CHAPTER-1
INTRODUCTION

1.1 Background Information

Nepal is an independent kingdom full of ancient glories bearing testimony to her rich culture and civilization. With an area of about 147,000 square kilometres, it has a strategic location in south Asia between two big nations, India and China. The country is situated align the south scopes of the Himalayas between the Tibetan plateau in the north and the Gangatic plain in the south, it stretches between longitudes 80°44" to 88°12"east and latitudes 26°22" to 30°27" north. The kingdom has an elongated shape roughly north–west to south-east orientation (Shrestha CB, 1981).

Nepal is the land of various castes, creeds, tribes and ethnic groups. These people have their own unique language, culture, social organization, myths, legends, customs, moral values and traditions. They have different creeds, tribes and ethnic groups which are settled in different parts of Nepal from plain of south to the high Himalayas of the north. Few countries exhibit such social, ethnical, linguistic and cultural diversity within such a small compass as Nepal so that the country may rightly be called the ethnic turntable of Asia (Toni Hagen, 1961).

Life in Nepal like in most of the third world countries is characterized by poverty, ignorance and diseases. Literacy, poverty, malnutrition, high infant mortality rate inadequate health facilities, poor water supply and unsanitary conditions have led the country to a very poor socio-economic condition (Chhetri, 1993). The health status is also dominated and badly affected by parasitic diseases.

An organism living on or in another living organism (host) part or all of its nutrients from the host is known as parasite (from Greek, para= besides, site= food). The host provides food and shelter for parasite without compensation (Craig and Faust, 1943). In most cases, parasites damage or cause disease in the host. The parasites remain closely associated with their hosts biologically and ecologically. In its medical usage, it is an association in which one animal, the host, is injured in some degree through the activities of the parasites. In such condition, the parasites are called pathogens and the condition that results from the damage constitutes disease.

Strictly speaking, all organisms causing infections and infestation, thus also viruses, bacteria and fungi are parasites. However, for reasons of tradition only, in medicine and veterinary medicine, protozoa, helminths and arthropods are subsumed under the term "parasites". Among these are numerous pathogens, particularly in tropical and sub-tropical regions, that cause misery disease and millions of deaths. However, Central Europe also harbours several parasites that cause diseases of high medical significance (Aspock, 2002).

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

Protozoan parasite consists of a single cell like unit which is morphologically and functionally complete (Chatterjee, 2001). They cause serious health problem for human. Some common intestinal protozoan parasites are: *Entamoeba histolytica*, *Giardia lamblia*, *Entamoeba coli, Trichomonas hominis*, *Balantidium coli*, *Cyclospora, Cryptosporidium, Isospora* etc. Among them, *Entamoeba histolytica* and *Giardia lamblia* are important parasites.

Entamoeba histolytica was first discovered by Lamb (1859) and Losch (1875) proved its pathogenic nature. It is world-wide but more common in the tropics and sub-tropics. Trophozoites of *Entamoeba histolytica* live in the mucosa and sub-mucosa layers of the large intestine of human. Morphologyically *Entamoeba histolytica* has 3 stages in its life-cycle. a) **Trophozoites**- It is irregular and not fix in shape and size ranges 18 - 40 μm in diameter. It is feeding stage. b) **Precystic stage**- It is smaller is size varying from 10-20 μm in diameter. It is round or slightly ovoid in shape. It is 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. Faecal oral route transmission of *Entamoeba histolytica* from human to human is through the ingestion of food or drinks contaminated with quadrinucleated cysts.

Infection of *Entamoeba histolytica* commonly results in amoebiasis. Amoebiasis is second leading cause of death from parasitic disease world wide (Stanley, 2003). In the developing world, amoebiasis causes some 450 million infections *per annum*, about 50 million incidents and about 1, 00,000 deaths (Ravdin, 1988). Invasive amoebiasis is

prevalent in the whole of South East Asia and the Indian subcontinent. It secretes proteolytic enzymes that dissolve host tissues and host cells and engulfs RBCs (Smyth, 1996). *Entamoeba histolytica* trophozoites invade the intestinal mucosa causing amoebic colitis. Intestinal amoebiasis is characterized by abdominal pain, mucous in stool, weakness, dehydration along with malaise, loss of appetite etc. In some cases, amoeba breaches the mucous barrier and travels through the portal circulation to the liver where they cause abscesses (Stanly, 2003). Amoebiasis is of two types: a) **Invasive amoebiasis:** When clinical symptoms result, the disease is referred to as invasive amoebiasis. Possibly only about ten percent of infections result in invasive amoebiasis (Smyth, 1996). b) **Non-invasive amoebiasis**- A high percentage of individuals infected with *Entamoeba* show no symptoms of disease. This condition is referred as non-invasive amoebiasis and sometimes also called luminal amoebiasis.

Giardia lamblia was first discovered by Leeuwenhoek in 1681 while examining his own stool. It is world wide in distribution. It is confined in its distribution to the small intestine particularly the duodenum and upper part of Jejunum occasionally invading the bile ducts. **Morphologically,** it exists in two forms, trophozoite and cyst. a) **Trophozoite-** It is a 'tear drop' shaped with convex dorsal surface and concave ventral one (Smyth, 1996). The ventral surface possesses two depressions called adhesive discs which make contact with the intestinal cells of the host. Its size is 14μm long by 7μm broad. It is feeding stage. b) **Cyst-** The fully formed cyst is oval in shape with thick wall and measures 12 μm broad. It is infective phase. Cysts are passed in the faeces. Transmission is through faecal-oral route i.e. *Giardia* cysts passed in the faeces of one person result in a new infection when swallowed by another person.

The resulting infection of *Giardia lamblia* is usually referred to as giardiasis. It is recognized as one of the most common agents for diarrhoea world-wide. Giardiasis is also known as flagellate diarrhoea. *Giardia lamblia* has world-wide 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 diarrhoea due to protozoan infection in human. 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, anaemia as well as enteritities and sometime chronic cholecystopathy. 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 and Wright, 1978).

The World Health Organization (WHO) estimated that more than one billion people are chronically infected with intestinal helminths (WHO, 1998). The helminths belong to the phyla Platyhelminth and Nemathelminth. They are endoparasites of intestine and blood of human body and cause different diseases. Most helminth parasites come under the heading of intestinal infection. Many parasitic helminths require one or more intermediate hosts. It is estimated that there exist in the world today among some 2200 million people, 72 million nematode infections (Chandler, 1961). *Hymenolepis nana*, *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale* and *Strongyloides stercoralis* are important nematodes.

Ascaris lumbricoides was observed and reported as a parasite of man by many ancient people (Craig and Faust, 1943). It has undoubtedly been one of man's most faithful and constant companion from time immemorial (Chandler, 1961). *Ascaris lumbricoides* is the most cosmopolitan and most common of all helminths. It flourishes in warm moist climates or in moist temperate regions where personal hygiene and environmental conditions combine to favour embryonation of the eggs in polluted soil. The adult worm lives in the small intestine of human beings. Morphologically**,** 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 to 25 cm in length with a maximum diameter of 3 to 4 mm and female is 25-40 cm in length with diameter of 5 mm. Faecal-oral route infection occurs by the ingestion of food or water contaminated with embryonated eggs of the parasite.

Ascaris lumbricoides 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% (Crompton *et al.*, 1989). In some surveys of children between the ages of six and twelve years, the infection rate was as high as 90%. The infection results in malnutrition and retardation of growth in children but other symptoms associated with both the larval (tissue) and adult (intestinal) stages include pneumonitis, asthma, diarrhoea, nausea, abdominal pain and anorexia.

Trichuris trichiura worm was first described by Linnaeus in 1771. The life cycle was first studied by Grassi (1887) and later by Fulleborn (1923) and Hagegawa (1924) (Craig and Faust 1943). It is also known as whipworm. 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. The adult worm lives in the large intestine particularly the caecum and also found in the vermiform appendix. They are called whip-worms, 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 is thick and stout. Male measures 3-4 cm in length with ventrally curved tail. Female measures 4-5 cm in length with arc or comma shaped. Eggs are brown in colour with the size about 50 μm in length by 25μm in breath, barrel shaped with a mucous plug at each pole. Human is infected by swallowing embryonated eggs with food or water.

Trichuris trichiura 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, dysentery with blood tinged mucous, acute appendicitis and prolapsis of rectum. Trichuris dysentery, rectal prolapse, anaemia, poor growth and clubbing of the fingers constitute an important public health problem (Stephenson *et al,* 2000).

1.2 Statement of the Problem

Intestinal parasitic infections have always been an important public health problem in the tropical and sub-tropical areas particularly in developing countries like Nepal, where the humid climate, the unsanitary environment and poor socio-economic conditions contribute to the problem. Prevalence of intestinal parasite infection in some areas in developing countries reportedly approaches one hundred percent with high level of polyparasitism (Rai, 2000). This has primarily been attributed to the sleazy hygienic and environmental condition, poor or lack of education, poverty and over dispersion of parasites within the human communities (Rai *et al.,* 2000). The intestinal worm infections including roundworm (*A. lumbricoides*), hookworm (*Necatar americana* and *A. duodenale*) and whipworm (*T. trichiura*) affect a quarter of the world's total production and are major international health concerns (Williams-Blangero *et al.,* 1998). *Giardia, Entamoeba, Cyclospora, Cryptosporidium, Isospora* infections are being very common in developing

countries. These protozoa constitute the leading causes of death in Nepal (Sherchand *et al.*, 1999; 2001; 2002; 2003, Ghimire *et al.*, 2005). Intestinal parasitosis remains to be of great health and socio-economic concern in Nepal (Rai *et al.* 1995). It is highly prevalent in rural communities of Nepal (Sherchand *et al.*, 1997) and constitutes an important cause of morbidity and mortality among Nepalese people. In certain rural areas prevalence has been found to be over 90% (Rai *et al.*, 2000).

Its high prevalence percentage in the country causes decreased work capacity and productivity of children and adults, increased maternal and foetal morbidity and mortality, premature delivery, low birth weight, slower cognitive development, poor school performance, increased absenteeism in school children, decreased ability to grow or procure food and prone to many infection of the diseases by the citizen. Hence the country suffers from poverty, malnutrition and infection (Chhetri, 1997; Stephenson *et al.*, 2000).

1.3 Significance of the Study

Among the many health problems prevalent in Nepal, intestinal parasite infection constitutes a major health problem which is associated with water and sanitation of country. The country has 37% people access to safe drinking water but only 6% people have safe excreta disposal system (Chhetri, 1997). World Bank in 1990 reported that 7% population of the country is in absolute poverty (Chhetri, 1997). Poor economy, health education and sanitation have resulted high incidence of parasite in the country. So the study of the parasite infection is crucial. The high prevalence of the intestinal parasite might be indication of human behaviours like walking barefoot, poor sanitation, feeding behaviours, low socio-economic status, illiteracy and lack of awareness. So there need to study the relationship of intestinal parasitic infections with the socio-economic status of the people. The present work is aimed to establish the same relationship.

In Nepal, there are many ethnic groups and the government is not well concerned with the health status of these groups. In the present study, two ethnic groups Jalari and Kumal are considered. Their feeding habit, education level, housing condition, personal and community sanitation, availability of health services, per capita income have been observed poor. These means are the determinants of the poor socio-economic status. There are many NGOs, INGOs and other organization in the city whose aim is concerned with the health and socio-economic status of these groups. But they are always office-centered/

city-centered/ home-centered due to which the people who are socio-economically low status are unknown to such organizations. People in the study areas are continuously infected with different types of diseases (such as common cold, typhoid, diarrhoea, dysentery, jaundice, ENT-Ear, Nose, Throat Infections and viral infections), but no one is here to look, think, study and solve the problems of these ethnic groups. Diarrhoea might be the important result of the parasitic infection in these areas. Intestinal parasitic infection also lowers the capability of working. So, the present study was conducted to find out the prevalence of the intestinal parasitic infection and its relationship with socio-economic status in the two different ethnic groups of Lekhnath Municipality of Nepal.

1.4 Limitation of the Study

- The number of sample during the study was low. This is because of the low numbers of population in Jalari community and the lack of time enough to collect the samples of Kumal community.
- The study was focused only to the humans, which may not be sufficient for description of possible sources of infection.
- The study was carried out only by using common diagnostic methods like microscopic examination due to the financial limitation and time constraint.

CHAPTER - 2
OBJECTIVES

2.1 General Objective

The general objective of the study was to determine the prevalence of intestinal parasites in the people of two ethnic groups (Jalari and Kumal) of Lekhnath Municipality ward number 9 and 1 respectively.

2.2 Specific Objectives

- To assess the relationship of intestinal parasitic infection and the socio-economic status of the two ethnic groups.
- To determine the prevalence of intestinal parasites in different sex and age-groups.
- To determine the knowledge, attitudes and practices in study population in relation to transmission of intestinal parasites.
- To bring the awareness regarding intestinal parasitic infection among the two ethnic groups in studied areas.

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 were 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 latter half of 17th century Francesco Redi, grandfather of Parasitology stated that maggots developed from eggs of flies. At the same time, Leeuwenhoek perfected microscopes and discovered *Giardia* in his own stool and other protozoans in rainwater, saliva etc. (Chandler and Read, 1961).

Rudolphi (Linnaeus of Parasitology) classified all the parasites known up to his time. In 1773 O. F. Muller discovered cercaria larvae but though them as protozoans.

In 1782, Dubini discovered human hook worm. Similarly, Looss (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.* Schaudinn, 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.*

Human intestinal parasites have been studied by many workers. Some recent studies on human intestinal parasites are as follows:-

3.2 Literature Review in the Context of World

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 enteroparasites was 25.3%. The most frequently found enteroparasites were *G. lamblia* 3.7%, *A. lumbricoides* 5.5%, *T. trichiura* 2.7% 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.

Toma *et al.* (1999) carried out questionnaire survey and studied prevalence of intestinal helminth infections in Barru, Sulawesi, Indonesia. A total of 654 samples were collected and examined. The most common enteroparasites were *A lumbricoides, T. trichiura,* hookworm and *S stercoralis, H. nana* infection was also confirmed. *T. trichiura* was most common followed by Hookworm and *A. lumbricoides* in both 4-14 and over 15 years age group. The prevalence of Hookworm infection was significantly higher in males than in females of older age. The inhabitant with higher education background had significantly lower infection rates of *A lumbricoides* and *T. trichiura.* The prevalence of Hookworm infection was not significantly different between the inhabitant owning latrines and without latrines, but prevalence of *Ascaris* and *Trichuris* differed significantly.

Roche *et al.* (1999) assessed the prevalence of intestinal parasitic infections among two different groups of persons on the island of Bioko, Equatorial Guinea. In the first group, parasitological examinations were performed on stool specimens from a house hold based samples of 557 dwellers from the rural area of the island. In the second group 1633 in patients and out patients at the general hospital of Malabo were studied. All age groups were represented in both groups. The average prevalence of the most common protozoan and helminthic intestinal infections in rural and urban areas respectively was as follows: *E histolytica were (*14.9% and 32.7%), *G. lamblia* (7.2% and 8.6%), *A lumbricoides* (45.8% and 32.4%) and *T. trichiura* (25.7% and 36.4%). This study showed that parasitic infections in Equatorial Guinea represent a major health problem.

Paul *et al.* (1999) carried out a study to determine the prevalence of intensity of intestinal helminth 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 parasite 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 1-88 years, were examined. The prevalence of helminthes was found *A. lumbricoides, T. trichiura* and Hookworms.

Lili *et al.* (2000) investigated the prevalence and intensity of geo-helminth infections caused by hookworm, *Ascaris* and *Trichuris* in two rural Yunnan villages. In Liuku, village of Lisu indigenous person in Lushui County, there was an overall geohelminth prevalence of 72% (48%, 43% and 16% for hookworm infection, ascariasis and trichuriasis respectively). The prevalence of ascariasis was greatest among pre-school and school aged children, whereas the prevalence of trichuriasis was greatest among teenagers and the prevalence of hookworm increased until the age of 10-15 years and then remained high throughout adulthood. In Linger, a village of Han Chinese, located in Puer Country, there was an overall geo-helminth prevalence of 77% (30%, 60% and 36% for hookworm infection, ascariasis and trichuriasis respectively). The difference in prevalence for hookworm and ascariasis were statistically significant.

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), 4 confirmed species of helminth 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 inflection 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 in Kaohsiung County. 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 parasite detected were *A. lumbricoides*, Hookworm, *T. trichiura, H. nana* and *G. lamblia.* The male had highest infection rate (24%) than females (11%). The infection rate of aboriginal and non-aboriginal children was 17% and 14% respectively. Grade 1 and Grade 6 had the highest infection rate (21%). Out of 302 tape perianal examination revealed 25% prevalence.

Janakiram *et al.* (2001) worked on prevalence of intestinal parasitic infections among patients attending Adichunchanagiri Hospital and Research Center, B. G. Nagar, Mondya, Karnataka. Total of 4133 stool samples were collected from OPD patients suffering from diarrhoea 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 helminthic (6.7%) parasites. Majority of them, 97.98% was detected with single pathogen and rest 2.02% with more than one pathogen. The species wise prevalence of intestinal parasite was *G. lamblia* 4.66%, *E. histolytica* 4.13%, Hookworm 5.03%, *A lumbricoides* 0.44%, *H. nana* 0.15% *T. trichiura* 0.07% and *E. vermicularis* 0.12%.

Sofia *et al.* (2001) worked on intestinal parasitic infections in the University Campus of Aligarh. Faecal samples of 3695 persons complaining for diarrhoea, 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, and G. lamblia.* Among them, *E. histolytica* showed highest prevalence rate (37.55%) followed by *G. lamblia* (14.95%), while *A. lumbricoides* showed the least infections rate (5.71%).

Uchoa *et al.* (2001) conducted a parasitological survey of children from five community day-care centers from Niteroi City, Rio de Janeiro, Brazil in 1999. Of 218 stool samples of children surveyed, 120 (55%) had positive samples for intestinal parasites. The most frequently found protozoan parasite was *G. lamblia* (38.3%), followed of *E. coli* (26.6%), *Endolimax nana* (17.5%), *E. histolytica* (11.6%) and *Blastocystis hominis* (2.5%). The most common helminth parasite was *A. lumbricoides* (30%) followed by *T. trichiura* (26.6%), *H. nan*a (0.8%) *and E. vermicularis* (0.8%). Monoparasitism was found in 57.5% of positive cases.

Uga *et al.* (2002) studied to undertook to determine the current status of intestinal parasites among the school children in West Java , Indonesia and to compare the infection rates obtained by 3 different methods of faecal examination . A total of 285 faecal samples were collected from 131 males and 154 females at a junior high school and samples brought to Department of Parasitology, Faculty of Medicine, University of Indonesia, and were examined for parasites by the Kato Katz thick smear method (K-K).The residual samples were suspended in more than 5 volumes of 2% $K_2Cr_2O_7$solution and brought to Department if Parasitology , Kobe University School of Medicine , Japan , where they were examined for parasites by Army Medical School Method (AMSIII) and by the sucrose centrifugal flotation method (SFL). The K-K, AMS III and the SFL revealed 2 of helminthes (10%=29/285), 9 spp. of parasites (31%=89/285) and 10 spp. of parasites (22%=62/285) respectively. Overall 12 species of parasites were detected by 3 methods: 4 species of nematodes (*Trichuris trichiura*, *Ascaris lumbricoides*, hookworm, *Enterobius vermicularis*), 5 species of protozoa (*Giardia intestinalis*, *Entamoeba histolytica*-like cyst, *E. coli*, *Cyclospora* spp., *Blastocystis hominis*), 2 unidentified spp. of nematode eggs and one unidentified spp. of mite eggs.

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 protozoan parasite detected followed by *E. histolytica* 4.0%. In contrast under urban setting out of the 199 stool samples tested the positivity 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%, 0.5% of *E. vermicularis* and *A. lumbricoides* 0.5% were found to have much lower prevalence in comparison to the rural area.

Rao *et al*. (2002) studied worm infestation and anaemia, a public health problem among tribal pre-school children of Madhya Pradesh. Total samples of 985 from pre-school children were collected from Jabalpur district. The result revealed that 48% of them had intestinal parasitic infections. Common parasites observed among them were *H. nana* 16%, Hookworm 26%, *A. lumbricoides* 34% and *E. histolytica* 7.0%. High prevalence of

anemia (86.7%) was also observed among such high prevalence of intestinal parasite and anaemia could be due to indiscriminate defecation, low socio economic status, ignorance and low standard of personal hygiene.

Mirdha *et al.* (2002) studied on *Hymenolepis nana* a common cause of pediatric diarrhoea in urban slum dwellers in India. The prevalence of intestinal parasitic infection was studied for a period of 5 years (April 1996, April 2001). Among urban slum dwellers, parasitological examinations were performed on 939 faecal specimens. Collected on a household bases. The total prevalence of pathogenic parasite was 33.6%. The most common intestinal parasites were recovered on following prevalence rate *H nana* 9.9%, *A. lumbricoides* 8.5%, *G. lamblia* 8.4% and *E histolytica* 3.7%.

Waikagul *et al.* (2002) conducted a cross-sectional study of the prevalence of intestinal parasitic infections at eight schools in Bo Klau district and four schools in Chelerm Prakiet district, Nan Province, in January and February, 2001. A total of 1010 faecal samples were examined using the formalin-ether sedimentation technique. Results revealed that the rate of helminthes infection was 60.6% while protozoa accounted for 36.2% of infections; mixed infections were common, resulting in a total prevalence of both parasites of 68.1%. Helminth parasites, listed by frequency of infections were *A lumbricoides* (21.7%), hookworm (18.5%), *T. trichiura* (16.3%), *Opisthorchis viverrini* (1.7%), *S. stercoralis* (0.9%) and *E. vermicularis* (0.9%). The protozoan infections were *E. coli* (25.8%), *G. lamblia* (5.3%), *Endolimax nana* (2.5%), *E. histolytica* (1.4%), *B. hominis* (0.8%), *Chilomastix* mesnili (0.3%) and *Iodamoeba butschlii* (0.1%).

Kaur *et al.* (2002) determined the parasitic causes of diarrhoea in children in Delhi by the direct smear technique; stool specimens of 127 children were examined for intestinal parasites. In 59 cases (46.5%) intestinal helminths and protozoa were demonstrated. *A. lumbricoides* was observed in 1 (0.8%) case, while *T. trichiura* was found in 3(2.4%). Protozoan parasites included *G. intestinalis* and *E. histolytica* in 14(11%) cases each, *Balantidium coli* in 3 (2.4%) cases and *Cryptosporidium sp*. in 24 (18.9%) patients. Mixed infection was not seen in any of the cases.

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. Total 1109 stool samples were collected during the period of Study. Eleven (0.99%) were confirmed

to be positive to *Cyclospora Cayetanensis* oocysts. Other parasites were also detected including *Cryptosporidium, Entamoeba, Ascaris, Trichuris, Strongyloides* species and hookworm.

Diaz *et al.* (2003) studied the parasitic infection in 272 children (age range =2-14 years) in Mexico .121 (44%) children tested positive for protozoa such as *Giardia lamblia* (18%), *E.histolytica*/*E.dispar* (10%), *Blastocystis hominis* (7%), *Cryptosporidium parvum* (4%) *Cyclospora cayetanensis* (3%) and helminthes such as *H. nana* (10%), *T. trichiura* (6%) and *Ascaris lumbricoides* (6%) and 2 samples of *Enterobius vermicularis*. Then 121 patients received nitaxoxanide. Overlay 84% of the protozoa and 95% of the helminthes were completely eliminated from the patients.

Buchy (2003) worked on intestinal parasites in the Mahajanga region West Coast of Madagascar. A total of 401 stool and 112 sera samples were collected from OPD patients of Mahajanga's Hospital during November 1996 to January 1997. The examination of stool specimens revealed 67.6% overall prevalence. The frequency of protozoa was higher 47.7% than helminthes 23.4%. The specific prevalence was *H. nana* 2.5% and *Taenia saginata* / *Taenia solium* 0.75%. Out of 112 sera examined 50% of sera contained antibodies (anti *A. lumbricoides* and anti *S. stercoralis).*

Kim *et al.* (2003) carried out small state survey to investigate the status of intestinal protozoa and helminths infection of inhabitants in Roxus City, Mindoro, the 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 helminth was *A lumbricoides* (51.2%) followed by *T trichiura* (27.6%) hookworm (8.0%) and *E vermicularis* (0.3%). The protozoan infection status revealed that *E Coli* was the most frequent (15.0%). *Iodamoeba butschlii* and *E. histolytica* were found but few. The multiple infection more than two parasites was 29.6% and double infection with *A lumbricoides* and *T trichiura* was common. The intestinal helminth infections were highly prevalent in this area.

Sirivichayakul *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 the 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. intestinalis* (8.0%), *H. nana* (7.8%) and *E. histolytica / disper* (7.1%).

Miller *et al.* (2003) examined the presence of intestinal protozoan and helminth 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 *Cryptosporidium*. Prevalence of helminth infection was 11% for *Ascaris* 11% for *T. trichiura* 0.0% for *S. stercoralis* and 2% for *H. nana.*

3.3 Literature Review in Nepal Context

Sharma *et al.* (1971) carried out a study on intestinal parasites amongst auxiliary health worker's student in Kathmandu. They examined 80 stool specimens of which 10 did not show any infestation, the rest 70 were suffering from different types of infestations. The commonest infestation found was roundworm *(Ascaris lumbricoides)*. The second commonest infestation was hookworm (*A. duodenale).* Other infestations were *E. histolytica, G. lamblia* and *T. trichiura. E. vermicularis* was found in only one case. In some cases, mixed infections were also seen.

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.

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

Nepal and Palfy (1980) reported about a study of prevalence of intestinal parasites in the Mahanchal Panchayat. Out of 225 examined stool samples, 95.3% were positive. The most common parasites were roundworm (63.5%) followed by hookworm (34.2%), *E. histolytica* (28.8%) and *G. lamblia* (28.4%).

Khetan (1980) carried out the study of the incidence of parasitic infestation in Narayani Zone. Stool examinations of 2073 patients were done between the years 1977-1980. Out of total samples 1522 stool samples had worm infestation, of which 458 samples had *Ascaris*, 591 had hookworm, 203 had *Trichuris*, 175 had *G. lamblia* and 83 had other infestations.

IFPPCP (1985) examined 25260 stool samples of students from 46 schools of Kathmandu valley out of which 22626 (89%) were found positive. The infection by *A. lumbricoides* was 15423 (68.16%) followed by *T. trichiura* 8104 (35.8%), Giardia, 2491 (11%), hookworm (6.7%) and tapeworm 220 (0.97%).

Suguri *et al*. (1985) surveyed to find the helminth infections, in 737 Nepalese people living in the Gandaki, Dhaulagiri, Lumbini and Sagarmatha Zone of Nepal and in 26 Japanese living in Kathmandu from February to April in 1975, employing the so called thick smear method. The overall helminths infection rate was found 86.8% including roundworm (50.3%), hookworm (44.1%), whipworms (47.6%) pinworms (1.2%) and *Taenia* sp. (0.1%). The positive rate was the lowest in Bhairahawa (53.8%) and the highest in Darbang (98.8%). In Namche Bazar, round worm infection rate was the highest (70.3%) and that of hookworms was the lowest (0.2%).

Gupta *et al.* (1988) collected 285 stool samples in Kirtipur. Among them 192 (67.36%) was found to be positive for intestinal parasite. Out of 192 positive stool samples, 49 (25.52%) cases were infected with protozoan parasite, 9.12% by *G. lamblia* and 9.47% by *E. histolytica* Out of 192 stool samples, 155 (80.72%) were positive for helminth parasite, *A. lumbricoides* (40%), *T. trichiura* (25.26%), hookworm (4.56%), *H. nana* (2.46%) and *T. solium* (0.55%).

Geollman (1988) carried out an extensive disease survey in Paten Hospital General out Patient Clinic from December 1986 through November 1987. A total of 79,404 people were seen during the period and the incidence of the related infections diseases were as follows: Amoebic disease. 1.7%, Giardiasis 2.7%, Ascariasis 3.5% hookworm infection 0.85% and other parasites 0.7%.

Rai *et al.* (1991) showed the prevalence of various intestinal parasites in Kathmandu Valley, Nepal. The overall prevalence of parasites was 30.9%. There were no significant differences in the prevalence between two sexes. Intestinal parasites were more common among children below 15 years than in adult more than 15 years. *A lumbricoides* was the common parasite followed by hookworm, *Taenia* sp., *E. vermicularis* and others. Among protozoan parasites, *G. lamblia* was the most common followed by *E .histolytica.*

Gianotti (1993) surveyed, in 1990, a total 137 cases from Kathmandu valley and 22 cases from Solukhumbu in children. He reported *Ascaris* 11.2%, *Trichuris* 9.8% *Giardia* 5.9%,

E. histolytica 5.3%, hookworm 3.3%, *H .nana* 0.5% and *T. solium* 0.5% in Kathmandu valley TUTH cases, but in Solukhumbu cases *Ascaris* 22%, *G. lamblia* 31.8%, and *E. histolytica* 9.1%.

Sherchand *et al.* (1996) carried out study on intestinal parasites from Kathmandu area of Nepal and reported 28.1% parasitic load among subjectively healthy children (HC) and 38.8% parasitic load among healthy adults. Where as 62.7% parasitic load was recorded among children with abdominal discomfort. *H. nana* was recorded as most common tapeworms associated with patient having abdominal discomfort. Among protozoan parasites prevalence of *Giardia* was highest among the sick children. In healthy children the prevalence of mixed parasite 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.

Rai *et al.* (1999) studied *Ascaris,* Ascariasis and its recent scenario in Nepal which 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.* (2001) studied the intestinal parasitic infection in rural hilly area of Western Nepal, Achham district. The stool test revealed 76.4% prevalence of intestinal parasites in the children of the district.

Shrestha (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 years age groups were collected. Among them 81.94% of children were found to be infected with parasites. Among them prevalence of *A. lumbricoides* was found to be highest (73.45%) in rural and (71.66%) in urban children. But *T. trichiura* was found to be higher among children of urban area 37.91% where as that of rural was 27.27%. 78.36%

and 84.07% male and 92.45% and 73.72% of female children from the urban and rural respectively were found to be infested with the protozoan and helminths parasites.

Yong *et al.* (2001) investigated the status of intestinal infections in two rural villages in Chitwan district, Nepal in 1999. Stool examination was performed with a total 300 specimens from school children by formalin-ether sedimentation technique. The prevalence rate of intestinal parasite infections in the surveyed areas was 44.0%. The prevalence rate in Jerona was slightly higher than that of Chitrasari. The prevalence rate of intestinal parasite infections in female was slightly higher than male without statistically significant difference. *E. coli* was the most commonly found protozoan parasite (21.0%) followed by *G. lamblia* (13.7%) and other (5.3%). Hookworm was the most prevalent intestinal helminth (13%) followed by *T trichiura* (3%) and others (5%). 43 specimens (14.3%) showed mixed infections.

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

Karki *et al.* (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%).

Parajuli (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.* d*uodenale* (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* sp. (1.63%).

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 the cross-sectional descriptive type of study from April 2005 to October 2005 in Kirtipur, Kathmandu and Gunjanagar VDC, Chitwan, Nepal 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. A total of 400 stools were processed by using a standard formalin-ethyl acetate concentration method, direct light microscopy, modified acid fast stain, ocular 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 ($P<0.05$). The prevalence of each parasites were: *Ascaris* 10.3%, *Giardia* 8.3%, *Entamoeba* 5.3%, *Trichuris* 5.0%, *Hymenolepis* 4.0%, hookworm 3.8%, *Strongyloides* 2.5%, *Cyclospora* 1.8%, *Cryptosporidium* 1.0% and *Enterobius* 0.25% with total prevalence 42.0%. There was statistically significant of low concentration of haemoglobin in the helminths and protozoa infected males and females with different age groups ($P<0.05$).

Ghimire *et al.* (2006) conducted a study is to highlight the intestinal parasites in the role of diarrhoea in Human Immunodeficiency Virus infected patients who attended in Sukra Raj Tropical and Infectious Disease Hospital of Kathmandu. The totals of 86 stool samples were collected from 86 HIV patients once and they were examined by direct smear methods and modified Kinyoun acid-fast stain. Eighteen 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%. *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 (χ^2=18.3, P<0.05).

CHAPTER- 4
MATERIALS AND METHODS

4.1 Study Area

4.1.1 Location

Lekhnath municipality is located about 181 km west from Kathmandu, the capital of Nepal and it is 10 km east from Pokhara. It lies in Western Developmental Region, in Gandaki zone, in Kaski district. It lies from 28^0 5'- 28^0 12' North to 84^0 02'-84^0 08' east. Its area is about 77.45 square kilometres. This municipality was formed by the combination of other three village development committee: Lekhnath, Shisuwa and Begnas. It was named after the famous Nepalese poet Shiromani Lekhnath Poudel.

4.1.2 Climate

The climate is sub-tropical. It is the region where highest rainfall occurs within Nepal. Its maximum and minimum temperatures are 37.4 ^{0}C and 1.8 ^{0}C (average 20.6 ^{0}C). The maximum rainfall is 3868.5mm with the average count 3045 mm respectively. The Seti River is the main river in this region. Begnas, Rupa, Khaste Lake, Dipang Lake, Gunde lake, Neureni and Maidi are the lakes of this area. Bijayapur, Khudi, Kotre, Gaduwa, Bagadi, Taalbesi, Swyankhudi are the streams of this area. Begnas and Bijayapur irrigated canals are important canals for farming (Source: Lekhnath Municipality "Garden City of Seven Lakes": An overview Year-2002. Published by: Lekhnath Municipality, Tal Chowk, Kaski, Nepal).

4.1.3. Demography of Lekhnath Municipality, Kaski

Religion: Hindus, Buddhists, Muslims, Christians

Population

Total households: 9362

Total population: 41369

Males: 19475

Females: 21894

Average lifespan: 59.7 years

Fertility rate: 2.9%

Population Density: 4.67 per km^2

Population distribution on the basis of castes

Bahun: 38%

Gurung: 13%

Occupational castes: 13%

Chhetri: 9%

Magar: 4%

Newar: 3%

Others: 20%

4.1.4 Basic services

Health

Primary health centre: 1

Sub health centre: 3

Ayurvedic centre: 2

Private clinics: 22

Education

University: 1 (Pokhara University)

Higher secondary schools: 3

Secondary schools: 12

Lower secondary schools: 2

Primary schools: 26

Private schools (boarding): 11

Sewage management

Private toilets: 60% (average)

Public toilets: 2

Drinking water

Private tap: 38

Public tap: 310

Well: 60

District Red Cross Society Drinking Water and Sanitation Planning Program are being conducted in ward numbers 9 and 14. Similarly, Kaski District Drinking Water and Sanitation (World Vision) Planning Program is being conducted in ward numbers 4, 5, 6,9,10, 11 (Source: Lekhnath Municipality "Garden City of Seven Lakes": An overview Year-2002. Published by: Lekhnath Municipality, Tal Chowk, Kaski, Nepal).

4.1.4 Characteristic features of studied population

The studied population was from Jalari and Kumal Gaun. The Jalari Gaun lies in ward number 9 and the Kumal Gaun lies in ward number 1 of the Lekhanath Municipality. These two toles are the areas where the two ethnic groups are living. The population of Jalari is 127, whereas the population of Kumal is 564. The main occupation of the Jalari people is fishing however, some Jalari people are engaged in restaurants, and some being in foreign countries. They use fish as their primary food. As they live at the side of Beganas Lake, it is easy to fish, and go to near market (around Fewa Lake) to sell them. One can observe the poor sanitary condition of the most of the Jalari children and the women in this community.

The main occupation of the Kumal is farming. However, some of these people have gone to foreign countries (golf countries) to earn money and a few of them keep their occupation as fishing. One can observe the poor hygienic condition of the Kumal people, mostly that of the children and old people.

4.2 Data Collection

The primary data was collected by questionnaire method and by examining the collected stool samples from the interviewed individuals. For this study population was provided with sterilized vials a day before for the collection of stools. They were instructed on the proper way to introduce the faecal matter inside the vials.

Secondary data were collected from municipality, internets, books, journals, newspapers, articles, letters, dissertation and concerned authorities.

4.3 Materials

4.3.1 Equipments and Materials

Cotton	Microscope	Bottles (500 ml.Capacity)
Cover slips	Needle	Funnel
Forceps	Refrigerator	Test tube (15 ml. Capacity with caps)
Gloves	Slides	
Bamboo stick	Tray	
Gauge	Container	

4.3.2 Chemicals

2.5% $K_2Cr_2O_7$ solution
Normal Saline solution
Lugol's Iodine solution
Distilled water

4.4 Methods

4.4.1 Questionnaire Administration: Socio-economic status, cultural behaviour factors, educational and attitudes towards the cure of parasitic infection, personal prophylaxis, sanitary measures (condition of toilet), drinking water supply and feeding habit of Jalari in ward no. 9 and Kumal in ward no. 1 in Lekhnath Municipality were studied through questionnaires and pilot survey.

4.4.2 Stool Sample Collection: A total of 236 stool samples were colleted from the 236 people of Jalari Gaun and Kumal Gaun (Tole). Out of the total population of 127 Jalari persons, 104 samples were collected and out of 564 Kumal persons from Kumal Gaun, 132 samples were collected at the morning time. The sampling was of random type.

4.4.3 Laboratory Work

The samples were tested at Shisuwa Health Post, Mohoriya Community Hospital of Lekhanath Municipality and brought at Central Department of Zoology, Tribhuvan

University, Kirtipur for the confirmation. After collection, the stool samples were examined microscopically under electric microscope. 2.5% Potassium dichromate was added to the samples as preservatives and were kept in refrigerator if the samples couldn't be tested at the collected day.

4.4.3.1 Macroscopic Examination

The collected samples were examined for their physical appearance by naked eye on the same day.

4.4.3.2 Microscopic Examination

Stool samples were examined by direct smear technique. The iodine solution and 2.5% Potassium Dichromate were used for examination of the stool samples to identify protozoan trophozoites, cysts, helminths eggs and larva.

Fresh stool was examined by using normal saline and iodine solution while preserved stools were examined in Potassium dichromate and iodine solution. For the preparation of slide, iodine solution or 2.5% Potassium Dichromate was taken on the clean glass slide, then small amount of stool was added to the slide with the help of sticks and cover slip was placed over them and excess of fluid was removed with the help of filter paper.

The prepared slides were first examined under the low power under 10x objectives for the presence of helminthes eggs and for identification of helminthes eggs and larva and identification of protozoan trophozoites and cysts, it was examined under high power (40x objectives) of microscope. Identification of trophozoites, cysts and eggs of parasites were done on the basis of Medical Laboratory Manual. The cysts and trophozoites of *Entamoeba histolytica* and *Giardia lamblia* were observed. Similarly, the eggs of Ascaris lumbricoides and *Trichuris trichiura* were observed.

4.5 Data Analysis

The obtained data from the examination of stool samples were edited, coded, classified, tabulated and analyzed. Analysis was done by representing with the table, bar diagram, pie chart on the basis of findings like prevalence rate, age, hygienic behaviour, feeding behaviour and awareness. The significant difference was calculated by chi-square (χ^2-test) and it was considered significant if its value was less than 0.05 at 95% confidence interval.

4.6 Validity and Reliability of the Study

- Quality control on specimen collection, processing and confirmation of intestinal parasites was maintained throughout the test.
- All reagents, equipments and laboratory methods were standardized.
- The study was properly instructed and guided by the supervisors.
- Questionnaires were filled by the respondents in trend of the investigator.
- Symptoms and pathogenicity of some diarrhoeal persons were recorded from doctors, health workers, patients and their guardians.

CHAPTER-5

RESULTS

A total of 236 stool samples of the persons of different age and sex groups were collected and examined from Jalari and Kumal community of Lekhnath Municipality, Kaski district from June 1, 2003 to September 27, 2003.

Out of total 9362 households and 41369 populations in the municipality, 2.9% (27 households) and 3.1% (127 persons) are of the Jalari community in ward number nine. The total households observed were 22 (81.5% out of 27) with the total observed population 104(81.9% out of 127) among the Jalari community.

Similarly, out of total 9362 households and 41369 populations in the municipality, 1.0% (94 households) and 1.4% (564 persons) are of the Kumal community in ward number four. The total households observed were 24 (25.5% out of 94) with the total observed population 132 (23.4% out of 564).

5.1 GENERAL PREVALENCE OF INTESTINAL PARASITES IN TWO ETHNIC GROUPS

5.1.1 General prevalence of Intestinal Parasite in both Jalari & Kumal Community

Out of 236 stool samples examined, 132 persons were infected with intestinal parasites and the prevalence was about 56.0%.

5.1.1 General prevalence in Jalari community

Out of 104 Jalari persons, 57 were infected with intestinal parasites and the prevalence was 54.8%.

5.1.2 General prevalence in Kumal community

Out of 132 Kumal persons, 75 were infected with intestinal parasites and the prevalence was 56.8%.

There was no significant relationship of prevalence of intestinal parasites with the ethnic groups of study area (χ^2= 0.08, P>0.05).

Table 1: Ethnic-Wise Prevalence of Intestinal Parasites

SN	Ethnic groups	Total samples	Positive samples	Positive (%)
1	Jalari	104	57	54.8
2	Kumal	132	75	56.8
Total		**236**	**132**	**56.0**

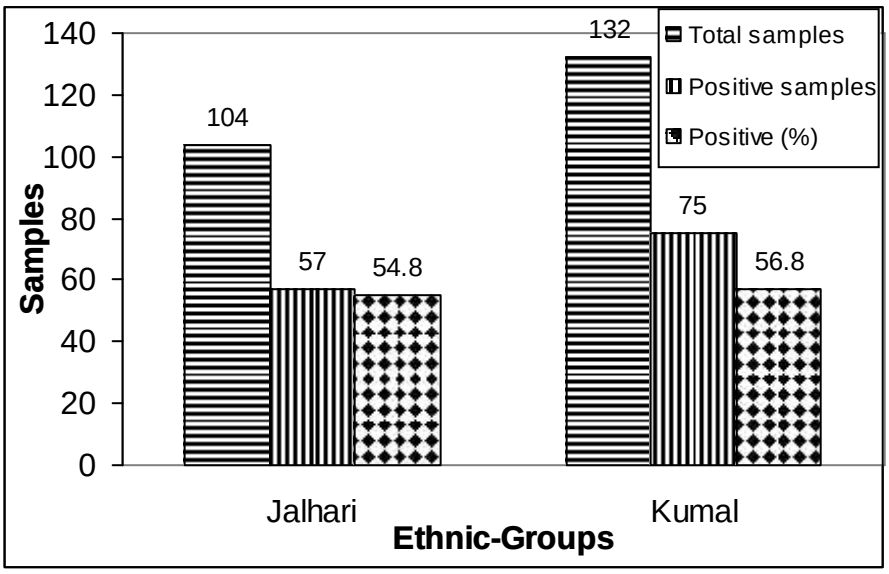

Fig. 1: Ethnic-wise Prevalence of Intestinal Parasites

5.2 PREVALENCE OF INTESTINAL PARASITES IN JALARI COMMUNITY

5.2.1 General prevalence

In the present study, out of 104 Jalari persons, 57 persons were infected with intestinal parasites and the prevalence was 54.8%. This is depicted in Table 2 and Fig. 2.

5.2.2 Age and sex-wise prevalence

Table 2 and figure 2 shows the prevalence of intestinal parasites with age and sex of Jalari persons. The prevalence in males and females were 59.6% (31 out of 52) and 50.0% (26 out of 52) respectively. In males, the prevalence was highest in the age of ≤10 years. Whereas, the lowest prevalence was from the age groups 41-50 years and ≥51 years age, which is about 50.0%. In females, the highest prevalence (60.0%) was from the age ≤10 years and the lowest prevalence was from the age ≥51 years of age (42.8%).

There was no significant relationship in the prevalence of intestinal parasites with the age-groups of Jalari persons (χ^2= 1.03, P>0.05).

There was no significant relationship in the prevalence of intestinal parasites with the sex of Jalari persons (χ^2= 0.94, P>0.05).

Table 2: Age and Sex Wise Prevalence of Intestinal Parasites of Jalari Community

Age groups (yrs.)	Male Samples examined	Infected number	+ve %	Female Samples examined	Infected number	+ve %	Total Samples examined	Total infected number	+ve %
≤10	22	14	63.6	18	10	55.5	40	24	**60.0**
11-20	9	5	55.5	14	7	50.0	23	12	**54.5**
21-30	12	7	53.8	11	5	45.4	23	12	**48.0**
31-40	5	3	60.0	2	1	50.0	7	4	**55.0**
41-50	2	1	50.0	2	1	50.0	4	2	**50.0**
≥51	2	1	50.0	5	2	40.0	7	3	**42.8**
Total	**52**	**31**	**59.6**	**52**	**26**	**50.0**	**104**	**57**	**54.8**

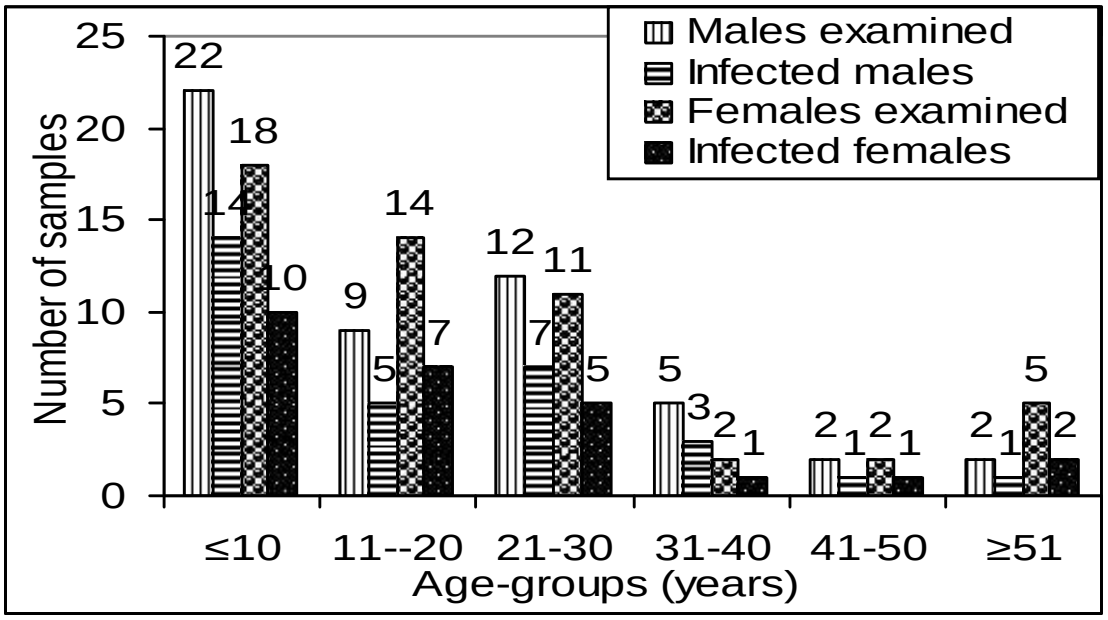

Fig. 2: Age and Sex wise Prevalence of Intestinal Parasites of Jalari Community

5.2.3 General Prevalence of Specific Parasites in Jalari Community

Out of 52 males, the lowest (3.8%) and the highest (17.3%) prevalence was those of *Trichuris trichiura* and *Ascaris lumbricoides* respectively. Similarly, out of 52 females, the lowest (2.00%) and the highest (13.5%) prevalence was those of *Trichuris trichiura* and *Ascaris lumbricoides* respectively. This is depicted in Table: 3 & Figure: 3.

Table 3: General Prevalence of Specific Parasites in Jalari Community

Types of parasites	**Males (n=52)**		**Females (n=52)**		**Total (N=104)**	
	Positive No.	**%**	**Positive No.**	**%**	**Positive No.**	**%**
Entamoeba histolytica	3	5.8	2	3.8	5	**4.8**
Giardia lamblia	7	13.5	5	9.6	12	**11.5**
Ascaris lumbricoides	9	17.3	7	13.5	16	**15.4**
Trichuris trichiura	2	3.8	1	2.00	3	**2.9**
Total	**21**	**40.4**	**15**	**28.8**	**36**	**34.6**

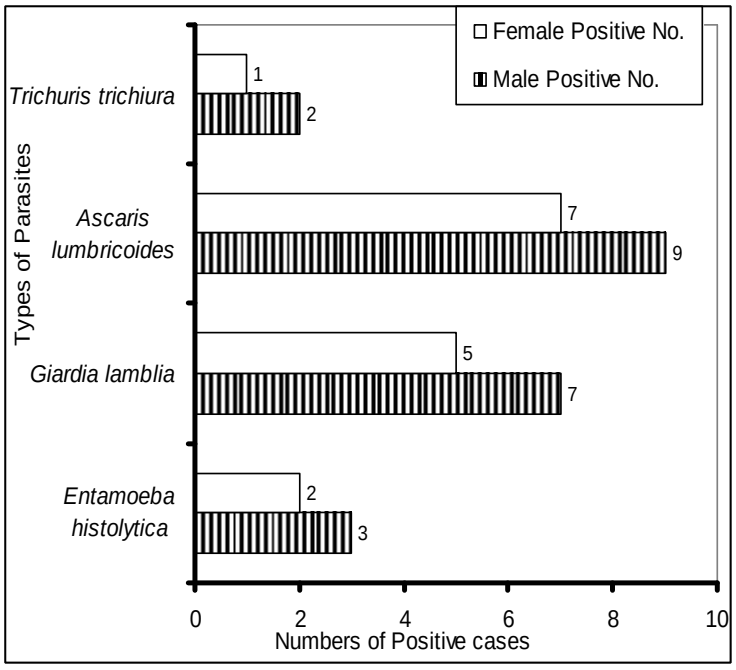

Fig.3: General Prevalence of Specific Parasites in Jalari Community

5.2.4 Prevalence of intestinal parasites according to different risk factors of transmission of the parasites

5.2.4.1 According to Food Habit

Out of 52 examined males, the prevalence of intestinal parasites in vegetarian and non-vegetarian was 66.7% and 59.2% respectively. Similarly, out of 52 females examined, the prevalence of intestinal parasites was 20.0% and 53.0% respectively.

There was no significant relationship in the prevalence of intestinal parasites with the food habit of Jalari persons (χ^2= 1.12, P>0.05). This is depicted in Table 4:A & Fig. 4:A.

5.2.4.2 According to Ways of defecation

The prevalence of the intestinal parasites was 54.8% and 66.7% in the persons who use toilet and open place such as grounds, fields, pond, rivers etc respectively for defecation.

There was no significant relationship in the prevalence of intestinal parasites with the ways of defecation of Jalari persons (χ^2= 0.349, P>0.05). This is depicted in Table 4: B and Fig. 4: B.

5.2.4.3 According to Water Drinking Habit

The highest prevalence of intestinal parasites was from the persons who drink well water (66.7%) directly or lake water (66.7%) directly without any treatment and the lowest prevalence was from the persons who drink boiled water (42.9%).

There was no significant relationship in the prevalence of intestinal parasites with the drinking habit of Jalari persons (χ^2= 5.41, P>0.05). This is depicted in Table 4: C and Fig. 4: C.

5.2.4.4 According to Domestic animals

The highest prevalence (64.0%) of intestinal parasites was from the owners of chickens, whereas the lowest prevalence (33.3%) was from the persons who have not reared any animals in their houses.

There was no significant relationship in the prevalence of intestinal parasites with the domestic animals of Jalari persons (χ^2= 5.31, P>0.05). This is depicted in Table 4:D and Fig. 4: D.

5.2.4.5 According to Occupation

The highest prevalence (65.5%) of intestinal parasites was from the persons whose occupation is fishing and job in hotels, restaurants and offices, whereas the lowest prevalence (62.0%) was from the persons of fishing occupation.

There was no significant relationship in the prevalence of intestinal parasites with occupation of Jalari persons (χ^2= 2.26, P>0.05). This is depicted in Table 4:E and Fig. 4:E.

5.2.4.6 According to Educational status

The prevalence of intestinal parasites was highest (66.7%) in pre-primary children and lowest (33.3%) in illiterate persons.

There was significant relationship in the prevalence of intestinal parasites with the educational status of Jalari persons (χ^2= 11.31, P<0.05). This is depicted in Table 4:F and Fig. 4:F.

5.2.4.7 According to Economic status

The prevalence of intestinal parasites was highest (62.2%) in the persons whose family annual income is ≤10 thousands and the lowest (37.5%) in the persons whose family income is ranging about 41 thousands to 50 thousands Nepalese rupees.

There was no significant relationship in the prevalence of intestinal parasites with the economic status of Jalari persons (χ^2= 2.53, P>0.05). This is depicted in Table 4:G and Fig. 4:G.

5.2.4.8 According to Knowledge of Parasites

The highest prevalence (55.9%) of the parasites was in the persons who didn't know anything about parasites. The lowest prevalence (44.4%) of the parasites was in the persons who knew the names and simple cause of parasites such as *Giardia*, roundworm, pinworm, hookworm and they believe that these parasites are transmitted through drinking unboiled water.

There was significant relationship of intestinal parasites with the knowledge of parasites of Jalari persons (χ^2= 7.57, P<0.05). This is depicted in Table 4: H and Fig. 4:H.

Table4. Prevalence of Intestinal Parasites with Different Risk Factors in Jalari Community

CATEGORIES	No. of respondents	Infected	Prevalence %
A. Food habit (¡ ^{2}= 1.12, P>0.05, not significant).			
Vegetarian	8	3	**37.5**
Non-vegetarian	96	54	**56.3**
B. Pattern of defecation (¡ ^{2}= 0.349, P>0.05, not significant).			
Toilet	98	53	**54.8**
Open place	6	4	**66.7**
C. Water drinking habit (¡ ^{2}= 5.41, P>0.05, not significant).			
Direct tap water	79	44	**55.7**
Boiled	7	3	**42.9**
Filtered	9	4	**44.4**
Direct well water	6	4	**66.7**
Direct lake water	3	2	**66.7**
D. Domestic animals in house (¡ ^{2}= 5.31, P>0.05, not significant).			
Chickens	25	16	**64.0**
Ducks	22	12	**54.5**
Ducks + Chickens	36	22	**61.1**
None	21	7	**33.3**
E. Occupation (¡ ^{2}= 2.26, P>0.05, not significant).			
Fishing	29	18	**62.0**
Fishing+ Jobs	58	28	**65.5**
Fishing + Farming	17	11	**64.7**
F. Educational Status (¡ ^{2}= 11.31, P<0.05, significant).			
Preprimary	51	32	**66.7**
Primary	19	11	**57.9**
Lower secondary	11	5	**54.5**
Secondary	9	4	**55.6**
Higher secondary	2	1	**50.0**
Illiterate	12	4	**33.3**
G. Economic Status (Annual income in NRS. Thousands) (¡ ^{2}= 2.53, P>0.05, not significant)			
≤10	45	28	**62.2**
11-20	21	10	**47.6**
21-30	14	7	**50.0**
31-40	11	6	**54.5**
41-50	8	3	**37.5**
≥51	5	3	**60.0**
H. Knowledge of Intestinal Parasites (¡ ^{2}= 7.57, P<0.05, significant)			
Nothing (having misunderstanding about parasites and its transmission by telling that parasites are transmitted through taking sweet, overexposure of sugars etc.)	93	52	**55.9**
Little (can say names and simple cause of parasites	9	4	**44.4**
Much (can fully discuss intestinal protozoa and helminths and its causes, effects and transmission)	2	1	**50.0**

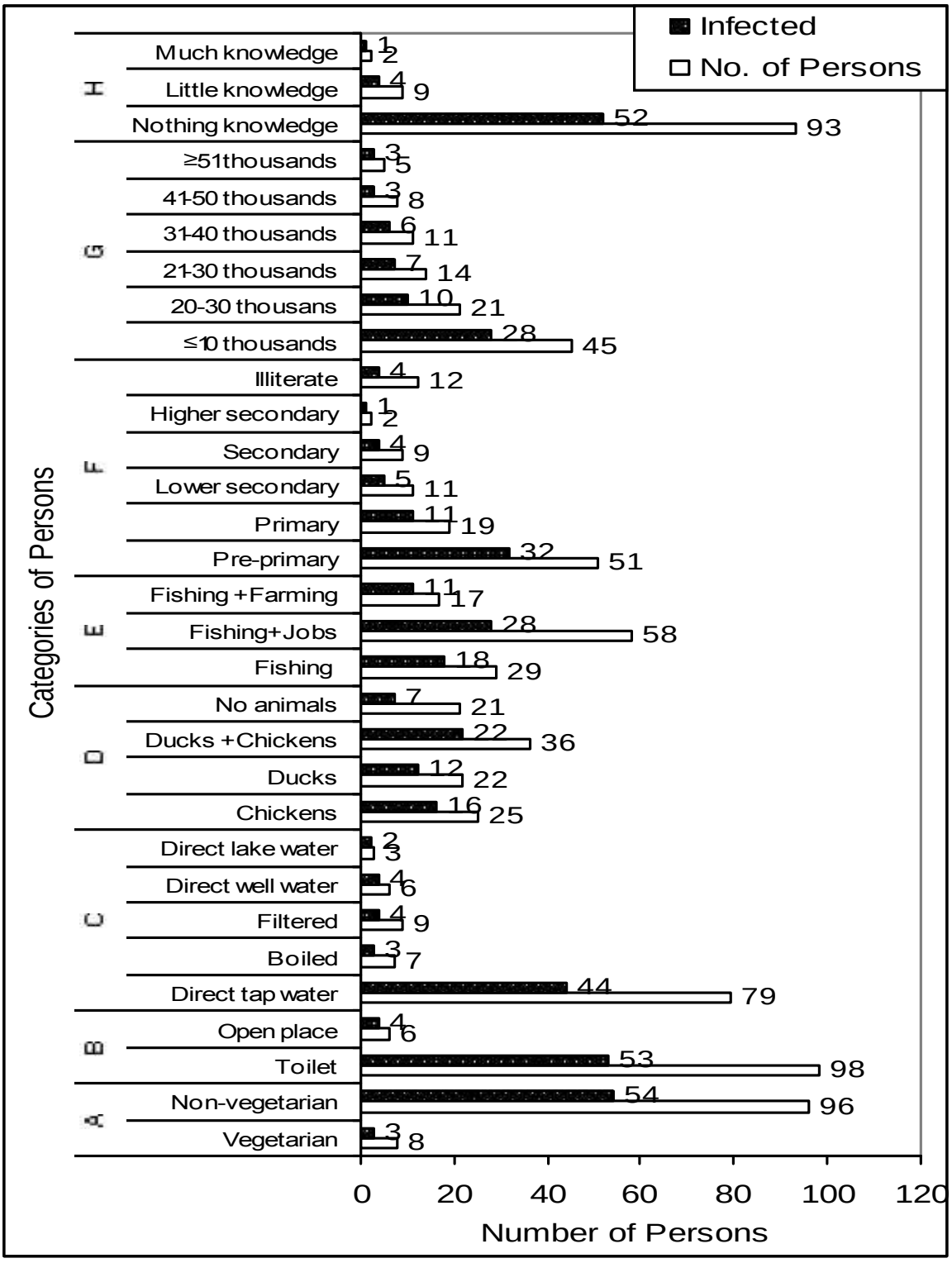

Fig. 4: Prevalence of Intestinal Parasites with Different Risk Factors in Jalari Community

5. 3 PREVALENCE OF INTESTINAL PARASITES IN KUMAL COMMUNITY

5.3.1 General prevalence

In the present study, out of 132 Kumal persons, 75 persons were infected with intestinal parasites and the prevalence was 56.8%. It is depicted in table 5 and figure 5.

5.3.2 Age and sex-wise prevalence

The prevalence in males and females were 63.9% (39 out of 61) and 50.7% (36 out of 71) respectively. In males, the prevalence (80.0%) was highest in the age groups of 31-40 years. Whereas, the lowest prevalence (33.3%) was from the age groups 21-30 years. In females, the highest prevalence (60.0%) was from the age ≤10 years and the lowest prevalence (30.8%) was from the age groups of 21-30 years of age.

There was significant relationship in the prevalence of intestinal parasites with the age-groups of Kumal persons (χ^2= 20.42, P<0.05).
There was no significant relationship in the prevalence of intestinal parasites with the sex of Kumal persons (χ^2= 2.32, P>0.05).

Table 5: Age and Sex Wise Prevalence of Intestinal Parasites of Kumal Community

Age groups (yrs.)	Male Samples examined	Infected No.	+ve %	Female Samples Examined	Infected No.	+ve %	Total samples Examined	Total infected No.	+ve %
≤10	9	7	77.8	20	13	65.0	29	20	**69.0**
11-20	18	13	72.2	20	9	45.0	38	22	**57.9**
21-30	15	5	33.3	13	4	30.8	28	9	**32.1**
31-40	10	8	80.0	13	8	61.5	23	16	**69.5**
41-50	3	2	66.7	3	1	33.3	6	3	**50.0**
≥51	6	4	66.7	2	1	50.0	8	5	**62.5**
Total	**61**	**39**	**63.9**	**71**	**36**	**50.7**	**132**	**75**	**56.8**

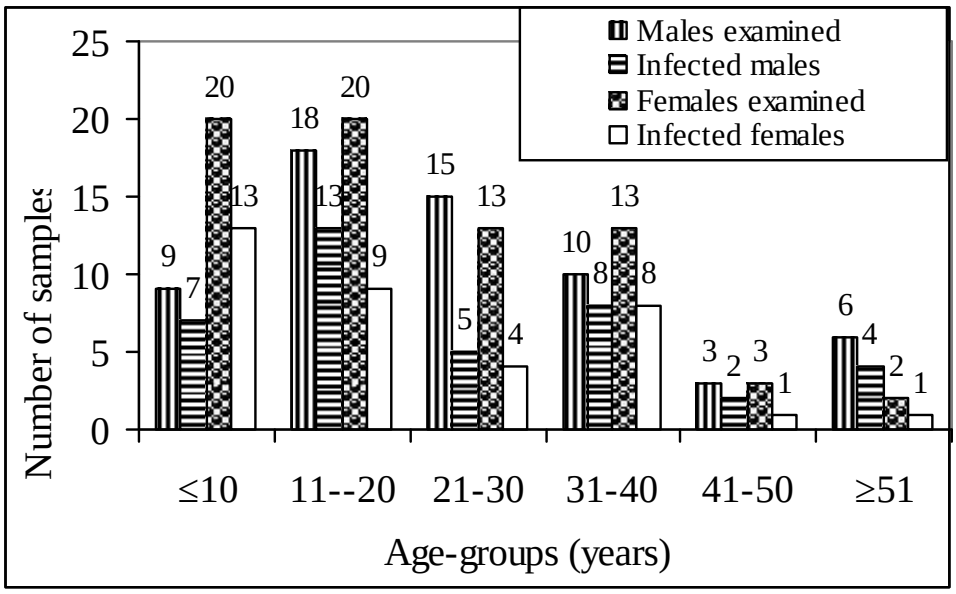

Fig. 5: Age and Sex Wise Prevalence of Intestinal Parasites of Kumal Community

5.3.3 General Prevalence of Specific Parasites in Kumal Community

Out of 61 males, the lowest (3.3%) and highest (21.3%) prevalence was those of *Trichuris trichiura* and *Ascaris lumbricoides* respectively. Similarly, out of 71 females, the lowest (2.8%) and highest (17.0%) prevalence was those of *Trichuris trichiura* and *Ascaris lumbricoides* respectively. This is depicted in Table: 6 and Fig.: 6.

Table 6: General Prevalence of Specific Parasites in Kumal Community

Types of parasites	**Males (n=61)**		**Females (n=71)**		**Total (N=132)**	
	Positive	**%**	**Positive**	**%**	**Positive**	**%**
Entamoeba histolytica	5	8.2	4	5.6	9	6.8
Giardia lamblia	11	18.0	10	14.1	21	16.0
Ascaris lumbricoides	13	21.3	12	17.0	25	19.0
Trichuris trichiura	2	3.3	2	2.8	4	3.0
Total	**37**	**60.7**	**28**	**39.4**	**59**	**42.4**

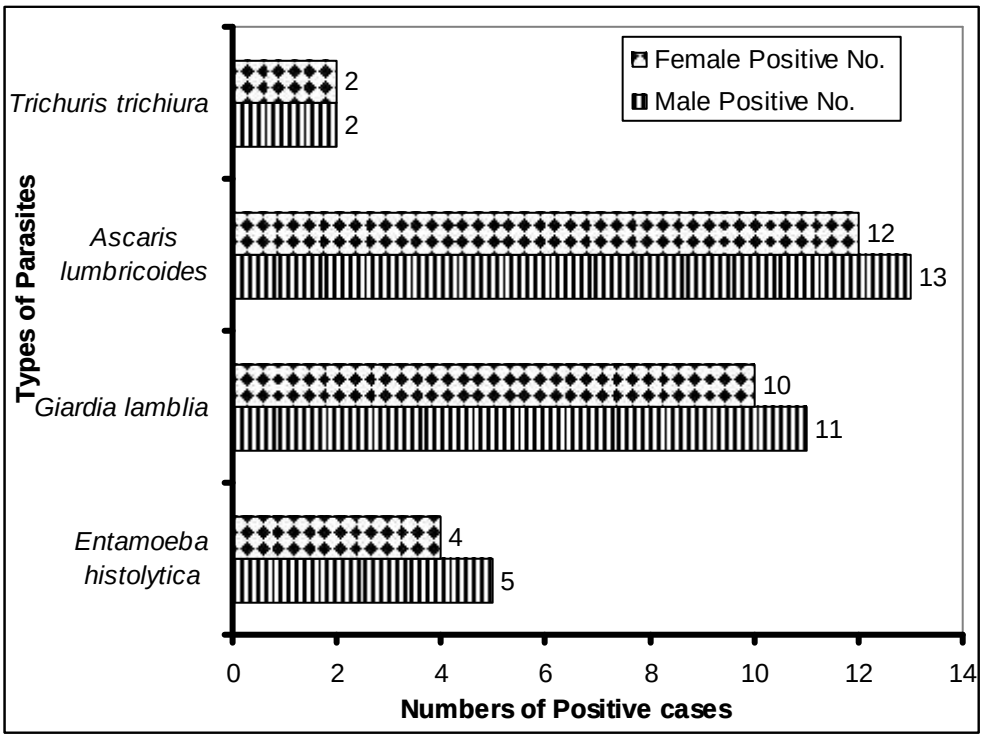

Fig. 6: General Prevalence of Specific Parasites in Kumal Community

5.3.4 Prevalence of Intestinal Parasites According to Different Risk Factors of Transmission of the Parasites in Kumal Community

5.3.4.1 According to Food habit

Out of 61 males, the prevalence in vegetarian and non-vegetarian was 50.0% and 64.9% respectively. Similarly, out of 71 females, the prevalence was 28.6% and 53.1% respectively.

There was no significant relationship in the prevalence of intestinal parasites with the ways of defecation of Kumal persons (χ^2=2.02, P>0.05). This is depicted in Table 7: A and Fig. 7: A.

5.3.4.2 According to Ways of defecation

The prevalence of the intestinal parasites was 56.5% and 62.5% in the persons who use toilet and open place such as grounds, fields, pond, rivers etc respectively for defecation.

There was no significant relationship in the prevalence of intestinal parasites with the ways of defecation of Kumal persons (χ^2= 0.172, P>0.05). This is depicted in Table 7: B and Fig. 7: B.

5.3.4.3 According to Water drinking habit

The highest prevalence of intestinal parasites was from the persons who drink well water (60.0%) directly without any treatment and the lowest prevalence was from the persons who drink boiled water (33.3%).

There was no significant relationship in the prevalence of intestinal parasites with the ways of defecation of Kumal persons (χ^2= 2.33, P>0.05). This is depicted in Table 7: C and Fig. 7: C.

5.3.4.4 According to Domestic animals

The highest prevalence (74.0%) of intestinal parasites was from the owners of chickens, whereas the lowest prevalence (43.5%) was from the persons who have not reared any animals in their houses.

There was no significant relationship in the prevalence of intestinal parasites with the domestic animals of Kumal persons (χ^2= 8.8, P>0.05). This is depicted in Table 7: D and Fig. 7: D.

5.3.4.5 According to Occupation

The highest prevalence (75.9%) of intestinal parasites was from the persons whose occupation is farming, whereas the lowest prevalence (54.8%) was from the persons of both fishing and farming occupation.

There was significant relationship in the prevalence of intestinal parasites with the occupation of Kumal persons (χ^2= 9.39, P<0.05). This is depicted in Table 7: E and Fig. 7: E.

5.3.4.6 According to Educational Status

The prevalence of intestinal parasites was highest (66.1%) in pre-primary children and lowest (33.3%) in illiterate persons.

There was no significant relationship in the prevalence of intestinal parasites with the educational status of Kumal persons (χ^2= 8.49, P>0.05). This is depicted in Table 7: F and Fig. 7: F.

5.3.4.7 According to Economic status

The prevalence of intestinal parasites was highest (65.5%) in the persons whose family annual income is ≤10 thousands and the lowest (40.0%) in the persons whose family income is ranging about 41 thousands to 50 thousands Nepalese rupees.

There was no significant relationship in the prevalence of intestinal parasites with the economic status of Kumal persons (χ^2= 4.84, P>0.05). This is depicted in Table 7: G and Fig. 7: G.

5.3.4.8 According to Knowledge of Parasites

The highest prevalence (59.6%) of the parasites was in the persons who didn't know anything about parasites. The lowest prevalence (33.3%) of the parasites was in the persons who knew much about parasites and their causes, effects and transmission.

There was highly statistical relationship in the prevalence of intestinal parasites with the knowledge of parasites of Kumal persons (χ^2= 50.48, P<0.05). This is depicted in Table 7: H and Fig. 7: H.

Table 7: Prevalence of Parasites with Different Risk Factors in Kumal Community

Categories	No. of respondents	Infected	Prevalence %
A. Food habit (¡ ^{2}=2.02, P>0.05, not significant)			
Vegetarian	11	4	**36.4**
Non-vegetarian	121	71	**57.2**
B. Pattern of defecation (¡ ^{2}= 0.172, P>0.05, not significant).			
Toilet	124	70	**56.5**
Open place	8	5	**62.5**
C. Water drinking habit (¡ ^{2}= 2.33, P>0.05, not significant,).			
Direct tap water	98	58	**59.2**
Boiled	9	3	**33.3**
Filtered	15	8	**53.3**
Direct well water	10	6	**60.0**
D. Domestic animals in house (¡ ^{2}= 8.8, P>0.05, not significant).			
Chickens	46	34	**74.0**
Ducks	22	10	**45.4**
Ducks + Chickens	24	12	**50.0**
Ducks + Pigs	17	9	**53.0**
None	23	10	**43.5**
E. Occupation (¡ ^{2}= 9.39, P<0.05, significant).			
Farming	87	50	**75.9**
Farming+ Jobs	31	17	**54.8**
Farming + Fishing	14	8	**57.1**
F. Education (¡ ^{2}= 8.49, P>0.05, not significant).			
Pre-primary	59	39	**66.1**
Primary	22	14	**63.7**
Lower secondary	16	10	**62.5**
Secondary	14	6	**42.9**
Higher secondary	3	1	**53.3**
Illiterate	18	6	**33.3**
G. Annual income (in NRS. Thousands) (¡ ^{2}= 4.84, P>0.05, not significant).			
≤10	55	36	**65.5**
11-20	26	14	**53.8**
21-30	21	10	**47.6**
31-40	13	8	**41.5**
41-50	10	4	**40.0**
≥51	7	3	**43.9**
H. Knowledge of Intestinal Parasites (¡ ^{2}= 50.48, P<0.05, significant)			
Nothing (having misunderstanding about parasites and its transmission by telling that parasites are transmitted through taking sweet, overexposure of sugars etc.)	114	68	**59.6**
Little (can say names and simple cause of parasites)	15	6	**40.0**
Much (can fully discuss intestinal protozoa and helminths and its causes, effects and transmission)	3	1	**33.3**

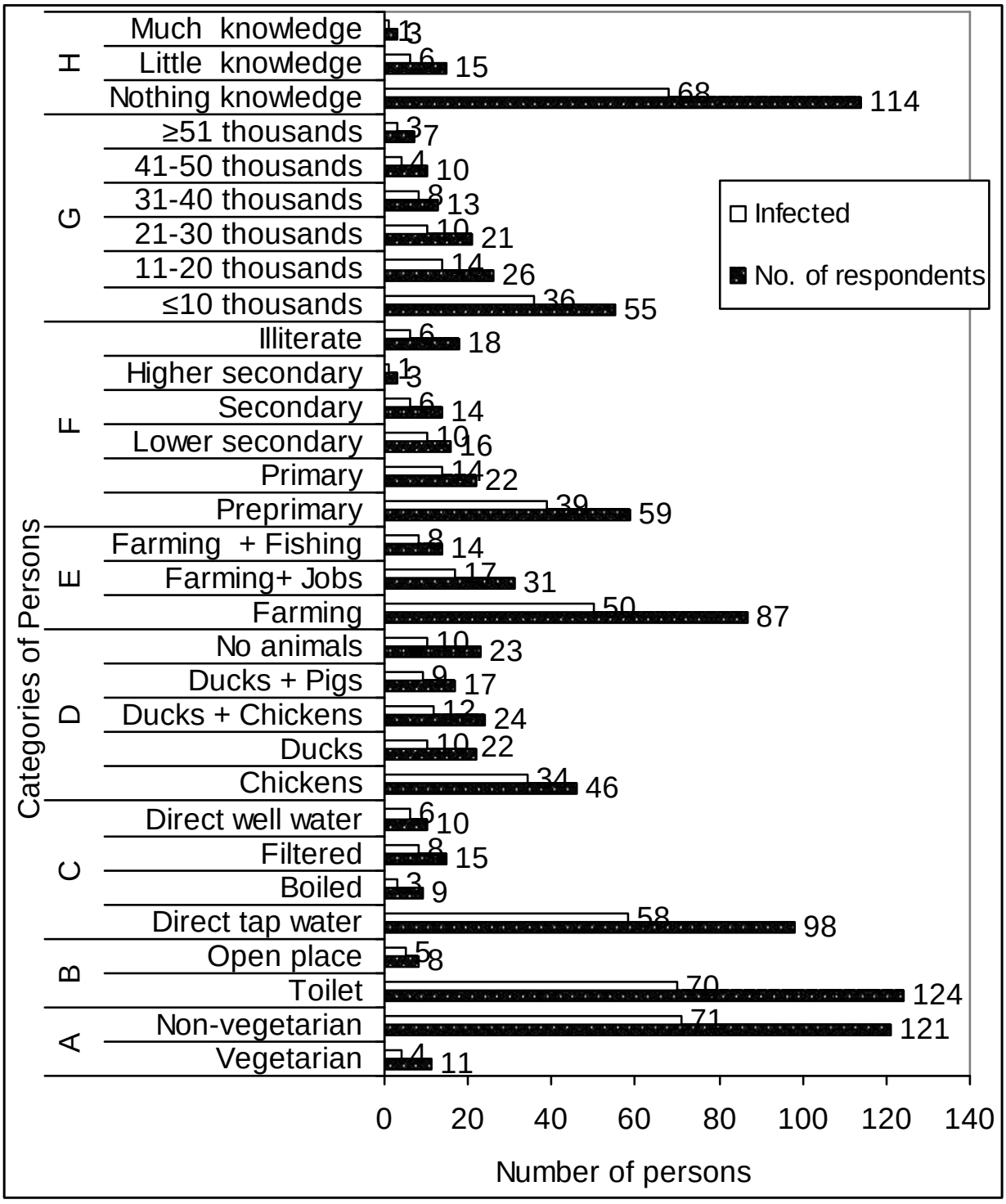

Fig.7: Prevalence of Parasites with Different Risk Factors in Kumal Community

CHAPTER-6
DISCUSSION AND CONCLUSION

The intestinal parasites of human are cosmopolitan in distribution, posing very serious health problems in the developing countries where disease, ignorance and poverty are interlocked (WHO 1981). Intestinal parasitic infections remain an important cause of morbidity and mortality in developing countries especially among paediatrics (Okpala, 1961; WHO, 1981; Awogun, 1984). They are frequently transmitted by unhygienic habit such as direct transfer of ova or cysts from anal region to mouth, eating with unwashed hands or eating and drinking of contaminated food and drink (Okpala, 1961). The main symptom of intestinal parasites is the diarrhoea. It accounts for over 50 million deaths (in all ages) worldwide and is ranked 3rd among diseases responsible for human mortality globally. Diarrhoea remains a major problem in the developing countries due mainly to poverty, characterized by the absence of potable drinking water, proper sanitary habits, absence of good faecal disposal system, poor hygienic practices by the impoverished citizens and over crowding (WHO, 1998).

Estimated global infection rates for some helminthic parasites such as *Ascaris, Trichuris trichiura, Entamoeba histolytica* and *Giardia lamblia* are 1000 million, 500 million, 400 million and 200 million respectively (Warren and Mahmoud 1984, Walsh 1986). In Nepal, about 4.8% of people died of cholera/diarrhoea (CBS 2002). Morbidity due to intestinal parasites has always been an important public health problem in the tropics (Sherchand *et al.*, 1996, Ghimire, 2004, Ghimire *et al.*, 2005; 2006).

In the present study, the total prevalence of the intestinal parasites was about 56.0%. This prevalence is probably higher than reported from previous studies (30.9%, Rai *et al.*, 1991; 44.0% Yong *et al.,* 2001; 40.8%, Jha, 2004; 42.0%, Ghimire *et al.,* 2005 and 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, 2004; 66.9%, Karki *et al.,* 2004; 77.1%, Parajuli, 2004; 67.4%, Ghimire *et al.,* 2006 in different areas of Nepal. The difference in the present prevalence might be due to the different materials and methods, different types of observed patients, different seasons, different parasites and other unknown factors.

Ethnically, the prevalence was slightly higher in Kumal (56.8%) than in Jalari (54.8%). The high prevalence in the persons of both of these communities might be due to the poor socio-economic status and usual contact with the risk factors of parasite transmission. Other studies showed high prevalence in ethnic groups such as 77.1% in Mushahar community in Chitwan (Parajuli, 2004), 66.9% in Magar community in Palpa (Karki *et al.*, 2004), 39.4% in Newar and 71.2% in Jalari community in Kirtipur, Kathmandu area (Jha, 2004), 36.5% in Newar and 80.3% in Jalari community in Kirtipur, Kathmandu (Maharjan, 2004).

The high prevalence in Kumal community might be because of their traditional occupation (farming), poor environmental sanitation and lack of awareness towards personal hygiene and intestinal parasites. One can observe the unwashed hands before and after food, uncut finger nails, usual contact with soil and mud mostly by children, few bathing habit of these Kumal people. Soulsa (1975) carried out a survey of the prevalence of intestinal parasites in Pokhara and observed that dirty finger nails might play an important role in the transmission of intestinal parasites.

In the present study, in Jalari community, the presence of high prevalence in males and females, in the children of ≤10 years shows that intestinal parasites are prevalent in children due to low immune status, usual contact with infected soil, food, water and other risk factors (Ghimire, 2004, Ghimire *et al.*, 2005; 2006). The lowest prevalence in males in Jalari community in the age groups 21-30 years might be due to their awareness towards the personal hygiene and intestinal parasites and low contact with risk factors for parasite transmission. The lowest prevalence in females in this community in the age groups of ≥ 51 years might be due to low contact with the risk factors. The females of these age usually live in the houses and don't go to agricultural fields/ fishing. The higher prevalence in males than in females might be explained on the basis of usual contact with soil, fields, water and other risk factors by males.

In Kumal community, the high prevalence of parasites in both of males and females was in the children ≤10 years and this might be explained on the basis of same factors as low immune status, usual contact with risk factors such as soil, water, food etc (Ghimire, 2004, Ghimire *et al.*, 2005; 2006). Similarly, the lowest prevalence in both males and females was in the persons of age groups 21-30 years and this might be due to awareness of parasites and low contact with risk factors. Most of these people used to drink treated water, have sandal bearing, bathing and washing of hands before and after food and going to toilet. Besides, they have effective immunity against parasitism (Sherchand *et al.*, 1996; 2002; 2003; Ghimire, 2004, Ghimire *et al.*, 2005; 2006). The higher prevalence in males than in females might be because the males are frequently out of house and they have to work mostly in fields, water, soils which are risk factors of parasitosis.

The total prevalence of intestinal parasites in both community were as follows: - *Ascaris*: 17.4%, *Giardia lamblia:* 14.0%, *Entamoeba histolytica:* 5.9% and *Trichuris:* 3.0%. In both ethnic groups, the prevalence of specific *Ascaris lumbricoides* was the highest and that of *Trichuris trichiura* was the lowest in male and female persons. Similarly, in the males and females of both communities, the prevalence of *Giardia lamblia* was highest and the prevalence of *Entamoeba histolytica* was the lowest among protozoa and the prevalence of *Ascaris* was the highest and the prevalence of *Trichuris* was the lowest among helminths.

The present studies follows the other studies for the highest prevalence of *Ascaris* which shows that *A. lumbricoides* was the most common helminth in Nepal (Geollman 1986, Gupta *et al.,* 1988, Gianotti 1990, Rai *et al.,* 1994; Rai *et al.,* 1997; Chhetri 1997; Rai *et al.,* 1998; Rai *et al.,* 2001; Ghimire *et al.,* 2005). This highest prevalence can be explained on the basis of less sandal wearing habit, usual contact of infected soil, water, fields where water becomes medium for the survival of embryonated eggs of *Ascaris*. The high prevalence of helminths than protozoa shows that soil transmitted helminth has been increasingly recognized as an important public health problem, particularly in developing countries (Estevez, 1983; Sherchand *et al.,* 1997; Ghimire *et al.,* 2005).

Regarding the protozoan parasite, the prevalence of *G. lamblia* was highest, followed by *E. histolytica* which resembles with the finding of Sherchand *et al.* (1997), according to which also *G. lamblia* was highest, and followed by *E. histolytica* and *Cyclospora*. In this study, *Cyclospora* was not reported either because of the low sensitivity of the single wet mounts for coccidian parasites or due to the absence of acid fast staining (Ghimire *et al.,* 2005; 2006). Other results which support the highest prevalence of *Giardia* from the

research conducted in Nepalese areas are those of Khetan, 1980; Rai *et al.*, 1991; Shrestha 1995; Ghimire *et al.,* 2005. *Giardia* infections are very common in developing countries ranging from about 5-43% (Islam, 1990; Farthing, 1994; Rabbani *et al.,* 1994, Ghimire *et al.,* 2005) similar to present results**.** Consumption of contaminated food, water or untreated water contaminated by human sewage or by wild rodents, cross-connections or damage in water-distribution systems, ineffective filtration are the transmission of *Giardia* cysts (Thompson *et al.,* 1990; Brodsky *et al.,* 1974; Ghimire *et al.,* 2005) which explains such a high rate of prevalence.

The presence of *Entamoeba histolytica* in the present study might be explained on the basis of some literatures which describe that it is the second leading cause of death from parasitic disease world wide (Stanley, 2003). The present prevalence is similar to other studies (Gupta *et al.,* 1988; Rai *et al.,* 1991) with similar modes of transmission of *Giardia*.

The world Health Organization noted that human behaviour may influence the prevalence and intensity of intestinal infections (WHO, 1981). Different factors are considered risk factors for the parasite transmission. These are infected food, water, soil, pattern of defecation, food habit, water drinking habit, presence of domestic animals in houses, and types of occupation, level of education, family income, and knowledge to specific parasites.

In both communities, the prevalence of intestinal parasites was higher in the persons who used to defecate in open places. So, the human behaviour such as open air defecation and defecation near water sources can be described as contributing factors in transmission of

parasites. Some parasites such as *Entamoeba histolytica, Giardia lamblia*, *Ascaris lumbricoides, Trichuris trichiura* are directly related to open air defecation because their cysts and eggs can survive several days in moist stool (Smyth, 1994, Ghimire *et al.*, 2005).

In both communities, the prevalence of intestinal parasites was higher in the persons who are non-vegetarians. Infected raw meet, improperly cooked meat and meat prepared by slaughtering near the infected water sources are the possible risk factors.

In both communities, the highest prevalence of intestinal parasites was higher in the persons who used to drink untreated water (direct well water or lake water or tap water). The presence of parasites in the persons who used to drink filtered water might be due to ineffective filtration or other risk factors. The presence of parasites in the persons who used to drink boiled water might be due to ineffective boiling for short time or other risk factors.

The presence of domestic animals in houses is the important risk factors (Sherchand *et al.*, 1999; 2001; 2003) for parasite transmission. In Jalari and Kumal community, the prevalence was highest and lowest among the persons, who have domesticated chicken in their houses and the persons who have not domesticated any animals in their houses respectively. This is due to the zoonotic transmission and cross-connection of some parasites between humans and animals.

The occupations of the persons greatly play the role in parasite transmission (Sherchand *et al.*, 2003; Ghimire, 2004; Ghimire *et al.*, 2006). In the present study, the persons whose occupation was both farming and fishing were highly infected with parasites. Similarly, the farmers were highly infected with parasites among Kumal community. This is due to

the probability of the contamination of infective stages of intestinal parasites in the persons of these occupations.

The level of education also plays significantly in the parasite transmission. That is because of the awareness among the highly educated persons as they mostly read about the life cycle, epidemiology of the intestinal parasites in their courses. Due to this causes, students of higher studies have low rate of parasite infection. In contrary, illiterate people have high rate of infection.

The family income is also a risk factor of parasite transmission. If the family income is high, they are less susceptible to parasites because they usually take boiled water, have good personal and environmental hygiene, careful feeding habit and proper soap using habit before and after food and toilet. If they are infected with parasites, the members of the parasite infected persons (diarrhoeal persons) can go to treatment. They can visit proper doctors/medical. They can use proper medicines/ nutritious foods such as fruits which are needed to increase the RBCs counts, antibody etc. Anaemia is aggravated by low nutritional status of subjects whose staple foods, such as rice, cassava, and maize are poor sources of folate, and iron (Ghimire *et al.,* 2005) and these foods are frequently used by the two ethnic groups of low income persons in the studied area. Parasites are more frequently susceptible to those persons who have low haemoglobin level in their blood (Roche, 1966; Huq, 1983; Ghimire *et al.,* 2005).

This study showed that a significant proportion of the population had lack of awareness about the intestinal parasites. A survey of perception and treatments of helminthic infections 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% the sample had no suggestions for strategies to prevent worm infection. Similarly, a study of Brazilian population living in the municipality of Carlos in the state of Sao Paulo, an area endemic for soil transmitted helminthic infections, indicating that 14% of the sampled population did not know how individuals contract soil-transmitted infection (William-Blangero *et al.,* 1998). Similar results were observed during the surveillance study of present research work.

It was reported that causality of helminthic infections attributed to sweet foods in an urban Brazilian population living in the state of Bahia (Williams-Blangero *et al.* 1998). Similar kinds of responses were obtained during surveillance study, according to respondents' sweet things like sugar, toffee, chocolate, ice creams etc. when taken in excess amount there would be greater chances of parasite infection. This delusion might be spread by parents in childhood to lessen their demands (Jha, 2004).

Finally epidemiological studies are important for identifying etiological factors that play a role in risk assessment and in decision-making. The molecular method should be applied and the case-controlled study should be made to confirm the roles of risk factors to transmit intestinal parasites in these ethnic groups in Nepal. Besides, haematological and histopathological studies should be assessed to confirm other intestinal parasites present in these people.

CHAPTER-7
RECOMMENDATIONS

1. People should be encouraged for sanitary improvements including personal hygiene like nail cutting, hand washing before and after taking food and going toilet, environmental sanitation such as proper disposal of waste faecal materials, maintenance of broken pipe, sanitation of toilets etc.
2. In both of these ethnic groups, children as well as other adults should be forced to use latrine. They should be avoided to defecate near the source of water, vegetable farms etc.
3. Farmers should be motivated to use boots and gloves during working in field.
4. The children of these ethnic groups should be encouraged to go to school. The government should give free education, scholarship and fellowship to these people for study in school as well as other medical and health related universities.
5. Public health education (intestinal parasitosis) should be introduced in the text book of the primary level as a compulsory subject.
6. People should be provided with knowledge about feeding behaviour like use of boiled water for drinking purpose and consuming properly cooked meat/ meat products.
7. Basic health education programs should be conducted time to time in these ethnic communities for raising awareness towards the parasitic infections and prevention and control by NGOs, INGOs, private health agencies, government health agencies, health ministry, environment ministry, and education ministry.
8. Health workers should be trained to make familiar with newly emerging coccidian parasites such as *Cyclospora*, *Crptosporidium* etc.
9. Blanket treatment of deworming should be implemented per year especially during the peak season of parasitic infection.
10. The research works on the prevalence of intestinal parasites and prevention should be encouraged as it is one of the major public health problems of our nation.
11. Molecular diagnosis of the intestinal parasites should be assessed in the people and risk factors in the present study area to confirm the chain of transmission.
12. Hematological and histopathological studies should be assessed to confirm other intestinal parasites present in these people.

REFERENCES

- Acharya S. Malnutrition and diarrhoeal disease. *J Inst Med* 1979***;*** **1:** 21-23.
- Aspock H and Walochnik J. What are parasite? *Denisia* 2002; **6:** 1-12
- Awogun IA. The Prevalence of Intestinal Parasitic Infection in Children Living in Ilorin Kwara State, Nigeria. *West Africa J Med* 1984; **4(1):** 16-21.
- Brodsky RE, Spencer HC, Schultz MG. Giardiasis in American travelers to the Soviet Union. *Journal of Infectious Diseases* 1974; **130:** 319-23.
- Buchy P. Intestinal parasitoses in the Mahajanga region, west coast of Madagascar. *Bull Soc Pathol Exot* 2003; **96:** 41 - 45.
- CBS. Population Census-2001. HMG/N National Planning Commission Secretariat Central Bureau of Statistics, Ram shah-path, Thapathali, Kathmandu, Nepal, 2002.
- Chandler AC and Read CP. Introduction to Parasitology, John Wiley and Sons, Inc. New York. London. 1961.
- Chatterjee KD. Protozoology and Helminthology, Chatterjee Medical Publisher. 2001.
- Chaudhari B, Mishra PN and Sherchand JB. Prevalence of Human Intestinal Parasites in rural village development committee, Machchhegaun, Kathmandu. Fourth National Conference on Science and Technology March 23-26, 2004. Royal Nepal Academy of Science and Technology. SSZ-PS-8. PP. - 333.
- Chessbrough, M. Parasitological tests. In: District Laboratory Practice in Tropical Countries. Monica Chessbrough (ed.). *Tropical Health Technology* 1998; PP.-184-235.
- Chhetri MK. Parasite Infection in Nepal. *Jour of Nep Med Assoc*1997; **35:** 60-65.
- Clarke SC, McIntyre M. The incidence of in stool samples submitted to a District General Hospital. *Epidemiol Infect* 1996; **117:** 189-193

- Craig CF and Faust EC. Clinical Parasitology. LEA and FEBIGER, PHILADELPHIA. 1943.

- Crompton DWT. Hookworm disease: Current status and new directions. *Parasitology Today* 1989; 5**:** 1-2.

- Current WL, Reese NC, Ernst JV, bailey WS, Heyman MB and Weinstein WM. Human Cryptosporidiosis in Immunocompetent and Immunodeficient Persons. *New Engl J Med* 1983; **308:** 1252-57.

- Estevez EG, Levine JA and Warren J. Intestinal parasites in a remote village in Nepal. *J Clin Microbiol* 1983; **17:** 160-61.

- Farthing MJG. Giardiasis as a disease. In: Thompson RCA, Reynoldson JA, Lymbery AJ, eds. *Giardia: from molecules to disease*. Wallingford, Eng-land, CAB International, 1994: 15–37.

- Fernandez MC, Verghese S, Bhuvaneswari R, Elizabeth SJ, Mathew T, Anitha A and Chitra AK. A comparative study of the intestinal parasites prevalent among children living in rural and urban setting in and around Chennai. *J Com Dis* 2002; **34:** 35- 39.

- Geollman R. Incidence of disease in Paten Hospital in general OPD. *J Nep Med Assoc*1988; **26:** 921.

- Ghimire TR, Mishra PN. Intestinal parasites and Haemoglobin concentration in the people of two different Areas of Nepal. *Journal of Nepal Health Research Council,* 2005; **3(2):** 1-7.

- Ghimire TR, Mishra PN. Intestinal parasites in the Human Immunodeficiency Virus Infected Patients in Kathmandu, Nepal. *The Nepalese Journal of Zoology*, 2006; **1(1):** 9-19.

- Ghimire TR. *Cyclosporiasis in HIV and Non-HIV patients: A study in Kanti Children's Hospital, Maharajgunj and Shukra Raj Tropical and Infectious Disease Hospital, Teku, Kathamdnu, Nepal*. Dissertation submitted in partial fulfillment of Master's Degree in Zoology (Parasitology), Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal, 2004.

- Glanottims A. Intestinal Parasites of Nepal. *J Nep Med Assoc* 1999, **28:** 242 - 247.
- Gongol DN. Case of Roundworm in Gall Bladder. *J Nep Med Assoc* 1972. **11.**
- Gupta R and Gupta HN. Studies on the Infection rate of Human intestinal parasites of Kirtipur. *J Nepal Med Assoc* 1988; **26:** 23 - 29.
- Gurbacharya DL. Problem of Soil Transmitted helminthiasis in Nepal. *Jour Nepal Med Assoc* 1981; **19.**
- Huq RS, Abalaka JA, Standord WL. Folate content of various Nigerian Foods. *J Sci Food Agric* 1983; **34:** 404-06.
- Integrated Family Planning and Parasite control Project (IFPPCP), Nepal: Annual Progress Report 1980-1985: **(1-6)**.
- Islam A. Giardiasis in developing countries. In: Meyer EA, ed. *Humanparasitic diseases: Giardiasis*. *Amsterdam, Elsevier:* 1990; **3:** 235–66.
- Janakiram K, Shetty SK, Peaddy KV, and Lalithamma BP. Prevalence of intestinal parasitic infection among patients attending Adichunchanagiri Hospital and Research centre B.G. Nagar, Mandyan (Karnataka). *J Com Dis* 2001; **33:** 297 -299.
- Karki D, Maharjan M and Joshi DD. Prevalence of intestinal parasites particularly *Taenia* sp. among Magar ethnic group in Barangdi VDC of Palpa District. Fourth National Conference on Science and Technology, March 23-26, 2004. Royal Nepal Academy of Science and Technology. 2004; SSZ. PS. 1.328p.
- Kaur R, Rawat D, Kakkar M, Uppal B, Sharma VK. Intestinal Parasites in Children with Diarrhea in Delhi, India. *Southeast Asian J Trop Med Public Health* 2002; **33(4):**725-28.
- Keshari AK. Status of Parasitology in Nepal. Thesis submitted in fulfillment of the requirement for the degree in Zoology, 1986.
- Khetan RP. Incidence of Parasitic infestation in Narayani zone. *J Nepal Med Assoc* 1980; **18:** 29 - 31.

- Kim BJ, Ock MS, Chung DII, Yong TS and Lee KJ. The intestinal parasite infection Status of inhabitants in the Roxus city, the Philippines. *Korean J of Parasitology*. 2003; **41:** 113 - 115.

- Lee TW, Park GM, Lee DH, Park SJ, and Yong TS. Intestinal parasite infections at an institution for the handicapped in Korea. Korean *Journal of Parasitol* 2000; **38:** 119-181.

- Lili Z, Bingxiang Z, Hong T, Shuhua X, Hotez P. Bing Z, Yangzhong L, Yangzhong K, Ying L, Haichou X, Howdon J, Hui Y, Huizhen W and Zhen F. Epidemiology of human geohelminth infections (Ascariasis, Trichuriasis and Necatoriasis) in Lushui and Puer Counties, Yunnan Province, China, 2000; **31:** 448 - 451.

- Ludwig KM, Frel F, Alvores FF, and Paes JTR. Correlation between sanitation condition and intestinal parasitosis in the population of Assis, State of Sao, Paul. *Rev. Soc. Bras, Med. Trop*. 1999; **32**: 547-555.

- Miller SA, Rosarb CL, Rojas E and Scorza V. Intestinal parasitic infection and associated symptoms in children attending day-care centers in Trujillo, Venezuela. *Trop Med and International Health* 2003; 8**:** 342-347.

- Mirdha BR. and Samantray JC. *Hymenolepis nana*: A common cause of pediatric diarrhoea is urban slum dwellers in India. *J. Tropical Pediatrics*, 2002; 48: 331 - 334.

- Navitsky RC, Dreyfuss ML, Shrestha J, Khatry SK, Stoltzfus RJ Albonico M. *Ancylostoma duodenale* is responsible for hookworm infections among pregnant women in the rural plains of Nepal. *J Parasitol* 1998; **84:** 347-51.

- Needham C, Kim HT, Hoa NV, Cong LD, Michael E, Darke L, Hall A and Bundy DAP, Epidemiology of Soil transmitted nematode infections in Ha Name Province, Vietnam. *Tropical Medicine and International Health*, 1999; **3:** 904-912.

- Nepal M and Palfy B. A study of prevalence of intestinal parasites in the Mahankal Panchayat and their relation with haemoglobin Levels. *Journal of Institute of Medicine*, 1980; **2:**175-182.

- Okpala I. A survey of the incidence of intestinal parasites among Government Workers in Lagos, Nigeria. *West Africa Med Journal,* 1961; **10:** 148 – 157.

- Olsen A, Samuelsen H and Onyango-Ouma W. A study of risk factors for intestinal helminth infections using epidemiological and anthropological approaches. *J Biosoc Sci* 2001; **33:** 569: 584.

- Parajuli RP, Mishra PN and Joshi DD. Prevalence of intestinal parasites in Mushar community of Chitwan district. Fourth National Conference on Science and Technology, March 23-26, 2004, Royal National Academy of Science and Technology. 2004; SSZ. PS-9. 334p.

- Parajuli RP. "Prevalence of Intestinal Parasites in Mushar Community of Chitwan District is Relation to Their Socio-cultural and Socio-economic status, A Dissertation Submitted for Partial Fulfillment in Central Department of Zoology, T.U., 2003.

- Paul IGG and Nallam NR. Intestinal helminth infections among school children in Vishakhapatnam. *Indian Journal of Pediatrics* 1999; 66**:** 669-673.

- Rabbani GH, Islam A. Giardiasis in humans: populations most at riskand prospects for control. In: Thompson RCA, Reynoldson JA, Lymbery AJ, eds. *Giardia: from molecules to disease*. Wallingford, England, CAB Inter-national, 1994, 217–49.

- Rai SK and Gurung CK. Intestinal Parasitic infection in High School level students of Birgunj City. *J Inst Med* 1986; **8:** 33-38.

- Rai SK and Rai G. Ascaris, Ascariasis and its present Scenario in Nepal. *J. inst. Med,* 1999; **21:** 243-245.

- Rai SK, Matsumura T, Ono K, Oda Y, Uga S, Rai N and Shrestha HG. Intestinal Parasitoses in “an unknown Disease outbreak” hit rural hilly area is western Nepal. *Nepal Medical. Council Journal* 2001; **2:** 61-64

- Rai SK, Bajracharya K, Budhathoki S, Khadka JB, Rai KK, Shrestha MK, Sharma CM, Nakanishi M, Kubo T and Shrestha HG. Status of intestinal parasitoses of T.U. Teaching Hospital. *Journal of the Institute of Medicine* 1995; 17**:** 134-142.

- Rai SK, Bajracharya K, Budhathoki S, Khadka JB, Rai KK, Shrestha MK *et al*. Status of intestinal parasitoses of T.U. Teaching Hospital. *Journal of the Institute of Medicine* 1995; **17:** 134-42.

- Rai SK, Hiari K, Abe A, Ishiyama S, Rai G, Ono K and Uga S. Intestinal parasitoses among school children in a rural hilly area of Dhading District Nepal, 2002.

- Rai SK, Kubo T, Nakamishi M, Sumi K, Shibato H, Matsuoka A and Shrestha HG. Soil Transmitted helminthic infection in Nepal. *The J of the Japanese Assoc of Infections diseases*, 1994, **68:** 625 - 630.

- Rai SK, Nakanishi M, Khadka JB, Shrestha MK, Sharma CM, Shrestha HG. Intestinal Parasitoses in Kathmandu Nepal. Asian Conference in Medical Laboratory Technology, 4th Bangkok, Thailand, Proceeding of the Asian Conference in Medical laboratory Technology, 1991.

- Rai SK, Uga S, Ono K and Rai G. Contamination of Soil with helminth parasite eggs in Nepal. *Southeast Asian J Trop Med. and Public health,* 2000; **31:** 388 - 393.

- Rao VG, Yadav R, Bhondeley MK, Das S, Agrawal MC and Tiwary RS. Worm infestation and Anaemia: A public health problem among tribal pre school children of Madhya Pradesh. *J Com Dis,* 2002*;* **34:** 100-105.

- Roche J and Benito. Prevalence of intestinal parasite infections with special reference to *Entamoeba histolytica* on the island of Bioko (Equatorial Guinea). *American Journal of Tropical Medicine and Hygiene* 1999; **60:** 257-262.

- Roche M, Layrisse M. The nature and causes of “Hookworm Anaemia”. *Am J Trop Med Hyg* 1966.

- Sharma BP. Roundworms and their infestations. *Journal of Nepal Medical Association,* 1965; **3:** 120 - 123.

- Sharma RP, Tuladhar NR. A study on intestinal parasites among auxiliary health workers in Kathmandu. *J Nep Med Assoc* 1971; **9:** 257 - 61.

- Sherchand JB, and Cross JH. Emerging Pathogen *Cyclospora cayetanensis* in Nepal. *Southeast Asian Journal of Tropical Medicine Public Health*, 2001; **32:** 143-150.

- Sherchand JB and Cross JH. *Cyclospora cayetanensis* in Nepal: A study of Epidemiological and Microbial Aspects. *Journal of Nepal Health Research Council* 2003*;* **3:**1-8.

- Sherchand JB, Cross JH, Jimba M, Sherchand S, Shrestha MP. Study of *Cyclospora cayetanensis* in health care facilities, sewage water and green Leafy Vegetables in Nepal. *Southeast Asian Journal of Tropical Medicine Public Health* 1999; **30:** 58-63.

- Sherchand JB, Cross JH. *Cyclospora* Diarrhea at the Kanti Children's hospital Nepal. Paper Presented in *XIV International Congress for Tropical Medicine and Malaria.* "New Goal for the 21st Century" Nagasaki, Japan Nov. 17-22, 1996; 296.

- Sherchand JB, Cross JH. Emerging Pathogen *Cyclospora cayetanensis* in Nepal. *Southeast Asian J Trop Med Public Health* 2001; **32:** 143-50.

- Sherchand JB, Larsson S, Shrestha MP. Intestinal Parasites in children and adults with and without abdominal discomfort from Kathamndu area of Nepal. *Int J Tropical Gastroenterology* 1996; **17:** 15-22.

- Shrestha CB. Cultural geography of Nepal. Shrestha KK and Joshi KL, Bhaktapur, Nepal, 1981, P.10.

- Shrestha S. Year wise stool Examination Report with Parasitic Infection Report, FPAN, Kathmandu, 1995.

- Sirivichayakul C, Anant CP, Wisetsing P, Siripanth C, Chenthavanich P and Pengsaa K. Prevalence of Intestinal parasitic infection among Thai people with mantel handicaps. *Southeast. Asian I of Trop Med. and Public health* 2003; **34:** 259-263.

- Smith HM, Dekaminsky RG, Niwas S, Soto RJ and Jolly PE. Prevalence and intensity of infections of *Ascaris lumbricoides* and *Trichuris trichiura* and associated socio-demographic variables in four rural Honduras communities. *Memorias do Instituto Oswald Cruz*, 2001; **96**: 303-314.

- Smyth JD. *Animal Parasitology*. Cambridge University Press, Great Britain, 1994. ISBN 0 521 566996 7.

- Soulsa VO. Intestinal Parasitism is Pokhara. *J Nep Med Assoc* 1975; **15:** 9-13.

- Stanley SL. *Lancet* (North American Edition), 2003; **361:** 1025-34.

- Stephenson LS, Latham MC, and Ottesen EA, *Parasitology*, 2000; **121:**S23- S38.

- Stoll NR. The Wormy world. *J Parasitol* 1947***;*** **33:**1-17.

- Sugari S, Tongu Y, Inatomi S and Pradhan HD. A Survey on human parasitic infection in Nepal. *Japan Journal of Parasitology* 1985; **34:** 285 - 291.

- Thompson RCA, Lymbery AJ, Meloni BP. Genetic variation in *Giardia*, Kunstler 1882: taxonomic and epidemiological significance. *ProtozoologyAbstracts*, 1990; **14:**1-28.

- Toma A, Miyagi I, Kamimura K, Tokuyama Y, Hasegawa H, Selomo M, Dahlan D, Majid I, Hasanuddi I, Ngatimin R, Mogi M and Kuwabara N. Questionnaire survey and prevalence of Intestinal helminthic infection in Barru Saluwesi, Indonesia *Southeast Asian Journal of Tropical Medicine and Public Health*, 1999; **30 :** 68-77.

- Toni Hagen. Nepal: the kingdom in the Himalayas, New Delhi, oxford book and stationary, 1961; PP.59-60.

- Tzipori S, Griffiths JK. Natural History and Biology of *Cryptosporidium parvum*. *AdvParasitol* 1998; **40:**5-36. 34.

- Uchoa CMA, Lobo AGB, Bastos OMP, and Matos AD. Intestinal Parasitism: Prevalence in day-care centres of Niteroi city, Rio de Janeiro Brazil. *Reviste do Instituto Adolfo Lutz,* 2001; **60:**97-101

- Uga S, Kimura D, Kimura K, and Margono SS. Intestinal Parasitic infections in Bekasi District, West Java, Indonesia and a comparison of the infection rates determined by different techniques for faecal examination. *South east Asian J Trop Med Public Health* 2002: **33:** 462 - 467.

- Warren KS and Mahmoud AAF. Tropical and Geographical Medicine. New York, Mc Graw-Hill Book Company, 1984.

- WHO, Intestinal Protozoan and Helminthic Infections: Report of WHO Expert Committee, 1981; Tech Rep Ser: 666.

- WHO, Intestinal Protozoan and Helminthic Infections: Report of WHO Expert Committee, 1987; Tech Rep Ser: 749.

- WHO. Guidelines for the Evaluation of Soil-Transmitted Helminthiais and Schistosomiasis at community level. Mimeographed document. WHO/CTB/SIP/98. 1. World health Organization, Geneva, 1998.

- Williams- Blangero S, Subedi J, Upadhayay RP, Manral DB, Khadka K, Jirel S, Robinson ES and Blangero J. Attitudes towards Helminth Infection in the Jirel Population of Eastern Nepal. *Soc Sci Med* 1998; **47:**371-379.

- Wilson ML. Emerging Infections: The Once and Future Diseases. *Am J Clin Pathol* 1999; **112:** 595-596.

- World Health Organisation (WHO): Intestinal Protozoan and Helminthic Infections. *WHO Technical Report Series* 1981; **666:** Geneva.

- World Health Organization. The State of World Health. In: The World Health Reports 1998. Life in the 21st century: A Vision for All. *WHO Geneva,* 1998; 57-58.

- Yong TS, Sim S, Lee J, Ohrr H, Kim MH, and Kim H, A small scale survey on the status of intestinal parasite inflections in villages in Nepal. *The Korean J of Parasitology*, 2000; **38:** 275-277.

ANNEX-1

χ^2 Test as a Test of Goodness of Fit.

χ^2 test of goodness of fit was used in one way classification tables of observed frequencies in a single row or column.

Under the mull hypothesis, (H_0) that there was no significance different between observed and expected values (or there is a good compatibility between theory and experiment), Karl Pearson proved that the statistic.

$$x^2 = \sum \frac{(O-E)^2}{E} = \frac{(O_1 - E_1)^2}{E_1} + \frac{(O_2 - E_2)^2}{E_2} + ... + \frac{(O_n - E_n)^2}{E_n}$$

Follows χ^2 –distribution with n-1 degrees of freedom.

Where $0_1,0_2,……..0_n$ are the observed frequencies and $E_1,E_2,……E_n$ are the corresponding expected frequencies.

χ^2 Test as a Test of Independence of Attributes.

K^2 test of independence of attributes was used in contingency tables of observed frequencies occupying t rows and c columns

$$x^2 = \sum \frac{(O-E)^2}{E} = \frac{(O_{11} - E_{11})^2}{E_{11}} + \frac{(O_{12} - E_{12})^2}{E_{11}} + ... + \frac{(O_{nm} - E_{nm})^2}{E_{11}}$$

Follows K^2-distribution with (r-1) (c-1) degree of freedom.

Where 0_{11}, 0_{12}…0nm are the observed frequencies of 1st row and 1st column, 1st row and 2nd column……..nth row and mth column respectively and

$$\text{Enm} = \frac{\text{n}^{\text{th}}\ \text{row total} \times \text{m}^{\text{th}}\ \text{column Total}}{\text{N}}$$

$$= \frac{\text{Row Total} \times \text{Column Total}}{\text{Total No. of Observation}} = \frac{\text{RT} \times \text{CT}}{\text{N}}$$

Plate: 1
Unsanitary condition of study area in the Jalari community

Plate: 2
Photo showing children defecating near a small water canal in Kumal community

Plate: 3
Unsanitary condition around house. Photo showing child defecating and lapping his fingers. His mother is cooking nearby in Jalari community

Plate: 4
Photo showing a person drinking water after meal in unhygienic surrounding in (in Kumal community)

Plate: 5
Photo showing washing clothes and net-cage of rearing fishes. Often people bring water for drinking

Plate: 6
Survey in study area (Kumal community)

purpose from the place

27 (A)

Plate: 7
Jalari gaun (study area)

Plate: 8
Survey in study area (Jalari gaun)

Plate: 9
Survey in study area (Kumal gaun)

Plate: 10
Preparation of stool smear in lab of health center

Plate: 11
Microscopic observation of stool smear in lab of

Plate: 12
Conformation of parasite in Lab of Health

Zoology Department Center

27 (B)