I

INTRODUCTION

Good health is the great quality and virtue of an individual. Healthy citizens lead the country in the path of progress, happiness and satisfaction. Although, Nepal is recognized as the country full of natural resources, diversity of flora and fauna, pleasant climatic situation, it is also known as one of the developing country in the world. Parasites are a major invader of people in developing country like Nepal. It often causes disability and fatal diseases. People are more susceptible to infection of parasitic disease due to the unhygienic management, malnutrition and ignorance about complicated life cycle of parasites.

Parasites are those organisms which receive nourishment and shelter from other organisms. They remain closely associated with their hosts biologically and ecologically. Different types of parasites found in our community, such as ectoparasites, endoparasites, accidental parasites, facultative parasites, temporary parasites, permanent parasites, obligatory parasites etc. Among them, endoparasites cause different types of intestinal diseases which are cosmopolitan in distribution posing very serious health problems in the developing countries where diseases, ignorance and poverty are interlocked. Roundworms linked to food borne illness in human include *Ascaris, Trichuris, Enterobius*. Food borne cestodes like *Hymenolepis* is also noticeable. Protozoa like *Entamoeba, Giardia* cause a large number of food borne out breaks each year leading to dysentery like illness that can be fatal. Intestinal parasitic

infectiona are major causes of morbidity and mortality among school aged children of developing countries (WHO, 1987). There is a strong association between giardial infection and under-nutrition of many primary school children (Loewenson *et al.,* 1986). It is because of dirty fingers and nails which might play an important role in the transmission of intestinal parasites (Soulsa, 1975).

Bhaktapur district is one of the famous places of Nepal from historical point of view. It is well known for its unique cultures and traditions. Cultures and traditions express originality of citizens but it is not good to follow bad traditional activities which do not allow going in the path of development. If all the citizens living in Bhaktapur district take care about this matter, it can be one of the example districts in the field of development along entire Nepal. Especially people living in village area of Bhaktapur district are troubled by parasitic infections due to their poor health habits. Communicable diseases such as diarrhoea and dysentery influence a very depressing health. These are the major source of death and sickness especially among children and infants in our country. One of the survey conducted in Bhaktapur district on stool test showed 99% positive for the eggs of soil transmitted helminthes (Shrestha, 1983). A random sample study of patient in Bhaktapur was conducted to ascertain the incidence of roundworm infection (Sharma, 1965).

Low economic status is not the sole factor for parasitic infection, but also the increased water pollution is one of the major public health issues in Nepal. Diarrhoeal parasitic infections of gastro-intestinal tract are the result of water pollution. Diarrhoea (10%) is the disease caused by contaminated water in

Nepal (DoHS, 1998 and SAEHN, 2002). Intestinal infections like giardiasis, ascariasis, amoebiasis, ancylostomiasis, fascioliasis and taeniasis are common in Nepal (Acharya, 1979). Children were found to be infected more frequently than adults (Rai *et al.*, 1994).

Significance of study

Nothing is constant. The time and situation are the ever changing factors in this area of globalization. Then also some parts of our country are still in the conservative and bad traditional aspects. The present survey may play tremendous role to get the dream of state by creating awareness to the people living in that places. People of that area are being suffered from different parasitic diseases continuously because such type of survey has not been done before to enlighten the awareness related to intestinal parasite. The symptoms caused by parasitic infection vary and are not enough to be relied upon for diagnosis. The clear etiological agents and life cycle of some parasite has not been declared yet. Very few, among health related personnel know about these parasites. Thus it is essential to know in advance about its destructive characteristics, by which it can be recognized easily. Heavy infection effects on growth of the host, weakens the body causing death. The death rate is higher in young ones than in old.

Basically, children of the rural area are more infected than adult because of the lack of awareness about sanitation. They spend most of the time playing in soil and dirty places, which help to transmit the parasite. The infection rate of

different intestinal parasites may differ in different communities or castes of people since they have different traditional habit and habitat.

Outbreaks of Acute Diarrhoel Diseases (ADD) occur frequently in many districts of Nepal. These outbreaks cause morbidity and mortality in a high scale. WHO estimates globally, in every eight seconds a child dies of a water related diseases. Every year more than five million human beings die from illness linked to unsafe drinking water, unclean domestic environments and improper excreta disposal. In Nepal, previous records showed that the main cause of these ADD outbreaks is due to unsafe drinking water. Cope these outbreaks, the Ministry of Health, DoHS and EDCD established a mechanism for minimizing outbreaks (EDCD, 2002-2003).

Many schools of town area have managed the regular examination of stools of children to minimize the intestinal parasites and hence keep the school children healthy. Regarding this view, the study of intestinal parasite in children of Sipadol VDC of Bhaktapur district has been undertaken for the first time to find the prevalence of infection on the basis of age, sex, occupation which contributes to aware the people towards intestinal diseases. This will help in the in minimizing different intestinal diseases in children and continuing such implementation regularly each and every year in the near future. Moreover, the present study might help the future investigators to advance this knowledge and throw light on different problems faced by the rural communities notifying the burden of infections of the intestinal parasites.

II

OBJECTIVES

General objective

- To study the prevalence of intestinal parasitic infection among children of Sipadol VDC of Bhaktapur district in relation to feeding habits, drinking water, personal hygiene and sanitation to control parasitic intestinal infections.

Specific objectives

- To find the prevalence of different types of intestinal parasites.
- To study the age, class and sex-wise distribution of intestinal parasites among children of “Ganesh Secondary School”.
- To know the intestinal parasites in relation to parents occupation, drinking water, feeding habit, personal hygiene and sanitation.
- To accelerate against the knowledge about intestinal parasitic infections.

III

LITERATURE REVIEW

Intestinal Parasitic Infections in Global Context

Al Ballaa *et al.,* (1993) determined the prevalence of pathogenic intestinal parasites among preschool children in Saudi Arabia through a randomized multi stage sampling of 800 school children. The over all prevalence of intestinal parasite among children screened was 18.4%. Out of the 1461 children positive for parasites, 183 (12.5%) had mixed parasitic infection. Prevalence among preschool children was highly associated with older age, rural resistance and non municipal water supply, in adequate latrine type, low level of parental education, abdominal pain and diarrhoea.

Alo *et al.,* (1993) determined the prevalence of intestinal helminthiasis among students of Government Secondary School, Gairei. Song Local Government Area of Adamawa State, Nigeria, between January and July 1991. Out of 200 students between the age group 10-32 years old examined, 86 (43.0%) were infected.

Hassan *et al*., (1994) surveyed 4 primary and 2 secondary schools at Kafr Hakeem, El-Mansuria and Barkash villages in Imbaba district. Urine and stool specimens of 791 students were examined. Results revealed Amoebiasis (22.4%), *Hymenolepis nana* (6.2%), *Ancylostoma duodonale* (5.7%), Ascariasis (1.5%) and Enterobiasis (1.1%). There was no statistical difference between primary and secondary school students regarding the rate of infection.

Hadju *et al.,* (1995) studied the prevalence and intensity of helminth infections and nutritional status in urban slum school children (276 boys and 231 girls), in Ujung Pandang, Indonesia. Prevalence of *Ascaris, Trichuris* and hookworm was 92%, 98% and 1.4% respectively. 91% children had both *Ascaris* and *Trichuris* infections. About half of the *Ascaris* and *Trichuris* infected children (46% and 58%) had moderate infections. Stunting was seen in 55% of the children, while wasting was observed in 10%.

Sorensen *et al.,* (1996) studied 1614 children of the age group 3-12 years and 246 women of the age group 18-44 years in Sri Lanka. 89.7% of children and 86.2% of women had one type of nematode infection. 77% of children and 69.5% of women were infected by *Ascaris*, likewise 69.4% of children and 56.5% of women had *Trichuris* and 23.2% of the children and 41.4% of the women had hookworm.

Kobayashi *et al.,* (1997) studied the intestinal infection of 128 children in Khammovane Province, Southeastern Sao, Paulo, Brazil. Prevalence of helminthes infection was 77.3% in children under 6 years age group, 88.5% in the age group 6-10 years and 81.8% in the age group above 11 years. The parasites were *Ascaris* 48.4%, *Trichuris* 43.8%, hookworm 37.5% and *Opisthorchis viverrini* 37.5%.

Mafiana *et al.,* (1998) conducted a study to determine the prevalence of soil transmitted helminthes parasites in children of Abeokuta, the capital city of Ogun State Nigeria. Stool sample of 1060 children were observed. 64% *Ascaris*, 14.5% *Ancylostoma* and 21.9% *Trichuris* were found as result.

Paul *et al.,* (1999) carried out a study to determine the prevalence and intensity of intestinal helminth infections. The children were between 7-13 years of age and belonged to lower socioeconomic status. Stool samples collected were processed by modified formalin ethyl acetate sedimentation technique. 177 children were infected with one or more of the intestinal parasites viz; *A. lumbricoides, T. trichiura* and hookworm. The overall prevalence of infection was 82%, *A. lumbricodes* was the most common infection with a prevalence of 75% followed by *T. trichiura* (66%) and Hookworm (9%).

Lee et *al.*, (2000) examined stool and cello-tape anal swab carried out in August 1997 on handicapped people at an institution located in Chorwongun,Kangwon-do, Korea. Out of 112 stool samples, 3 cases of *T. trichiura* and 1 case of *E. vermicularis* infections were found and *E. coli* (25%), *E. histolytica* (1.8%), *Endolimax nana* (21.4%), *I. butschii* (1.8%) and *G. lamblia* (0.9%). Out of 165 cello-tape anal swab samples, the prevalence rate of *E. vermicularis* was (20.6%).

Toma *et al.,* (2001) studied on *Strongyloides* infection conducted by fecal examination and subsequent treatment of the population on a model island (Kume Island) in Okinawa, Japan for 5 years from 1993 to 1997. More than 1200 persons, accounting for 17% to 20% of the person and subjected, received fecal examinations each year.

Amin *et al.,* (2002) conducted an investigation to determine the prevalence of intestinal parasites in the United States. Prevalence of infection was lowest in

winter, gradually increased during the spring, reached peaks of 36-43% between July and October and gradually decreased to 32% in December. In single infections, pathogenic protozoa caused asymptomatic sub clinical infection in 0.31% of the cases and nonpathogenic protozoa unexpectedly caused symptoms in 73-100% 0f the cases.

Farook *et al.,* (2002) carried out a study to determine the intestinal helminthes infections among tribal population of the Kottar and Achankovil areas in Kerla (India). Out of total 258 stool samples examined, 60 shows ova of one or more intestinal helminthes. Hookworm infection was found to be predominant (58.82%) in Achankovil and remaining (41.1%) was due to only roundworm, whereas in Kottar area roundworm infection predominated (74.41%) followed by hookworm (18.6%) and other type (6.97%).

Botero *et al.,* (2003) assessed a preliminary study of prevalence of intestinal parasites in immuno compromised patients with and without gastrointestinal manifestation. A bettery of tests was performed on each individual to identify the presence of parasites with saline solution and by concentration, culture and special staining. No significant differences were found among the frequencies of potentially pathogenic and opportunistic parasite which were 32.4% (36/111) and 9% (10/111) respectively. The most frequently encountered are *Cryptosporidium* sp, *Mierosporidium* sp and *Strongyloides stercoralis*.

Rim *et al.,* (2003) carried out the study to determine the prevalence of intestinal parasitic infections on a national scale among primary school children in Laos. From May 2000 to 2002 June, examined once with the cellophane thick smear

technique. The cumulative egg positive rate for intestinal helminthes was 61.9%. By species, the rate of *Ascaries lumbricoides* was 34.9%, hookworm 19.1%, *Trichuris trichiura* 25.8%, *Taenia* sp 0.6% and *Hymenolepis* sp 0.2%, *Opisthorchis viverrino* was 10.9%.

Saksirisampant *et al.,* (2003) put forward the study about intestinal parasitic infections among children in an orphanage in Pathum Thani Province. During investigation, *Blastocystic hominis* was found at the high prevalence (45.2%). The infection caused by *Giardia lamblia* was 37.7% and *E. histolytica* was 3.7%. Other non pathogenic protozoa were found.

Kurpad *et al*., (2003) carried out the survey to determine the intestinal parasites that increase the dietary lysine requirement in chronically undernourished Indian. After the eradication of intestinal parasites, there was a significant ($P<0.001$) improvement in 24-h leucine balances, which were positive at both lysine intakes. On the basis of the 24-h indicator amino acid balance approach, it appears that the higher lysine requirement observed in persons with chronic under nutrition.

Wiwanikit *et al.,* (2003) studied platelet parameter in subjects infected with hookworm. Out of 100 subjects, hookworms were identified in stool of six cases, giving an infection rate equal to 6%. The platelet parameters of the subjects showed a statistically significant lowering of mean platelet volume (MPV) in the subjects with hookworm infection.

Benicio *et al*., (2004) carried out the prevalence and risk factors in the city of Sao, Paulo, Brazil during the evaluation of wheezing conditions in early

childhood. The prevalence of recent wheezing was12.5%, 93% of children with wheezing was also reported to have medical diagnosis asthma. Recent wheezing was associated with low per capita income, poor quality housing, day-care attendance and infection with intestinal helminthes.

Deepmala *et al.,* (2004) investigated on the prevalence of intestinal parasitic infections in human population of Darbhanga region of Bihar. In the epidemiological survey of intestinal parasitic infection, out of 2553 stool samples examined 920 (36.03%) were found to be positive for protozoan parasites, 1162 (15.52%) for helminthes and 471 (18.45%) for mixed infection. In overall infection, males and even those of 21-30 years age group showed higher prevalence rate (55.55%) than females (44.45%).

Singh *et al.,* (2004) studied on helminthic infections of the primary school going children in Manipur. Out of 1010 stool samples collected from the primary school going children between the age group 5-10 years, 248 (24.5%) were positive for various helminthes. Among the positive cases, 110 (26.3%) were from urban area and 138 (23.4%) from the rural areas of Manipur. Maximum number of parasitic infections was found in the age group 5-6 years. 27% *Ascaris lumbricoides*, 19.6% *T. trichiura*, 2.18% *H. nana*, 0.99% hookworm, 0.09% *S. stercoralis.*

Nithikathkul *et al.,* (2005) evaluated the impact of health educational programme on the prevalence of enterobiasis in school children in Thailand. The study showed a decrease in infections among children who received supplementary education. This decrease was significant in comparison to the

decrease shown among children who received medical treatment only. The study therefore showed that educating high risk individuals played a key role in the prevention of enterobiasis.

Duran *et al.,* (2005) conducted an investigation on the distribution of intestinal parasites in students of the Mustafa Kemal University School of Health. In their study, the prevalence of intestinal parasites in female students (aged from 16-18 years) in the Mustafa Kemal University, out of 142 fecal samples and 136 cellophane tape preparation, 65 (45-77%) fecal samples were positive. *Blastocystis hominis* in 63 samples (96.92%) and *Giardia intestinalis* in 63 samples (3.08%). *Enterobius vermicularis* was found in 9 (6.61%), out of 136 cellophane tape preparations.

Aydin and Juncer (2005) conducted the study on distribution of intestinal parasites in children from the Nisam primary school in Hakkari. In this study, out of 114 stool samples i.e. 60 male and 54 female students, 66 (57.8%) samples were found positive. *Giardia intestinalis* (28.9%), *Blastocystic hominis* (23.6%), *Entamoeba coli* (12.2%) and *Ascaris lumbricoides* (6.14%) were most prevalent parasites.

Intestinal Parasitic Infections in Nepal Context:

Several works regarding human intestinal parasites at different places of Nepal have been done. Some are given below:

Nepal and Palfy, (1980) examined 225 stools. Only 4.4% of the samples showed the presence of more than one parasite. 3.1% of the samples had up to five parasites.

Shrestha, (1983) surveyed in Bhaktapur district showed 99% stools were positive for the eggs of soil transmitted helminthes. Similarly from the Panchkhal area 41% stools were positive for the eggs of helminthes. During stool test Kato-Katz method was followed.

Rai *et al.,* (1986) collected 200 stool samples and examined by direct smear technique over a period of 16 days. The incidence of roundworm was the highest (35%) followed by hookworm (14%). The infection rate was 69% and the result showed that the infection was more common in girls than the boys.

Rai *et al.,* (1991) presented the paper to show the prevalence of various intestinal parasites in Kathmandu valley, Nepal. The overall prevalence of intestinal parasites was 30.9%. There was no significant difference in the prevalence between two sexes. Intestinal parasites were more common among children than in adult.

Sherchand *et al.,* (1997) studied the intestinal parasitic infection in rural areas of southern Nepal, Dhanusha district. Out of 604 children aged between 0-9

Years examined, 63.1% were found positive for one or more intestinal parasites.

Rai *et al.,* (2000) investigated the contamination of soil with helminth eggs in Kathmandu valley and outside of valley in Nepal by centrifugal floatation technique using sucrose solution. Out of 156 total samples, 122 were taken from Kathmandu valley and 34 samples from outsides of valley. The overall soil contamination rate was 36.5%. The prevalence was uniform in Kathmandu valley (36.3%) and outside of the valley (35.3%). In Kathmandu valley, soil contamination rate was higher (48.3%) during wet season compared with that observed in dry season (33.3%) but without significant difference (P>0.05). All together 5 species of nematodes were recorded and 2 species of cestoda. *A. lumbricoides* was prominent in Kathmandu valley while *Trichostrongylus* was the commonest one in outside of valley.

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

Annual Reports of Intestinal Infection at National Level for five consecutive years are as follows. (Epidemiology and Disease Control Division, Teku)

Table I: Infection of Diarrhoea diseases in five different years.

1999/00	2000/01	2001/02	2003/04	2004/05
713463	787567	816481	949630	921901
3.12%	3.35%	3.38%	3.87%	3.68%

Table II: Infection of Intestinal worms in five different years.

1999/00	2000/01	2001/02	2003/04	2004/05
651308	663629	666362	659582	611072
2.85%	2.82%	2.76%	2.73%	2.44%

IV

MATERIALS AND METHODS

Study Area:

"Ganesh Secondary School" lies in Sipadol VDC at ward no. 9. Out of 16 village development committee in Bhaktapur district, Sipadol VDC lies in the southern part of the district.

Introduction of Bhaktapur district:

Bhaktapur lies in Bagmati zone, which is situated in Central Development Region and is surrounded towards north-west by Kathmandu, south-west by Lalitpur and south-east by Kabrepalanchok. It is the smallest district in term of area in Nepal. Even though, it is the smallest district of Nepal, it carries a lot of historical monuments. Among them Changunarayan and Bageshwori are famous temples of Bhaktapur. Nagarkot, from where view of sunrise and sunset can be observed is also located here. So this district is one of the commercial centres for the tourist trade.

Bhaktapur district has two municipalities and 16 Village Development Committee. It is situated at 27°37' to 27°44' latitude and 8°520' to 85°28' longitude. The total area covered by this district is 119 km² occupying 0.08% of total area of Nepal. It has various climate with the variation of elevation or geographical features. Most of the people are depended on agriculture. So climatic situation plays important role in livelihood of citizens of Bhaktapur.

According to the Central Bureau of Statistics (2005), the total population of Bhaktapur district is 2,25,461; among them 1,14,798 are male and 1,10,663 are female in 41,253 households. Economically, most of the population depend on agriculture where as others are jobholders and businessmen.

Ethnically, Newars occupy the major place in total population of this district. Besides that there are Bramin, Chettri, Magar, Bhote and others. Most of them are Hindus while a fraction of population are found to be follower of Buddhist, Islam, Kirat, Jain, Christian, Sikha, others. “Bisket Jatra” and “Gai Jatra” are peculiar festivals celebrated in Bhaktapur.

Introduction of Sipadol VDC:

Sipadol VDC is one of the underdeveloped and rural areas in Bhaktapur district. It is situated 27°37’ to 27°40’ latitude and 85°26’ to 85°27’ longitude. The total population of this VDC is 7004, among them 3569 are males and 3435 are females in 1358 total household. The main castes are Newar, Brahmin, Chettri, Magar, Bhote, others. Most of the people are illiterate here. Farming and agricultural labour are livelihood job of these people. Because of illiteracy, unhygienic living habit, poor socioeconomic condition and conservative thinking, they are suffering from different kinds of parasitic infection.

Out of 9 wards in Sipadol VDC, “Ganesh Secondary School” lies in ward no. 9. This is only one secondary school in 9 no. ward. It is the government school. Some of the students of this school are not capable to buy their educational necessaries. So school has searched the different fund to provide scholarship

for these students. Some students need to walk 2 hours to reach school due to lack of transportation facilities. Now a days, school is in the path of progress by the great contribution given by experienced principle, well qualified teachers and co-operative staffs.

The study was divided into two parts. First part was questionnaire surveillance study and second part was stool sample collection for examination of intestinal parasites of children from class nursery to ten.

Stool Sampling:

Out of total 248 students studying in the school, 224 stool samples of children were collected in sterilized sample collection vials with instruction for collection procedure.

The stool samples were collected and also a set of prepared questionnaires were asked to the same student population. At first, vials were distributed to all the students and later stool samples were collected from them. Immediately after collection, potassium dichromate was put in the vials containing stool for preservation.

Equipments and Chemicals:

- Compound microscope, glass slides, cover slips, cotton or filter paper, gloves, needle, sticks, vials.
- Potassium dichromate, normal saline, iodine solution.

Examination of Stool Samples:

Firstly, the stools were examined by naked eyes for the worms of helminth parasites (adult worm of *Ascaris, Trichuris,* hookworm and other intestinal flukes) or a part of it (segments of *T. solium* and *T. saginata*) as well as mucous, blood and consistency.

Microscopical examination of the stool:

- Unstained preparation of stool smear: A portion of stool was taken with the help of stick and emulsified with normal saline on a clean glass slide and cover slip was placed over it and excess of fluid was removed with the help of filter paper.
- Stained preparation of stool smear: Stained preparation was necessary for the identification and the study of the nuclear character. The iodine stained preparation was used for this purpose.
- Method of observation: Both stained and unstained preparations were first examined under the low power of microscope under 10X objective. Observation was made starting from one end of the slide to another. Objects were centered and focused under the high power for detailed diagnosis.

To detect the rate of infection caused by any particular parasite, egg counting method was followed. The eggs were counted by microscopic examination under high power. If 1-3 numbers of eggs were observed in a microscopic field, it was denoted by single + (+), which expressed low infection rate of

corresponding parasite. Likewise if 4-6 numbers of eggs were observed in a microscopic field, it was denoted by double + (++), which expressed medium infection rate of corresponding parasites. Whereas if above 6 numbers of eggs were observed in a microscopic field, it was denoted by triple + (+++), which expressed high infection rate of corresponding parasite.

V

RESULTS

The study was conducted among children of "Ganesh Secondary School" of Sipadol VDC. The school has a total of 248 students from nursery to class ten. The study was performed among 224 school children in two ways:

I. Data collection on questionnaire regarding sanitary, illiteracy, hygienic condition, sources of water, awareness about parasites etc.

II. Stool sample collection and examination.

During the process of study, 224 children were interviewed with the help of questionnaire and then their stools were collected and examined.

⟩General Prevalence of Intestinal Parasites of School

Out of 224 students, 75 (33.48%) were found to be infected with one or more types of intestinal parasites. General prevalence of intestinal parasites of school revealed that the students were remarkably infected.

Table 1: General prevalence of intestinal parasites of school.

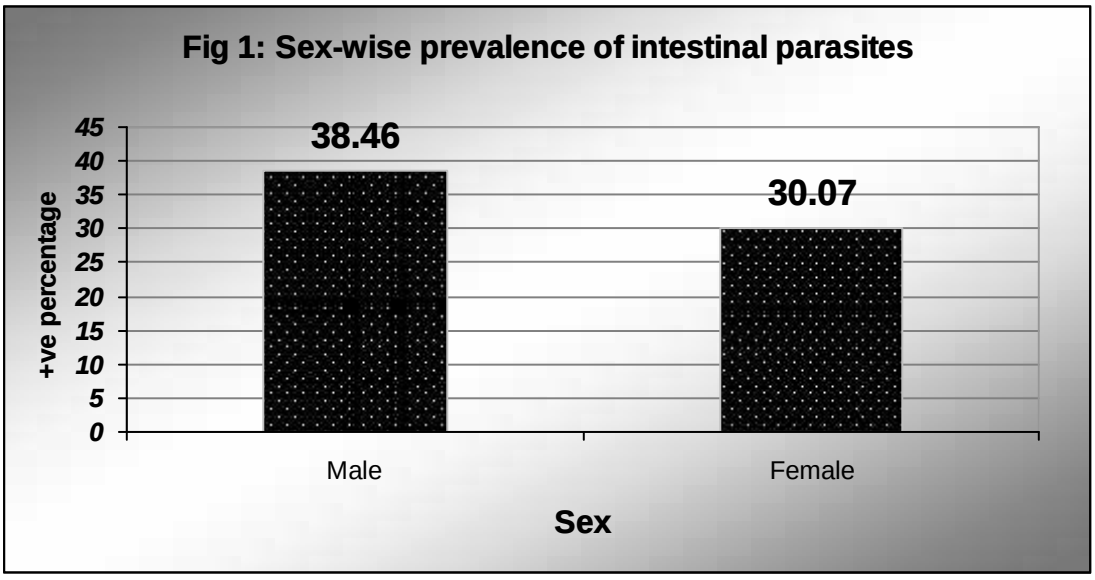
Name of school	Total no. of samples examined	No. of + ve cases	+ ve %	- ve %
Ganesh Secondary School	224	75	33.48	66.52

⁾Sex-wise Prevalence

Out of 224 examined stool samples, 91 were of male children and 133 of female children. Out of 91 male stool samples examined, 35 (38.46%) were found to be positive. Likewise out of 133 female stool samples examined, 40 (30.07%) were found to be positive for intestinal parasites. Hence, the infection rate was found higher in male children than female (Table 2, Fig 1). Statistically, the difference in sex-wise prevalence of parasites was found insignificant ($\chi 2=1.708$, $P>0.05$).

Table 2: Sex-wise prevalence of intestinal parasites.

Sex	Total samples examined	+ve cases		-ve cases	
		No.	%	No.	%
Male	091	35	38.46	056	61.53
Female	133	40	30.07	093	69.92
Total	224	75	33.48	149	66.51



⟩Sex and Caste-wise Distribution of Intestinal Parasites

The analytical study of Table 3 shows that, in Newar community, male children (30.00%) were less infected than female children (39.93%). In Brahmin community, male children (44.44%) were more infected than female children (26.08%). In Chettri community, male children (42.85%) were more infected than female children (11.53%). In Magar community, male children (71.42%) were more infected than female children (20.00%). In Bhote community, male children (50%) were less infected than female children (66.66%).

Hence in overall, Bhote children (60%) were found more infected than other castes followed by Newar (35.34%), Brahmin (34.14%), Chettri (22.50%) and Magar (42.10%).

Table 3: Sex and Caste-wise distribution of intestinal parasites.

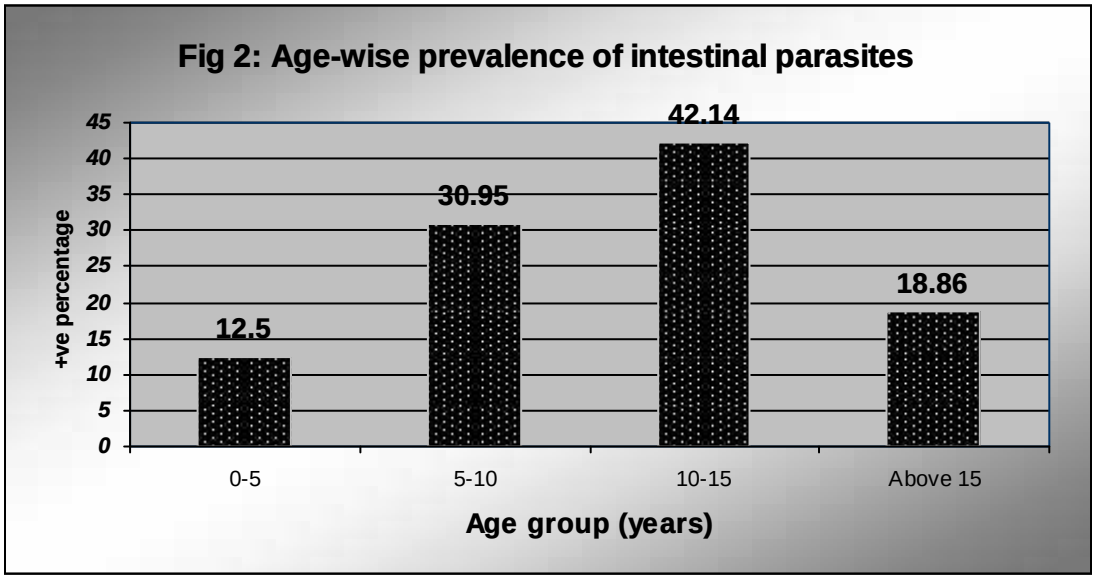
Caste	Newar		Brahmin		Chettri		Magar		Bhote	
Total	116		41		40		22		5	
	+ ve cases		+ ve cases		+ ve cases		+ ve cases		+ ve cases	
	No.	%	No.	%	No.	%	No.	%	No.	%
Male	15	30.00	08	44.44	6	42.85	5	71.42	1	50.00
Female	26	39.93	06	26.08	3	11.53	3	20.00	2	66.66
Total	41	35.34	14	34.14	9	22.50	8	42.10	3	60.00

⁾Age group-wise Prevalence

Table 4 and Fig 2 reveal that, the distribution of intestinal parasites was maximum (42.14%) in 10-15 years age group and minimum (12.50%) in 0-5 years age group. Statistically, no significant difference regarding parasitic infection was found in different age groups ($\chi 2=11.168$, $P>0.05$).

Table 4: Age-wise prevalence of intestinal parasites.

Age	Observation no.	+ ve cases	
		No.	%
0-5	008	01	12.50
5-10	042	13	30.95
10-15	121	51	42.14
Above 15	053	10	18.86
Total	224	75	33.48

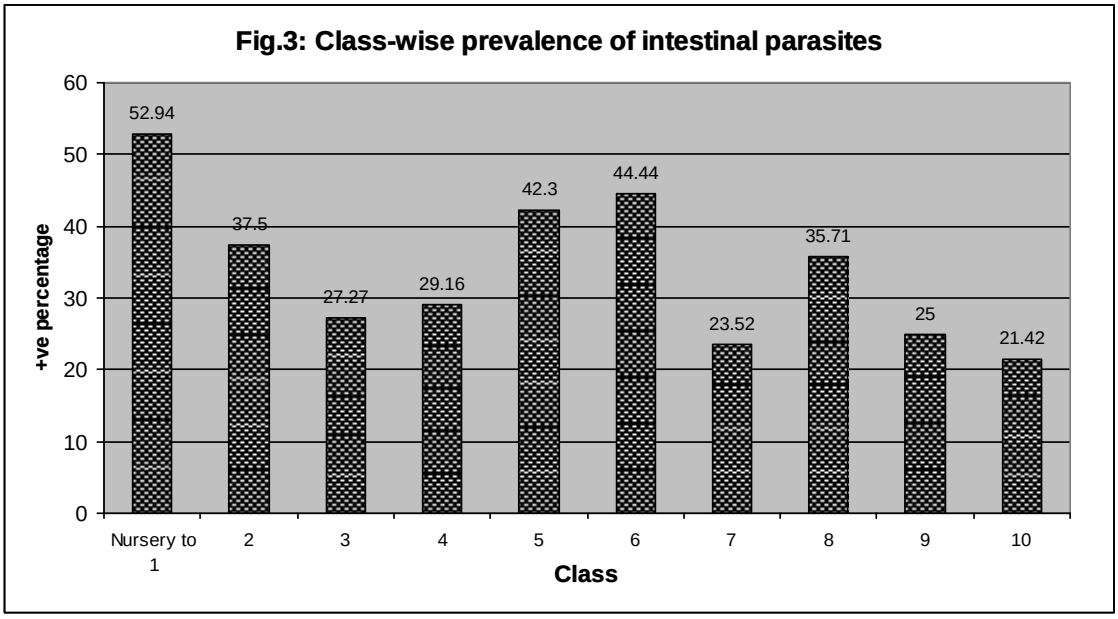


) Class-wise Prevalence

Table 5 and Fig 3 showed that, the distribution of intestinal parasites were maximum (44.44%) in class 6 and minimum (21.42%) in class 10. Statistically, the difference among different classes on prevalence of parasitic infection was found insignificant ($\chi 2=9.144$, $P>0.05$).

Table 5: Class-wise prevalence of intestinal parasites.

Class	Observation no.	+ ve cases	
		No.	%
Nursery to 1	17	09	52.94
2	08	03	37.50
3	22	06	27.27
4	24	07	29.16
5	26	11	42.30
6	27	12	44.44
7	34	08	23.52
8	28	10	35.71
9	24	06	25.00
10	14	03	21.42
Total	224	75	33.48

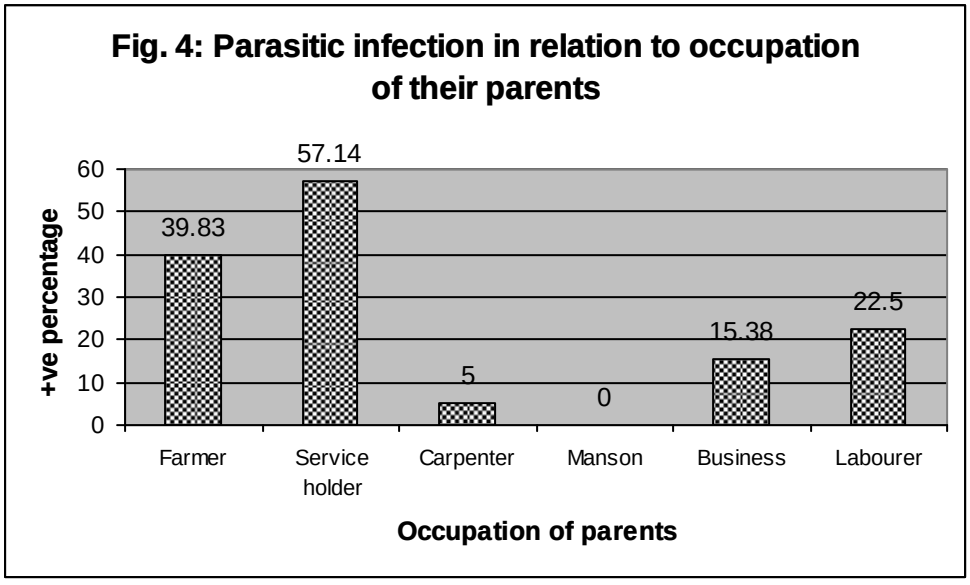


) Parent's Occupation-wise Prevalence

Table 6 and Fig 4, reveal that the prevalence of parasitic infection was found to be maximum (57.14%) in children of those families whose parents are service holder and minimum infection (5.00%) was found in children of those family whose parents are carpenter. Statistically, difference in the prevalence of intestinal parasites of the children according to their parent's occupation was significant ($\chi 2=23.06$, $P<0.05$).

Table 6: Parasitic infection in relation to occupation of their parents.

Occupation of parents	Observation no.	+ ve cases	
		No.	%
Farmer	118	47	39.83
Service holder	028	16	57.14
Carpenter	020	01	05.00
Manson	005	00	00.00
Business	013	02	15.38
Labourer	040	09	22.50
Total	224	75	33.48

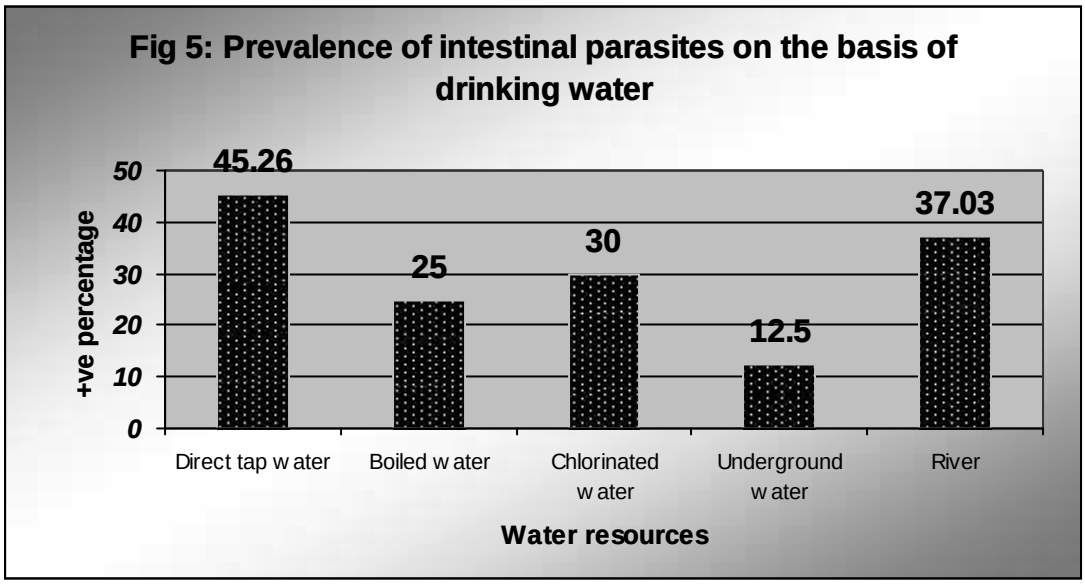


) Prevalence of Intestinal Parasites on the Basis of Drinking Water

Table 7 and Fig 5, reveal that the distribution of parasitic infection was found maximum (45.26%) in direct tap water consuming children, whereas underground water consuming children were found less infected (12.50%). Statistically, no significant difference in parasitic infection rate was found among different drinking water resources user ($\chi 2=15.16$, $P>0.05$).

Table 7: Prevalence of intestinal parasites on the basis of drinking water.

Water resources	Observation no.	+ ve cases	
		No.	%
Direct tap water	95	43	45.26
Boiled water	32	08	25.00
Chlorinated water	30	09	30.00
Underground water	40	05	12.50
River	27	10	37.03
Total	224	75	33.48

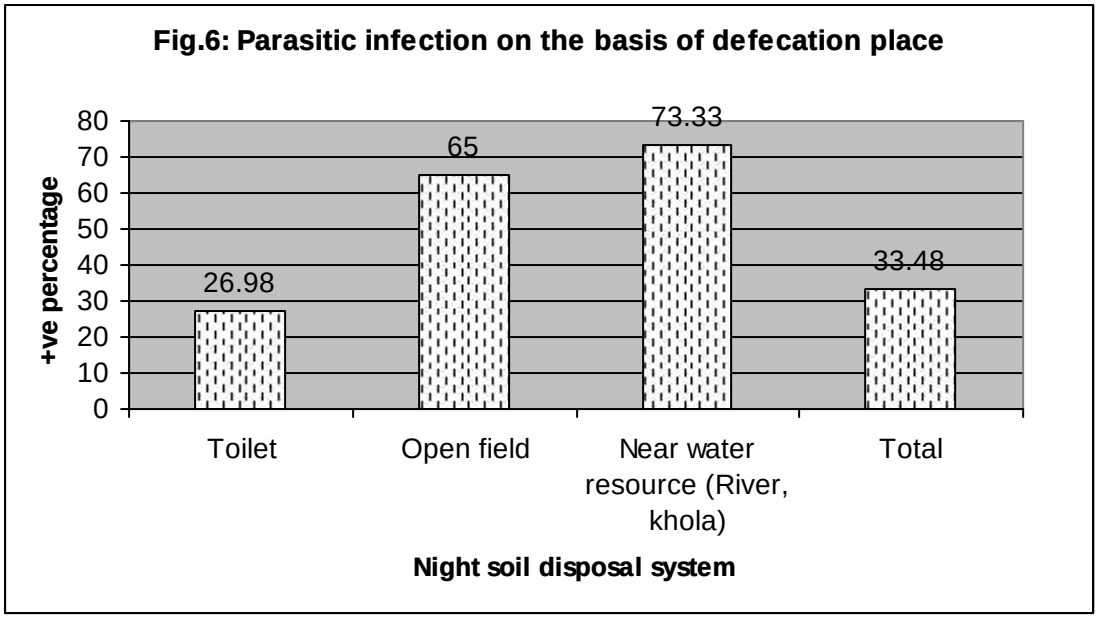


Prevalence of Parasites on the Basis of Defecation Place

Table 8 and Fig 6 show that the distribution of parasitic infection was found maximum (73.33%) in those children who used to defecate at places near by water resource and minimum infection (26.98%) was found in those children who used safe toilet as defecation place. Statistically, the difference in the prevalence of intestinal parasites on the basis of toilet users was significant ($\chi 2=35.93$, $P<0.05$).

Table 8: Parasitic infection on the basis of defecation place.

Night soil disposal system	Observation no.	+ ve cases	
		No.	%
Toilet	189	51	26.98
Open field	020	13	65.00
Near water resource (River, khola)	015	11	73.33
Total	224	75	33.48

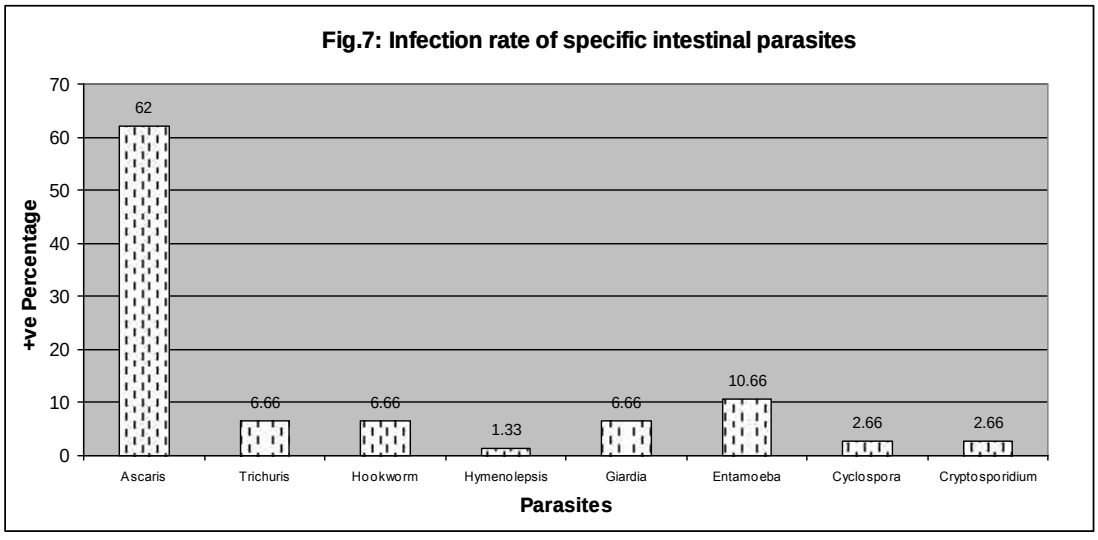


) Prevalence of Specific Intestinal Parasites

Table 9 and Fig 7, reveal the infection rate of specific intestinal parasites in 75 infected stool samples of children were specific. Out of 75 positive samples, 47 samples (62.00%) were infected with *Ascaris*, 5 (6.66%) with *Trichuris*, 5 (6.66%) with hookworm, 1 (1.33%) with *Hymenolepsis*, 5 (6.66%) with *Giardia*, 8 (10.66%) with *Entamoeba*, 2 (2.66%) with *Cyclospora* and 2 (2.66%) with *Cryptosporidium*.

Table 9: Infection rate of specific intestinal parasites.

Parasites	Total infected cases		No. of infected male	No. of infected female
	No.	%		
Ascaris	47	62.00	23	28
Trichuris	05	06.66	03	02
Hookworm	05	06.66	03	02
Hymenolepsis	01	01.33	01	00
Giardia	05	06.66	02	03
Entamoeba	08	10.66	03	05
Cyclospora	2	2.66	2	0
Cryptosporidium	2	2.66	1	1
Total	75	100	35	40

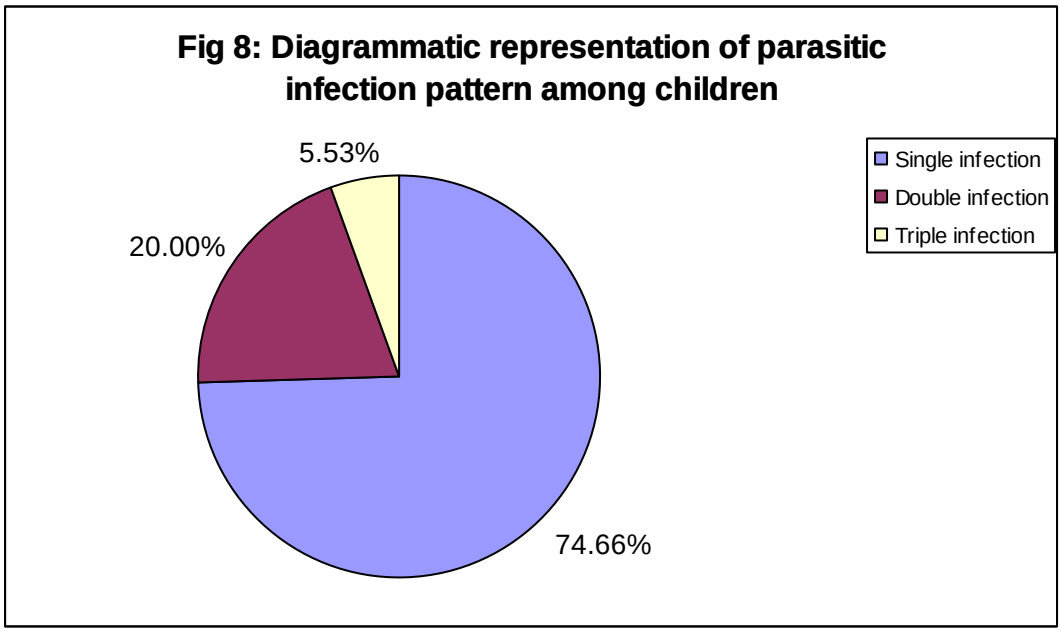


⟩Parasitic Infection Pattern (Concurrent Infection) Among Children

The stool infection with single parasite was more than double and triple parasites in a single patient. Out of 75 positive cases, 56 children were infected with single species of parasite, 15 were infected by double species of parasites and 4 were infected by triple species of parasites. Regarding double infections, maximum infections were of *Ascaris*+*Trichuris*, *Ascaris*+Hookworm, and *Giardia*+*Entamoeba*. In triple combination, *Giardia*+*Entamoeba*+*Ascaris*, *Giardia*+*Cyclospora*+*Ascaris* and *Ascaris*+*Trichuris*+*Cyclospora* were found.

Table 10: Parasitic infection pattern among infected children.

Parasitic infection	Total infected cases	
	No.	%
Single infection	56	74.66%
Double infection	15	20.00%
Triple infection	04	05.53%
Total	75	100%



VI

DISCUSSION & CONCLUSION

Intestinal parasites are cosmopolitan in distribution causing serious health problem in society. Poverty, lack of knowledge, illiteracy and conservative thinking cause the parasitic infection in the developing country. Prevalence is higher in the economically deprived regions of the world especially in the developing countries (Gupta *et al*., 2004)

Analysis of surveillance data showed that out of 224 children of Sipadol VDC, 75 (33.48%) were harboring different kinds of intestinal parasites. The remarkable prevalence was found in this rural area because of poor environmental sanitation, low-grade personal hygiene, low education and poor socio-economic conditions which favours the transmission of parasites. Comparable prevalence of parasites, 72.4% by Ishiyama *et al.,* (2001) and 76.4% by Rai *et al.,* (2001), were reported from school children of sub-urban area in Kathmandu valley and from a remote area in Accham district in Far-western region respectively.

Present findings indicate that there were not significant difference in prevalence of parasites in between two sexes ($\chi 2=1.708$, $P>0.05$). It is because of equal possibilities of transmission of parasites among them due to over dispersal of parasites in all the communities. This finding is also supported by Rai *et al.,* (2002).

The prevalence rate of helminthes was higher than protozoans. Soil transmitted helminthes parasite *A. lumbricoides* had the highest (62%) prevalence among the intestinal parasites. It is in agreement with the report published by WHO (1993), according to which infections by soil transmitted helminthes has been increasingly recognized as an important public health problem, particularly in developing countries. Out of 75 positive cases there were 56 (74.66%) having single infection, 15 (20%) double infection and 4 (5.53%) triple infection.

The most common double infection was (*Ascaris*+*Trichuris*) and (*Ascaris*+Hookworm). (*Ascaris*+*Giardia*+*Entamoeba*) was found remarkably in triple infection. This also showed that *Ascaris* was highly influenced among children. So this finding also coincides with the report presented by Rai *et al.*, (1994), according to which the annual rate of the positivity for soil transmitted helminthiasis (i.e. *A. lumbricoides*) had the highest prevalence rate than others (i.e. *T. trichiura* and Hookworm).

Similarly, *Entamoeba* had the highest prevalence rate (10.66%) than *Giardia* (6.66%), *Cyclospora* (2.66%) and *Cryptosporidium* (2.66%) among entire protozoan. It may be due to utilization of drinking water from open streams, river and well, contaminated with high percentage of feaces, garbage due to wind or rain water. Water supply is contaminated through seepage into water pipes from sewage in cities and the open source of water (i.e. well, ponds, springs, rivers) are polluted from the contact of waste disposal deposits in rural areas of Nepal. Supporting this fact, present study also showed the highest prevalence (45.26%) of intestinal parasites in tap water consuming children and

minimum in underground water consumers due to the phenomenon of natural filtration. Significantly, no difference was found among the different drinking water resource user in prevalence of parasite ($\chi 2=15.16$, $P>0.05$). Although more studies are needed to determine the direct link between parasitic infection and other sources, the present study showed that drinking water and unsystematic defecation place are possible sources of infection in Bhaktapur district. Defecation near the water streams, wells and khola also serve to contaminate the water resource responsible for parasitic infection. Drinking direct water accelerates the infection due to maximum chance of contamination and transmission (Sherchand *et al.*, 1997-2001).

The present prevalence of parasites was found highest (42.14%) as a whole in the age group 10-15 years, which is similar with the report given by Rai *et al.*, (1991), according to which intestinal parasites were more common among children <15 years than in adults >15 years. The prevalence rate of intestinal parasites was higher (44.44%) in the students of class 6 than the other classes and minimum (21.42%) in the students of class 10. This kind of infection distribution is due to the carelessness, playing in dirty places and haphazard feeding habits. Till class 5, they receive proper cared from their parents, so infection rate was found unnoticeable in those classes. After class 7, the students were somewhat responsible towards their health and duties themselves. Similar rapid acquisition of *A. lumbricoides* had found during infancy and the incidence reached to 100% by the age of 10 years that was reported by Kightlinger *et al.*, (1995) and Xu *et al.*, (1995). Nation wide survey

in China had reported higher prevalence of Ascariasis and Trichuriasis from the age group 6-14 years. Thus the higher prevalence among younger children appeared to be associated with their less hygienic habit, lack of awareness about personal cleanliness and most active age.

Present study indicates that there was no significant difference in prevalence of parasites in different age groups ($\chi 2=11.168$, $P>0.05$). Because all age groups can acquire the disease, the highest attack rate occurs among children older than 18 months. There is no apparent immunity to infection and re-infection can occur in all ages (Connar *et al.,* 1993).

Among the different ethnic castes, Bhote had the highest prevalence (60%) followed by other castes like Newar (35.34%), Brahmin (34.14%), Chettri (22.50%) and Magar (42.10%). The prevalence was significantly related to economic status, education, housing conditions, drinking water and their personal hygiene which is supported by De Silva *et al.,* (1996). Lesser the monthly earnings, significantly higher the prevalence of parasites was found. People with low economic status are able to spend less money for food and safe drinking water that may lead to malnutrition with respective increase of parasitic infections which are supported by Loewenson *et al.,* (1986) and Cutting (1988).

Significantly higher prevalence was found among those people who were careless about personal prophylaxis, who had no toilets in their home and following unhygienic feeding habits. Congested housing conditions and

insufficient sanitary facilities may also help in transmission of parasites, which is supported by Sorensen *et al.*, (1996).

The highest prevalence (57.14%) was found in those children whose parents are service holder. This may be due to lack of time to take care of their children. At the certain time, they have to reach in offices and while returning back they feel tired, so they can't give time to their child in spite of their desire. Minimum infection was found in those children whose parents are carpenter. This may be due to proper care of child from parents since this work can be done sitting inside the home. So difference in prevalence of intestinal parasites of the children according to their parent's occupation was significant ($\chi 2=23.06$, $P<0.05$).

Since the school children are the backbone of the nation we need to built up the children with good health and powerful confident to develop our country. So control measures should be undertaken in time, otherwise the situation might be aggravated and beyond our reach. It may be assumed that similar situation might be prevailing in other places of our country, which are yet to be investigated.

VII

RECOMMENDATIONS

From the present research work, following recommendations are extracted for efficient prevention and control of intestinal parasites.

- Public health education in the school curriculum must be made compulsory.
- Basic health education programme should be conducted time to time in communities for raising awareness towards the parasitic infections, prevention and control.
- Habit of defecating at open field, on the bank of river etc. should be prevented. Well established sanitary toilet should be built up in each and every home.
- People should be made aware about their feeding behaviour and use of boiled water for drinking purpose.
- Awareness programme on children rights (i.e. consuming balance diet, regular cleanliness, health check up etc.) should be organized in school inviting parents and members of health post.
- Intervention strategy including health education programme should be designed and implemented to control parasitic infections.
- People should avoid walking bare foot.
- The research work on the prevalence of intestinal parasites and prevention should be encouraged.

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