STUDY ON INTESTINAL PARASITIC INFECTIONS IN THARU COMMUNITY OF BARDIYA DISTRICT

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BY
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RECOMMENDATION

This is to certify that **Ms. Pragya Sharma** has completed this dissertation work entitled **"STUDY OF INTESTINAL PARASITIC INFECTIONS IN THARU COMMUNITY OF BARDIYA DISTRICT"** as a partial fulfillment of Master of Science Degree in Microbiology under our supervision. To our knowledge, this work has not been submitted for any other degree.

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Date: **Pragya Sharma**

ABSTRACT

Present study was carried out among *Tharu* people of Rajapur-6 VDC of Bardiya District to determine the prevalence of intestinal parasitic infections. This study also specifies the correlation between parasitic infection and sanitary facilities, source of drinking water and others among the *Tharu* people. The study was conducted from June 2006 to July 2007. Altogether 511 stool samples were collected from the volunteers of Rajapur-6 VDC (257 initially and 254 after antiparasitic drug distribution). The samples were formalin fixed and brought to Kathmandu. The laboratory process was done at NITMPHR. The samples were examined using direct smear technique, formal ether sedimentation technique, sucrose floatation technique and modified acid-fast stain. The overall prevalence of intestinal parasites was found to be (68.0%) initially and (60.0%) after drug distribution, out of which (16.0%) had multiple parasitism and (84.0%) had monoparasitism. Females were marginally more infected (68.5%) than male (67.6%) (P>0.05). Hookworm (17.0%) was the commonest helminth and *Giardia lamblia* (18.5%) was the commonest protozoa found. People below 15 years were more infected (74.5%) than above 15 years (63.5%) (P>0.05). Prevalence of parasitic infection rate in family size above 6 was found higher (70.3%) than below 6 (66.1%) (P>0.05). The rate of parasitic infection was found to be higher (84.4%) to those suffering from recent diarrhoea than non suffer (64.6%) (P>0.05). After drug distribution, prevalence was found to be (60.0%), out of which (72.5%) had monoparasitism and (27.5%) had multiparasitism Those people who had taken antiparasitic drug within past 6 months had significantly lower prevalence rate (56.6%) than those who had not taken (62.8%) (P<0.05). Hence prevalence of parasitic infection was studied along with correlation of different parameters.

Key words: Tharu people, intestinal parasites, Rajapur VDC, Bardiya district

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LIST OF ABBREVATIONS

AF	Acid Fast
STH	Soil Transmitted Helminthes
A. lumbricoides	*Ascaris lumbricoides*
S. stercoralis	*Strongyloides stercoralis*
H. nana	*Hymenolepsis nana*
E. histolytica	*Entamoeba histolytica*
E. coli	*Entamoeba coli*
I. butschlii	*Iodamoeba butschlii*
C. mesnili	*Chilomastix mesnili*
E. nana	*Endolimax nana*
E. hartmani	*Entamoeba hartmani*
B. hominis	*Blastocystis hominis*
C. cayetanensis	*Cyclospora cayetanensis*
T. trichiura	*Trichuris trichiura*
N. americanus	*Necator americanus*
P. westermani	*Paragonimus westermani*
VDC	Village Development Committee
WHO	World Health Organisation
NITMPHR	National Institute of Tropical Medicine and Public health Research
Total n	Total number
Pos n	Positive number

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CHAPTER I

1. INTRODUCTION

Gastroenteritis is one of the major public health problems in the world having cosmopolitan distribution. More than half of the human population in the world live in misery pain and suffer vast economic loss due to parasites. About one fourth of the world population is estimated to be infected by one or more species of intestinal parasites (Rai *et al*, 1998). Enteric pathogens, reportedly affect 3.5 billion people globally (Rai *et al*, 2004).

Ascaris lumbricoides, *hookworm* and *Trichuris trichiura* infect 1.4 billion, 1.3 billion, and 1.0 billion people world wide respectively. The protozoan parasites although being less common are associated with the highest number of mortalities (Chan *et al*, 1994). Intestinal parasitic infections are distributed virtually through out the world, with high prevalence rate in many regions. Amoebiasis, ascariasis, hookworm infection and trichuriasis are common among the ten top most infections in the world (Warren *et al*, 1984).

Intestinal parasites are endemic in most tropical and subtropical countries, particularly in developing countries and are one of the important causes of diarrhoeal diseases. Due to diarrhoeal diseases, at least 5 million deaths per year occur in developing countries (Shakya *et al*). Gastroenteritis is a major killer disease in Nepal. Every year 30-40 thousand people die of gastroenteritis (Bista *et al*, 1993). *Cyclospora cayetanensis*, *Cryptosporidium parvum* an emerging parasitic enteropathogen of human being increasingly recognized throughout the world.

According to WHO, in many countries malabsorption, diarrhoea, blood loss, impaired work capacity and reduced growth rate due to intestinal parasitic infections constitute important health and social problems. Furthermore, other parasitic infections such as abdominal angiostrongyliasis intestinal cyclosporiasis and strongylordiasis are local or regional public health concern.

Intestinal parasitic infection cause significant morbidity and mortality in the population, especially children of tropics and sub tropics, due to deficient life conditions with lack of adequate hygiene and sanitation, illiteracy, overcrowding and low construction level (Chan *et al*, 1994)

In developed countries, outbreaks of infective gastroenteritis are known to occur among elderly patients in nursing home, with considerable mortality. Meanwhile, in developing countries many gastroenteritis are endemic in the community and those people who are exposed to these in childhood, with resultant immunity.

There are different predisposing factor that cause intestinal disorder. The predisposing could result from several factors including age related immune system dysfunction, achlorhydria, altered intestinal of colonic motility and changes in faecal flora. Gastric acid is one of the recognized barriers that protect against gastrointestinal infection and its absence may increase the probability of developing infections diarrhea. Disturbances in intestinal motility due to neuromuscular diseases such as stroke, diabetes or micro vascular atherosclerosis is common in the elderly and may predispose to colonized by enteropathogens.

Sanitary and other living condition of majority of Nepalese families leads to be the victim of parasitic infection. The physical disability, lack of awareness leads to insufficient sanitary practice and poor personal hygiene that makes people more susceptible to gastrointestinal infection.

Nepal is a small and impoverish country located in south Asia where intestinal parasites are prevalent (Rai and Gurung, 1986; Rai *et al*, 1994a, 1994b, 1995, 1997, 1998, 2000a, 2000b; Sherchand *et al*, 1996, 1997; Ishiyama *et al*, 2001, 2003; Ono *et al* 2001, Kimura *et al*). The health status of the population is a reflection of the socio-economic development of the country. It is influenced by a variety factors like the level of income and living standards, housing, water supply, education, sanitation including work place environment, employment, consciousness, the coverage, accessibility and affordability of health care delivery services, social security, and participation in the socio-political activities of the community, recreation and human rights. (RECPHEC, 1997)

Children are more commonly infected than adult in Nepal (Rai *et al,* 1986). There was strong association between giardiasis and malnutrition of many school children (Chaudhary *et al*, 2000). Malnutrition is more common among children aged less than five years and it is associated with child mortality. Nepalese women suffer from chronic malnutrition. (Rai *et al*, 2002).

Similarly, the soil contamination with helminths eggs in Nepal is higher in wet season. Intestinal infection like giardiasis, amoebiasis, ascariasis, ancylostomiasis, fascioliasis and taeniasis are common in Nepal (Acharya *et al*, 1979). It is because of the dirty finger and nails which might play an important role in the transmission of intestinal parasites (Soulsa, 1975).

1. Background information of the study population:

Nepal is a land of cultural diversity. It is recognized as multi-caste, multi-lingual country.We can find syncretism of various cultures, as a garden of all castes and ethnic groups. The racial, religious, cultural and social systems are diversified according to the diversity of castes of living with respect to geography. The different multi-caste are assumed to be *"Tibeto-Burmans*" and *"Indo-Aryans"* including *Brahmin, Chhetri, Tharu, Teli, Dhobi, Mushar, Sharki, Damai* and *Kami*.

Rajapur area of Bardiya district is situated in mid western part of Nepal. It is connected with kailali district 629 km away from the capital. It lies 635m above from the sea level.

Rajapur holds 11 VDC's and 1lakh 20 thousand population in its own, in which more than 60% were Tharu. According to 2001 census of Nepal's Central Bureau of Statistics there are more than 17 lakh Tharu. But, *Tharu* have been questioning the credibility of that 2001 census and opines that there are more than 3 million *Tharus* residing in the lowland Terai from Mechi to Mahakali.

The *Tharus* have a great written history but it never came into light and the history that we read today about these people came out in a distorted manner. This unique community was shrouded in mystery for almost three thousand years. They were the landlords of whole Terai before the unification of Nepal and remained so until malaria was eradicated from the plains in the sixties. Some scholar have propounded the fictitious and baseless theory regarding the origin of the *Tharus* creating confusion in the minds of population in understanding the glorious part of this ethnic group of the southern plains of Nepal. Some historian stated that Tharu migrated from Thar Desert in between thirteen to sixteen century. But, fact was that long years back Terai area was known as *Tharai* and the people who lived in *Tharai* were called *Tharu*. Anyway, it is rightly said by the scholar that the *Tharus* are the settler of Terai and are the pioneers of civilization.

According to some researcher of Tharu community, “Mother of Lord Buddha belongs to Tharu family; she was daughter of contemporary *Tharu* King Parikshit of recent Ram gram of Nawalparasi District." In 15th century recent Sukoura of Dang District was ruled by a *Tharu* King named Dangi Sharan, later on the process of migration some of his sons entered to Bardiya. They enjoy their life with farming and hard work. Now days they are also involving in education. But their literacy rate is very low. They are resistance towards malaria but mostly they suffered from abdominal diseases. *Tharus* are very simple, friendly, disciplined and trustable community. They prefer to live in-group and mostly like farming rat. They mostly like to take fish, chicken and pork. Therefore, they keep these livestocks in their home.

Since low literacy rate among *Tharu* community, these people were really deprived of health education. The lack of studies in the above-mentioned sector may have serious consequences in terms of mortality, morbidity, and quality of life of the *Tharu* people along with the deficiency of complete information on *Tharu* people health.

Thus, the study about the prevalence of intestinal parasitic infection among *Tharu* community of Nepal may be fruitful for demarcation of health status with their low socio-economic status and also for the determination of modes of outbreaks of the newly emerged parasites with their clinical and epidemiological aspects.

Moreover, this study may guide the researchers for the further studies on the health status of *Tharus* and help planners in launching appropriate plans and policies on their health care.

The present study throws light on different problems faced by the rural communities notifying the burden of infections of the intestinal parasite.

CHAPTER II

2. OBJECTIVES OF THE STUDY

2.1 General objective

To determine the prevalence of intestinal parasitic infections in Tharu Community of Bardiya district.

2.2 Specific objectives

- To assess the prevalence of intestinal parasitosis among *Tharu* Community.
- To correlate between parasitic infection and sanitary facilities, source of drinking water and others among the *Tharu* people.
- To know the sanitary status as well as the public awareness among *Tharu* people in Rajapur-6 V.D.C.
- To determine the prevalence of intestinal parasites with relation to socio-economic conditions.
- To determine the prevalence of parasitic infection after deworming of 7 months.

CHAPTER III

3. REVIEW OF LITERATURE

3.1 Global Scenario

About 80% of all illness and disease in the world is caused by inadequate sanitation, unsafe water and unavailability of water (WHO, 2000), intestinal parasitosis being one of them. Both the protozoa and helminthes are responsible for the intestinal infections leading to high mortality and morbidity, particularly in developing countries.

The global burden of the diseases caused by three major intestinal nematodes *A. lumbricoides*, Hookworm and *T. trichiura* is very high. These three parasites are associated with 39.0 million disability adjusted life years (DALY). Hookworm causes 22.1 million DALY losses whereas *A. lumbricoides* and *T. trichiura* causes 10.5 million and 6.4 million DALY losses, respectively (Chan *et al*, 1994).

In a community-based study among pediatrics of Saudi Arabia, (21.1%) was found to harbor intestinal parasites, the most affected age group being 5-9 years and no difference in genderwise distribution. Specific prevalence rates were *G. lamblia* (9.0 %), *E. histolytica* (5.0%), *H. nana* (2.0%) and *E. vermicularis* (2.0%) (Assuhaimi *et al*, 1995).

Haswell *et al* (1989) studied the distribution of *A. lumbricoides* within a community and found significant variation in the intensity of infection between households in the community. The number of family members living in the house strongly influenced the mean *Ascaris* burden and proportion of relatively heavy infections within adults and children. This finding suggests that the density of people in a house positively influences the frequency of exposure to infective stages of *Ascaris*, which in turn plays a major role in determining which individuals will harbor heavy infections. A comparative examination of hypothetical treatment strategies suggests that for *Ascaris* infections in this community, targeting age groups with antihelminthic treatment would probably be more cost-effective in the long term in reducing the abundance of this parasite than selective treatment of individually identified heavy infections.

Fagberno-Beyioku *et al* (1987) examined microscopically the stool samples from 1,659 children, aged 15 years and below in metropolitan Lagos and showed a (71.9%) and (68.3%) infection with *T. trichiura* and *A. lumbricoides,* respectively. While the infection rate with hookworm was (22.5%). Infection with more than one parasite was also very common. Those children whose households had no toilet facilities had the lowest infection frequency with the intestinal parasites, while those who used buckets as their means of fecal disposal had highest rates.

Study conducted by Arfaa in 1981 in California showed that stool examinations of 186 Indochinese refugees and 90 immigrants from Mexico resettled in Contra Costa, County, California, have shown that (60.0%) of refugees and (39.0%) of immigrants are infected with one or more species of pathogenic protozoa and helminthes. The mean prevalent of infections among refugees and immigrants, respectively, were Hookworms (25 and 2.0%); whipworm (22 and 12.0%); *Ascaris* (20 and 12.0%); *G. lamblia,* (11and 11.0%); *Strongyloides* (9 and 1.0%) and *E. histolytica* (2 and 4.0%). *Clonorchis sinensis* was found in 13.0% of refugees and *H. nana* in 9.0% of immigrants.

Sugunan *et al* (1996) carried out a survey among the rural and urban settlers and two tribal groups viz. Nicobarese and Onges, of Andaman and Nicobar islands in 1996. The survey was conducted between preschool school aged children and adults. Among the preschool children, Nicobarese showed the highest overall prevalence rate (80.5%) followed by urban (46.7%) and rural (38.6%) preschool children. *A. lumbricoides* was the commonest form of parasite encountered in all the groups of preschool children, followed by *T. trichiura*. The school age children among rural settlers showed an overall prevalence rate of 61.1% which was significantly higher than that among the rural preschool children. The Nicobarese and Onge adults showed significantly higher overall prevalence rates (72.2%) and (71.1% vs. 48.6%) compared to rural adults. In all the groups, studied ascariasis was the commonest form of parasitosis except in Onges among whom trichuriasis and giardiasis were more common than ascariasis.

The total of 1,167 stool specimens collected from 0.6-6 years old patients attending King Abdel Aziz University Hospital in Riyadh, were examined for intestinal parasites. Of these 243 (20.8%) were positive. *G. lamblia* (13.5) and *E. vermicularis* (4.2%) were the commonest parasites found. Other parasites present include *A. lumbricoides*, *E. histolytica* and *H. nana.* Abdominal pain (38.6%) and diarrhea (27.6%) were the most common causes of referral presented between both males and females examined groups are 5% less. It signifies that that diarrhea is not a major sign of parasitic infestation in 0.6-6 years old age group.

According to Wiesenthal *et al* (1980) 165 Meo Laotians stool sample were screened for intestinal parasites. One hundred twenty-nine had at least one pathogenic parasite detected. Hookworm was detected most frequently, followed by *G. lamblia, T. trichiura,* and *A. lumbricoides.* Hookworm and overall infection were more frequent in persons 4 years of age and older, while giardiasis, ascariasis, and trichuriasis were the most common in the 4-14 years age group. Most infections were helminthic and of no public health consequence in the United States. However, giardiasis was seven times as prevalent in refugee children as in the general US population, posing a potential public health risk in child-care settings.

A survey conducted by Park *et al* (2004) determined the extent of intestinal parasite infection in Bat Dambang, Cambodia. The overall infection rate of intestinal parasites was 25.7% (boys, 26.2%; girls, 25.1%), and the infection rates of intestinal helminthes by species were as follows: *Echinostoma* sp. (4.8%), Hookworm (3.4%), *H. nana* (1.3%) and *Rhabditis* sp. (1.3%). The infection rates of intestinal protozoa were; *E. coli* 4.8%, *G. lamblia* (2.9%), *I. butschlii* (1.4%), *E. polecki* (1.1%), and *E. histolytica* (0.8%). All children infected were treated with albendazole, praziquantel, or metronidazole according to parasite species. The results showed that intestinal parasites are endemic in Bat Dambang, Cambodia.

Study conducted by Fontobonne *et al* (2001) into the ethno-epidemiological profile of the Pankararu indigenous group in the State of Pernambuco, Brazil, identified multiple intestinal parasites in nearly all members of the community. For the detection, possible environmental risk factors were under taken using the database from a previous survey. The sample consisted of 84 families from the original sample of 112. Selection was based on the number of stool tests performed in the family. The mean number of parasite species was 5.0 per family, for a mean family size of 6.1 members. Other household characteristics and hygienic habits did not significantly influence this number. It has been concluded that multiple intestinal parasitism in the Pernambuco Pankararu community is frequent, to the point of being the rule, and that it relates essentially to water source and treatment.

According to Milano *et al* (1995) investigation was done to evaluate the importance of enteroparasitosis in a young urban population. Serial stool samples were analyzed and Graham tests were performed in each infant. The degree of nutrition of each infant was also studied. Environmental data were collected via semi-structured surveys. Soil samples were tested to determine the degree of soil contamination. The following species were identified: *B. hominis, E. vermicularis, coccidios* sp., *G. intestinalis***,** hookworms, *S. stercoralis, T. trichura, A. lumbricoides, E. coli, E. nana* and *Taenia* sp. Children infection prevalence was (73.5%). The frequency of enteroparasitosis was largest in the population from 3 to 8 years. The homes of the children analyzed were brick houses with tin roof and access to tap water. Of these (79.5%), houses had bathrooms. The remaining used outdoors latrines. In (95.5%) of these houses, the residents lived with one or more dogs and cats. The soil collected from nine houses was contaminated with infectious forms of *T. canis* and Anclyostomideos. The relationship between parasitosis and latrines and overcrowding were verified. Five cases of malnutrition were detected (4.4%).

For the evaluation of the role of intestinal parasites on nutritional status in three rural areas of Brazil, measurements of weight and height were performed along with three-stool samples collection on consecutive days for parasitological analysis. Scores of the standard deviation (z-scores) for the weight-for-height and height-for-age were used to characterise the growth profile. A high prevalence of intestinal parasites was detected, with *G. lamblia* (44.0 %), *E. nana* (43.0 %), *A. lumbricoides* (41.0 %) and *T. trichiura* (40.0%) being the most prevalent. Eleven percent of the children were classified as showing stunting. Inadequate daily caloric intake was observed in 78% of the population and the proportion of those with inadequate protein intake was 34% (Saldiva *et al*, 1999).

Anderson *et al* (1993) carried out the research on the distribution of intestinal helminth infections in a rural village in Guatemala. Fecal egg count scores were used to investigate the distribution and abundance of intestinal helminthes in the population of a rural village. Prevalances of the major helminthes were (41.0%) with *A. lumbricoides*, (60.0%) with *T. trichiura* and (50.0%) with *N. americanus*. Infected females had higher burdens of *T. trichiura* than infected males in all age classes of the population; there were no other effects of the host gender. Analysis of associations between parasites within hosts revealed strong correlations between *A. lumbricoides* and *T. trichiura*. Individuals with heavy infections with *A. lumbricoides* and *T. trichiura* showed highly significant aggregation within households. Associations between a variety of household features and heavy infections with *A. lumbricoides* and *T. trichiura* were described.

Study conducted by Cachin-Bonilla *et al* (1992) showed that prevalence of intestinal helminthes parasites were assessed in a sub urban community of Maracaibo, Venezuela by examination of stool from 342 individuals, using iron hematoxylin stained fecal smears and formalin-ether concentration. The overall parasitic infection rate was (80.4%) and (65.8%) of the population had multiple infections. *T. trichiura* (71.9%) and *A. lumbricoides* (54.0%) were the most common parasites, particularly in schoolchildren. The high rates of parasitic and multiple infections reflect the low socio-economic status of the community studied.

Lee *et al* (1994) examined fecal specimens of a total 52,522 patients by formalin-ether sedimentation or direct smear method. The overall egg positive rate of helminthes was (6.5%). The egg positive rate for each species of helminthes was *C. sinensis* (3.2%), *T. trichiura* (2.0%), *A. lumbricoides* (0.2%), *Trichostrongylous orientalis* (0.1%), *Taenia sps.* (0.05%), *H. nana* (0.03%), Hookworms (0.03%), *P. westermani* (0.02%), *Echinostoma* sp. (0.03%), *E. vermicularis* (0.02%), *S. stercolaris* (0.1%) and *Diphylloboyhrium latum* (0.004%). In comparison to previous data *A. lumbricoides* and *T. trichiura* has been found in decreasing ratio.

Mamo *et al*, (1989) studied from about 5% of the residents of Akaki by kato thick smear technique. For helminthic infections the prevalence of various parasites like *S. mansoni* (1.5%), *A. lumbricoides* (40.7%), *T. trichuira* (27.5%), *E. vermicularis* (2.2%), *T. saginata* (3.2%) and *H. nana* (0.6%).

Obiamiwe and Nmorst (1991) examined 862 fecal samples from male and female donors of nine age groups (1-90 years) in three geographical zones; after examinations of concentration from formal-ether concentration technique they found the overall percentage incidence of six parasites which were encountered were as follows: *E. coli* (19.7%), *E. histolytica* (3.9%), *G. lamblia* (1.4%), hookworm (29.4%), *A. lumbricoides* (38.2%) and *T. trichiua* (7.3%).

Mao (1991) upto date, 30 species of protozoa 12 species of cestodes, 26 species trematodes, 23 species of nematodes, 2 species of gordius and 1 acanthocephalan species had been reported as parasites of man in main land china.

Ibrahim *et al* (1993) conducted retrospective study among expatriate workers in Al-Ain city, United Arab Emirates to determine the prevalence of pathogenic parasitic infection. Stool specimens were examined. Overall prevalence was 23.1%. The most common parasitic found included: *Ancylostoma* sp. (6.7%), *A. lumbricoides* (6.6%), *T. trichiura* (6.2%), and *G. lamblia* (2.4%). The distribution of intestinal parasites among expatriates was different for all nationalities. The results showed that *G. lamblia,* was more prevalent among Iranians (54.7%) and Pakistanis (42.2%), *Ancylostoma* sp was found to be more prevalent among Sri Lankans (22.3%) and Indians (39.6%). *A. lumbricoides* was more prevalent among Bangladeshis (3.1%) and *T. trichiura* was more prevalent among Philipinos.

Alo *et al* (1993) determined the prevalence of intestinal helminthiasis among students of Nigeria. Of the 200 students between ages 10-20 years old examined, 86 (43%) were found infected. The most commonly found worm were Hookworm, *A. lumbricoides, T. trichiura* with mean egg per gram of 4800, 2600 and 1250, respectively.

Xu *et al* (1995) sampled randomly in 2848 different study sites, with about 500 people from each sites. By examinations of the stool using Kato-Katz thick smear and larval culture techniques, overall prevalence of *A. lumbricoides*, *T. trichiura* and Hookworm infections were found, (47%), (18.8%) and (17.2%), respectively. Higher Prevalence of ascariasis and trichiuriasis were found in the age group of 5-9, 10-14 and 15-19 years and among adults for hookworm students, farmers and *fishermen* were the occupational groups with high infection rates.

Bangs *et al* (1996) examined on two occasions to determine the prevalence of intestinal parasites on Indonesia. Overall, 478 subjects i.e. (10.0 %) of the population from three villagers were sampled. Using standard wet mounts techniques, fifteen different species of parasites were found. Hookworm was the highest prevalent parasites in all age groups. The other helminthes were *A. lumbricoides* (46.0-57.0 %) and *T. trichiura* (15.0-25.0 %).

Saito *et al* (1996) surveyed for intestinal parasites by using thin smear and floating method for fecal examination in residents in Caazapa Department, Paraguay. Out of 608 samples of residents in Boqueron, a community of Caazapa Department, 343 (56.5%) were found positive. The most prevalent parasite was *N. americanus* (27%) followed by E. coli (19.8%), G. lamblia (12.7%), *A. lumbricoides* (4.8%) and others. The infection rate with *G. lamblia* and *A. lumbricoides* were more frequent in children than in adults.

The evaluation of the impact of drug treatment on infection by *A. lumbricoides*, *T. trichiura* and hookworms in a rural community from the sugar-cane zone of Pernambuco, Brazil was performed. Individual diagnosis was based on eight slides (four by the Kato-Katz method and four by the Hoffman method) per survey. Infected subjects were assigned to two groups for treatment with either albendazole or mebendazole. Prevalence of infection fell significantly ($p < 0.05$) one month after treatment: *A. lumbricoides* (from 47.7% to 6.6%), *T. trichiura* (from 45.7% to 31.8%) and Hookworm (from 47.7% to 24.5%). One year after treatment, infections by *T. trichiura* and Hookworm remained significantly below pre-control levels (Zani *et al*, 2004).

A prospective study was performed to determine the prevalence of *B. hominis* infection in schoolchildren from Bolivar City. Altogether 446 children, between five and fourteen years old, both sexes, using direct examination of feces and Willis Method. They were also evaluated clinically. Results showed that *B. hominis* had a prevalence of 16.8%. In 39 schoolchildren (52.0%) they found other parasites along with B. hominis, the most frequent was *T. trichiura* as helminth and *G. lamblia* as protozoan. *B. hominis* alone was found in 36 cases (48.0%) (Devara *et al*, 1997).

Infection with *E. histolytica* was studied in two slum communities in northeastern Brazil. Twenty-eight index patients colonized with *B. hominis* were identified. Three stool specimens from the index patients and their household contacts were gathered over a 45-day period and tested for *E. histolytica* by means of a specific enzyme-linked immunosorbent assay-based detection kit. Blood samples were also collected at the start of the study, at 45 days, and at 6 months and analyzed for *E. histolytica*-specific antibody. High rates of colonization were seen in the family units. Colonization was self-limited, with 85% of colonized patients clearing their infections within 45 days (Braga *et al*, 2001).

A community-based study of *Blastocystis* and other intestinal parasites was done in the Asaro Valley, Papua New Guinea. Apart from infants, nearly everybody had at least one infection, and the mean number of infections per person was around 2.7. The graph of age-specific prevalence for *Blastocystis* is similar in shape to those for *E. coli* and *E. nana*, indicating probable similarity in transmission patterns and host response (Ashford *et al*, 1992).

A community-based study was conducted among randomly selected 300 children aged less than five years selected from three camps of the police force in Khartoum, Sudan. The commonest infestations were giardiasis (21.1%), taeniasis (10.4%) and enterobiasis (7.4%). Non-pathogenic *E. coli*, *E. histolytica* and *T. saginata* were detected in (2.7%), (0.7%) and (1.7%) of stools specimen, respectively. Children aged between 3 years and above were the most affected group and the infection rate was highest among the illiterate, overcrowded and large sized families. Malnourished children comprised (9.4%)

of the study group but there was no significant association between malnutrition and the overall prevalence of intestinal infestations, although *G. lamblia* significantly affected the malnourished group (Karrar *et al*, 1995).

The study was conducted to relate personal data, socio-cultural and environmental characteristics, and the presence of symptoms/signs with the frequencies of Giardia sp. and *B. hominis* among a rural population in Buenos Aires Province, Argentina. Of the surveyed population (350), (3.7%) were infected with only *Giardia* sp. or (22.9%) with *B. hominis*, and 2.3% were infected with both protozoa. The frequency of infection according to sex; 6.1% of males were infected and 1.6% of females by *Giardia* sp., (26.7%) and (19.5%) by *B. hominis*, and (2.4%) and (2.2%) by both parasites, respectively. *Giardia* sp. was detected in only three adults (over 14 years), but *B. hominis* was more frequent in adults than in children (Minville *et al*, 2004).

A cross-section of 175 healthy children at the Wesley Guild hospital, Ilesa, Nigeria had microscopic examination of fresh stool samples for intestinal parasites; 58 (33.1%) had various parasites while 4.0% had poly-parasitism. Among the 175 children, 23 (13.1%), 18 (10.3%), 9 (5.1%), 8 (4.6 %), 6 (3.4%) and 1 (0.6%) had *A. lumbricoides, N. americanus, E. histolytica, S. stercoralis, T. trichuria* and *G. lamblia* respectively. While 51 (29.1%) children had single parasites, 7 (4.0%) had poly-parasitism; 4 (2.3%) had *A. lumbricoides* and *E. histolytica* while 3 (1.7%) had *A. lumbricoides* and *N. americanus* (Jao *et al*, 2005).

The status of intestinal parasite infections among the residents of nationwide geographical areas in the Republic of Korea had been studied. Fecal samples of 4,137 people (men: 2,170, women:1,967) has been examined. Helminthes eggs, larvae, and protozoan cysts were found in 322 (7.8%) of the 4,137 specimens examined. The helminth species detected were *C. sinensis* (in 259 specimens; 6.3%), *Metagonimus* sp. (14; 0.34%), *Pygidiopsis summa* (5; 0.12%), unidentified heterophyids (24; 0.58%), *Echinostoma* sp. (4; 0.1%), Gymnophalloides seoi (4; 0.1%), *P. westermani* (1; 0.02%), *T. trichiura* (10; 0.24%), *A. lumbricoides* (1; 0.02%), hookworms (1; 0.02%), and *S. stercoralis* (larva positive) (1; 0.02%). The protozoans detected were *E. coli* (9;

0.22%), *G. lamblia* (1; 0.02%), and *Isospora* sp. (1; 0.02%) (Chai *et al*, 2006). *G. lamblia*, a gastrointestinal protozoan, is one of the most common disease-causing parasites in the world. Giardiasis is primarily encountered in areas with poor sanitation, but it is also seen in more developed countries. A possible sequela of *Giardia* infections of the bowel is reactive arthritis or synovitis. Few reports of synovitis secondary to giardiasis exist in the literature. Arthropathy secondary to giardiasis is uncommon, but may be underdiagnosed.

A 23 year-old woman who had polyarthritis after *Giardia lamblia* infestation. The diagnosis of *G. synovitis* should be suspected by the presence of *Giardia* cysts in the stool (Kim *et al*, 2001).

A small scale survey was performed in children of the residential institutions and street communities in Metro Manila, Philippines. A total of 284 stool samples were collected. The scotch tape anal swab was adapted to investigate the infection status of *E. vermicularis*. It was found that 62.0% of the children examined were positive for one or more intestinal parasites. Multiple infections were observed in (34.2%) of the children. Among 172 children who gave detail information, the prevalence for *A. lumbricoides, T. trichiura,* and hookworm was (36.0%), (44.8%), and (7.0%), respectively. Of the children examined, (47.7%) werefound to be harboring parasitic protozoans such as *E. histolytica, G. lamblia,* and *B. hominis*. The most prevalent of these protozoans was *B. hominis* with an infection rate of (40.7%) (Eleonar *et al*, 2004).

The prevalence of *B. hominis* was evaluated in the community of Campo Verde, a district of Pitanga. Samples of faeces from children and adults were collected and submitted to the techniques of direct wet mount, flotation in zinc sulphate solution, tube sedimentation, sedimentation in formalin-ether and staining by Kinyoun and iron hematoxylin methods (70.7%) showed protozoa and/or helminths in stool samples. The most prevalent species were *E. nana* (33.7%); *B. hominis* (26.5%); *G. lamblia* (18.2%); *E. coli* (17.1%); *A. lumbricoides* (16.6%); *I. butschlii* (9.4%); and ancylostomatidae (7.7 %) (Nascmento *et al*, 2005).

The incidence of parasitic infections was found to be (48.0%) among the immunocompromised patients whereas it was (20.0%) in normal control. In immunocompromised patients, the parasitic findings were intestinal (46.0%), pulmonary (6.0%), intranasal (2.0%) and mixed (6.0%). *C. parvum* oocysts in (30.0%), *Microspora* spores in (12.0%), *Cyclospora* oocysts in (8.0%) and *G. lamblia* cyst in (14.0%) were the intestinal parasites detected. Diarrhoea was found in 13 cases out of 15 harboring cryptosporidia (Diffrawy *et al*, 2002). Only 1 out of 244 tested positive for hepatitis B surface antigen; the same child also tested positive for intestinal parasites (*G. lamblia*) and lead poisoning. Only 1 out of 253 children tested positive for bacteria (*Campylobacter jejuni*) in the stool; the same patient also tested positive for *G. lamblia*.

Study conducted by Pamela *et al* (2003) in Florida showed 75(31.1%) children with evidence of infection with 1 or more type of organism; 60 (80.0%) of these were infected with 1 type of parasite, 12 (16.0%) with 2 types, and 3 (4.0%) with 3 types. Parasite screening results were not significantly associated with either age or sex. *G. lamblia* was the most commonly identified organism, in 38 (50.6%) of the children; only 8 (10.7%) were infected with intestinal helminthes.

The prevalence of *C. cayetanensis* among apparently healthy persons in Peru. One group included those consulting private physician and next included people from marginal area. They had common complain of abdominal pain and diarrhea. The incidence rate has been found to be (41.6%) and (7.3%), respectively among the two groups. He reported higher rate among young and elder adults up to 60 year-old. (Burstein *et al*, 2005) A study conducted in a community of rural Coted'Ivoire found the prevalence of hookworm, *E. histolytica/E. dispar* and *S. mansoni* to be (45.0%), (42.2%), and (39.8%), respectively. Three-quarters of the population harboured multiparasites (Raso *et al*, 2005).

Kappus *et al* (1994) examined stool specimens and found high percentage of protozoans along with helminthes. The most commonly identified helminthes were nematodes: hookworm (1.5%), *T. trichiura* (1.2%) and *A. lumbricoides* (0.8%).

In order to investigate the epidemiological situation of intestinal parasite infections in Laosparasitological surveys were carried out in the Vientiane Municipality. The cumulative egg positive rate for intestinal helminths was (61.9%). By species, the rate *for A. lumbricoides* was (34.9%), hookworm (19.1%) *T. trichiura* (25.8%), *Opisthorchis viverrini* (10.9*%), Taenia* sp. (0.6%) and *Hymenolepsis* sp. (0.2%). The northern mountainous regions such as Phongsaly, Huaphan or Saysomboune Province showed a higher prevalence (over 70%) of soil- transmitted helminths. On the other hand, *S. mansoni* eggs were detected in (1.7%) of schoolchildren. An additional small-scale survey by cellophane anal swab detected *E. vermicularis* eggs in (35.7%) of 451 schoolchildren aged 6-8 years in Vientiane Municipality. Meanwhile, the mean blood haemoglobin level of hookworm-infected children was not lower than that of children not infected with hookworm, suggesting that nutritional factors are more important than parasitic infection (Rim *et al*, 2003).

G. lamblia (15.2%) and *H. nana* (20.4%) were the two most frequently reported species in a study of intestinal parasites from 1683 aboriginal people in Western Australia. Concurrent infection with the two species was statistically significant in the 0 to3 years age group only (P<0.01), and it was suggested that in older age groups the presence of one of these parasites may in some way inhibit the development of the other. *H. nana* infection was more common in males than in females (P<0.001). Hookworm and *S. stercoralis* infections were confined to the tropical north of the State. The total or near-total absence of infection with *A. lumbricoides*, *T. trichiura* and *Entamoeba* sp. (all frequent in Eastern Australian aboriginal communities) was noted (Jones, 1980).

In a study by Phompida *et al* (2001) in Vientiane Municipality, the prevalence of Hookworm, *T. trichiura* and *A. lumbricoides* was found to be (9.8%), (5.3%) and (4.3%), respectively has been reported. Majority of infected were healthy adults.

3.2 SAARC countries scenario

Several reports of patients with cysticercosis from many countries in Asia such as India, China, Indonesia, Thailand, Korea, Taiwan and Nepal are a clear indicator of the wide prevalence of *T. solium* cysticercosis and taeniosis in these and other Asian countries. It is also a major cause of epilepsy in Bali (Indonesia), Vietnam and possibly China and Nepal. Seroprevalence studies indicate high rates of exposure to the parasite in several countries (Vietnam, China, Korea and Bali (Indonesia)) with rates ranging from (0.02 to 12.6%). An astonishingly high rate of taeniosis of (50.0%) was reported from an area in Nepal populated by pig rearing farmers. Undoubtedly, cysticercosis is a major public health problem in several Asian countries affecting several million people by not only causing neurological morbidity but also imposing economic hardship on impoverished populations. (Rajshekhar *et al*, 2003).

Analysis of egg and worm counts of *Ascaris* recorded at various intervals following a mass anthelmintic treatment programme in a South Indian fishing community was done. Three indices of infection in the community are compared, namely the prevalence and intensity of egg output (at 2, 6 and 11 months following treatment) and the number of worms expelled following an 11 month period of reinfection. Detailed examination of these measurements revealed significant associations with patient sex and age. Although (85.0%) of both males and females harboured *Ascaris* initially, the prevalence following 11 months reinfection was decreased, due to a significantly lower proportion of males being reinfected. By the 11th month of reinfection, the age-intensity profiles of egg output were similar to those observed at initial treatment in the older age groups (10 years and above) and in male children (less than 10 years) (Elkins *et al*, 1988).

Stool survey was carried out in some of the villages of Dadraul and Bhawal Khera PHC's of district Shahjahanpur (Uttar Pradesh). Among them (29.2 %) were found positive for one or the other intestinal parasite. *A. lumbricoides* superseded all the parasites by showing a positivity of (17.8%). Other parasites found were Hookworm, *H. nana*, Tapeworm, *T. trichiura*, *E. vermicularis*, *E. coli* and *G. lamblia*. Parasitic load was slightly higher in females (33.5%) than males (28.1%). The highest positivity was encountered in the age groups between 6 to 14 years (Virk *et al*, 1994).

Study conducted at South Kalimantan Province of Indonesia; by Cross *et al* (1976)1 to 8 different intestinal parasitic infections were detected in 97.0% of the people. Those parasites most frequently found were *T. trichiura* (83.0%), *A. lumbricoides* (79.0%), and

Hookworm (65.0%), followed by *E. coli* (37.0%), *E. nana* (12.0%), *E. histolytica* (12.0%), *G. lamblia* (5.0%), *E. hartmanni* (2.0.0%), *C. mesnili* (2.0%). Other parasites found were *E. vermicularis, S. stercoralis, Capillaria* sp., *Echinostoma* sp., *H. diminuta and T. hominis*. *G. lamblia* was found more often in younger people *and E. coli, I. butschlii* and hookworm in the older age group. Hookworm occurred more frequently in males and *A. lumbricoides* in females.

Survey for intestinal parasites was conducted in Napsan on the island of Palawan, Philippines. A total of 353 stool specimens were obtained from 155 males and 198 females ranging in age from one and half months to 70 years. *A. lumbricoides* (34.8%), Hookworm (34.8%) and *T. trichiura* (25.2%) were the most common helminthes encountered, while E. coli (27.7%) and *E. nana* (22.2%) were the common protozoans (Oberst and Alquiza, 1987).

Hookworm prevalence rate was found to be 29.0% among people in two villages of Malayasia (Cheghani *et al,* 1989). A study conducted in some semiurban region of Bangladesh inhabited by the fisherman found the parasite positive rate of 50.0% (Rahman, 1993).

Ascaris lumbricoides infestation (ALI) is one of the most common helmintic disease of the gastrointestinal tract, and may cause severe surgical complications, especially in children. A case of a 5-years old Pakistan girl treated in Italy for acute abdomen in which ALI was detected during surgical exploration (Mosiello et al, 2003).

A study conducted in Srilanka, showed examination of total 192 stool samples from the adult and the pre-school children) was done. *E. histolytica* was not seen in any of the samples; *Giardia* cysts and *Cryptosporidium* oocysts were seen in 3 and 1 sample respectively from the pre-school children. The overall prevalence of geohelminth infections was (21.3%) among the adults and (24.5%) among the children. *A. lumbricoides* was the predominant species in both populations (De silva *et al,* 1994).

Sayyari *et al* (2005) in a national survey of intestinal parasitosis in Iran, intestinal parasitic infection rate was detected as 19.3% (19.7% male, 19.1% female). In the study, *G. lamblia* (10.9%), *A. lumbricoides* (1.5%), *E. histolytica* (1.0%) and *E. vermicularis* (0.5%) were the most common parasites. The infection rate was highest in the 2–14 years age group (25.5%) and in rural residents (23.7%). The prevalence rate of *T. saginata*, *T. colubriformis*, *T. trichiura* and *A. duodenale* were (0.2%), (0.2%), (0.1%) and less than (0.1%) respectively. The total prevalence of intestinal parasite among people of age group 40-69 was (15.0%) and greater than 69 years was (11.6%). The prevalence of individual parasites in 40-69 years age group was *G. lamblia* (7.3%), *A. lumbricoides* (1.5%), *E. histolytica* (1.1%) and *E. vermicularis* (0.2%). The prevalence of individual parasites was *G. lamblia* (5.0%), *A. lumbricoides* (1.2%), *E. vermicularis* (0.1%) and *E. histolytica* (0.7%) in age group.

The study was undertaken to measure the impact of periodic deworming with albendazole on growth status and incidence of diarrhea in children aged 2-5 years in an urban setting in India. . The two study groups received two doses of albendazole (400 mg) or placebo six months apart. Mean weight increased significantly in the albendazole group compared to the control group at three months, six months and nine months following treatment ($P<0.01$, $P<0.01$ and $P<0.001$, respectively). The albendazole group also experienced fewer episodes of diarrhoea than their control counterparts (relative risk 1.3, 95% CI 1.07-1.53) with a 28% reduction (Sur *et al*, 2005).

Study conducted in the union Territory, Chandigarh, India estimate the prevalence of intestinal parasitic infections in different population groups. The prevalence of intestinal parasitic infections was found to be 14.6% with highest prevalence of 19% from the slum area. Children were the most commonly affected group (18%) with those from slums showing the highest prevalence (24.6%). The most common parasite was Giardia (5.5%) followed by *H. nana* and *A. lumbricoides* (2.8% and 2.7%, respectively), (Khurana *et al*, 2004).

Singh *et al* (2004) parasitic infection among primary school-going children between the age group of 5 to 10 in the urban and rural areas of Manipur. A total of 248 (24.5%) were positive for various helminths. Among the positive cases, 110 (26.3%) were from the urban area (city) and 138 (23.4%) from the rural areas of Manipur. Maximum number of parasitic infection occurred in the age group of 5 to 6 years (27.0%) in both sexes. Among the parasites, *A. lumbricoides* was the commonest (19.6%) followed by *T. trichiura* (2.18%), *H. nana* (0.99%), *Tapeworm* (0.19%), Hookworm (0.09%), *S. stercoralis* (0.09%), *E. vermicularis* (0.09%).

Stool samples were collected 3 to 6 months post-treatment to study the rate of reinfection. The cure rates for *A. lumbricoides, T. trichiura* and hookworms were 70.8%, 68.7% and 93.0%, respectively. Re-infection rates after 3 months of successful treatment were 19.6% for *A. lumbricoides*, 30.9% for *T. trichiura* and 11.3% for hookworms. Six months post-treatment, the prevalence of re-infection was highest with *T. trichiura* (43.6%); followed by *A. lumbricoides* (35.3%). The rate of reinfection with hookworms was lower (11.3%) six months post-treatment. The rates of re-infection with *A. lumbricoides and T. trichiura* were higher in children below 15 years of age, compared with adults. Hookworm reinfection was higher in the adult age group (15 to 39 years). The rates of new infection in previously uninfected subjects were lower compared with the rates for re-infection (Narain *et al*, 2004).

The health risks of wastewater use in agriculture were investigated by Ensink *et al* (2005) in the city of Faisalabad, Pakistan, by means of a cross-sectional study. The study showed an increased risk of intestinal nematode infection and hookworm infection, in particular, in wastewater farmers (OR = 31.4, 95% CI 4.1-243) and their children (OR = 5.7, 95% CI 2.1-16) when compared with farming households using regular (non-wastewater) irrigation water.

The study was designed to examine stool specimens of irritable bowel syndrome (IBS) patients for *B. hominis.* One hundred fifty patients were enrolled, 95 IBS cases and 55 controls. The 95 cases (51 males and 44 females) had a mean +/- SD age of 37.8 +/- 13.2 years. Stool microscopy was positive for *B. hominis* in 32% (30 of 95) of the cases and 7% (4 of 55) of the controls ($P = 0.001$). Stool culture was positive in 46% (44 of 95) of the cases and 7% (4 of 55) of the controls ($P < 0.001$. Stool culture has a higher positive yield for *B. hominis* than stool microscopy (Yakoob *et al*, 2005).

The study was conducted in Konkor, Gadap, District East, Karachi to determine the prevalence of intestinal parasitic infection. Out of 263 residents 185 tested for intestinal parasites and 88 (47.5%) had pathogenic parasites. The distributions of parasites were *G. lamblia* 50% and *E. histolytica* (48.86%). Statistically none of the socio-demographic variables were associated except education and age group (Siddiqui *et al*, 2002).

This study was carried out at the northern part of Bangladesh to determine the impact of sanitary latrine use and of health education on intestinal parasites in school-aged children. The children were between 5 and 13 years of age and stool samples revealed that more than half (53%) of the study sample was still infected with one or more intestinal parasites even after 4 years of intervention. Ascariasis was found to have the highest prevalence rate (36.2%) and hookworm the lowest (10.7%). Intestinal parasite infection was significantly lower ($P < 0.05$) among those who used a sanitary latrine and received health education (Hosain *et al*, 2003).

Gilgen *et al* (2001) conducted a randomized clinical intervention trial over 24 weeks on a tea estate in north-east Bangladesh to investigate the effect of iron supplementation and anthelmintic treatment on the labour productivity of adult female tea pluckers. A total of 553 full-time tea pluckers, not pregnant and not breastfeeding, were randomly assigned to one of the four intervention groups: group 1 received iron supplementation on a weekly basis, group 2 received anthelmintic treatment at the beginning and half-way through the trial (week 12), group 3 received both iron supplementation as group 1 and anthelmintic treatment as group 2, and group 4 was a control group and received placebos. However, there was a negative association for all three worms (*A. lumbricoides, T. trichiura* and hookworms) between the intensity of helminth infections (eggs/g faeces) and all measures of labour productivity. Lower haemoglobin values and anaemia (< 120 g/l Hb) were both associated with lower labour productivity and more days sick and absent. Taller women with greater arm circumference were able to pluck more green leaves, earn higher wages and were absent less often.

In developing countries many enteric infections are caused by acid-sensitive pathogens. Study was conducted in 185 Bangladeshi men admitted to hospital for the treatment of enteric infection. Patients with dysentery (amoebiasis, n = 24 and shigellosis, n = 19) and culture-negative diarrhoea (n = 69) had similar mean gastric acid levels (basal, 3-5 mmol/h; stimulated, 11-17 mmol/h), which remained stable in those patients studied throughout 12 weeks of convalescence. Gastric acid levels were not associated with *G. duodenalis* or *S. stercoralis* co-infection, fever, use of tobacco, or chewing betel nut. Factors which impair gastric acid secretion may predispose to diarrhoeal disease in developing countries (Evans *et al,* 1997).

Gastrointestinal problems have been reported as the most common health problems among elderly people in Bangladesh and Myanmar and a leading cause of death over there. Diarrhoea has been recognized as the commonest cause of hospitalization among the elderly people in Thailand. In India too, it is one among top ten causes of hospitalization and death (WHO, 2004).

Stool samples from 880 residents in an urban slum in Dhaka, Bangladesh, were collected and examined for intestinal parasites. Information on many potential risk factors for infection was obtained by questionnaire from a respondent in each household studied. In a crude univariate analysis of the data, several of the factors were found to be significantly associated with S. *stercoralis* infection. Most of these factors were co-variate with one another and with poverty generally (Hall *et al,* 1994).

Allen *et al* (2004) surveyed in the western region of Bhutan to assess the prevalence and intensity of soil-transmitted helminth (STH) infections after 15 years of school deworming in the country. Stool samples were collected from each child as well as nutritional indicators and general information on each school. The survey found a cumulative prevalence of (16.5%) STH (4.8% in schools treated in the last three months and 24% in the untreated schools). An unexpected finding was that the tapeworm infection rate of 6.7%. These results indicate a high reinfection rate in this area. WHO recommends 50% prevalence as the threshold for the establishment of community intervention.

3.3 National Scenario

Intestinal parasitic infestation continues to be of public health importance in many tropical and subtropical countries for their high prevalence and effects on the morbidity in the population. This analysis was aimed to find out the intestinal protozoal parasitic profile in pre-school and school-going children visiting the hospital with gastrointestinal illness. *G. lamblia* was the most prevalent pathogenic protozoan intestinal parasite (73.4%), followed by *E. histolytica* (24.4%). Interestingly, newer opportunistic pathogens like *C. cayetanensis* (1.0%) and *Cryptosporidium* sp. (1.0%) were detected from immunocompromised children below 2 years of age (Easow *et al*, 2005).

The study was conducted to represents the status of intestinal parasitosis in public schoolchildren (1 to 10 classes) in a rural area of the Kathmandu Valley her habits, including factors predisposing to parasitic infections. Stool samples from the children were examined. The overall prevalence of parasitosis was 66.6% (395/533). Altogether, nine types of parasites were recovered. The recovery rate of helminths was higher (76.9%) than protozoa (23.1%). *T. trichiura* was the most common helminth detected, followed by hookworm, *A. lumbricoides* and others. *E. coli* was the most common protozoan parasite, followed by *E. histolytica*, *G. lamblia* and others (Sharma *et al*, 2004).

Intestinal parasitological survey was conducted to clarify the distribution of intestinal parasites in Nepal and Lao Peoples' Democratic Republic (Lao PDR) from 2001 to 2003.The stool specimens were examined using the formalin-ether sedimentation (FES) and sucrose centrifugal flotation (SCF) techniques. Nine species (3 Nematoda, 1 Cestoda, and 5 Protozoa) of parasites were recovered from Nepal, whereas seven species (3 Nematoda, 1 Trematoda, and 3 Protozoa) from Lao PDR. Out of which (14.4%) was the most common in Nepal, and was *O. viverrini* (29.8%) in Lao PDR. Infection rates were markedly different among age groups in both countries; higher rates were observed in age groups of 10-29 years than in 0-9 years group (Takemasa *et al*, 2004).

Intestinal parasites were dectected in diarrheal stool samples collected from individuals aged 1 to 68 years (males: 239 and females: 157) in Nepal. Parasites were detected by employing the formal-ether sedimentation technique. Of a total of 396 fecal samples investigated, 193 (49.0 %) were positive for some kind of parasite. Altogether, 15 species of parasites were detected. *G. intestinalis* topped the list of protozoa, whereas *T. trichiura* was the most frequently detected among helminth parasites. Of the 193 positive samples, 109 (56.0 %) had single parasite infections, whereas 84 (43.0 %) had multiple infections with a maximum of five species. Of the total positive, 45 (23.0%) had both protozoa and helminths whereas 37 (19.0%) had only protozoa. Females (52.0%) and children (15 years and under) (52%) had a marginally higher prevalence compared with males (46.0%) and adults (45.0%), respectively ($p > 0.05$) (Uga *et al*, 2004).

The present study on intestinal parasites from the Kathmandu area of Nepal was done in children (HC) and adults (HA) the total parasite load was 28.1% and 38.8%, respectively, whereas children (ADC) and adults (ADA) with abdominal discomfort had a load of 62.7% and 67.8%. The prevalence of nematodes in the 4 groups was significantly higher in those with abdominal discomfort, particularly of Hookworm, *Enterobius*, and *Ascaris*. *H. nana* was the most common tapeworm, and with the highest incidence in patients with abdominal complaints. *T. solium* and *T. saginata* were only found in the two adult groups, but with low prevalence rates. The highest incidence of Cryptosporidium was found in both groups with abdominal discomfort, notably among children. The presence of Giardia was highest among the sick children, many "healthy" carriers among both children and adults were noted. *E. histolytica* and *E. dispar* had a surprisingly low prevalence in all 4 groups. *B. hominis* was most common among adults with abdominal complaints (2.8%). *Trichomonas* sp. was also more common in this group, in which of 34 positive specimen, 28 were from women (Sherchand *et al*, 1996).

Kimura *et al* (2005) studied diarrheal diseases associated with *C. cayetanensis* in Nepal and Lao PDR. *C. cayetanensis* was detected by direct microscopy using ultraviolet and differential interference contrast microscopy. The overall positive rate in Nepal was 9.2% (128/ 1397). A higher positive rate was observed in children aged 10 years and under (11.1%) and was lowest in the age group of 51-60 years (3.1%). A significantly higher positive rate was observed in the summer (rainy season) (12.6%) with the lowest prevalence in the spring (dry season) (1.8%) ($P<0.05$). The positive rate was closely associated with rainfall (ml/month). Only one of the total 686 samples (0.1%) from Lao PDR was found to be positive for *Cyclospora* oocysts.

Rai *et al,* (1999) a hospital-based study in Kathmandu showed ascariasis as major casuses of public health problem in Nepal though the extent of ascariasis-associated morbidity and mortality has not been investigated yet. In some rural areas, over (75.0 %) people are infected with this parasite.

The prevalence of intestinal parasitic infection was carried out in Tribhuvan University Teaching Hospital, in Kathmandu. Stool samples were examined. Among the various types of protozoan parasites, the most common was *G. lamblia* followed by *E. histolytica* (Rai *et al,* 1995).

According to Rai *et al (*1997) the health and sanitary status of Boya village was studied. The number of households having latrine increased significantly ($p<0.05$) in one year period but without significant impact on the reduction of intestinal helminth infection ($p>0.05$). *A. lumbricoides* was the commonest intestinal parasite followed by hookworm and others. Public piped line water was provided to (32.6%) households while remaining (48.4%) and (19.0%) were using natural tap and *kuwa* water, respectively. No association between the type of water source and gastro-enteritis was observed. There was poor hygienic condition. Majority of complaints were gastrointestinal.

The parasitic infection rate of (50.0%) has been reported by the studies conducted in the Nepalese communities from 1979-1995 by different organizations. *A. lumbricoides* and *G. lamblia* topped the list respectively among helminthes and protozoans. Similarly, the hospital records showed the infection rate of 30 to 40 % (Chhetri, 1997).

The burden of parasitic infection including other infections also reflected in the list of top ten diseases of Nepal.

Ishiyama *et al* (2001) has reported the parasite prevalence of 72.4% among school children in Kathmandu. *Indo-Aryans* were found to have marginally high rate of infection. Among which (46.9%) had multiple infections. *T. trichiura* (30.4%) was found to be the commonest helminth and *G. lamblia* (17.0%), the commonest protozoan. No bacterial enteropathogens were reported in the study population.

A study conducted in Jiri revealed that the prevalence of Whipworm, Roundworm and Hookworm among *Jirel* were (18.1%), (25.3%) and (73.5%), respectively. Similarly, prevalence of Whipworm, Roundworm and Hookworm among *Sherpa* above were (11.2%), (23.6%) and (46.1%), respectively. Similarly, the prevalence of Whipworm, Roundworm and Hookworm among *Hindu* of age group 45 above were (7.1%), (26.2%) and (59.5%) respectively. The study found the increasement in multiple helminthic infections with increasement in age (Blangero *et al*, 1993).

Sherchand *et al* (1997) a stool survey on intestinal parasites and its transmission factors were carried out in rural village of Dhanusha Districts, Southern Nepal. Out of 604 children aged between 0-9 years examined, 363 (60.1%) were found positive for one or more intestinal parasites. Hookworm infection superseded all the parasites by showing a positivity of (11.6%). Other parasites found were *A. lumbricoides*, *T. trichura, Oxyuris vermicularies, S. stercolaris,* Tapeworm, *H. nana, E. histolytica, E. coli, G. lamblia, C. parvum, C. cayetanensis, I. belli*, *O. viverrini*, *S. mansoni* and *I. butschlii*. The parasitic load was found slightly higher in female children (58.1%) compared to male children (41.9%).

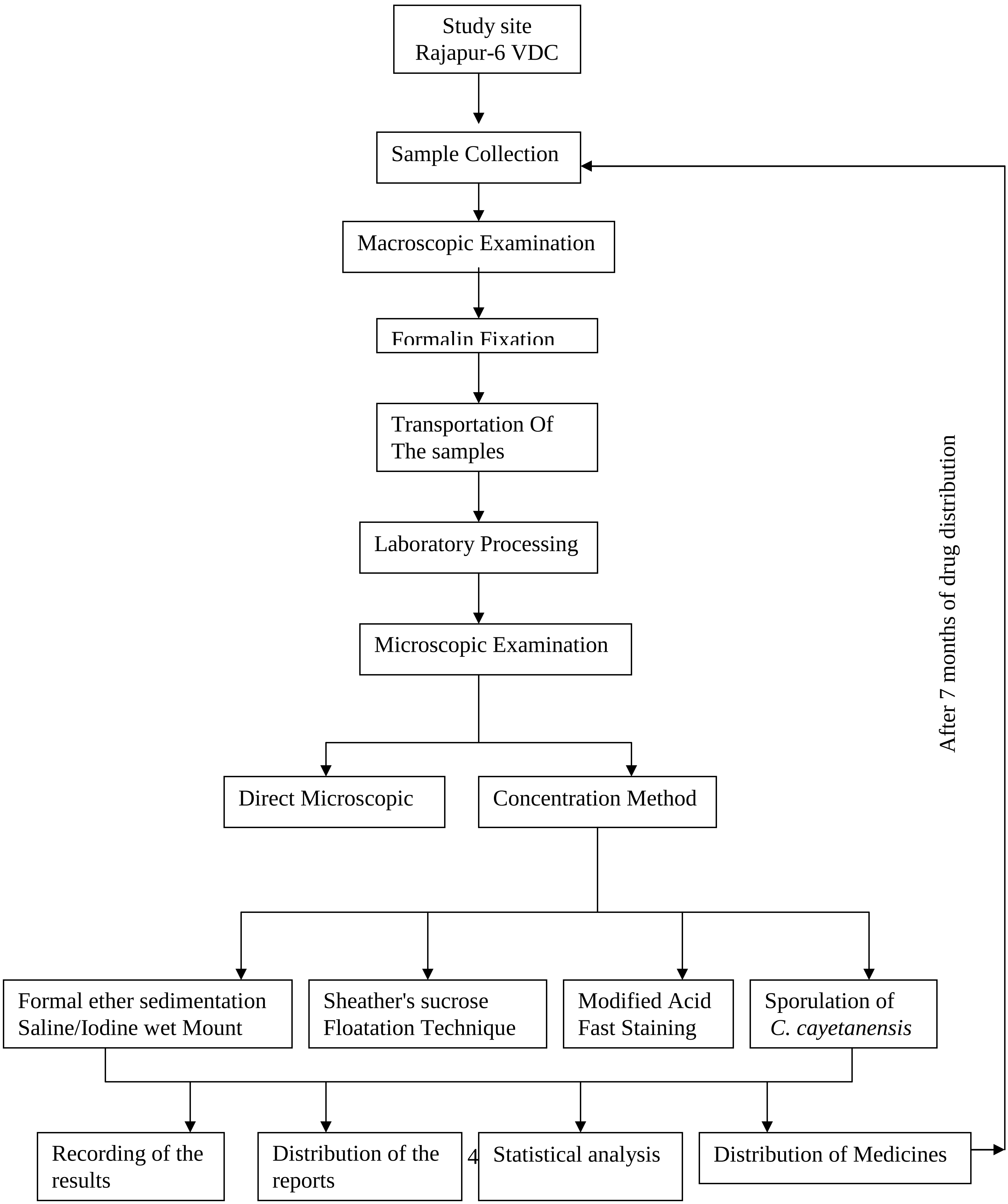
Rai *et al* (2000) intestinal helminth infection and its effect on vitamin A, retinol and B carotene, was studied in Okharpauwa Village Development Committee (VDC) (Nuwakot district) and 79 inhabitants (mainly adults) of Boya VDC (Bhojpur District)] subjects living at an altitude of 2000 m. Most common helminth detected was *A. lumbricoides* followed by *T. trichiura* in Okharpauwa VDC and by Hookworm in Boya VDC, respectively. Mixed helminth infections are were relatively low (7.3% in Okharpauwa VDC and 11.1% in Boya VDC). The retinol and B-carotene were estimated by high performance liquid chromatography (HPLC). The retinol concentration in helminth eggs positive children significantly increased after one month of anti-helminthic (albendazole) treatment ($P>0.05$). No significant difference in serum retinol concentration was observed among helminth eggs positive and negative inhabitants of Boya VDC ($P>0.05$) but in B-carotene level ($P<0.05$).

Rai *et al* (2001) studied the intestinal parasitic infection in rural hilly area of eastern Nepal, Achham district. The stool test revealed (76.4%) prevalence of intestinal parasites in the children of the district.

Study Period: June 2006-July 2007

Laboratory Processing: NITMPHR

Flowchart of the methods



CHAPTER IV

4. MATERIALS AND METHODS

A list of materials, chemicals, equipments, reagents for the study is presented in Appendix 1.

4.1 Subject and site of the study

The laboratory investigation part of this dissertation was carried out in National Institute of Tropical Medicine and Public Health Research, Maharajgunj, Chakrapath, Sankhamarg, Kathmandu. The study period was from June 2006 to July 2007. The stool samples were collected from the *Tharu* people of Rajapur -6 VDC.

4.2 Sample collection

Each volunteer of *Tharu* Community were given the brief description about the importance of the examination of stool to detect the parasite. They were advised not to contaminate the stool with water and urine. The containers were labeled with patient's name, code number, date and time of collection. During the process of specimen collection from each person, a questionnaire accompanying the queries about their clinical history, hygienic practice and nutritional behaviour was filled.

Labeled dry, clean disinfectant free wide mouthed plastic container was distributed and asked them to bring about 20 gms stool sample next morning.

4.3 Transportation of the samples

The collected stool samples were immediately fixed with 10% formal saline mixing with equal part of formal saline and stool. The formalin fixed samples were brought to Kathmandu. Then laboratory processing was done at NITMPHR.

4.4 Laboratory processing of the samples (Rai *et al*, 1996)

Each stool sample was processed in 2 steps as:

Macroscopic examination (were done at field)

Microscopic examination

4.4.1 Macroscopic examination

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

Colour

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

Consistency

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

Blood and mucus

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

Adult worms and segments

The stool specimen were observed whether it contains adult worms and segments or not. The adult worms of *A. lumbricoibes* and *E. vermicularis* are often seen in the specimen. Tapeworm segments may be occasionally seen in stool specimen.

4.4.2 Microscopic examination

This is required for the defection and identification of protozoal cysts, oocysts, trophozoites and heminthic eggs or larva.

Microscopical examination was done by saline and iodine wet mount and modified acid fast stain. The slides were observed under low power (10x) followed by high power (40x) of the microscope. Parasites were identified by their morphology, motility and staining characteristics.

While performing wet mount, all the samples were subjected to concentration. It concentrates the eggs, larva and cysts when they are present in small number and increases the sensitivity of microscopic examination. Trophozoites are destroyed in the process. There are various floatation and sedimentation techniques of concentration.

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

This is the most sensitive method of concentrating cysts, eggs and larva without distortion of their morphology. It takes short time and the chances of error are minimum. The technique was applied as follow:

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

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

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

tube.

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

5. The tube was immediately centrifuged at 1000 rpm for 10 minutes

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

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

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

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

    d. A layer of diethyl ether at the top.

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

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

Saline wet mount

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

Iodine wet mount

This was mainly used for dectecting protozoal cysts, however helminthic eggs were also stained and could be dectected. Iodine stained cysts showed pale refractile nuclei, yellowish cytoplasm and brown glycogen material. A drop of 5 times diluted Lugol’s iodine was taken on a slide and a drop of sediment from above process was mixed with it. The preparation was covered with a cover slip and observed microscope.

The diarrhoeal stool samples were undertaken Sheather's sucrose floatation technique followed by modified acid fast staining for the dectection of the oocysts of *C. parvum, I .belli, C. cayetanensis.*

Sheather's sucrose floatation technique

1. About one gram of stool sample was mixed with 5ml of normal saline in a test tube.
2. The suspension was filtered through 3 layers of cotton gauze to give 2 ml in a test tube.
3. The tube was filled up to its brim with the sucrose solution. The tube was centrifuged at 1000 rpm for 10 minutes.
4. With the help of a bent inoculating loop of shorter length the particles floating on the top surface of the sucrose solution were picked up used to prepare smears on the glass slide.
5. The smear was stained with modified AF stain.

Modified AFB staining

It is required for the accurate identification of the oocysts of *C. parvum, I. belli* and *C. cayetanensis* and the spores of *Microsporidia* sp. The oocysts are acid- fast and stained red or pink against green background stained with malachite green. Both hot and cold methods of staining can be used with equal sensitivity. The cold Kinyoun method was followed in this study.

1. The smear was made with the particles obtained from Sheather's sucrose floatation method and dried on air .

2. The smear was fixed in absolute methanol for 3 minutes.

3. The slide was flooded with carbol fuchsin for 15-20 minutes and washed with tap water.

4. The smear was decolourised with 1% acid alcohol for 10-15 seconds.

5. The smear was washed with tap water and then counter stained with 0.5% Malachite green for 30 seconds.

6. The slide was washed with tap water, air dried and examined under 40x followed by oil immersion.

Sporulation of ***C.cayetanensis oocysts***

C. cayetanensis oocysts are excreted unsporulated in the faeces. Specific identification of this coccidian parasite can be established by stimulating its sporulation and subsequent finding of two sporocysts within each oocysts of the parasite .For the enhancement of sporulation, about 2 gm of stool sample was mixed with about 5 ml of 2.5% potassium dichromate solution and incubated at room temperature for 15 days. Assessment of sporulation was confirmed in light microscopy by observing two sporocysts in each oocysts.

4.4.3Recording of the results

After laboratory processing of the samples the result obtained was recorded in thesis log book. Then it was recorded in computer.

4.4.4 Report distribution

The report distribution was done as the result was obtained after laboratory processing of the samples. Each volunteer with positive cases were given antiparasitic drug along with the report. The complete dose of antiparasitic drugs distributed were albendazole, metronidazole, niclosamide and trimethoprim sulfamethoxazole according to the parasites detected.

4.4.5 Statistical Analysis

Chi-square test was used to evaluate apparent differences for significance. Association of intestinal infections with different variables was tested. Results were considered significant if P values were less than 0.05.

CHAPTER V

5. Results

A total of 511 stool samples (257 samples collected initially and 254 after drug distribution) were included in this study. The positive rates found in initial samples and after drug distribution were 68.0% (175/257) and 60.0% (153/254), respectively. Among the initial samples, both males and females had similar prevalence rates (Males: 68.5% and Females: 67.6%) (P>0.05) (Table- 1).

Table 1: Gender wise prevalence of parasitic infection before drug distribution

Sex	Total n	Pos n	%	P-value
Male	136	92	67.6	P>0.05
Female	121	83	68.5	
Total	**257**	**175**	**68.0**	

The types of individual parasites are shown in (Table-2). Among the helminthes, Hookworm was the most common (17.0%) followed by *H. nana* (8.0%), *A. lumbricoides* (6.0%), *T. trichiura* (4.5%) and others. Among the protozoa, *G. lamblia* (18.5%) was the most common *E. histolytica* (18.0%), *B. hominis* (6.0%), *E. coli* (5.5%), *C. cayetanensis* (5.5%) and others.

Out of 257 stool samples, 175 (68.0%) samples had one or more intestinal parasites. Of the 175 positive samples, 147 (84.0%) samples were found to contain single parasite, where as 28 (16.0%) samples found to contain multiple parasite (Table-3).

The prevalence rate of parasites was higher (74.5%) among children (15 or less than 15 years) compared with adults (more than 15 years) (66.5%), however, this difference was not significant (P>0.05) (Table - 4).

Table 2: Types of parasite detected before drug distribution

Parasites	**Total no.**	**%**
Hookworm	34	17
H. nana	16	8
A. lumbricoides	12	6
T. trichiura	9	4.5
S. stercolaris	7	3.5
Taenia sp	4	2
Total helminthes	82	41
G. lamblia	37	18.5
E. histolytica	36	18
B. hominis	12	6
E. coli	11	5.5
C. cayetanensis	11	5.5
E. hartmanii	6	3
E. nana	5	2.5
Total Protozoans	118	59
Total parasites	**200**	**100**

Table 3: Pattern of parasitic infections before drug distribution

Type of infection	**Total n**	**%**
Single parasite	**147**	**84.0**
Protozoa	86	49.1
Helminth	61	35.0
Multiparasites	**28**	**16.0**
Protozoans	6	3.4
Helminthes	2	1.1
Protozoans + Helminthes	20	11.4
Total	**175**	**100.0**

Table 4: Prevalence of parasitic infections in different age-groups

Age (yrs)	Total n	Pos n	%	P- value
≤15	106	79	74.5	P>0.05
>15	151	96	63.5	
Total	**257**	**175**	**68.0**	

Table 5: Prevalence of parasite by family size

Family size	Total n	Pos n	%	P-value
≤ 6	139	92	66.1	P> 0.05
> 6	118	83	70.3	
Total	**257**	**175**	**68.0**	

The prevalence rate of parasitic infection according to family size was found to be least (66.1%) in family size less equal to 6, whereas family size above 6 was found to be (70.3%) with no significant difference (P> 0.05) (Table-5).

The highest prevalence rate of parasitic infection was found to those people without washing their hands before meal (77.3%) than who washed their hands (64.2%). However, no significance difference is observed (P>0.05) (Fig. 1).

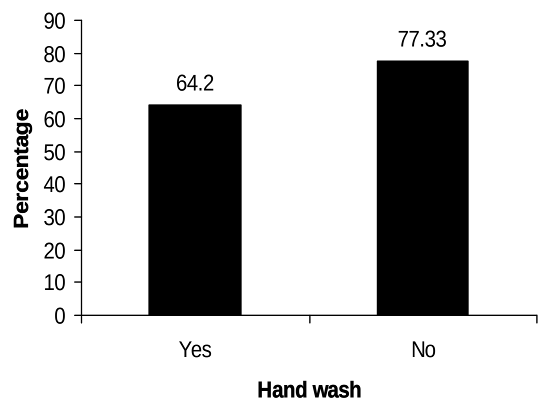


Fig 1: Parasitic infection in relation to hand washing.

The prevalence rate of parasitic infection is higher in the people using open defaecation in land (75.6%) than using modern toilet (58.4%) before drug distribution but not statistically significant (P>0.05) (Fig. 2).

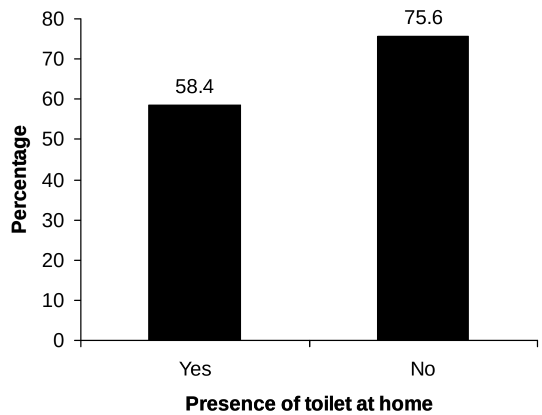


Fig. 2: Parasitic infection in relation to presence of toilet at home**.**

The incidence rate of parasitic infection is higher in the people not washing hands after toilet (73.2%) than washing hands after toilet (65.0%)as shown in (Fig. 3) before drug distribution was not statistically significant (P>0.05).

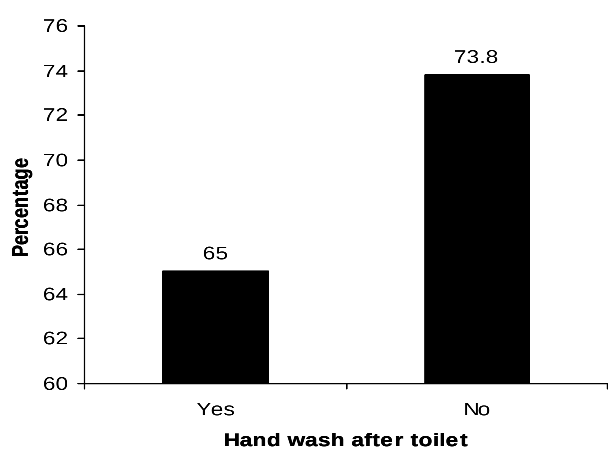


Fig. 3: Parasitic infection in association with hand washing (with soap) after toilet. Before drug distribution.

The prevalence rate of parasitic infection was found lowest in the people who cut their nails (62.2%) than those who did not (67.1%) but not statistically significant (P> 0.05) (Fig. 4).

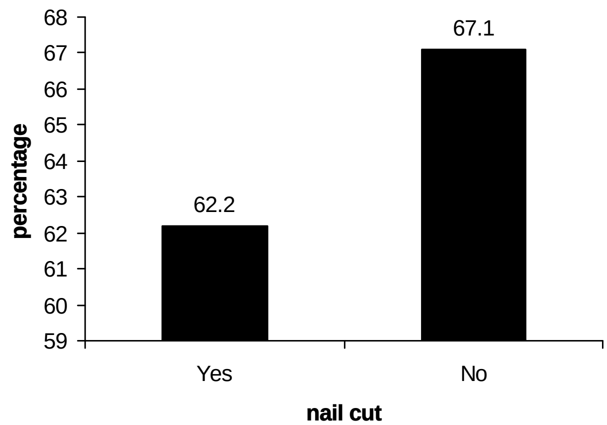


Fig. 4: Parasitic prevalence in relation to nail cut

Table 6: Prevalence of parasite by recent diarrhoea suffering

Recent diarrhea	**Total n**	**Pos n**	**%**	**P- value**
Yes	45	38	84.4	P> 0.05
No	212	137	64.6	
Total	**257**	**175**	**68**	

The rate of parasitic infection was found to be highest (84.4%) to those suffering from recent diarrhoea than who had not suffered (64.6%). However, this was not statistically significant (P> 0.05) (Table-6).

The prevalence of parasitic infection highest (70.0%) in those without taking antihelminthic drug and lowest among people who has taken (67.7%). The difference was not statistically significant (P>0.05) (Fig. 5).

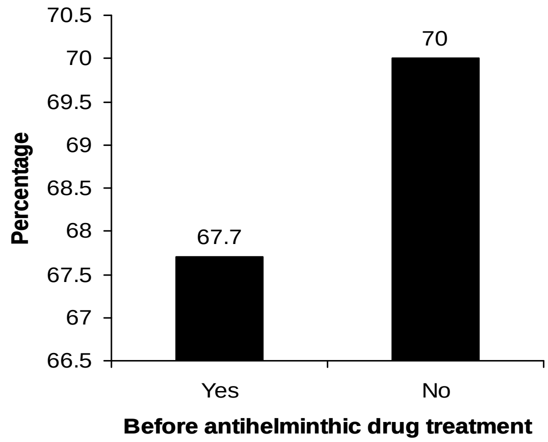


Fig. 5: Prevalence of parasitic infection before antiparasitic drug treatment

Table 7: Gender wise prevalence of parasitic infection before and after drug distribution

Before drug distribution					**After drug distribution**				
Sex	**Total n**	**Pos n**	**%**	**P-value**	**Sex**	**Total n**	**Pos n**	**%**	**P-value**
M	136	92	67.6	P>0.05	**M**	132	79	59.9	P>0.05
F	121	83	68.5		**F**	122	74	60.6	
Total	**257**	**175**	**68.0**		**Total**	**254**	**153**	**60.0**	

Out of 511 stool samples, 257 samples before drug distribution showed positive rates of 68.0% (257/175). There was no difference in the significance of parasite positive rates in males (67.6%) and females (68.5%) (P>0.05). After drug distribution 254 samples were screened. The positive rates were 60.0% (153/254). There was no significant difference males (59.9%) and females (60.6%) in the incidence of parasite rates (P>0.05) (Table-7).

Table 8: Comparison of parasitic infection before and after drug distribution

Before drug distribution			**After drug distribution**		
Type of infection	**n**	**%**	**Type of infection**	**n**	**%**
Single parasite	**147**	**84.0**	**Single parasite**	**111**	**72.5**
Protozoa	86	49.1	Protozoa	34	22.2
Helminths	61	35.0	Helminth	77	50.3
Multiparasites	**28**	**16.0**	**Multiparasites**	**42**	**27.5**
Protozoans	6	3.4	Protozoans	23	15.0
Helminthes	2	1.1	Helminthes	7	4.5
Protozoans & Helminthes	20	11.4	Protozoans + Helminthes	12	7.8
Total	**175**	**100.0**	**Total**	**153**	**100.0**

Out of 257 stool samples, 175 (68.1%) samples had one or more intestinal parasites. Out of 175 positive samples, 147 (84.0%) samples were found to contain single parasite, where as 28 (16.0%) samples found to contain multiple parasite before drug distribution. After distribution of different antiparasitic drugs; albendazole, metronidazole, trimethoprim and sulfamethoxazole and niclosamide for various detected parasites the pattern of infection has been changed. Out of 254 stool samples, 153 (60.0%) samples had one or more intestinal parasites. Out of 153 positive samples, 111 (72.5%) samples were found to contain single parasite, where as 42 (27.6%) samples found to contain multiple parasite (Table -8).

Table 9: Types of parasite detected before and after drug distribution

Before drug distribution			After drug distribution		
Parasites	**Total n**	**%**	**Parasites**	**Total n**	**%**
Hookworm	34	17	Hookworm	49	23.6
H. nana	16	8	*A. lumbricoides*	21	10.1
A. lumbricoides	12	6	*H. nana*	20	9.6
T. trichiura	9	4.5	*T. trichiura*	8	3.8
S. stercolaris	7	3.5	*Taenia* sp.	4	1.9
Taenia sp.	4	2	*S. stercolaris*	0	0.0
Total helminthes	82	41	**Total helminthes**	102	49
G. lamblia	37	18.5	*G. lamblia*	28	13.5
E. histolytica	36	18	*E. coli*	26	12.5
B. hominis	12	6	*E. histolytica*	22	10.8
E. coli	11	5.5	*C. cayetanensis*	13	6.5
C. cayetanensis	11	5.5	*B. hominis*	11	5.5
E. hartmanii	6	3	*E. nana*	5	2.2
E. nana	5	2.5	*E. hartmanii*	0	0.0
Total protozoans	118	59	**Total protozoans**	105	51
Total parasites	**200**	**100**	**Total parasites**	**207**	**100**

The type and prevalence of individual parasites before and after drug distribution was studied. Among the helminthes before drug distribution, Hookworm was the most common (17.0%) followed by *H. nana (*8.0%), *A. lumbricoides* (6.0%), *T. trichiura* (4.5%) and others. Among the protozoa *G. lamblia* (18.5%), *E. histolytica* (18.0%), *B. hominis* (6.0%), *E. coli* (5.5%), *C. cayetanensis* (5.5%) and others were detected. After drug distribution, among the helminthes Hookworm was the most common (23.6%) followed by *A. lumbricoides* (10.1%), *H. nana* (9.6%), *T. trichiura* (3.8%), *Taenia* (1.9%). Among the protozoa, *G. lamblia* (13.5%), *E. coli* (12.5%) *E. histolytica* (10.8%), *C. cayetanensis* (6.5%), *B. hominis* (5.5%) and *E. nana* (2.2%) were detected (Table-9).

The prevalence rate of parasitic infection is higher in the people not washing hands after toilet (67.1%) than washing hands after toilet (52.8%) after drug distribution but statistically significant($P<0.05$) (Fig. 7).

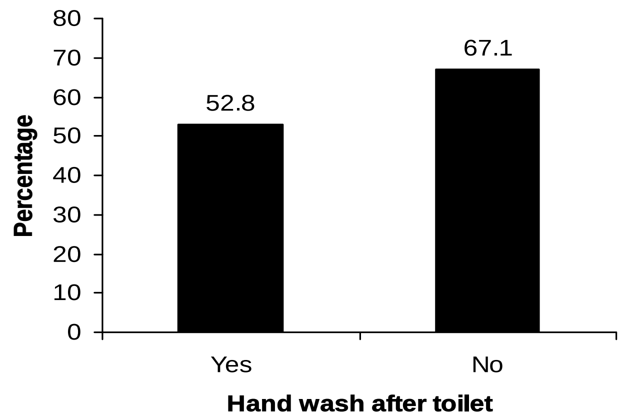


Fig. 6: The prevalence rate of parasitic infection in association with hand washing (with soap) after toilet (After drug distribution)

The parasitic rate of infection was higher (62.8%) in those without taking antihelminthic drug than who has taken (56.6%) after 7 months of deworming. The difference was statistically significant ($P<0.05$) (Fig.7).

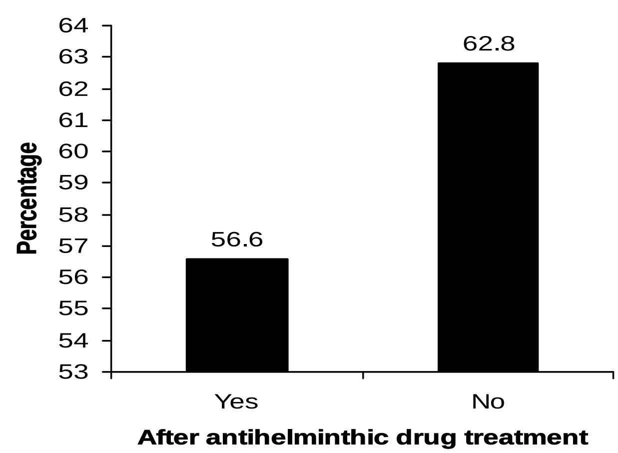


Fig. 7: The Prevalence of parasitic infection after antiparasitic drug treatment

CHAPTER VI

6. DISCUSSION AND CONCLUSION

6.1 Discussion

Nepal is a small and impoverished country with various parasites and bacterial infections, (Rai *et al,* 2001, 2002a) consisting one of the important causes of morbidity and mortality (Rai *et al*, 2001, 2002a). The present study is done to know the different factors that cause obnoxious parasitic infections among *Tharu* community. The *Tharus* were depressed of health education so; this study mainly focuses on their public awareness towards disease.

Present study revealed high prevalence (68.0%) of intestinal parasitosis among *Tharu* community. This was in agreement with previous reports from Nepal (Rai and Gurung 1986; Rai *et al*, 2001). It could be due to over dispersion of parasites, poor sanitary condition, and low socio-economic status of people and deprived of health education. Previous report by Rai *et al* (1999) in rural areas showed (75.0%) infected people with parasite. Alo *et al* (1993) reported prevalence of intestinal helminthiasis among students of Nigeria (43.0%).

Sherchand *et al* (1996) found low prevalence (less than 45.0%) in schoolchildren in the suburban area of capital only. Yong *et al* (2000) found the prevalence of (44.0%) in rural village of Chitwan District and Ishiyama *et al* (2003) found the prevalence (27.0%) in a remote village of western Nepal. It could be due to difference in parasitic detection in technique and location of the study. Ishiyama used direct smear detecting technique. Congested housing conditions and insufficient sanitary facilities may also help in transmission of parasites, supported by (Sorenson *et al*, 1996).

The rate of protozoal infection was higher than helminthic infection that agreed the previous report from Meo Laotians (Wiesenthal *et al*, 1980; Milao *et al,* 1995). The higher rate of protozoal infection may be due to the presence of farming land contaminated with faecal matter resulted due to open defecation, lack of public awareness and use of contaminated drinking water might be the cause behind higher protozoal infection. They used hand pipe as a major source of water. One recent study has also shown higher protozoal infection rate than the helminthes in private elderly (Shakya *et al*, 2006). However, other studies in Nepal among general population have found higher prevalence of helminthic infection (Estevez *et al*, 1983; Nepal and Palfy, 1980; Rai and Gurung, 1986; Rai *et al*, 1995; 2000; Sherchand *et al*, 1996; Sharma *et al*, 1994).

The parasitic infection rate is slightly higher in female than males observed in this study was in agreement with several previous reports (Phetsovannh *et al*, 2001; Rai *et al*, 1995; 2004b; Kightlinger *et al*, 1995; Singh *et al*, 1993; Xu *et al*, 1995). Though the difference was not significant. Females are mainly involved to have more soil contact by growing vegetables, eat raw vegetable with prepared food, health hygiene and nutritional care of their children. Elsewhere, Phetsouvannh *et al* (2001) has reported that the female has 1.25 times more chances of being infected with *A. lumbricoides* than the male. Marnell *et al* (1992) has reported the high prevalence of infection (70.0%) among female. However, these appeared to be in contrast to the earlier reports from Nepal (Rai and Gurung, 1986; Ishiyama *et al*, 2001). This indicated both male and female are equally exposed to infection also this indicate the gender may or may not play role in parasitosis depending on the region and other environmental or behavioral factors. Further, this could also be due to the sample size.

The percentage of monoparasitism were higher than multiparasitism in this study. These finding agreed with other pervious results (Saldiva *et al*, 1999) and Lao PDR (Phetsouvannh *et al*, 2001). Singh *et al*, (1993), Obiamiwe and Nmorst (1991), also observed higher multiparasitism rate. The rate of monoparasitism and multiparasitism were found to be independent of the gender of the elderly people; however, Rai *et al* (2000) has reported higher rate of multiparasitism among males in rural region of Nepal.

The parasitic infection rate was higher in children than adults. This statement was agreement with the previous report from Fagberno-Beyioku *et al* (1987), Sagunan *et al*

(1996), Cachin-Bonilla *et al* (1992) and Rai *et al* (1997). This could be attributed to childish activity like eating, playing outside, walking with bare foot, which causes larvae to penetrate in skin. However, eldery people of age groups 70-79 years were found to be more infected with the intestinal parasites (Shakya *et al*, 2006).

Parasitic prevalence in the *Tharu* community living in large family members consisting of more than 6 members had higher percentage of infection than those living in small sized family size of 6 or less than 6. The over crowdedness, poor sanitation and lack of proper care may be the causes behind high infection rate. This finding agreed with the finding by Rai *et al* (2005). This finding however, was inconsistent with the finding of others (Karrar and Rahim, 1995).

The parasitic prevalence rate was higher among people not having toilet (75.6%) compared with people having toilet (58.4%). It is consistent with the study conducted by Rai *et al* (2002b), Sorensen *et al* (1994) and Toma *et al* (1999). However, the difference was not statistically significant (P>0.05). Lack of toilet affects the environmental sanitation on prevalence of soil-transmitted helminthes. Due to lack of proper toilet, indiscriminate defecation around the houses, fields, roads, and playgrounds increases the chance of parasitic infection. A marginally higher positive rate was seen having pit latrine (75.3%) than having modern toilet (68.6%) Rai *et al* (2002), Ishiyama *et al* (2001) and Gamboa *et al* (1998). It could be due to pit type of toilet do not have proper flushing system as a consequences distribution of parasites is maximum.

The rate of parasitic infection among those washing hands after toilet with soaps showed lower (65.0%) than those not washing hands (73.8%). Most of people in *Tharu* community washed their hand with ash and mud, which is the main source of soil-transmitted helminthes that again enable people to be infected with parasites.

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In the above study, the prevalence of Hookworm infection was marginally higher than other helminthic infection. Phetosuvannh *et al,* (2001) have reported similar rate of Hookworm infection in Vietiane municipality whereas Phompida *et al* (2001) in Lao PDR. Higher rate of infection has been reported earlier from Nepal (Rai *et al,* 1997; Sherchand *et al,* 1997). The main reason of being Hookworm in the top list could be the people walking bare foot which cause skin penetration by Hookworm larvae. Hookworm is one of the most common soil transmitted helminthes in Nepal (Rai, 2005). Ingestion of the filariform larvae present in the soil but it occurs rarely, breast milk from mother to infants and transplacental transmission is rare. The higher prevalence rate may be of people defecate indiscriminately in the open ground.

A. lumbricoides has been reported as the predominant parasite in the country also by Nepal and Palfy (1980), Sherchand *et al* (1996), Rai *et al* (1994; 1995; 1998; 2000; 2001; 2004b) and Ishiyama *et al* (2003). However, the infection rate of *A. lumbricoides* is quite low in this study. This might be due to use of antihelminthc drug. Furthermore, *Ascaris* eggs can survive in environment for longer period due to presence of chitin protein layer in their shell (Rai *et al,* 1999). The geographical variation may be another factor for lower prevalence of *A. lumbricoides* (Adhikari, 2006).

In the above study low prevalence of *S. stercolaris* (3.5%) was in agreement from the previous report (Jao *et al,* 2005). *Strongyloides* is worldwide parasitic disease and of great importance. Low prevalence observed in this study may be diagnosing *Strongyloides* is difficult and even though the parasitological stool examination is the most used diagnosis test. Sometimes larvae cannot be identified (Pires *et al,* 1993). Delay in diagnosis of *Strongyloides* frequently results in death, despite vigorous treatment. Use of community latrine rather than a private latrine, living in house with an earth floor rather than cement floor (Hall *et al,* 1994) can decrease the prevalence of strongyloidiasis.

In this study, *H. nana* was detected (8.0%). *H. nana* is the most common tapeworm infecting man in Nepal. It was reported to be 3.3% in Southern Nepal (Sherchand *et al*, 2004) and 4.9% in Kathmandu valley (Sharma et al, 2004). Again, *H. nana* was also reported as commonest tapeworm in the Kathmandu Valley (Serchand *et al*, 1996). Highest prevalence has also been reported as 20.4% (Jone, 1980). The high prevalence in this study may be due to faeco-oral route by ingesting of eggs from contaminated hands, poor personal hygiene and poor environmental hygiene that contribute to result in high prevalence among *Tharu* community. Rarely transmission occurred from the ingestion of food contaminated with fleas harbouring the cysticercoid larvae.

Taenia in this study was found to be 2.0%. This result was in agreement with previous report from rural village of Honduras (2.0%) (Sanchez *et al*, 1997). Risk factors associated were eating raw or insufficiently cooked pork, raw vegetables grown in field fertilized with human faeces contaminated with eggs of *T. solium*. Similarly earthen floor, overcrowding, previous taeniasis and living in the same household are reportedly associated with taeniasis (Sanchez *et al*, 1997).

In the study, *G. lamblia* had been found to be the most common protozoa infecting one fifth of the total infected people. This result was in contrast to some of the previous result from Nepal (Rai *et al* 1995; Rai *et al* 2002b; and Sherchand *et al* 1997). The highest prevalence of *Giardia* in this study showed that *Tharu* people of Rajapur VDC indicate the poor sanitary and personnel hygienic condition. *G. lamblia* is considered as one of the important etiological agents of diarrhea in developing and developed countries (WHO 1994). Furthermore, the cyst of *G. lamblia* is resistant to the normal level of chlorination therefore; it can be easily transmitted through drinking water. However, the very low prevalence of *G. lamblia* was observed among Indian elderly people (Gambhir *et al*, 2003). Infection with *Giardia* both humoral and cellular immune response generated by host secretary IgA and IgM appear to play role in clearance of intestinal infection. This gives some degree of protection against reinfection (Oda *et al,* 2002). Giardiasis is one of the common causes of acute or persisting diarrhea in children in developing countries. It interferes with intestinal absorption nutrients and growth rate of children.

In the above study *E. histolytica* was found to be slightly lower (18.0%) than that of *G. lamblia.* Our findings for E. histolytica agree with Karrar *et al* (1995), Sayyari *et al* (2005) and Siddiqui *et al* (2002). Infection with *E. histolytica* is common in inhabitants of developing countries; it predominantly affects people with poor socioeconomic conditions, non-hygienic practices and malnutrition (Braga *et al*, 1998). Amoebiasis may be more severe during pregnancy and lactation and in persons with immunodeficiency, homosexuals, immigrants from certain tropical countries, and travelers. Urban migration, the deterioration of the economics of certain developing countries, and the increasing size of urban slums with crowded, unhygienic conditions may accelerate the spread of amoebiasis and so result in greater morbidity and mortality from this infection in future (WHO 1987). The lower prevalence might be due to the study of single stool specimen for detecting cysts and trophozoite of the parasite.

In the study, the prevalence rate of *E. coli* was found to be slightly lower than that of *E. histolytica.* The high *E. coli* prevalence has been reported by Oberst and Alquiza (1987) in Phillipines and Cabrera *et al* (2000) in Peru and Saito et al (1996) in Paraguya. In study, *B. homonis* was found to be lower prevalence rate (6.0%). *B. hominis* has been reported earlier in people with abdominal complaints (Sherchand *et al,* 1996) and in general population (Gianotti, 1990; Rai *et al*, 2001a). However, other workers (Uga *et al*, 2004) in similar types of study did not report *B. hominis*. It may be due to the autolysis of *B. hominis* cysts during the time lapsed between sample collection and examination (Uga *et al*, 2004).

Similarly, the prevalence of C*yclospora* and *E. coli* were observer in the same rate. It may be due to utilization of drinking water from contaminated water with high percentage of fecal garbage contaminated food has long been proposed as a possible route for transmission of *Cyclospora* (Cannor and Shlim, 1995). Vegetables are easily contaminated and provide organisms with an optional environment for survival prior to host ingestion. Cabbage, lettuce and mustard leaves were found to be contaminated with *Cyclospora*, which confirmed that food borne transmission, is also feasible (Sherhand and Cross 2001). The study conducted on vegetable samples showed the prevalence of Cyclospora 28.0% (Personal communication).

Other possible sources of infection are birds, rodents and insects due to which food and ripen fruits become unfit for human consumption. Although more studies are needed to determine the correlation between parasitic infection and other sources, the present study showed that drinking water and domesticated animals are possible sources of infection in Rajapur VDC.

After antiparasitic drug distribution, the positivity of the parasitic infection didnot decrease significantly (from 68.0% to 60.0%). After deworming and antiprotozoal drug distribution, again study was conducted after 7 months. Those who had history of taken drug 7 months ago showed decrease in parasitic infection to (56.0%) than those who had not taken showed (62.8%). A similar finding had been reported by Rai *et al* (2002), Bundy *et al* (1987) and Albonico *et al* (1999). It is therefore recommended that periodic chemotherapy should be implemented. Here high percentage of helminthes was seen after antiparasitic drug treatment this might be of those people who had no history of taking antiparasitic drug were also included in this study. Thus, periodic mass deworming with albendazole would seem to be a safe and effective method that could be adopted at the community level or as an integral part of school health services and could be expected to improve growth and reduce the incidence of parasitic.

Present findings indicated that the health status of Nepalese is still very poor. Approximately 2/3 of the health problems in Nepal are infectious disease (Rai *et al*, 2001b). Frequently epidemic occurs with high rate of morbidity and mortality. Among the various types of infectious disease, intestinal parasitosis (mainly soil transmitted helminthiasis) alone constitutes major health problem in Nepal (Rai and Gurung 1986; Rai *et al*, 1994a; 1995; 1997; 1998).

The government of Nepal and private sector are also taking part in the promotion of health services to every citizen. In spite of these efforts (government and private sectors), no significant progress has been made in controlling the intestinal parasitic infection in Nepal. Therefore, more effort is expected towards this and more practicable and reasonable policy has to be implemented without ambivalently.

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

Soil transmitted helminthes infections are endemic in the communities where poor environmental sanitation and poor personnel hygiene, as occurs in majority of developing countries Yodami *et al* (1982) and Yu *et al* (1993) showed that environmental pollution, sanitary condition and human behavior play an important role in transmission of STH infections. STH (*A. lumbricoides, T. Trichiura* and Hookworms) cause morbidity in humans in different ways by affecting nutritional equilibrium, inducing intestinal bleeding, inducing malabsorption of micronutrients, reducing growth, reducing food intake, causing complications such as obstruction rectal prolapsed and abscess and affecting congenital development.

To the best of our knowledge, this is the first research of its kind in the country, in terms of *Tharu* ethnic group. As there were not any previous researches done focused on *Tharu* community. This has resulted lack of comparison of our findings with the other regarding in different parameters.

Although this study provides a lot of information regarding the state of infection there are some important limitations absolve discussion.

- Due to time factor and other obstacle, the study had to be confined over limited sample size. Findings that are more significant would have occurred if more population were included.
- Result that is more reliable had been revealed if stool samples from single individual on three consecutive days were taken.
- The findings cannot be extrapolated to the entire *Tharu* community of Nepal. However, this study had tried to represent average *Tharu* people.

Increasing the living standard in relation to health and controlling the etiological agents leads to decrease in parasitic infection. In developing countries, geographical and socioeconomic conditions contribute problems in diagnosing the infection. These countries located in the warm or hot and relatively humid areas that combined with poverty, malnutrition, high population density, unavailable potable water and low health status. This provides optimum growth and transmission of parasites. The findings of this survey confirm the extremely complex nature of parasitic profile among *Tharu* community and indicate that relationships exist between cultural and ecological factors, sanitation, and observed pattern of intestinal parasites. Lack of sufficient research, lack of attention among backward ethnic group (*Tharu* community) and lack of follow-up treatment played barriers in decreasing the parasitic prevalence rate. Since these parasitic infections are the major public health problem of the country, it is obligatory to conduct surveys in different areas to find out their prevalence (Sherchand *et al*, 1998).

Public education on improved personal and environmental hygiene are cardinal in the control, additionally, routine periodic screening of children and possibly, the caregivers will guarantee early detection, prompt therapy and interruption of transmission of the pathogens. Changing behavior like wearing slippers, avoiding raw vegetables and meat also help in declining the parasitic ratio. Development of proper sewerage system and use of pipe borne water are the main elements in controlling the parasite infection. These factors may help mitigate the impact of community based intestinal parasitosis.

6.2 Conclusion

The parasitic infections are closely related with the hygienic and sanitary condition among *Tharu* community. The positive rates found in initial samples and after drug distribution were (68.0%) and (60.0%), respectively. Hookworm (17.0%) was the commonest helminth and *Giardia lamblia* (18.5%) was the commonest protozoa found. People without toilet in their houses had higher (75.6%) infection rate than those who had (58.4%). The incidence rate of parasitic infection is higher in the people not washing hands after toilet (73.2%) than washing hands after toilet (65.0%) before drug distribution while after drug distribution it was significantly decreased towards (67.1%and 52.8%), respectively. Those people who had used antiparasitic drug within past 6 months had significantly lower prevalence rate (56.6%) than those who had not taken (62.8%). Hence anti-parasitic treatment through mass chemotherapy can reduce symptomatic people as well as the carriers. All this plans will be successful only after getting knowledge about health education, for this one should be educated. Hence, the literacy rate and poverty alignment of this nation has to increase.

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CHAPTER VII

7. SUMMARY AND RECOMMENDATION

7.1 Summary

1. Stool sample were collected from 511 Tharu people in Rajapur-6 VDC; 257 initially and 254 after drug distribution. The positive rates found in initial samples and after drug distribution were (68.0%) and (60.0%), respectively.

2. Among them 84.0% had monoparasitism and 16.0% had multiparasitism initially and after 7 months, 72.5% had monoparasitism and 27.5 had multiparasitism. Females were marginally more infected (68.5%) than male (67.6%) in both the stage of sampling.

3. Hookworm (17.0%) was the commonest helminth and *Giardia lamblia* (18.5%) was the commonest protozoa found. Other parasites dectected were *A. lumbricoides, H. nana, T. trichiura, S. stercolaris, Taenia sp., E. histolytica, E. coli, B. hominis*, *C. cayetanensis*, *E. hartmani*, and *E. nana.*

4. The people of age group less than 15 were most affected (74.5%) with the parasites than adults (63.5%).

5. Prevalence of parasitic infection rate in family size above 6 was found higher (70.3%) than below 6 (66.1%).

6. People without toilet in their houses had higher (75.6%) infection rate than those who had (58.4%). The rate of parasitic infection is higher in the people not washing hands after toilet (73.2%) than washing hands after toilet (65.0%) before drug distribution while after drug distribution it was significantly

decreased towards (67.1%and 52.8%), respectively.

8. The rate of parasitic infection was found to be highest (84.4%) to those suffering from recent diarrhea than non suffer (64.6%).

9. Those people who had used antiparasitic drug within past 6 months had Significantly lower prevalence rate (56.6%) than those who had not taken (62.8%).

7.2 Recommendations

1. Keeping in view of high prevalence of enteric parasitic infections (68.0%), observed in this study conducted in a village setting, this might represent the present situation of backward ethnic group of the country. However, this type of study should be undertaken throughout the country in order to obtain the clear-cut picture.

2. Periodic administration of antiparasitic drugs is highly recommended and awareness creating activities with regard to controlling intestinal parasitic infection should be launched.

3. Of the various parasites detected, Hookworm was most common. This indicates personnel hygiene of the people. Hookworm causes low grade fever, anaemia, nausea, vomiting, diarrhea, and abdominal discomfort. For this, other examination such as hemoglobin measurement along with stool examination should be done and proper course of drug should be administered.

4. The prevalence of protozoa was higher than helminthes. This indicates the contamination in water supply in the village. So concerned sector should think about the proper management of water supply.

5. Though no significance impact of various predisposing factor studied was observed, use of toilet, maintaining hygienic conditions, not walking bare foot, proper washing of hands before meal, drinking of treated (boiled or filtered) water and others are highly recommended.

6. Since the transmission and persistence of intestinal parasitic infections are influenced by human behavior and culture, appropriate health education measures should be applied at all levels of program implementation.

CHAPTER VIII

8. REFERENCES

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APPENDIX -1

Materials and Chemicals used

1 Chemicals and reagents

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

2 Materials

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

3 Equipments

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

APPENDIX-2
MICROBIOLOGICAL PROFILE

Serial No: Date:
Name: Age:
Gender: Educational status:
Height: Weight:

Patient's Clinical History:…………………………………………………………………………………
…………………………………………………………………………………………

Questionnarie:
1. How many members are there in your family? ………………….
2. Which is the source of water you use to drink? I. Tap II. Kuwa III. River
3. Which type of water do you drink? I. Boiled II. Non Boiled
4. Do you wash your hands before meal? Yes / No
5. Do you have toilet in your house? Yes / No
6. Do you wash your hands after toilet? Yes / No
7. Do you cut your nail regularly? Yes / No
8. Did you suffer from diarrhea recently? Yes / No
9. Have you taken Antihelmenthic drug recently? Yes / No

Report of stool examination:

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

Authorised Signature………...

…………………………………………………………………………………………

Report of stool examination:

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

Authorised Signature………...

APPENDIX -3

MAP OF BARDIYA DISTRICT