drink boiled water, 16.90% used only after filtering, 4.68% used water only after boiling and filtering and 19.79% used chemically treated water. The children who used water directly or only filtered they are more effected.

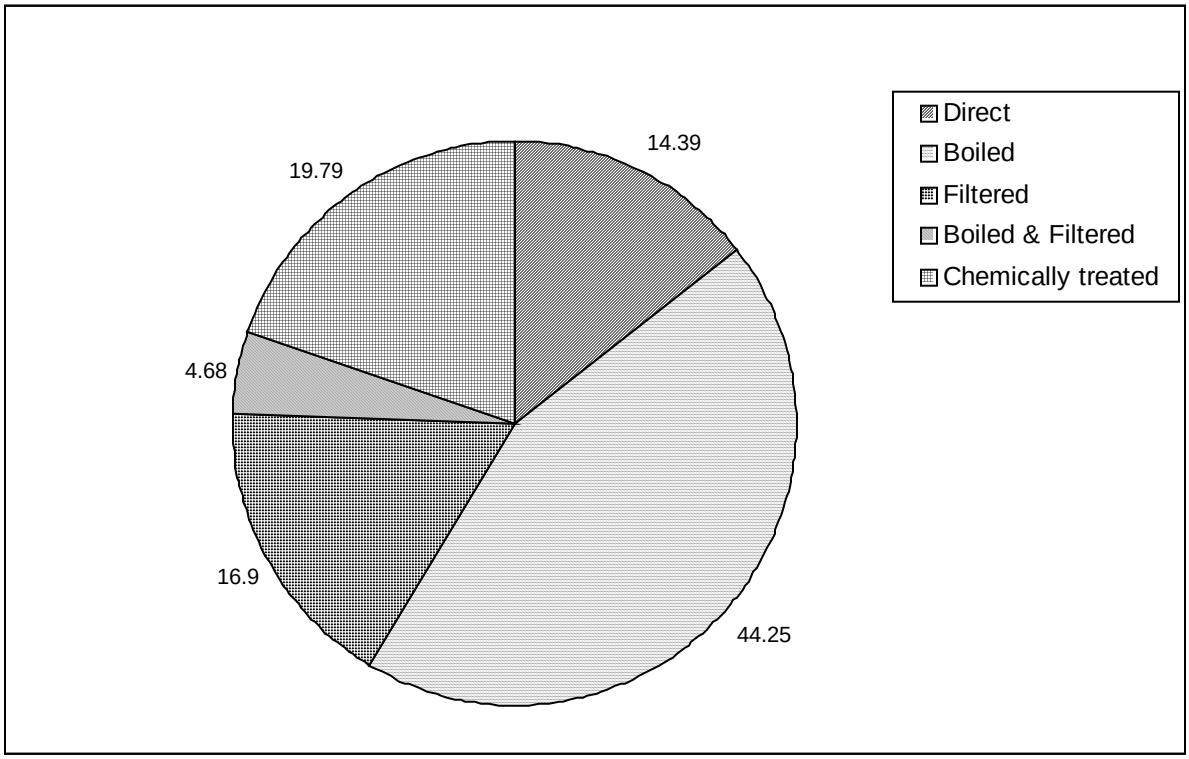

Figure 5: Drinking water used by respondents-

Table No. 6: Source of water used by respondents

S. No	Category	No of respondents	Percentage (%)
1	Tap	218	78.42
2	Tub well/well	24	8.64
3	Kuwa	5	1.8
4	Dhunge dhara	10	3.6
5	Mineral (Jar water)	7	2.52
6	Mul	14	5.04
	Total	**278**	**100%**

Regarding the sources of drinking water 219 (78.42%) use the tap water to drink, and then 8.64% children use tub well and remaining children use the other sources of water like kuwa, Dhungedhara, mul etc. Mainly water from these type of sources, like dhungedhara, mul etc are used directly i.e. with out treating.

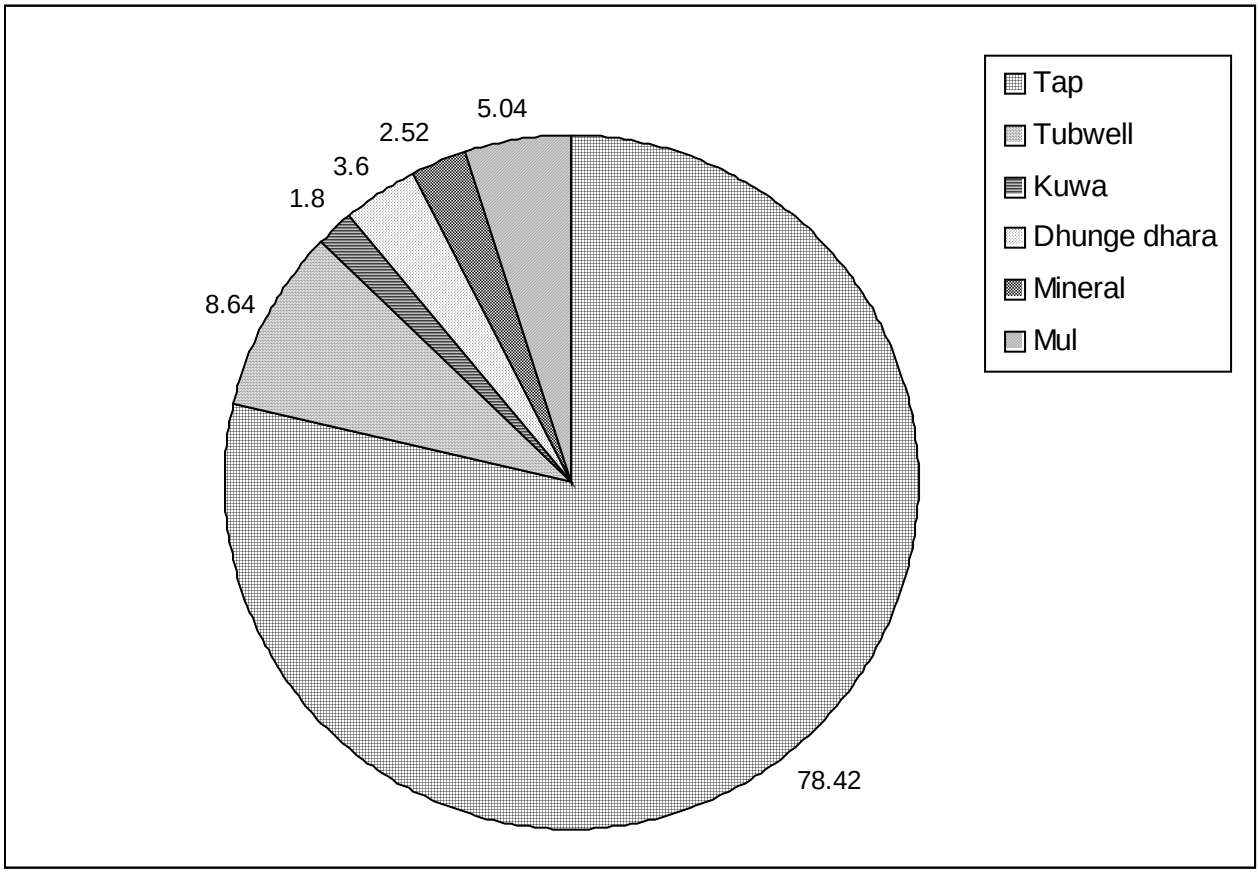

Figure 6: Source of water used by respondents

Table No. 7: Method of cleaning vegetables and fruits by respondents

S. No	Category	No of respondents	Percentage (%)
1	Washing by tap water	240	86.34
2	Rubbing by clothes	10	3.6
3	Both of above	28	10.08
	Total	**278**	**100%**

For cleaning vegetables and fruits maximum respondents (86.34%) clean vegetables and fruit by tap water or their drinking water and then 3.6% use clothes to rub the vegetables and fruits. Remaining 10.08% apply both of the above methods.

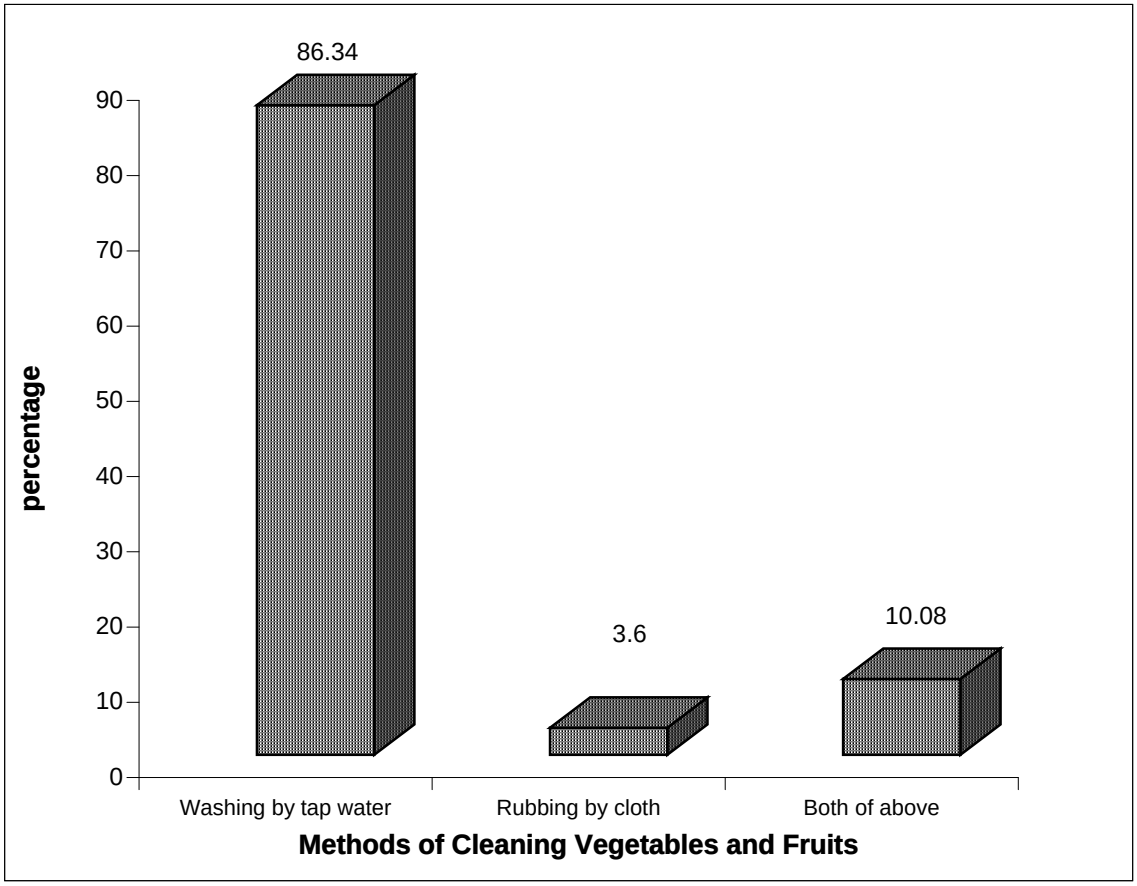

Figure 7: Method of cleaning vegetables and fruits by respondents

Table No. 8: Children habit about cleaning hand

S. No	Category	No of respondents	Percentage (%)
1	Before meal	70	25.18
2	After meal	100	35.98
3	After defecation	60	21.58
4	After playing	40	14.39
5	All of above	8	2.87
	Total	**278**	**100%**

Among 278 respondents, most of the children (35.98%) wash their hand after meal and only 14.39% children wash their hands after playing.34.18% respondents wash their hands on every time as mentioned in the above table.

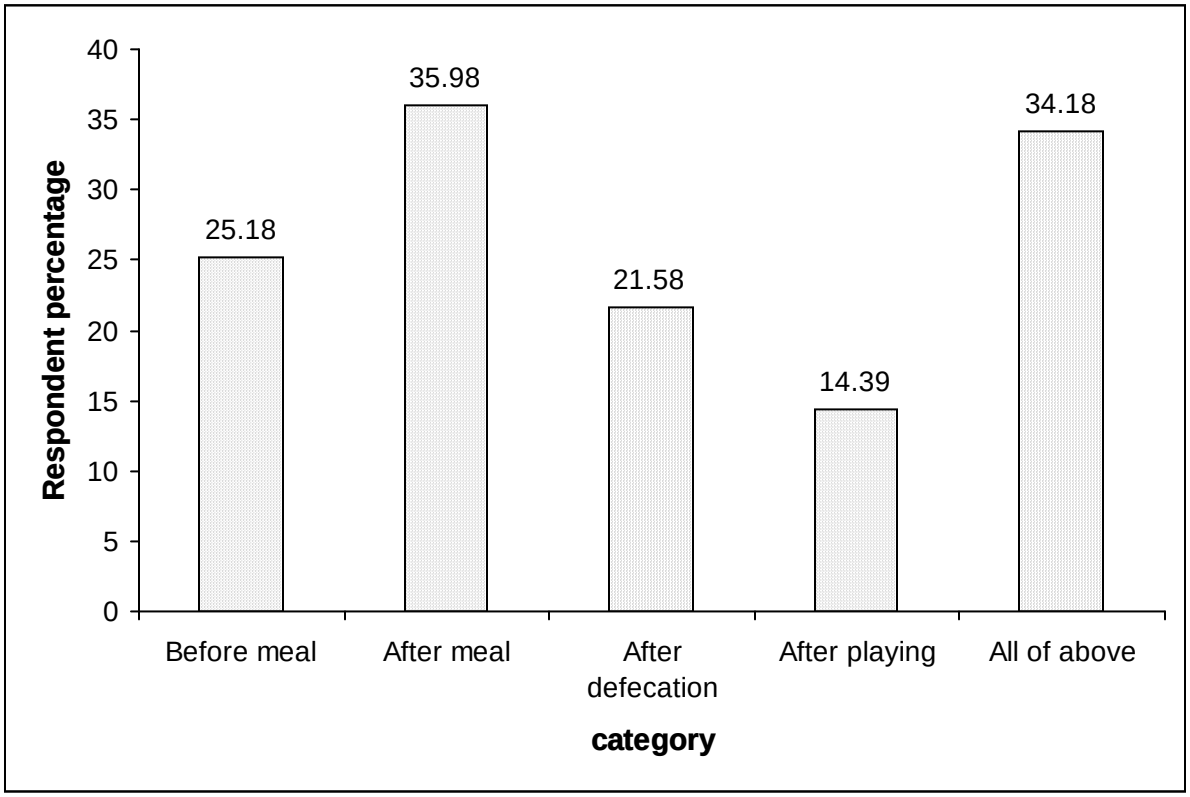

Figure 8: Children habit about cleaning hand

Table No. 9: Children habit about method of cleaning hand

S. No	Category	No of respondents	Percentage (%)	No of positive sample	Prevalence %
1	Water only	116	41.73	70	60.34
2	Soap and water	127	45.69	40	31.49
3	Both of above	35	12.59	16	45.72
	Total	**278**	**100%**	**126**	

Out of 278 children, 45.69% used soap and water to clean their hands, 41.73% used only water for washing hand and remaining 12.59% used both methods. From above table it is known that the children who used only water for cleaning they are more affected by parasites
(60.34%).

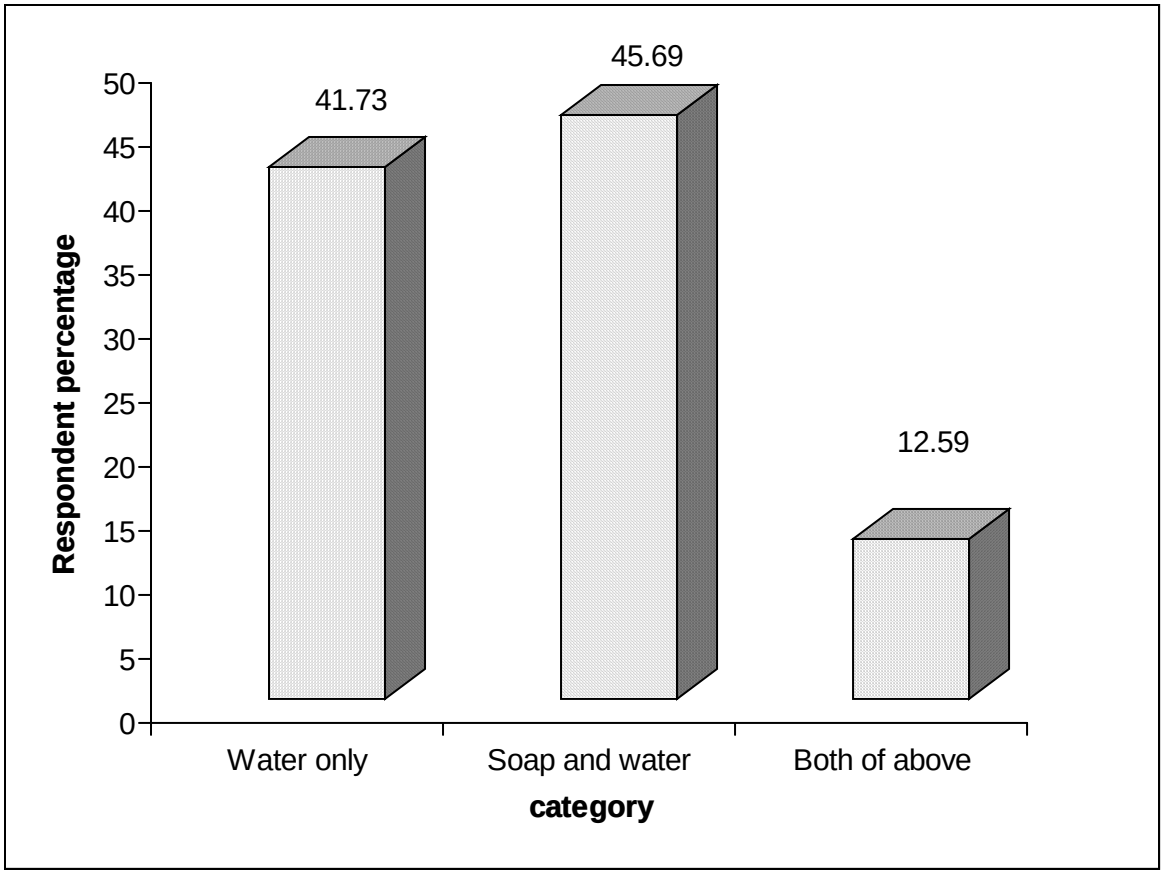

Figure 9: Children habit about method of cleaning hand

Table No. 10: Children habit about cutting nails

S. No	Category	No of respondents	Percentage (%)	No of positive samples	Prevalence %
1	Ones a week	170	61.16	72	42.35
2	Twice a month	70	25.18	33	47.14
3	Once a month	30	10.8	15	50
4	Irregularly	8	2.9	6	75
	Total	**278**	**100%**	**126**	

The analytical study of the table shows that out of 278 respondents 61.16% cut their nails once a week. 25.18 cut twice a month and then 10.8 per. once a month and 2.9 % re irregular in nail cutting habit. The children who are irregular in nail cutting habit they are more (75%) affected. The children who pay attention in regular nail cutting habit i.e. once week are least (42.35%) affected.

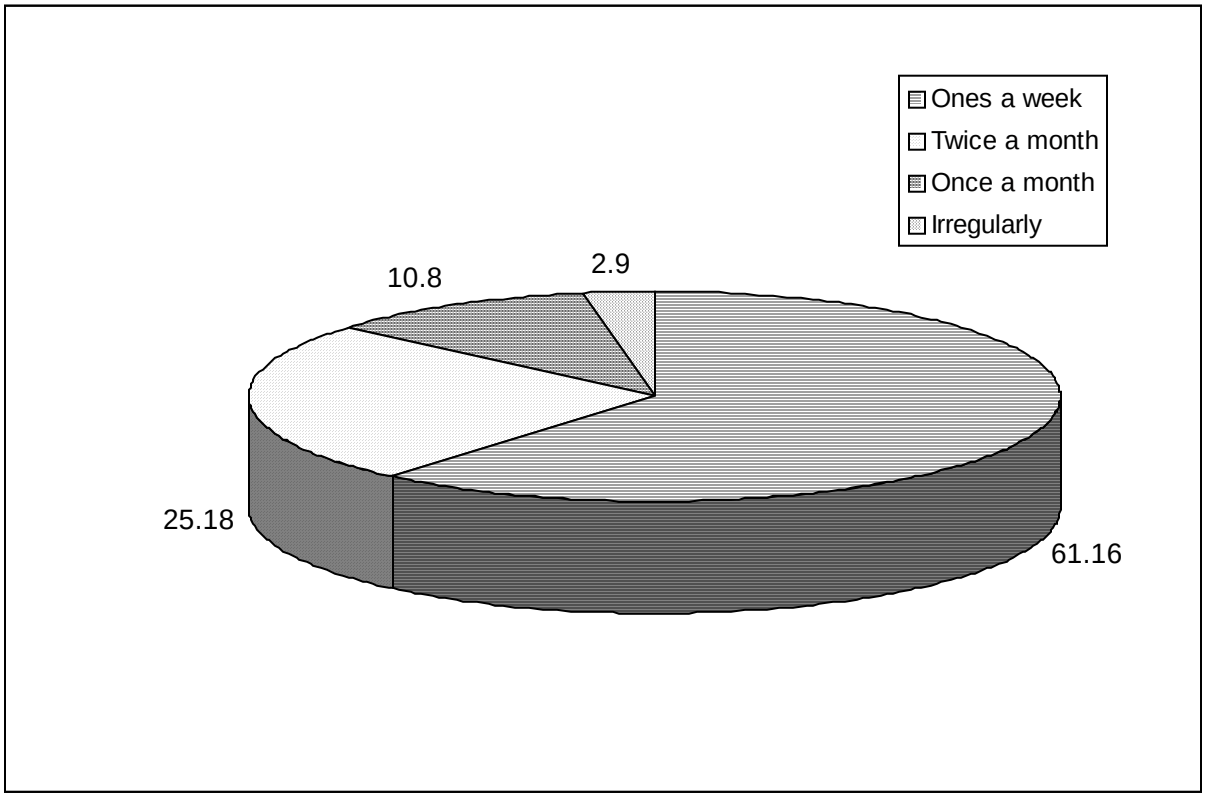

Figure 10: Children habit about cutting nails

Table No. 11: Caste-wise prevalence of intestinal parasites

S.N.	Cast	Total no of sample examined	No of positive sample	Prevalence
1	Brahman &Chettri	138	61	**44.20**
2	Gurung &Magar	26	16	**61.54**
3	Rai & Limbu	14	7	**50.00**
4	Lama, Tamang & Sherpa	28	16	**57.14**
5	Newar	25	9	**36.00**
6	Dalit	13	9	**69.23**
7	Other (Muslim, Chepang, Darai, Chaudhary)	34	8	**23.52**
	Total	**278**	**126**	

The analytical study of table shoes that out of 278 stool samples collected, 138 from Brahmin and Chettri, 26 from Gurung and Magar, 14 from Rai and Limbu, 28 from Lama, Tamang and Sherpa, 25 from Newar, 13 from Dalit and 34 from other communities. The study has shown that children from Dalit community have the highest prevalence of intestinal parasites 69.23% followed by Gurung and Magar 61.54%, Remaining prevalence rate in different cast is given in above table in detail.

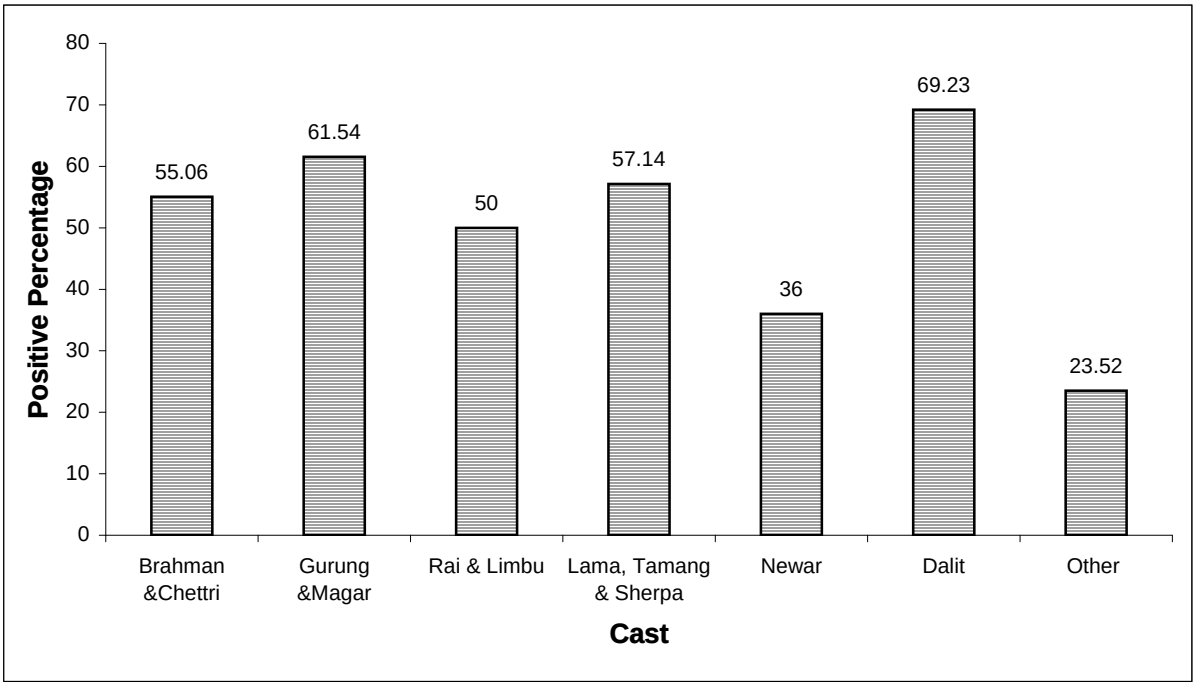

Figure 11: Caste-wise prevalence of intestinal parasites

Table No.: 12 Vegetarian and Non-vegetarian Respondents

It has maximum prevalence of intestinal parasites who used meats of different types.

S. No	Category	No of respondents	Percentage (%)	No of positive samples	Prevalence %
1	Buff only	4	1.43	1	25
2	Chicken only	6	2.16	2	33.33
3	Mutton only	33	11.87	9	27.28
4	Mutton, chicken, Buff and Pork	13	4.68	6	46.15
5	Buff & Chicken	7	2.51	2	28.58
6	Mutton & Chicken	97	34.89	43	44.33
7	Buff, Chicken & Mutton	88	31.65	50	56.81
8	Buff, Chicken & Pork	1	0.36	1	100
9	Mutton, Chicken & Pork	6	2.16	3	50
10	Mutton & Buff	7	2.51	3	42.85
11	Chauri, Mutton & Sheep	1	0.36	1	100
12	Vegetarian	15	5.39	4	26.67
	Total	**278**	**100%**	**126**	

Regarding food habits, most of the respondents (94.60%) were non -vegetarian that is very high compared to vegetarian (5.39%). Out of 263 non-vegetarians (34.89%) eat mutton and chicken, followed by Buff, chicken and mutton 31.65% and mutton only 11.87%. Detail of food habit and prevalence is given in above table.

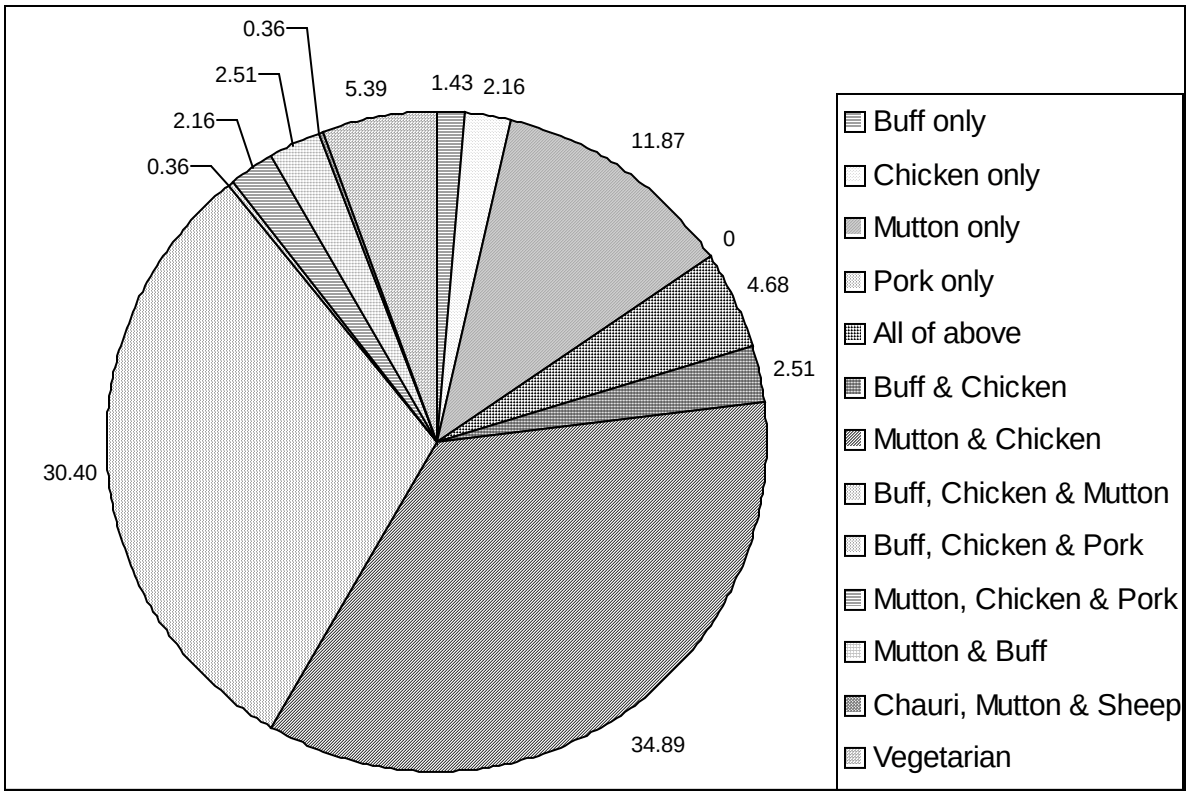

Figure12: Vegetarian and Non-vegetarian Respondents

Table No. 13 People's Experiences of Gastrointestinal symptoms

S. No	Category	No of respondents	Percentage (%)
1	One week before	3	1.08
2	Two week before	4	1.43
3	One month before	16	5.76
4	Three month before	25	8.99
5	Six month before	55	19.79
6	One year before	80	28.78
7	Don't know	95	34.18
	Total	**278**	**100%**

Regarding intestinal parasitic diseases, most of the respondents had already been suffered from such diseases. Experiences of intestinal parasitic diseases by respondents are tabulated above according to the time they have experienced.

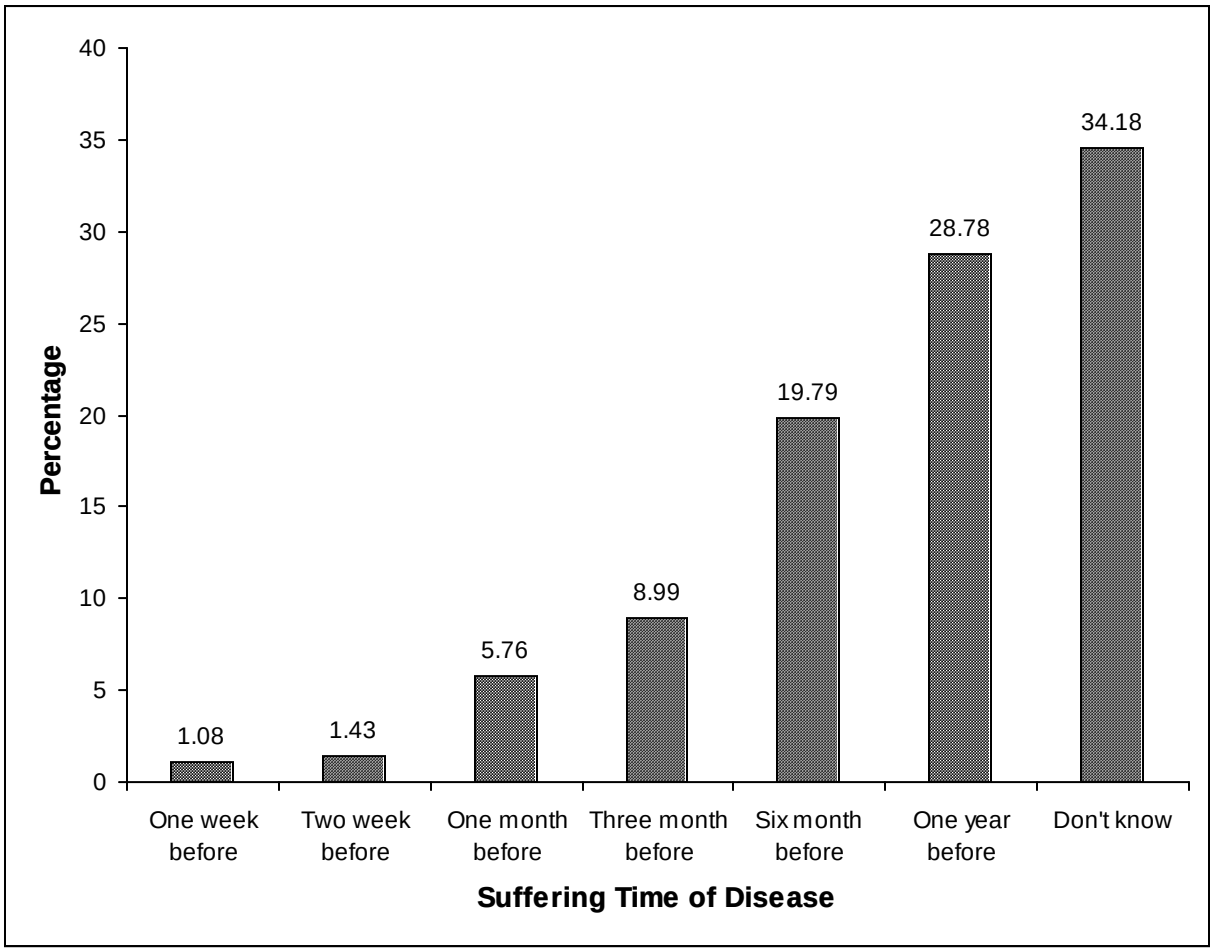

Figure 13: People's Experiences of Intestinal parasitic disease

CHAPTER-6
DISCUSSION AND CONCLUSION

Intestinal parasitic diseases are ranked among 20 most fatal infections in tropical countries of Asia, Africa and Latin America in 1977-1978 (Davis, A. 1980). 50 different species of intestinal parasites can infect human beings. They are posing serious health problems in developing countries as Nepal, where illiteracy, ignorance and poverty are interlocked. *Ascaris lumbricoides, Trichuris trichiura* and hookworms are the major helminthic parasites where as *Giardia lamblia* and *Entamoeaba histolytica* are the major protozoan parasites (Warren and Mahmoud 1984, Walsh 1984).

The importance of intestinal parasite thus can be judged by the great surveillance rate among the population of the world and amount of money spent for curative and preventive measures against these parasites.

In the present study, the prevalence of intestinal parasites was found 45.32%. This prevalence was lower than those reported in other studies as 87.5%, Sharma *et al.,* 1971, 95.3%, Nepal *et al.,* 1980, 89.0%, IFPPCP, 1985, 67.4% Gupta *et al.,* 1988, 81.9%, Shrestha, 2001, 76.4%, Rai *et. al.,* 2001, 60.0%, Rai *et al.,* 2002, 76.6%, Chaudhari B, 2004, 66.9%, Karki *et al.,* 2004, 77.1%, Parajuli R, 2004, 67.4%, Ghimire *et al.,* 2006 in different areas of Nepal and is probably higher than reported from previous studies (30.9%, Rai *et al.,* 1991, 44.0%, Yong *et al.,* 2001, 40.8%, Jha A., 2004, 42.0%, Ghimire *et al.,* 2005). The difference in the present prevalence from these studies might be due to the different materials and methods, different types of observed patients, different seasons, different parasites and other unknown factors.

The present study revealed that 45.32% of the children were infected by different kinds of intestinal parasites in which 45.91% were the male children and 44.53% were the female children. It is so because equally possibilities of transmission of parasites among children due to over dispersion of parasites in all communities.

The findings of Rai *et al.,* (2002) and Chaudhary (2003) were also close to these findings.

Total positivity was 126 among 278 stool sample examined. This positivity contains seven types of intestinal parasites *A. lumbricoides* 17.19%, *Ancylostoma duodenal* 2.15%, *S. stercoralis* 1.43%, *T.trichiura* 1.08%, *H.nana* 1.79% *G.lamblia* 21.23% and *E. histolytica* 7.91%. These parasites were also reported by Sherchand *et al.*, 1997 in rural area of Dhanusha district, Chaudhary (2003) in rural area of Kirtipur, Maharjan K. (2004) in Kirtipur and Pokhrel Y (2005) in Chepang of Gorkha district, Ghimire *et al.,* (2005) in Kirtipur and Chitwan and Ghimire *et al.,* (2006) in Sukra Raj Tropical and Infectious Disease Hospital, Teku, Kathmandu.

Regarding the protozoan parasites prevalence of *G. lamblia* was highest 21.23%, followed by E. histolytica, which resembles with finding of Sherchand *et al.*, (1997) and Chaudhary (2003) Maharjan K (2004). Sherchand *et al.,* (1997) reported 9.9% *G. intestinalis*, 7.2% *E. histolytica* while Chaudhary found 11.4% *G. intestinalis* 8.8% of *E. histolytica* and then Maharjan K. (2004) found 19.55% *G. lamblia* 7.69% *E. histolytica.* According to FPA School Health Program, *G. lamblia* was most prevalent intestinal parasites followed by *E. histolytica* in school Children of Kirtipur area. As these protozoan parasites transmit very easily through contaminated food and water the prevalence rate during endemic season are found to be maximum. According to Geollmann's finding in Patan Hospital during the prevalence rate of E. *histolytica* 1.7% and *G. lamblia* 2.7% during 1986-1987. Nepal and Palfy (1980) reported that *E. histolytica* (28.8%) and *G. lamblia* (28.4%). Other studies also obtained that *G. lambia* is the most common protozoan parasite in Nepal (Chaudhary 2003, Khetan 1977-1980, Rai *et al.,* 1991, Sherstha 1995).

Among the helminths parasites, previous several studies have shown that hookworm infection was the most common helminthes infection in Nepal (Esteven *et al.,* 1983, Navisky *et al.,* 1998). Some of the other studies also shows that *A.*

lumbricoides is the most common intestinal helminth parasite in Nepal (Geollman 1986, Rai et al., 2001 and Chaudhary 2003 and Maharjan 2004). The present study also provided the similar result that *A. lumbricoides* was most prevalent helminth parasite (17.99%) followed by *Ancylostoma duodenale* (2.15%), *H. nana* (1.8%), *S. stercoralis* (1.43%), *T. trichiura* (1.08%) and *E. vermicularis* (1.08%). This study coincides with Maharjan K. 2004 and Gupta *et al.,* (1988) in Kirtipur, where the prevalence of *A. lumbricoides* was found to be most (40%) in Gupta *et al*., (1988) and 24.04% in Maharjan K. (2004).

According to WHO, infection by soil-transmitted helminthes has been increasingly recognized as an important public health problem, particularly in developing countries. Fujita *et al.,* (1993) carried out an epidemiological survey for parasitic infection. Parasites were detected in 270 faecal samples, 57.4% of these specimens showed single infection 28.1% showed double infection, 9.6% triple, 4.1% quadruple and 0.4% quintuple infection. Likewise, Parajuli (2003) reported 32.8% single infection, 21.9% double infection and 45.3% multiple infection from Malpur VDC of Chitwan district.

Regarding the age group the high prevalence was found in 10-12 (63.36%) years age group. As children of this age group mostly spent their time outside the house playing in and outdoor games and are in contact with soil as well as water which might easily transmit intestinal parasites. At this age their parents also leave them free and they don't care about their hygiene so carefully. They also think that the children are able to take care of their health and hygiene but their children in this age are careless and they don't follow their guardians and they become more infected. The minimum prevalence was observed in children of age group 1-3 (26.20%) years. This low prevalence may be because of breast feeding and taking care by their mother properly. Besides, this age group has low chance to expose to source of infection as well as they gain immunity from their mother. This result is coincided with Rai *et al., (*1991), Chaudhary B, (2003), Maharjan (2004), Pokhrel YB, (2005). Pokhrel Y.B. reported that 100% prevalence was found in 10-12 years

age group. Maharjan 2004 also support this result, where it was reported that maximum (57.61%) children of age group (9-12) years were found to be more infected while minimum prevalence was observed in children of age group 3-4 years (9.8%). In present study, in there is no significant variation in infection was observed statically in other age groups (χ^2=15.21, p>0.05 at 4 d.f). This result coincides with Maharjan (2004).

The World Health Organization noted that human behaviour may influence the prevalence and intensity of intestinal infection (WHO, 1981). Such as open air defecation and cultural practices such as growing vegetables in faecally polluted gardens were found to be contributing factors in transmission of parasites. Polluted water, infected meat (raw meat) and bare footed are also conductive to the transmission (Sherchand *et. al.*, 1995 and shield 1987).

Defecation near the water stream, kuwa and kholsa also serve to contaminate the water source responsible for parasitic infection. During surveillance study regarding the use of toilets, 88.85% use the toilets, and 9.72% age group 1-3 years use pot toilets and the 5.03% use open places such as fields, roads and their surrounding of houses.

Regarding to the drinking water 78.78% respondents use tap water for drinking. Among them 14.39% drink tap water directly with out treating it. 44.25% respondents used boiled water. Children use kuwa, dhungedhara, minerals water and mul for drinking purposes where there is no available of tap water. 21.6% of respondents use these types of water sources. According to them water from dhungedhara and mul is used directly without treating 4.6% of respondents used water both filtering and boiling. 16.90% of respondents use water only filtering.17.79% of respondents use water after by chemical, mainly Waterguard (water purifier) is used by them.

Regarding the behaviour of washing their hands, only 34.18% properly after every occasion, such as defecation, working, playing in dust and before meal. While remaining respondents 45.69% do not give more priority in washing hands. 58.26% respondents use soap and water to wash their hands. Negligence in cleaning hand and foot is one of the causes of parasitic infection. According to Olsen *et al.*, (2001), households with out soap had a 2.6 times higher risk of being infected with parasites.

From the interview it was found that in habit of cleaning fruits and vegetables 86.34% use it only after cleaning with water. 3.6% respondents rub vegetables and fruits with their clothes and use it.

Regarding to the behaviour of cutting nails 61.16% cut regularly i.e. once a week. Remaining respondents 25.18% cut only twice a month. 10.8% cut once a month and 2.9% cut irregularly sometimes once a week sometimes once a month etc. One thing we can say that long nail gives the settlement for the egg or larval stage of the parasite. Even washing hand with soap is not sufficient to remove them from nail. With meal they enter the body so long nail helped in acceleration of prevalence of parasites.

Domestic animals serve as the reservoir or primary host of certain intestinal parasites and also create unhygienic conditions, which help the vectors to survive and also to transmit the parasites.

Taking the subject of food, prevalence of intestinal parasite is directly affected by feeding habit of people. In present study among 278 children, 263 were non-vegetarian and 15 were vegetarian. Among them 122 (46.38%) non-vegetarian and 4 (26.38%) vegetarian were found positive to intestinal parasites (χ^2=2.23, 1 d.f.). According to Chaudhary (2003), there was not significant difference in prevalence of parasites in vegetarian and non-vegetarian. Besides, Maharjan K.P. (2004) showed that distribution of intestinal parasite is independent on food habit.

A survey of perception and treatments of helminthes in Bangladesh indicated that 22% of the sample of Bangladeshi mothers had no idea how individuals become infected with roundworm, hookworm and whipworm and 38% of sample had no suggestions for strategies to prevent worm infection. Similarly a study of Brazilian people living in the municipality of Carlos in the state of Sao Paulo, an area endemic for soil transmitted helminthes contract soil transmitted infection (William Blangero et al; 1998) Similar results were observed during the surveillance study of present study work.

In this study, it was tried to know the methods of treatments on intestinal discomfort, 200 respondents (71.95%) were used to visit hospitals or private clinics to consult with doctors while 15.1% go on both doctor and traditional method. They practice both method and remaining 12.95%use medicine directly with out consultation.

Only taking anti-helminthes drugs in certain period of time (3months or 6 months) decreases the more percent of helminthes infection. 1-5 years children are provided anti-helminth drug by government with vitamin A capsule for free in every six months. Remaining others, only a few used to take anti- helminthic drugs at a certain interval of time.

Every cast has their typical traditions and cultures. Their culture may be also responsible for prevalence of intestinal parasites. Like in Newar community and some other casts mainly use buff. It is cheaper than other types and they use more. In Newar community they prepare different kind of meat varieties such as kachila, chhengula, chowela, sekuwa etc. Among them kachila and chengula are consumed without cooking. Consumption of such type of meat adds to the infection rate of intestinal parasites. The infected patients were advised to use anti-helminthic drugs by the physician. During survey guardian were given various information

and ideas about the causes and prevention measures of gastrointestinal parasitic diseases. They were also suggested to not to leave their children to play in dust and they were also suggested to examine the stool in the interval of every six-month.

Hence extensive study is needed for the determination of epidemiological and etiological factors that cause the high prevalence.

CHAPTER-7

RECOMMENDAION

From this study, following recommendations are constructed for better prevention and control of intestinal parasites in Nepal.

1. Mass awareness should be developed regarding the sanitation, personnel hygiene healthy eating habits and safe drinking water and people should be encouraged for sanitary improvements.
2. Children should be encouraged to use latrine for defection.
3. Mass treatment and individual treatment of all the individuals of the locality should be given importance and followed from time to time.
4. Mainly children may use book only with the point of examination so we have to give them emphasis to use knowledge in practical life. When stool test for students conducted in school it will be better to relay information to parents for the preventive measures and parents should be also informed about transmission and development of parasite.
5. Animal husbandry should be managed by launching training program.

6. High-skilled and sufficient manpower and latest equipments should be provided to Pathology Lab of hospital.
7. The research works on the prevalence of intestinal parasites and prevention should be encouraged.

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ANNEX-1

QUESTIONARE

Name..... Address.....

Age..... Sex.....

Profession of father..... No of family member.....

1. In which level do your child read?
   a. Playing age b. Primary c. Lower Secondary d. Secondary
2. Are you literate?
   a. Yes b. No
3. Where does your child defecate?
   a. Toilet b. Pot toilet c. Open place
4. Where do you get drinking water for family?
   a. Tap b. tub well c. kuwa d. Dhungedhara
   e. Mul f. Others
5. How do you drink water?
   a. Direct tap water b. Boiled c. Filter d. Boiled and filter
   e. Using chemical f. Others
6. How do you clean vegetables?
   a. Rubbing on clothes b. Washing with water c. With out washing
7. Do your child wash hand regularly?
   a. Yes b. No
8. If yes when does your child wash hands?
   a. Before meal b. After meal c. After defecation
   d. After playing e. All of above
9. What does your child use to clean hands?
   a. Water b. Soap and water
11. Does your child cut nail regularly?
    a. Yes b. No
12. If yes, when?
    a. Once a week. b. Twice a month c. Once a month
    d. Randomly

13. Do you have animal husbandry?
    a. Yes b. No
14. If yes what type?
    a. Cow b. Buff c. Goat
    d. Pig e. Pet
15. Does your child eat meat?
    a. Yes b. No
16. If yes what type of meat he/she eat frequently?
    a. Mutton b. Chicken c. Buff
    d. Pork e. Others
17. Has your child taken deworming tablet before?
    a. Yes b. No
18. If yes, when?
    a. One week before b. Two week before c. One month before
    d. Three month before e. Six month before
19. How do you treat in case of illness?
    a. Direct taking method b. Consult doctor c. Traditional method

ANNEX-2

HYPOTHESIS TESTING

1. IN RELATION TO AGE AND POSITIVITY OF INTESTINAL PARASITES

Contingency Table of Age and Positivity of Intestinal Parasites

S.N.	Age Group (Years)	No of positive samples	No of Negative samples	Total
1	1-3	16	44	60
2	4-6	33	31	64
3	7-9	35	36	71
4	10-12	27	17	44
5	13-15	15	24	39
	Total	**126**	**152**	**278**

Formulation of Hypothesis

Null Hypothesis- H0:- Intestinal parasites positivity is independent on age.

Alternative Hypothesis- H1:- Intestinal parasites positivity is dependent on age.

Level of significance is taken as 5%

Degree of freedom (c-1) (r-1)

= (2-1) (5-1)

= 4

Test statistic: - χ^2

Where $\chi^2 = \Sigma ((O- E)^2 /E)$

Computation of Expected Frequency

S.N.	Age group	Expected frequency (positive)	Expected frequency (negative)	Total
1	1-3	27.20	32.80	60
2	4-6	29	35	64
3	7-9	32.18	38.82	71
4	10-12	19.94	24.06	44
5	13-15	17.68	21.32	39

Computation of ¡ ²

S.N.	Observed frequency (O)	Expected frequency (E)	(O-E)	(O-E) ²	(O-E) ²/E
1	16	27.20	-11.2	125.44	4.61
2	33	29	4	16	0.55
3	35	32.1	2.9	8.41	0.26
4	27	19.94	7.06	49.85	2.51
5	15	17.68	-2.68	7.18	0.40
6	44	32.80	11.2	125.44	3.83
7	31	35	-4	16	0.45
8	36	38.82	-2.82	7.95	0.20
9	17	24.06	-7.06	49.84	2.07
10	24	21.32	2.68	7.18	0.33
					Σ ((O- E) ² /E) =15.21

Calculated value of χ^2 =15.21. Here degree of freedom =d.f. = 4

The calculated value of χ^2 for 4 d.f. at 5% level of significance is (9.488), it is highly significant ($p<0.05$) and hence null hypothesis is rejected i.e. distribution of positivity of intestinal parasite is dependent on age group.

2. IN RELATION TO SEX AND POSITIVITY OF INTESTINAL PARASITES

Contingency Table of Sex and Positivity of intestinal parasites.

S.N.	Sex	No of positive samples	No of negative Samples	Total
1	Male	73	86	159
2	Female	53	66	119
	Total	**126**	**152**	**278**

Formulation of Hypothesis

Null Hypothesis: - H_0 – Intestinal parasites positivity is independent on sex.

Alternative Hypothesis – $H_{1:}$ - Intestinal parasites positivity is dependent on sex.

Level of significance is taken as 5%

Degree of freedom (d.f.) = (c-1) (r-1)

= (2-1) (2-1)

= 1

Test statistic: χ^2

Where $\chi^2 = \Sigma ((O- E)^2/E)$

S.N.	Observed frequency (O)	Expected frequency (E)	(O- E)	(O-E) ^{2}	((O- E(O- E)^2/E
1	73	72.07	0.93	0.86	0.02
2	53	53.93	-0.93	0.86	0.02
3	86	86.93	-0.93	0.86	0.02
4	66	65.07	0.93	0.86	0.02
					$\Sigma ((O- E)^2/E)= 0.06$

Calculated value of χ^2 =0.06, here degree of freedom = d.f. = (2-1) (2-1) = 1

The tabulated value of χ^2 for 1 d. f. at 5% level of significance is 3.841. Since calculated value of χ^2

(0.06) is less than tabulated value of χ^2(3.841) for 1 d. f. at 5% level of significance, it is significant (p> 0.05) and hence null hypothesis is accepted i.e. distribution of intestinal parasite is independent on whether sex is male or female.

3. IN RELATION TO FOOD HABIT AND POSITIVITY OF INTESTINAL PARASITES.

Contingency Table of Food Habit and Positivity of Intestinal parasites.

S.N.	Food Habit	Positive samples	Negative samples	Total
1	Vegetarian	4	11	15
2	Non- vegetarian	122	141	263
	Total	**126**	**152**	**278**

Formulation of Hypothesis: -

Null Hypothesis- H_0: - Intestinal parasites positivity is independent on food habit.

Alternative Hypothesis- H_1: - Intestinal parasites positivity is dependent on food habit.

Level of significance is taken as 5%

Degree of freedom (d.f.) = (c-1) (r-1)

= (2-1) (2-1)

= 1

Test statistic: - χ^2 where, $\chi^2 = \Sigma ((O- E)^2/E)$

S.N.	Observed frequency (O)	Expected frequency (E)	(O-E)	$(O-E)^2$	$(O-E)^2/E$
1	4	6.8	-2.8	7.84	1.16
2	122	119.2	2.8	7.84	0.07
3	11	8.20	2.8	7.84	0.96
4	141	143.8	-2.8	7.84	0.06
				$\Sigma (O- E)^2/E = 2.25$	

Calculated value of $\chi^2 = 2.25$, here degree of freedom, d.f. = (2-1) (2-1) = 1.

The tabulated value of χ^2 for 1 d. f. at 5% level of significance is 3.841. Since calculated value of χ^2 (2.25) is less than tabulated value of χ^2 (3.841) for 1d.f. at 5% level of significance, it is insignificant and hence null hypothesis is accepted, i.e. distribution of intestinal parasite is independent on food habit.

4. IN RELATION TO CASTE AND POSITIVITY OF INTESTINAL PARASITES.

S.N.	**Caste**	**No of positive samples**	**No. of negative samples**	**Total**
1	Brahman and Chettri	61	77	138
2	Gurung and Magar	16	10	26
3	Rai and Limbu	7	7	14
4	Lama, Tamang & Sherpa	16	12	28
5	Newar	9	16	25
6	Dalit	9	4	13
7	Others	8	26	34
	Total	**126**	**152**	**278**

Formulation of Hypothesis:-

Null Hypothesis- H_0:- Intestinal parasites positivity is independent on caste.

Alternative Hypothesis- H_1:- Intestinal parasites positivity is dependent on caste.

Level of significance is taken as 5%.

Degree of freedom (d.f.) = (c-1) (r-1)

= (2-1) (7-1)

= 6

Test statistic: χ^2

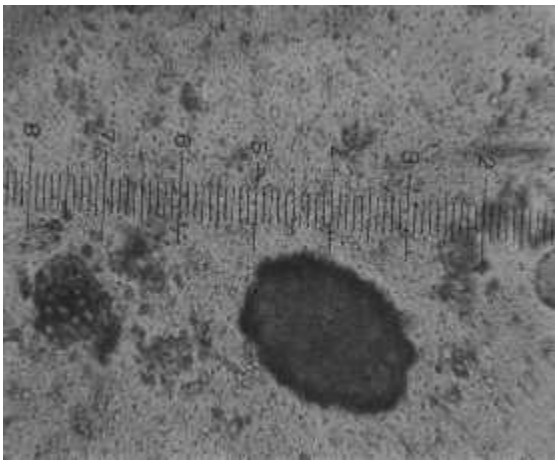
Where, $\chi^2 = \Sigma ((O- E)^2/E)$

Computation of ¡ ²

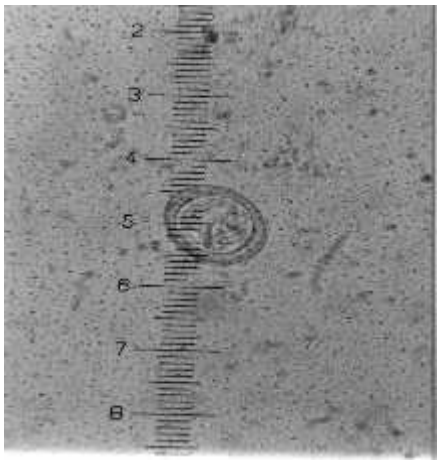
S.N.	Observed frequency (O)	Expected frequency (E)	(O- E)	(O-E) ²	¡ ² ¡ ²(((O- E) ²/E
1	61	62.55	-1.55	2.40	0.039
2	16	11.79	4.21	17.73	1.50
3	7	6.35	0.65	0.43	0.067
4	16	12.7	3.3	10.89	0.86
5	9	11.33	-2.33	5.43	0.48
6	9	5.9	3.1	9.61	1.63
7	8	15.41	-7.41	54.9	3.57
8	77	75.45	1.55	2.40	0.03
9	10	14.21	-4.21	17.73	1.25
10	7	7.65	-0.65	0.43	0.056
11	12	15.3	-3.3	10.89	0.72
12	16	13.67	2.33	5.43	0.4
13	4	7.1	-3.1	9.61	1.36
14	26	18.59	7.41	5.41	2.95
					Σ ((O- E) ²/E)= 14.92

Calculated value of χ^2 =14.92. Here degree of freedom = 6

The tabulated value χ^2 for 6 d.f. at 5% of significance is 12.592. Since calculated value of χ^2 (14.92) is greater than tabulated value of χ^2(12.592) for 6 d.f. at 5% level of significance, it is significant and hence null hypothesis is rejected i.e. distribution of intestinal parasite is dependent on caste group.

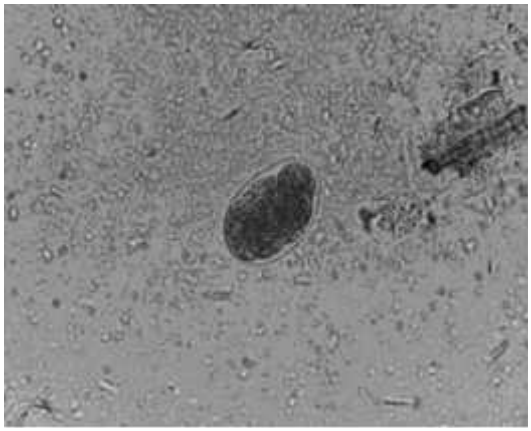


Ascaris lumbricoides



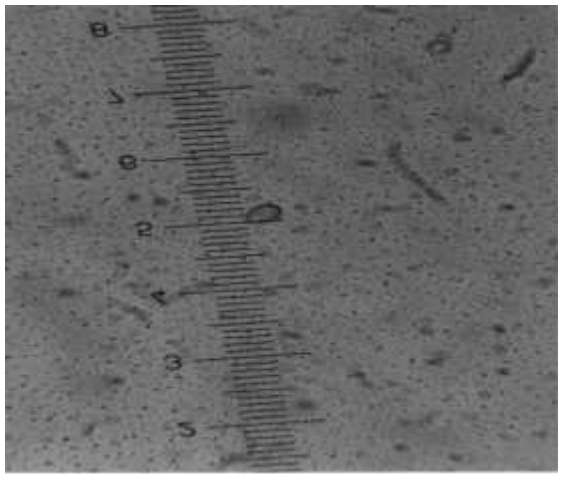
Hymenolepis nana

Entamoeba histolytica



Hookworm

Strongyloides stercoralis larva



Giardia lamblia

Consulting with the patients

Microscopic examination of stool sample

Preparation of stool smear

Department of Stool and blood collection

KANTI CHILDREN'S HOSPITAL