PREVALENCE OF GASTROINTESTINAL PARASITES IN EARTHQUAKE VICTIMS OF BYASI TOLE OF BHAKTAPUR MUNICIPALITY, NEPAL

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Submitted to

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DECLARATION

I hereby declare that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

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RECOMMENDATION AND LETTER OF APPROVAL

This is to recommend and approve that the thesis entitled **"PREVALENCE OF GASTROINTESTINAL PARASITES IN EARTHQUAKE VICTIMS OF BYASI TOLE OF BHAKTAPUR MUNICIPALITY, NEPAL"** has been carried out by Lekha Kumari Thapa for the partial fulfillment of Master's Degree of Science in Zoology with special paper Parasitology. This is her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions. And also this thesis is approved on my recommendation for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for Master's Degree of Science in Zoology with special paper Parasitology.

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CERTIFICATE OF ACCEPTANCE

This thesis work submitted by Miss Lekha Kumari Thapa entitled **"PREVALENCE OF GASTROINTESTINAL PARASITES IN EARTHQUAKE VICTIMS OF BYASI TOLE OF BHAKTAPUR MUNICIPALITY, NEPAL"** has been approved as a partial fulfillment of the requirements for Master's Degree of Science in Zoology with special paper Parasitology.

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LIST OF ABBREVIATIONS

Abbreviated form	Details of abbreviations
CDZ	Central Department of Zoology
DCSMEVSCC	Dalit Civil Society Massive Earthquake Victim Support and Coordination Committee
d.f.	Degree of freedom
E	East
et al.	and his associates
IP	Intestinal Parasite
IPI	Intestinal Parasitic Infection
JICA	Japan International Cooperation Agency
LMIC	Low and Middle-Income Country
N	North
No.	Number
NPC	National Planning Commission
T.U.	Tribhuvan University
WHO	World Health Organization
χ^2	Chi-square
µm	Micrometer

ABSTRACT

Nepal has experienced a catastrophic earthquake on 25th April 2015 and 12th May 2015. The study was carried out between January to June 2016 to observe the prevalence of gastro-intestinal parasites in earthquake victims of Byasi Tole of Bhaktapur Municipality. During the survey it was found that people were living in crowded circumstances with a limited number of rudimentary tents, lack of food, water and lack of toilets. Altogether 82 stool samples were randomly collected from different age groups and sexes and were preserved and examined by direct wet mount method. The study was based on stool examination and questionnaire survey. The overall prevalence of intestinal parasites was obtained 51(62.20%), where infection rate was higher in females 27(77.14%) than that of males 24(51.06%) with statistically insignificant association ($p>0.05$). Whereas, age-wise intestinal parasites were found to be the highest among elderly people of age group above 61 years 4(80%) and 11-20 years 8(80%) and found minimum in the age group 41-50 years 5(38.46%). Statistically significant difference was found in infection rate among different age group of people ($P<0.05$). The distribution of helminthic infection 45(88.24%) were higher than the protozoan infection 6(11.76%) among the people. Altogether five species of intestinal parasites were detected, the most common were *Ascaris lumbricoides* 31(60.78%). The study also showed that single infection was found higher 43(84.30%) followed by double and multiple infections in the people. According to the questionnaire method, prevalence of parasitic infection showed significant difference with awareness, type of drinking water, hand washing behavior, defecating place and use of deforming tablets, whereas insignificant association with hand washing time before-after meal and after the use of toilet. Thus, it was found that an upsurge in the transmission of infectious disease and outbreaks following natural disasters are associated with prolonged after-effects of the earthquake. Hence, to control the parasitic infection among infected people there should be health awareness, well managed public toilet, proper management and provision of antihelminthic drugs.

1. INTRODUCTION

1.1 Background

Intestinal parasitic infections are distributed virtually throughout the world (WHO, 1998). Parasites are the opportunistic organisms which attack or infect the person having low immunity power as well poor sanitary condition (Chatterjee, 1998). Poor sanitary condition can also be brought by the natural disaster. Natural disasters include earthquakes, volcanic eruptions, landslides, tsunamis, floods and drought (Checkley *et al*., 1997). These all conditions such as, poor sanitary conditions, overcrowding, population displacement, malnutrition etc. can also be brought by the natural disasters for the prevalence of parasitic infections (WHO, 2010). Parasitic infections caused by intestinal helminth and protozoan parasites, are among the most prevalent infection in humans in developing countries (Haque, 2007). More than 72 species of protozoa and helminth parasites can lodge in humans. Most are considered food and water-borne zoonoses (Slifko *et al.,* 2000; Pozio, 2003 and Leelayoova *et al.,* 2004). The common intestinal parasites are *Ascaris lumbricoides, Strongyloids stercoralis, Giardia intestinalis, Ancylostoma duodenale, Entamoeba histolytica, Cyclosporidium parvum* etc. Most tapeworms and roundworms develop in the human body and lay their eggs there. The eggs then pass out of the body through stool and can infest others (Birn and Armando, 1999). Intestinal parasitic infections such as Ascariasis, hookworm infection and Trichuriasis are among the ten most common infections in the world and being responsible for considerable morbidity and mortality (Desta *et al.,* 2014).

Developing countries are disproportionately affected by natural disasters because they lack resources, infrastructure and disaster-preparedness systems (Checkley *et al.,* 1997). Nepal is one of the developing countries. In 1934, in Nepal, an earthquake of Magnitude 8.4 caused serious damages to 60% of the buildings in the Kathmandu Valley and killed about 4,300 people. It was a cause for great concern that the next great earthquake may occur at any time after around 70 years of silence (JICA, 2002). Recently in 2015, Nepal has experienced a catastrophic earthquake of a magnitude of 7.6 on 25th April followed by earthquake of 6.8 magnitudes after 17 days (NPC, 2015). The two earthquakes together have claimed over 8000 lives and injured more than 16000. A total of 35 districts was affected. Out of affected districts, 14 districts were severely affected that included Gorkha, Dhading, Rasuwa, Sindhupalchowk, Kavre, Nuwakot, Dolakha, Kathmandu, Lalitpur, Bhaktapur, Ramechhap, Okhaldunga, Sindhuli and Makwanpur (WHO, 2015). In these severely affected districts, Bhaktapur was also one of them which was the study area for this research. On 8th May 2015, a district wise overall loss occurred and it was reported that in Bhaktapur 68636 houses were destroyed, 319 deaths, 1861 injured, 7000 private houses fully destroyed and 2000 private houses were partially destroyed (DCSMEVSCC, 2015).

Nevertheless, an upsurge in the transmission of infectious disease and outbreaks following natural disasters are associated with prolonged after-effects of the earthquake

(Nayak, 2015). The survivors have to live in crowded circumstances under conditions usually emerged in post-earthquake crisis (Wiwanitkit, 2011). A number of infectious diseases have been associated with natural disasters which include diarrheal disease, acute respiratory infection, measles, dengue etc. (Goyet, 2004). This all reasons give a favorable condition for parasites to rise.

1.2 Prevalence of diseases due to the earthquake

Parasites are the opportunistic organisms which attack or infect the person having low immunity power as well as poor sanitary condition (Chatterjee, 2009). The poor sanitary condition can also be brought by the natural disaster i.e. earthquake.

After the earthquake, the displaced populations in Haiti were at high risk from outbreaks of water, sanitation, hygiene and foodborne diseases. Typhoid fever, hepatitis A and hepatitis E, diarrhea was present after the earthquake (WHO, 2010).

Similarly, in 2005 earthquake in Pakistan, it was reported that among the displaced populations over 1,200 cases of acute jaundice was reported with many confirmed as hepatitis E (WHO, 2006).

In Muzaffarabad, Pakistan, an outbreak of acute watery diarrhea occurred in an unplanned, poorly equipped camp of 1,800 persons after the 2005 earthquake (WHO, 2005).

In 1991, an earthquake in Costa Rica's of Atlantic Region was associated with changes in habitat that was beneficial for breeding of vectors and preceded an extreme rise in malaria cases (Saenaz *et al.*, 1995).

In May 2008, after the Chinese Wenchuan earthquake, it was reported that infectious diarrheal diseases were common and hepatitis A, E, and dysentery were also reported (Tian *et al.*, 2016).

During Gujarat earthquake in 2001, a total of 691 cases of diarrhoea, 703 cases of fever, 89 cases of erythematous fever and 13 cases of jaundice were reported from 510 villages of Kutchh region (Tiwari *et al*., 2009).

1.3 Objectives

1.3.1 General objective

- To determine the prevalence of gastro-intestinal parasites of earthquake victims of Byasi Tole of Bhaktapur Municipality.

1.3.2. Specific objectives

- To study the morphometric identification of gastro-intestinal parasites among earthquake victims.
- To study the age and sex-wise distribution of intestinal parasites among earthquake victims.
- To determine the occurrence of single or concurrent infections with different groups of parasites.
- To find out the knowledge and practices of the earthquake victims inhabiting in temporary shelters.

1.4 Research questions:

1. What is the rate of prevalence of parasitic infection among the earthquake victims?
2. What is the relationship between the age and sex of earthquake victims with the prevalence of gastro-intestinal parasites?
3. What is the level of knowledge and practices among the earthquake victims regarding the intestinal parasites?

1.5 Significance

Intestinal parasite is globally endemic and is described as constituting the greatest worldwide cause of illness and diseases. Intestinal parasitic infections are due to the lack of sanitation, lack of access to safe water and improper hygiene, Therefore they occur everywhere where there is poverty. These conditions are also brought by the earthquake. IPI have always been an important public health problem in the tropics, particularly in the developing countries. Byasi Tole of Bhaktapur Municipality where poor sanitary and hygiene standards of the region, especially low standards of public sanitation is present due to the earthquake.

Study of IP in the earthquake victim of Byasi Tole has been done for the first time to find the prevalence of infection to give the idea about the preventive measures of such parasites which help to aware the people towards intestinal diseases. Moreover, the present study might play an important role to help the future investigators to advance their knowledge and throw light on different problems faced by the victim of Byasi Tole. To

some extent, this research will also help in planning and management for the control of parasitic infections after a natural disaster in future.

1.6 Limitations

- Stool sample of all the individual of the temporary shelter camps was not observed due to the lack of their cooperation
- Drinking water sample was not examined for its purity.

2. LITERATURE REVIEW

2.1 Scenario of natural disasters (Earthquake)

Natural disasters are extreme, sudden events caused by environmental factors that injure people and damage property. Natural disasters can be split into three categories: hydro-meteorological disasters, geophysical disasters and geomorphologic disasters. Hydro-meteorological disasters, like floods, are the most common (40%) natural disasters worldwide and are widely documented. The public health consequences of flooding are disease outbreaks mostly resulting from the displacement of people into overcrowded camps and cross-contamination of water sources with faecal material and toxic chemicals. Geomorphologic disasters, such as avalanches and landslides, also are associated with infectious disease transmissions and outbreaks. Geophysical disasters are the second-most reported type of natural disaster and earthquakes are the majority of disasters in this category (Isidore *et al.*, 2012).

Natural disasters occur in every part of the world. Recent disasters around the world have shown that even the most developed countries are vulnerable to natural disasters, such as Hurricane Katrina in the United States in 2005 and the Great Eastern Japan Earthquake and tsunami in 2011. Global population growth, poverty, land shortages and urbanization in many countries have increased the number of people living in areas prone to natural disasters and multiplied the public health impacts (Isidore *et al.*, 2012).

Each year, more than a million earthquakes occur in the world (Naghii, 2005) and over 530,000 deaths have been reported from earthquakes in the past 25 years (WHO, 2011). Recent big earthquake is the Indonesian earthquake with the subsequent Southeast Asian tsunami in 2004, the Haitian earthquake in 2010 and the Sichuan earthquake in 2008 (Wiwanitkit, 2011). Outbreaks of infectious diseases may be reported when earthquake disasters result in substantial population displacement into unplanned and overcrowded shelters, with limited access to food and safe water (Isidore *et al.*, 2012). All of these reasons give a favorable condition for the parasite to rise. Parasites are the opportunistic organisms which attack or infect the person having low immunity power as well poor sanitary condition (Chatterjee, 2009).

2.2 Literature review in the context of world

Saurez *et al.*, (2002) studied about the intestinal parasites after the earthquake in Columbia, where 217 stool samples were examined in which *Giardia* cysts, *Ascaris lumbricoides, Balantidium coli, Entoamoeba coli* and *Endolimax nana* were found. Out of these, *Giardia* cysts were observed in 60.4% of the samples and trophozoites in 4.6%.

Ozturk *et al.*, (2004) studied about the parasitic infection after the earthquake in Turkey, were *Giardia lamblia* cysts was observed in 10.4% of the faecal samples and *Enterobius*

vermicularis eggs were observed in 13.5% of selotype samples. The rate of Giardiasis and Enterobiasis was found to be significantly higher in children still living and studying in temporary houses and schools years after the earthquakes ($P < 0.05$).

Gunduz (2005) examined a total of 3216 stool samples of children with gastro-intestinal symptoms associated with socio-economic conditions in Manisa region. The most common parasite was *G. intestinalis* (40.1%) followed by *E. coli* (10.2%).

Nakamura (2005) reported that after the natural disaster & Indian Ocean Tsunami disaster in Japan there has been increasing in various diseases such as epidemic of tuberculosis, diarrhea, various parasitic infection, malaria, measles and acute respiratory infection

Jafari *et al*., (2007) reported that after the Bam earthquake in 2004, 6241 cases refer to the clinic because of acute respiratory tract infection. And also it was reported that 738 cases refer to the clinic because of gastro-intestinal infection which was the second common cause of referring to the clinic.

Karmakar *et al*., (2008) conducted a study on post- earthquake of rotavirus gastroenteritis in Kasmir, India. The earthquake led to contamination of drinking water such as tap water, river and stream. This lead to an outbreak of rotavirus between October and December 2005, among infants and small children, transmitted by the fecal- oral route and perpetuated by person- to- person transmission. The overall attack rate was 20% in children under 4 years of age.

Mohamed *et al.*, (2009) carried a study for the prevalence of intestinal parasitic diseases in Kassala (Eastern Sudan) with displaced peoples due to poor sanitation, the standard of living and personal habits of cleanliness, where 900 faecal specimens were collected and found four species of infective parasites. These were: *Giardia lamblia* (12.3%), *Hymenolepis nana* (4.9%), *Entamoeba histolytica* (0.4%) and *Trichuris trichiura* (0.2%).

Shah (2010) reported that in Kaghan valley of Pakistan diarrhea & dysentery were the most common disease in earthquake victim & its highest number of cases was noticed in July which is a rainy season & in spring water is contaminated with rain water similarly helminthes infestation was found in all age groups & both sexes.

Gen *et al*., (2011) studied the influence of earthquake in Wudu district, China and found that after the earthquake, the monthly incidence of diarrhea was significantly higher than before. Total of 393 stool samples from children were examined. The rate of intestinal worm infection was 32.3%. In term of the specific intestinal worm, the rate of *Ascaris lumbricoides* infection was 29.8% & the rate of whipworm infection was 3.6%.

Wiwanitkit (2011) reported that in the post-earthquake victim of Bangkok, Thailand gastro-intestinal infection such as diarrhoea, dysentery etc. was the common disease.

Isidore *et al.,* (2012) in the 2005 earthquake in Pakistan reported 42% increase in diarrhoeal infections. And also reported that during the Bam earthquake in 2003 out of 75,586 persons who were displaced in Iran found infected by 1.6% with diarrhoeal diseases. The similar case was also reported in Indonesia after the 2004 tsunami were 85% of the survivors in the town of Calang experienced diarrhoeal illness after drinking from contaminated wells and also in Thailand, the 2004 Indian tsunami also contributed to a significant increase in diarrhoeal disease incidences. An investigation conducted in 100 households after the 2001 earthquake in El Salvador showed that 137 persons out of 594 (22%) experienced diarrhoeal infections.

Zhong (2013) studied the impact of the earthquake on Lushan and Tianquan countries and found that Schistosomiasis transmission was high after the earthquake, since the stream and damaged ditches were blocked up, potentially leading to the spread of oncomelania snail and the people who were relocated due to the earthquake may have higher exposure to contaminated environment.

Abu-Madi *et al.,* (2016) carried a study to find out the role of immigrants in outbreaks of parasitic disease in Qatar. The prevalence of intestinal protozoan infections was analysed by stool examination were 29,286 records of subjects referred at the Hamad Medical Corporation over the course of a decade (2005 to 2014, inclusive). And it was found that the overall prevalence of combined protozoan infections was 5.93 %, were the most common protozoan was *Blastocystis hominis, Giardia duodenalis, Chilomastix mesnili, Entamoeba coli, Entamoeba hartmanni, Endolimax nana, Iodamoeba butschlii, Entamoeba histolytica dispar, Cryptosporidium sp.*

Salman *et al.,* (2016) carried a study that was conducted to estimate the prevalence of *Giardia lamblia* and other intestinal parasites among Iraqi displaced people. Where 417 stool samples were collected from peoples in 12 districts in Kirkuk Province, whom they live with the poor hygienic condition and low level of sanitation. The analysis of samples found that the overall rate of intestinal parasitic infection was 19.66 %. The report showed that *Giardia lamblia* was highly found among people aging from 1 year to 10 years than in other age groups.

2.3 Literature review in the context of Nepal

No articles or reports were found regarding the prevalence of parasitic infections of a human being of any earthquake affected areas of the recently occurred earthquake of 2015 but there are many reports on the prevalence of IPI due to different natural disasters, illiteracy, poor sanitation, poor hygiene, poverty, etc.

Nepal is a small impoverished country located in South Asia, where 70% of morbidity and mortality are associated with infectious diseases (Rai *et al.,* 2005). Among the various types of infectious diseases, IPI is one of the major causes of health problems (Rai *et al.,* 2005). In Nepal, giardiasis, ascariasis, amoebiasis and taeniasis are common IPI (Acharya, 1997). Intestinal protozoan infection and helminthic infection rank third and fourth respectively in Nepal (DHS, 2004).

Sharma (1965) reported that the round worm infection is very common in some parts of our country. He studied 976 stool samples and found 40% roundworm infection in Bhaktapur area.

Acharya (1997) reported that the intestinal infestations like giardiasis, amoebiasis, ascariasis, ancylostomiasis, fascioliasis and taeniasis were common in Nepal.

Piya *et al,* (2001) carried a survey on diarrhoea among children in Kanti Children Hospital, Kathmandu in relation to behavioural and environmental factors during May - Sep. 1999. Out of 374 children aged between 0-15 years examined, 49.1% showed positive for intestinal pathogens. The parasitic infections were detected in 41.3% with protozoal parasites comparatively higher than others. *Entamoeba histolytica* was accounted for 27.2% followed by *Ascaris lumbricoides* 9.23%, *Giaridia lamblia* 3.8%, *Hymenolepis nana* 0.5% and *Cyclospora* 0.6%. A low socioeconomic status, the habit of unboiled raw water consumption, no hand washing after defecation and before a meal and personal hygiene were predetermining factors for diarrheal diseases transmission.

Manandhar (2006) examined 224 stool samples from school children in Bhaktapur. Out of which 33.48% were found positive for the intestinal parasites. Out of positive cases, 62% *Ascaris* were found followed by 6.66% *Trichiura,* 6.66% Hookworm, 1.33% *Giardia,* 10.66% *Entamoeba* and 2.66% *Cyclospora.*

Jamarkattel (2007) studied on the parasite in prevalence of four human intestinal in Jalari and Kumal communities in Leknath municipality, Kaski, Nepal and found that more than 50% of people were infected with intestinal parasites.

Maharjan (2009) carried a study in the gastro-intestinal parasites of Kanti Children Hospital in Kathmandu, associated with the type and source of drinking water. She reported that out of 300 stool samples, 109 (36.3%) were found to be positive for intestinal parasites. Among them, the highest rate (62.38%) of the infection was found in children using tap water. The lowest rate (3.67%) was found in children using jar water. Among 109 (36.3%) positive cases, the highest rate (34.9%) was found in children using unboiled water and lowest rate (8.2%) was found in children using Halogen treated water.

Khanal *et al*., (2011) conducted a study to determine the prevalence of intestinal worm infestations among school children in Kathmandu, Nepal. A total of 142 stool samples

from healthy students were examined by formal ether concentration technique. The overall prevalence of intestinal parasites was found to be 17.6%. The infection was found to be high in male (22.0%) than in female (13.5%). 6-8 years aged children were highly infected (21.4%) followed by 9-12 years old (18.6%). 13-16 years of age were significantly less infected (10.7%) compared to other ($p<0.05$).The prevalence of intestinal parasites was found to be *Trichuris trichiura* (32.0%), *Ascaris lumbricoides* (20.0%), *Hymenolepsis nana*(16.0%), Hookworm (8.0%) and 24.0% cases showed mixed parasitic infections.

Tandukar *et al*., (2013) carried out a study to find the prevalence of intestinal parasites in school children of Lalitpur district of Nepal. 1392 stool samples were collected from school children of two governments, two private and two community school of the same district. Overall prevalence was found to be 16.7%. *Giardia lamblia* prevalence was found to be highest (7.4%) followed by *Entamoeba histolytica* (3.4%) and *Cyclospora cayetanensis* (1.6%). Small children of aged 11-15 years and person belongings to family of agriculture workers were most commonly affected. Type of drinking water and hand washing practice also showed significant difference.

Shrestha and Maharjan (2014) carried a study where a total of 495 stool samples from the school children aged 9-12 years from Bhaktapur were examined for helminth parasites by direct smear method. Out of total samples, 137 (27.68%) was found positive were *Ascaris lumbricoides* (22.63%) showed highest prevalence rate and *Enterobius vermicularis* (0.40%) showed lowest infection rate.

Shrestha *et al.,* (2016) carried a study where a total of 184 stool samples were collected from school children in Bhaktapur district between the age group 3-14 years. Prevalence of intestinal parasites among the children was found to be 42.9% (79/184). *Giardia lamblia* was the most predominant parasite, showing the incidence of 35.7%, followed by *Taenia* spp (22.6%) and *Blastocystis hominis* (14.3%).

3. MATERIALS AND METHODS

3.1 Study area

The study was conducted from January 2016 to June 2016 of the earthquake victims of Byasi Tole which lies in the Bhaktapur Municipality.

3.2 Introduction of Bhaktapur city

Bhaktapur is known as the 'City of Devotees', the 'City of Culture', the 'Living Heritage', and 'Nepal's Cultural Gem'. It is one of the 3 royal cities in the Kathmandu Valley. The others are Kathmandu, the capital of Nepal, and Patan.

Bhaktapur is filled with monuments, most terra-cotta with carved wood columns, palaces and temples with elaborate carvings, gilded roofs, open courtyards. The city is dotted with pagodas and religious shrines. Bhaktapur is filled with Hindu and Buddhist religious sites and art. A census of the study area was carried out in March 2010 according to which it was reported that, a total population of 77687 individuals in 16075 households was identified in the Bhaktapur Municipality. Of the total population 63% Newars, 10% Brahman and 5% Tamang people were living in Bhaktapur. Paddy, wheat, corn, pulse, millet, citrus, guava, pears, junar, haluwabed, cauliflower, peas, beans, cucumber and pumpkin are the main agricultural production of Bhaktapur (Shrestha *et al*., 2014)

3.3 Introduction of Byasi Tole and the nature of the camp in Bhaktapur Municipality.

Bhaktapur [27^{o} 41' O" N 85^{o} 25' O" E], literally translates to Place of devotees. Also known as Bhadgaon or Khwopa, it is an ancient Newar city in the east corner of the Kathmandu Valley, Nepal, about 8 miles (13 km) from the capital city, Kathmandu. It is located in Bhaktapur District in the Bagmati Zone. At the time of the 2001 Nepal census it had a population of 72,543. The male inhabitants of this city wear a special type of cap called the Bhadgaunle Topi (Shrestha *et al*., 2014)

Byasi Tole [27°40'26.46"N 85°25'42.02"E], which is the study area lies in the Bhaktapur Municipality of ward no. 10. Byasi is also known as Byasi tol, Sano Byasi or Byashi. It is one of the seventeen wards of Bhaktapur Municipality. The main inhabitants of this Tole are newars.

The study was carried out between January to June 2016. During the survey it was found that 224 people of earthquake survivors were living in temporary shelters built under the supervision of non-governmental organization. The rudimentary tents were located in open space near to the original settlement. The earthquake victims were living in crowded circumstances with lack of food, lack of water, lack of toilets and a looming season. It was also seen that residents whose homes were destroyed often have no choice but to use

parts of the temporary camps as communal, open air toilets. With no housing plans for those left homeless by the earthquake.

After a certain period the tents community residents have designated certain spots as toilets and made temporary toilets. The condition of toilet was so dirty with no availability of water and soap to wash hand after defecation. Some organizations and medical professionals were also rushed to meet the escalating need and distributed chlorine tablets and purifiers. Also the army transported tanks of water to Byasi Tole, but their supplies aren't sufficient to meet demand.

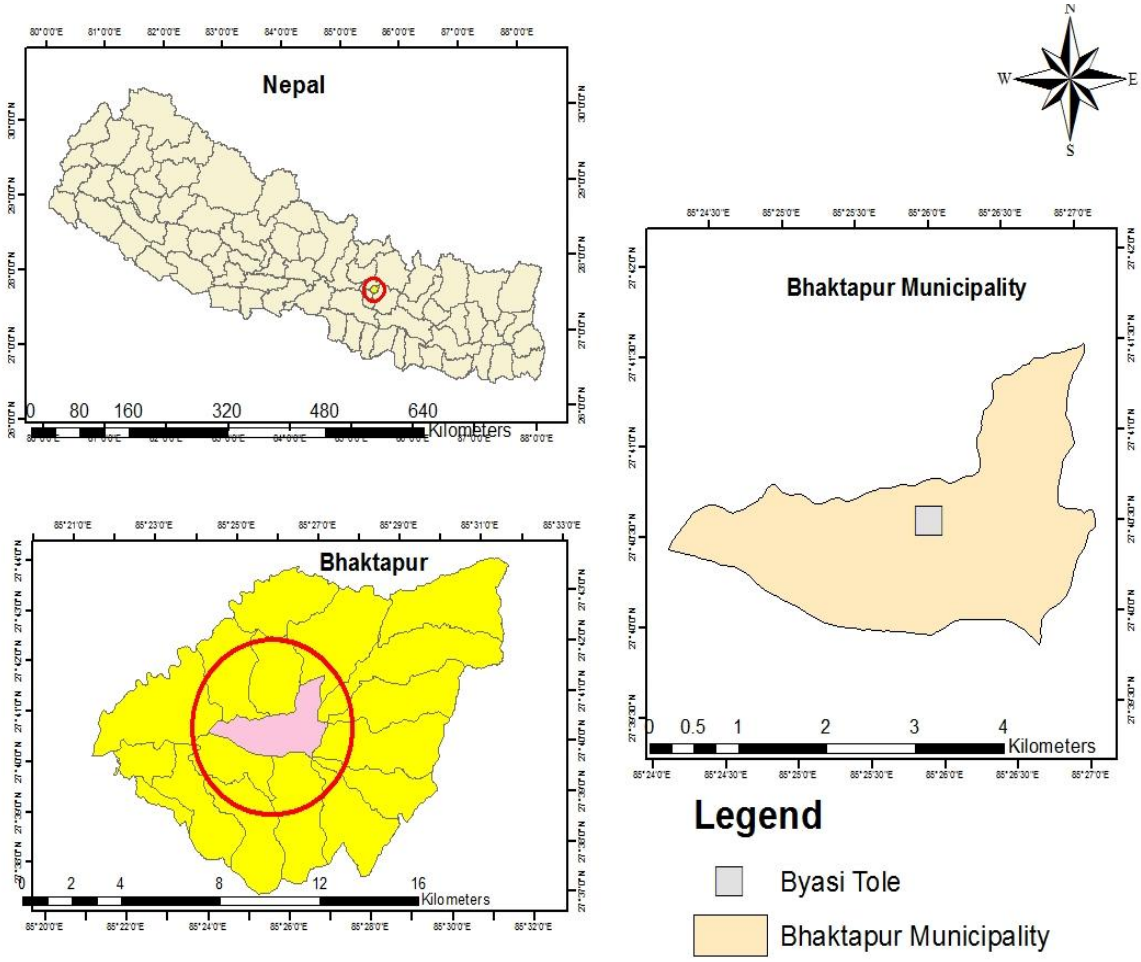

Fig 1. Map of Byasi Tole in Bhaktapur

3.4. Materials

3.4.1 Equipments

Compound microscope, filter paper or cotton, tray, coverslip, forcep, gloves, needle, sticks, slides, vials for sample collection and microscope slide with transparent tape.

3.4.2 Chemicals

2.5% Potassium dichromate, Dettol soap, 0.5% normal saline, 10% formaline and Iodine solution.

3.4.3 Preparation of Potassium Dichromate:

2.5 gm of Potassium Dichromate has weighed accurately with the help of electric balance and dissolved in 100 ml of distilled water. This solution was used for the preservation of parasite found in the stool (Zajac and Conboy, 2012).

3.4.4 Preparation of Normal Saline:

Normal saline was used for observing the characteristics movement of parasites. This solution was prepared by dissolving 8.5 gm of Sodium chloride in 1000 ml of distilled water, which was used in unstained preparation (Zajac and Conboy, 2012).

3.4.5 Preparation of Iodine Solution:

Iodine solution was used for studying the internal characters and identification of the species of protozoan parasites. Iodine solution was prepared by dissolving 10 gm of potassium iodine in 100 ml of distilled water and slowly adding 5 gm iodine crystals in it. The solution was filtered and then kept in a bottle (Zajac and Conboy, 2012).

3.5 Methods

Two methods were used for the present study: stool sample examination and questionnaire method.

3.6 Study Design

3.6.1 Sample size

Out of total of 224 affected people residing in Byasi Tole, the samples were collected from only 82 (36.61%) individual because of their lack of cooperation. The study of the population was divided into 7 age groups i.e. 1-10 years to above 61 years of age.

3.6.2 Stool sampling

On 20th January 2016 field visit and discussion with the team leader of the temporary shelters was done. From the study area 82 earthquake victims were randomly selected for the study purpose. On 22nd and 23rd of January proper instructions were given to the victims regarding the collection of the stool sample and they were given wide mouthed, clean, leak proof, labeled containers and toothpicks. From each person, a small amount of fresh stool was collected. Each of the specimens was checked for its labeling and quantity.

3.6.3 Preservation

The collected stool samples were preserved in potassium dichromate (2.5%) and transported to the CDZs laboratory for the further investigation of eggs and adult of intestinal parasites.

3.7 Laboratory work

The samples were processed for macroscopic and microscopic examination. All the laboratory works were done at Central Department of Zoology, TU, Kirtipur, Kathmandu under the supervision of a supervisor.

3.7.1 Macroscopic examination

The stool samples were examined by naked eyes for its consistency, colour, odour and presence of blood and mucus for the identification of the type of parasites present in the stool sample but this was not included in the result. Adult helminth parasites like *Ascaris* are easily visible; Hookworms and proglottids of cestodes may be present.

3.7.2 Microscopic examination

3.7.2.1 Saline wet mount examination:

A minute portion of stool was taken with the help of a toothpick and emulsified with normal saline (0.5) and a drop of it was taken on a clean glass slide. Then a cover slip was placed gently put over it so as to spread out the emulsion into a thin, fairly uniform and transparent layer and excess of fluid were removed with the help of filter paper (Zajac and Conboy, 2012).

3.7.2.2 Stained preparation of stool smear:

Stained preparation was required for identification and the study of nuclear characters of protozoan cysts and trophozoites. A small portion of stool was taken in a clean slide and a drop of iodine was added. Then a cover slip was put over it (Zajac and Conboy, 2012).

3.8. Methods of observation

Unstained smear was prepared and fixed in the microscope and examined under the low power 10X objective. The observation was started from the end of the slide to another. When the parasites, eggs were seen then objects were centered and focused on the high power for detailed diagnosis.

3.9 Identification of cysts, eggs of parasites

Cysts and eggs of parasites were identified on the basis of morphological characters (shape, size and colour) by using different books (Arora and Arora, 2012; Chatterjee, 2009) internet sources, published and unpublished articles.

3.10 Questionnaires

The questionnaires were done to know about the knowledge and practices of the victims of Byasi Tole which include a population of different age groups and sex. Short questionnaires were designed which included (a) socio-demographic: address, age, gender and socio-economic status. (b) behavioural data: hand washing habits and type of drinking water. (c) Participant's present medical history: any complaints of abdominal pain/discomfort, nausea and vomiting. Old people were interviewed in their mother tongue. The entire questionnaires were checked for accuracy and completeness. A set of questionnaires are shown in the annex-3.

3.11 Data analysis and Interpretation

All data, as well as laboratory findings, were analyzed according to their age, sex, feeding habit, and infection rate. Thus, analyzed data was interpreted by representing with table and pie-chart. Association of intestinal parasites with age–wise and sex-wise. Prevalence was assessed by using R 3.3.1 software. The total observed value was assumed as examined samples whereas the expected value is assumed as a positive sample.

4. RESULTS

4.1 Results of stool examination in earthquake affected people still living in camp of Byasi Tole of Bhaktapur Municipality:

4.1.1 General prevalence of intestinal parasites in earthquake victims

Out of 82 stool samples, the general prevalence of intestinal parasites of Byasi Tole of Bhaktapur Municipality were found to be 51(62.20%) positive (Fig. 2).

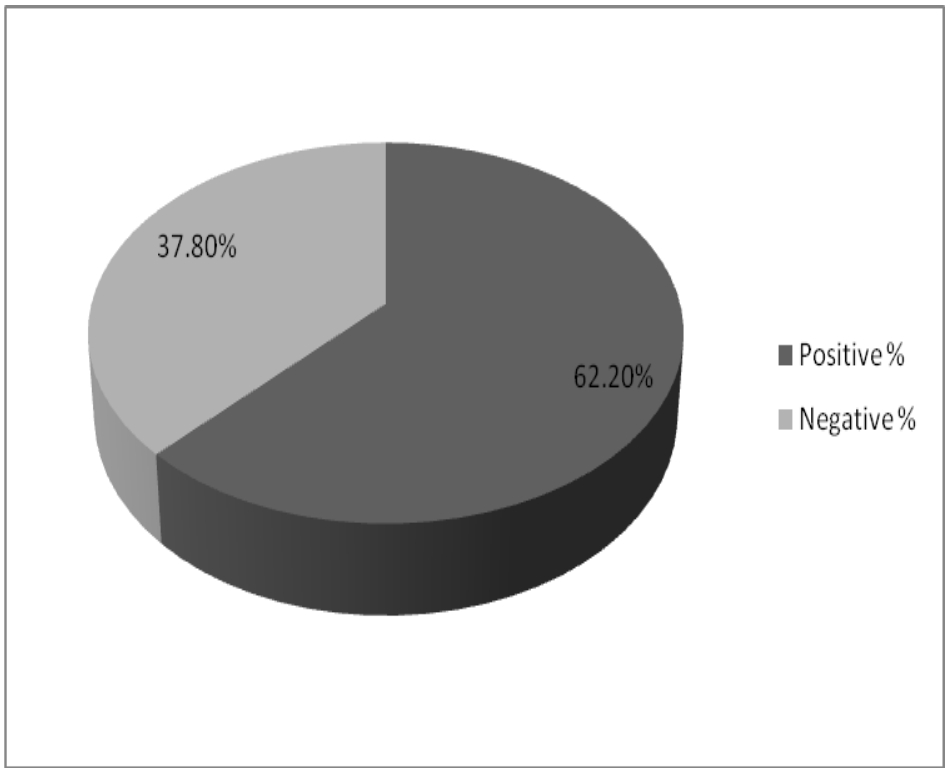

Fig 2. General prevalence of intestinal parasites in earthquake victims of Byasi Tole of Bhaktapur Municipality.

4.1.2 Morphometric measurement of gastrointestinal parasites

Table 1: Showing the morphometric measurement of gastro-intestinal parasites in comparison to Chatterjee (2009) and the present study.

Parasites	**According to Chatterjee (2009)**		**According to the study**
	Shape	Size (μm)	Size (average)
Ascaris lumbricoides	Round or oval	l=60-75μm b=40-50μm	l=60.47μm b=56.76μm
Trichuris trichiura	Spherical or oval	l=50μm b=25μm	l=59.34μm b=24.76μm
Hymenolepis nana	Oval or elliptical	30-45μm in diameter	43.86μm in diameter
Ancylostoma duodenale	Barrel-shaped	l=60μm b=40μm	l=63.05μm b=51.62μm
Entamoeba histolytica	Spherical	10-15μm in diameter	20.64μm in diameter

4.1.3 Human sex-wise prevalence of Intestinal Parasites:

Out of 82 stool samples examined, 47 were of males and 32 were of females. Out of 47 male stool samples examined, 24(51.06%) were found to be positive. Likewise, out of 32 female stool samples examined, 27(77.14%) were found to be positive for intestinal parasites. Hence, infection rate was found higher in females than males.

Statistically, there was no significant difference in the prevalence of intestinal parasites between male and female in earthquake victims of Byasi Tole (p= 0.09097).

Table 2: Sex-wise prevalence of Intestinal Parasites.

Sex	Total examined samples	Infection		No infection	
		Number	Percentage	Number	Percentage
Male	47	24	51.06	23	48.94
Female	35	27	77.14	8	22.86
Total	82	51	62.20	31	37.80
Statistical analysis		χ^2=2.8571, df=1, p-value=0.09097 No significant difference was found			

4.1.4 Age group-wise prevalence of Intestinal Parasites:

The entire study was categorized into seven age groups of human starting from 1-10 years to above 61 years old.

The distribution of intestinal parasites was maximum 8(80%) in 11-20 years and 4(80%) in 61 above years of age group and minimum 5(38.46%) in 41-50 years of age group.

Statistically, there was significant difference between the different age groups and the prevalence of intestinal parasites (p=0.04138).

Table 3: Age group-wise prevalence of Intestinal Parasites.

Age(yrs)	Total no. of samples	Positive Samples		Positive Male		Positive Female	
		Number	Percentage	Number	Percentage	Number	Percentage
1-10	9	6	66.66	2	33.33	4	66.67
11-20	10	8	80	4	50	4	50
21-30	15	9	60	5	55.55	4	44.44
31-40	22	13	59.09	6	46.15	7	53.85
41-50	13	5	38.46	3	60	2	40
51-60	8	6	75	2	33.33	4	66.67
61 above	5	4	80	2	50	2	50
Total	82	51	-	24	-	27	-
Statistical analysis		χ^2=13.106, df=6, p-value=0.04138 Significant difference was found.					

4.1.5 Prevalence of protozoans and helminthes

Out of 51 positive samples the distribution of helminthic infection 45(88.24%) were higher than the protozoan infection 6(11.76%) among the people of Byasi Tole of Bhaktapur Municipality.

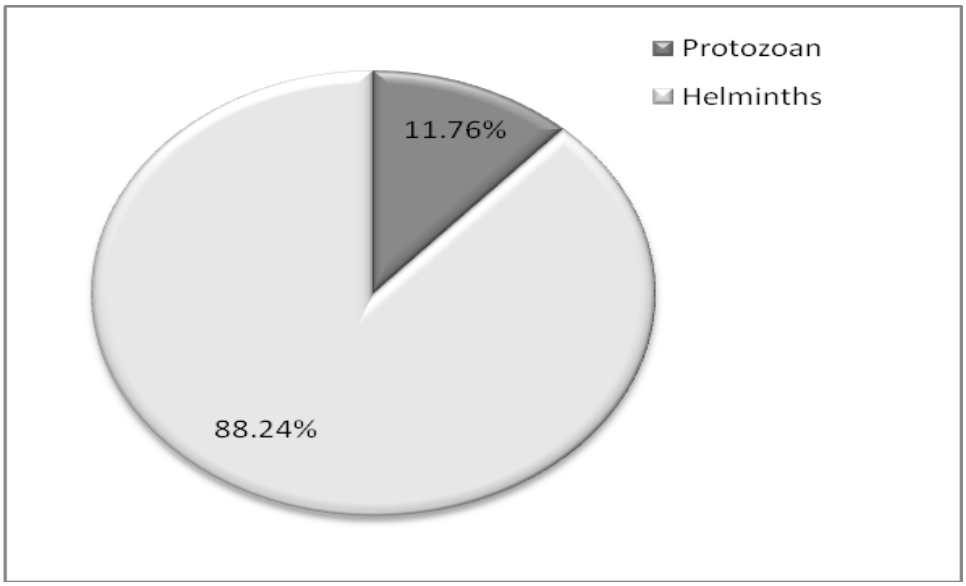

Fig.3 Prevalence of protozoans and helminths in earthquake victims of Byasi Tole of Bhaktapur Municipality.

4.1.6 Prevalence of Specific Intestinal Parasites:

Out of 51 positive samples, it was found that 31(60.78%) were infected with *Ascaris lumbricoides* followed by *Trichuris trichiura* 7(13.73%), *Hymenolepis nana* 5(9.80%), *Ancylostoma duodenale* 2(3.92%) and *Entamoeba histolytica* 6(11.76%).

4.1.7 Intensity of infection

The infection of single parasite was more common than double and triple infection. Out of total 51 positive cases, there were 43(84.30%) single infection while 6(11.76%) double and 2(3.92%) with multiple infection.

4.1.7.1 Intensity of single infection

Out of 82 stool samples, 43 samples was found to be single infected. The prevalence of *Ascaris lumbricoides* was found to be maximum 27(52.94%) cases, followed by *Trichuris trichiura* with 6(11.76%) cases, *Hymenolepis nana* and *Entamoeba histolytica* was found to be equal with 4(7.84%) cases and *Ancylostoma duodenale* with 2(3.92%) cases.

Table 4. Intensity of single infection

Parasites	Number of single infected samples	% of +ve cases (n=51)	No. of infected male	No. of infected female
Ascaris lumbricoides	27	52.94	10	17
Trichuris trichiura	6	11.76	4	2
Hymenolepis nana	4	7.84	2	2
Ancylostoma duodenale	2	3.92	2	-
Entamoeba histolytica	4	7.84	2	2
Total	43	84.30	20	23

4.1.7.2 Intensity of double infection:

Six samples were found to be double infected, out of which the prevalence of parasitic infection was found to be maximum in *Ascaris lumbricoides+Trichuris trichiura* 3(5.88) followed by *Ascaris lumbricoides+Entamoeba histolytica* 2(3.92%) and *Ascaris lumbricoides+Hymenolepis nana* 1(1.96%).

Table 5. Intensity of double infection

Parasites	Number of double infected samples	% of +ve cases (n=51)	Infected male	Infected female
Ascaris lumbricoides + Hymenolepis nana	1	1.96	-	1
Ascaris lumbricoides + Entamoeba histolytica	2	3.92	1	1
Ascaris lumbricoides + Trichuris trichiura	3	5.88	2	1
Total	6	11.76	3	3

4.1.7.3 Intensity of multiple infection:

Two samples have multiple infection, where the prevalence of multiple infection was found to be similar in both *Ascaris lumbricoides+Hymenolepis nana+Entamoeba histolytica* 1(1.96%) followed by *Ascaris lumbricoides+Entamoeba histolytica +Trichuris trichiura* 1(1.96%).

Table 6. Intensity of multiple infection

Parasites	Number of infected samples	% of +ve cases (n=51)	Infected male	Infected female
Ascaris lumbricoides + Hymenolepis nana + Entamoeba histolytica	1	1.96	-	1
Ascaris lumbricoides + Entamoeba histolytica + Trichuris trichiura	1	1.96	1	-
Total	2	3.92	1	1

4.2 Results of questionnaire survey analysis among the earthquake victim of Byasi Tole of Bhaktapur Municipality:

Interview was carried out with the earthquake victims of Byasi Tole of Bhaktapur Municipality. A set of questionnaires were asked to them for the information of parasitic infection, behavior and other different habitual behaviors. The results from the questionnaires survey analysis were as follows:

4.2.1 Assessment of knowledge

Knowledge of earthquake victims towards intestinal parasites was categorized into three groups on the basis of knowledge towards cause, symptoms and prevention of parasitic diseases. Out of 82 respondents, 65(79.26%) were aware and 17(20.73%) of the respondents were unaware about the cause of parasitic infection. This assessment reveals that there was statistically difference between the knowledge of earthquake victim towards the cause and prevalence of intestinal parasitic infection (Table 7). It also showed that 69(84.14%) people have knowledge about the symptoms and 13(15.85%) people were unaware about the symptoms of parasitic infection. Statistically there was significant difference between knowledge about symptom and prevalence of intestinal parasitic diseases.

Similarly, it was found that 60(73.17%) people were aware and 22(26.82%) people were unaware about the methods of prevention of intestinal parasites. Statistically, it was found that there was significant difference between the knowledge towards prevention and prevalence of parasitic infection.

Table 7. Knowledge assessment

Variables for knowledge		No. of respondents (n=82)	Frequency (%)	p-value
Cause of parasitic infection	Aware	65	79.26	χ^2=22.54, p<0.05 Significant difference was found
	Unaware	17	20.73	
Symptoms of parasitic infection	Aware	69	84.14	χ^2=31.369,df=1, p<0.05 Significant difference was found
	Unaware	13	15.85	
Methods of prevention of parasitic infection	Aware	60	73.17	χ^2=13.74, df=1,p= 0.0002099 Significant difference was found
	Unaware	22	26.82	

4.2.2 Assessment on practices

Sanitation, sanitary behavior and hygiene plays a vital role in the prevalence of parasitic infection. From the survey method it was found that out of 82 respondents, 9(10.97%) respondents were defecating in field and 73(89.02%) respondents were defecating in toilet. Statistically, the difference in the prevalence of intestinal parasites on the people on the basis of defecation place was significant.

The use of direct water without treatment is a leading cause of parasitic infection. Those people who drink direct water were highly infected 52(63.41%) than people who drink 25(30.48%) boiled and 5(6.09%) chlorinated water. Assessment revealed that there was significant difference between parasitic prevalence and type of drinking water.

Also, According to the survey it was found that out of 82 respondents, 58(70.73%) were using soap to wash hand, followed by 6(7.31%) respondents using soil and 18(21.95%) respondents were using water only to wash the hand. Statistically, there was significant difference between parasitic prevalence and hand washing with soap, soil and water only.

As per the survey, it was found that out of 82 respondents, 100% respondents were washing the hand before the meal, after the meal and after the use of toilet. This reveals that there was no significant difference between the parasitic prevalence and hand washing time.

To control and prevent the parasitic diseases deworming tablets plays very important role among the people. Overall assessment showed that 13(15.85%) respondents had already taken the deworming tablet and 69(84.14%) respondents had not taken the deworming tablet before the earthquake which means that people who had taken deworming tablet before earthquake were least infected with parasites with statistically significant association.

Table 8. Assessment on practices regarding parasitic infection.

Variable for practice		No. of respondents (n=82)	Frequency (%)	p-value
Defecating place	Field	9	10.97	χ^2=41.908,df=1, p<0.05 Significant difference was found
	Toilet	73	89.02	
Drinking water type	Direct	52	63.41	χ^2=37.786,df=2, p<0.05 Significant difference was found
	Boiling	5	6.09	
	Chlorinated/ purified	25	30.48	
Wash hand with	Soap	58	70.73	χ^2=46.697,df=2, p<0.05 Significant difference was found
	Soil	6	7.31	
	Water only	18	21.95	
Hand washing time	Before meal	82	100	No significant difference was found
	After meal	82	100	
	After use of toilet	82	100	
Taken deworming tablet (before earthquake)	Yes	13	15.85	χ^2=31.369,df=1, p<0.05 Significant difference was found
	No	69	84.14	

5. DISCUSSION

There are eight destructive earthquakes and 74 natural disasters happens annually all over the world. Earthquake are probably the most costly of all natural disasters, both in terms of the lives lost and the property destroyed (Jafari *et al*. 2007). After a major natural disaster, almost all houses and building may be destroyed, water and electricity supplies are suddenly curtailed. A large numbers of people forced to seek in temporary shelters in crowded circumstances under condition with inadequate sanitation and waste management, compromised sources of water, potential food shortage, malnutrition and a low level of immunity. These all factors play a key role in compounding the devastation and brought high possibilities for the outbreak of infectious disease in post- earthquake crisis (Connolly *et al*., 2004; WHO, 2005). Among such disease intestinal infection represent a large and serious medical and public health problem in developing countries. It is estimated that 3.5 billion people are affected, and that 450 million are ill as a result of these infection, the majority being children (WHO, 1998). The major parasitic infections reported globally are *Ascaris lumbricoides* (20%), Hookworm (18%), *Trichuris trichiura* (10%), and *Entamoeba histolytica* (10%) (Chatterjee, 1998; Warren and Mohmoud, 1984; Walsh, 1986). Intestinal protozoan infections, particularly, *Entamoeba histolytica* and *Giardia lamblia*, also cause significant morbidity and mortality in developing countries where water quality, waste disposal, sanitation and hygiene conditions are poor.

Direct microscopic observations were performed to study the presence of intestinal parasites in stool samples. The present study revealed that out of 82 earthquake victims inhabiting in camps of Byasi Tole of Bhaktapur Municipality 51(62.20%) victims were found to be infected by different kinds of intestinal parasites. This is greater with the finding of Gen *et al.*, (2011) in a study conducted in Wudu district, China after the earthquake with the percentage prevalence of 32.3%. This might be due to immediate and proper management of victims in China whereas, in Nepal even after a year of earthquake there was no proper management when the research was carried out. Also it is greater with the findings of Jhamarkattel (2007) were 50% of the people were infected with intestinal parasites. Whereas, it is different with the findings of Mehraj *et al.*, were positive cases was 52.8%. Similarly, 738 cases were referred by Jafari *et al.*, (2007) to clinic after Bam earthquake in 2004 because of gastro-intestinal infections. And this all incidence which increases the intestinal infections are might be of cold weather, lack of appropriate housing, lack of heating system and over crowded population in camps. Parasites were identified morphometric according to the shape and size.

Regarding the sex-wise prevalence of intestinal parasites, the results showed that comparatively females 27(77.14%) were more infected than males 24(51.06%). Statistically, there was no significant relationship in the prevalence of intestinal parasites with the sex of the victims of Byasi Tole. This result resembles with Shah *et al*., (2010) in which the prevalence of parasitic infestation was found higher in females 123(59.0%) than males 84(41.0%) in the earthquake affected areas of Pakistan. While disagree with Alwabr *et al.,* (2016) in which the prevalence rate of intestinal parasitic infections in male

was higher than female among school children of Yemen. This might be because of the contact of larva with the skin during walking with bare foot and also through ingestion of ova. And also one of the other reasons might be that most of food for their families was handled by females which may be responsible for spreading infection. The high prevalence rate of female may be due to involvement of female in various household activities, in the care of children during which they come in contact with faeces of children and they do not wash their hands properly and also may be due to usual contact with infected soil, water and food.

The age of earthquake victims was divided into seven groups, 1-10, 11-20, 21-30, 31-40, 41-50, 51-60 and >60. High rate of parasitic infection was found among 11-20(80%) years, 61 above (80%) years and low in 41-50(38.46%) years age group. The high prevalence in 11-20 years and above 61 years age group might be due to their unhygienic behavior and lack of sanitation. Which is different with the findings of Shah *et al.*, (2010) were in victims of Kaghan valley, Pakistan found maximum infection in 15-35 yrs age group and minimum in age group greater than 55 yrs and also this study was different with the findings of Mehraj *et al.,* where the infection rate was higher in age group 1-5 years and Dagci *et al.,* were the prevalence rate of was higher in children compared to adults.

Analysis of data established that prevalence of helminthic infections was much higher than the prevalence of protozoal infections of the studied groups which is similar to the study carried out by Shrestha *et al*., (2016) and Chatterjee (1998) among school going children and pregnant women in West Bengal, India. And also, this study is similar to the study carried by Bartram *et al*., (2005) were it was found that approximately 74% of the health burden in school children in LMICs is due to intestinal helminth infections.

This study found that out of 51(62.20%) positive cases the most prevalent parasites were *Ascaris lumbricoides* 31(60.78%) followed by *Trichuris trichiura* 7(13.73%), *Hymenolepis nana* 5(9.80%), *Ancylostoma duodenale* 2(3.92%) and *Entamoeba histolytica* 6(11.76%). This present study resemble with the study of several workers such as Gen *et al*., (2011), in which the commonest infestation found was roundworm among the earthquake victims, Shah *et al*., (2010) in which *Ascaris* was the highest found parasites among the displaced population after the earthquake, Nakamura (2005) where *Ascaris* was higher after natural disaster. Similarly, Wani *et al.,* (2007), Rashid *et al*., (2010), Shrestha and Maharjan (2013) are also some of examples having the highest prevalence of *Ascaris*. The high rate of *Ascaris* spp. is usually attributed to the habit of eating unwashed vegetables, less sandal wearing habits, usual contact of infected soil and also by drinking contaminated water. Whereas this finding is different from the findings of Saurez *et al.,* (2002), Ozturk *et al*., (2004), Tandukar *et. al.,* (2013) and Mehraj *et al.,* (2008) where *Giardia lamblia* was the most prevalent parasites. This may be due to drinking municipal water at camps and also due to use of communal toilet instead of individual toilet. And also the study was different with the findings of Dagci *et al.,* where

Blastocystis hominis was higher and Khanal *et al.,* (2011) where *Trichuris trichiura* was the most prevalent parasite.

In the present study among 51 positive samples, there were 43(84.30%) single infection while 6(11.76%) double and 2 (3.92%) with multiple infection. This result is similar with result shown by Shrestha and Maharjan (2013), Abahussain (2005) and Mehraj *et al.,* (2008) with higher single infection compared to double and multiple infections.

Earthquake victims were interviewed on the basis of cause of parasitic infection, symptoms of intestinal infection and the methods of prevention. It was found that out of 82 respondents, 65(79.26%) respondents were good in the awareness towards intestinal parasites. But being aware also it was found that maximum respondents were infected to parasites which is different to the findings of Tian *et al.*, (2016) in there it was reported that after the 2008 earthquake in China, health education and campaigns were promoted. Due to which it was seen that there was an increase in the proportion of personal hygiene from 59.7% to 98.3% ($p < 0.01$) among the students of Leigu Township Primary and Junior School. Likewise, it was reported that out of the sampled survivors from Wenchuan County, 92.3% reported to have improved their health knowledge and 54.9% improved their health practice ($p < 0.01$). But according to our findings it was found that having the knowledge about parasites but was not implemented in their life routine was the main cause of prevalence of parasites. Thus, health education and promotion during public health emergencies such as earthquakes play an important role in preventing injuries and infectious diseases among survivors.

Defecating place plays an important role in transmitting parasitic disease. In Byasi Tole maximum victims were found defecating in toilet 73(89.02%) rather than in field 9(10.97%) but the parasitic diseases were found maximum among victims using toilet for defecation. This might be due to the use of common toilet after the disaster. Similar finding forwarded by Saurez *et al*., (2002) recorded that parasitic prevalence was higher among the victims who use communal toilets after the earthquake.

As per the study it was found that 52(63.41%) victims were drinking direct water without any kind of treatment were only 5(6.09%) victims were drinking boiling water. The use of boiling is the main known water treatment procedure in line in rural Nepal, where 15% of households consistently boiled water before consumption (Kovalsky *et al*., 2008 and Shrestha *et al*., 2013). But after the earthquake there was not access to drinking water facility so in this study area prevalence of parasitic disease were found to be high due to the intake of direct water. Similar finding obtained by Tandukar *et al.,* (2013) and Woersching *et al*., (2004) revealed that parasitic prevalence was higher among the earthquake victims who consume direct water. Weniger *et al.,* (1983) reported an outbreak of gastro-intestinal illness affecting 780 people after natural disaster due to the intake of direct water in Montana (United States) whereas in Utah (United state) 1,230 people were affected with diarrhea due to consumption of unfiltered surface water after flooding (Perrotta *et al*., 1983).

Major people in Byasi Tole wash their hand with soap and water but due to the lack of proper way of washing hand they were suffering from different parasitic diseases. This study showed that hand washing without soap and water can significantly increase the rate of parasitic infection. Similar result obtained from other research such as Gen *et al*., (2011) showed that after the earthquake a markedly higher proportion of people tended not to wash their hands before meals and after defecation with soap and water than did before the earthquake and due to this the monthly incidence of diarrhea and intestinal worm infection was significantly higher than before.

Deworming tablet decreases the risk of intestinal parasitic infection (Smith and Brooker 2010). Victims who were using deworming tablet before earthquake were found less infected with parasitic infection than those who were not using tablet.

After the earthquake people were living in crowded circumstances under the shortage of drinking water, lack of toilet, health facilities, etc. During the survey period it was found that the Government and some organizations has delivered food, temporary shelters and drinking water for the people. But it was seen that according to the number of people residing in the temporary camps the supplied food water was not enough. The temporary toilets were dirty with no facility of soap and insufficient water. Since the people were using common toilet, living in crowded circumstances and drinking water without any proper treatment might be the reason for the prevalence of gastro-intestinal parasites in the people of Byasi Tole of Bhaktapur Municipality.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study was carried out to observe the prevalence of gastro-intestinal parasites in earthquake victims of Byasi Tole of Bhaktapur Municipality still residing in temporary shelters. Out of 82 stool samples, the prevalence of intestinal parasites among earthquake victims was found 51(62.20%) in which helminthic infection 45(88.24%) were higher than the protozoan infection 6(11.76%). Parasites were identified according to their morphology. Altogether five species of intestinal parasites were detected, the most common was *Ascaris lumbricoides* 31(60.78%) followed by *Trichuris trichiura* 7(13.73%), *Entamoeba histolytica* 6(11.76%), *Hymenolepis nana* 5(9.80%) and *Ancylostoma duodenale* 2(3.92%). The study also showed that out of 51 positive samples single infection was found higher 43(84.30%) followed by double and multiple infections.

Sex-wise prevalence showed parasitic infection higher in females 27(77.14%) than that of males 24(51.06%). Out of different age group the intestinal parasites was found to be highest among age group 11-20 years 8(80%) and above 61 years 4(80%) and found minimum in the people of age group 41-50 years 5(38.46%).

In the present study, most of the victims had knowledge about the 65(79.26%) cause of parasitic infection, 69(15.85%) about the symptoms of parasitic infection and 60(73.17%) about the methods of prevention of parasitic infection. According to the practices of the victims it was found that the prevalence of parasitic infection showed significant relationship with type of drinking water, hand washing behavior, defecating place and use of deforming tablets, whereas insignificant association with hand washing time before-after meal and after the use of toilet.

Hence, it is concluded that the people residing in Byasi Tole of Bhaktapur Municipality were infected by different kinds of intestinal parasites due to crowded circumstances with lack of food, lack of drinking water with any proper treatment and lack of toilets or use of common toilets with no facility of soap and insufficient water.

6.2 Recommendations

On the basis of the present study, following recommendations have been suggested for the effective control of intestinal parasitic infection among the earthquake victims:

- Public health education in the earthquake victims should be made compulsory to bring the knowledge about intestinal parasites into practice.
- Well managed public toilet should be built in each camp.
- To minimize the risk of transmission of gastro-intestinal parasites anti-helminthic doses should be rendered to the people.
- Pure and safe drinking water facility should be made easily accessible for the earthquake victims.

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ANNEX-1

Introduction of Intestinal parasite

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

Intestinal protozoan parasites

Protozoan parasite consists of a single cell like unit which is morphologically and functionally complete (Chatterjee, 2009). Some of the common intestinal protozoan parasites are *Entamoeba histolytica, Giardia lamblia, Endolimax nana, Enteromonas hominis, Entamoeba coli, Isospora belli, Trichomonas hominis, Balantidium coli, Cyclospora, Crypposporidium* etc.

Entamoeba and Amoebiasis

Amoebiasis is caused by *E.histolytica*, a protozoan that is 10 to 60µm in length and moves through the finger-like pseudopods. It may manifest as diarrhea, dysentery and hepatic or pulmonary amoebiasis. The morphology of the parasites can be divided into trophozoite, precyst and cyst. Trophozoite is feeding stage, also known as growing stage, and measuring 15-30µm in size. Precyst is colourless, round or oval smaller than trophozoite but larger than a cyst. It ranges between 10-20µm in size. Cyst becomes rounded and is surrounding by a smooth wall. The cyst is initially unicellular and then develops into a binuclear after binary fission (Ichhpujani *et al.,* 2002).

It is transmitted by the fecal-oral route, as well as by oral-anal sexual practices (Reed, 1995). Poverty, ignorance, impair personal hygiene are the major cause to facilitate the spread of disease. Amoeba's multiply rapidly in the tissue cells and use the cytolysed materials as their food.

Giardia and Giardiasis

Giardia intestinalis is also known as *G. lamblia, G. duodenalis* and *Lamblia intestinalis*. It is worldwide in distribution with the highest prevalence in the tropics and subtropics area. It appears in all age groups but the higher incidence in children. It is found in the duodenum and the upper part of jejunum in man. The morphology of *Giardia* exists in two forms: trophozoite and cyst. Trophozoite is feeding stage, measuring about 10-20µm in length, 6-15µm in width and 1-3µm in thickness. The parasite gives a typical monkey-face appearance on microscopic examination. Trophozoites multiply in the intestine by binary fission. Cyst convert from trophozoite when the environmental conditions are unfavorable. It is oval, measuring 8-14µm in length and 6-10µm in width. The cyst contains four nuclei. Cysts are the infective stages of man, which are transmitted from a water source (Ichhpujani *et al.,* 2002). The disease caused by *Giardia* is known as

Giardiasis. This disease is asymptomatic to a malabsorption syndrome. Diarrhoea, weight loss, abdominal cramps, anorexia, headache, chills etc. are the symptoms produced in acute and chronic Giardiasis.

Intestinal helminths parasites

The term helminthes has been derived from a Greek word meaning worm. There are metrozoa and are classified into two phylums: Platyhelminthes and Nemathelminthes. Platyhelminthes is divided into two classes: Cestoidea and Trematodea while Nemathelminthes has only one class Nematodea. Some of the common intestinal helminthes parasites are *Hymenlepsis nana, Hymenolepsis diminuta, Ascaris lumbricoides, Trichuris trichiura, Ancylostoma duodenale, Entamoeba vermicularis* etc.

***Ancylostoma* and Ancylostomiasis**

Ancylostomiasis is caused by *Ancylostoma duodenale* commonly called as old world hookworm. They are found in Europe, Africa, China, Japan, India and the pacific island. *Ancylostoma duodenale* is prevalent throughout the tropics and sub-tropics. Adults are small, grayish, white or brown cylindrical worms. The anterior end is slightly bent. The hookworm species are differentiated by their buccal capsule and arrangement of rays in the bursa. The buccal capsule of *A. duodenale* is provided with 6 teeth, 4 hooks like on the ventral surface and 2 knobs like on the dorsal surface. There are 5 glands associated with the digestive system which secretes an anticoagulant substance. The male is smaller (8-11mm × 0.45mm) than female (10-13mm × 0.66mm). Posterior part of the male is expanded in an umbrella-like fashion whereas the female is tapering and no expanded bursa. The adult worm lives in the intestine of man particularly in the jejunum and less often in the duodenum. Each female can lays 15,000-20,000 eggs per day. Humans are exposed to hookworm infection when third stage filariform larvae penetrate the skin exposed to contaminated soil. Penetration may occur at any site on the skin. Infection also takes place by ingestion of contaminated food materials containing filariform larvae occasionally (Ichhpujani *et al.,* 2002).

***Trichuris* and Trichuriasis**

The disease caused by *Trichuris trichiura* is Trichuriasis or whipworm infection. It occurs worldwide but mostly prevalent where the sanitation is poor and warm moist climates (Ichhpujani *et al.,* 2002). *T. trichiura* lives in the large intestine, particularly in the caecum and less commonly in the vermiform appendix and colon of man. Adult's worms are characteristically whip-shaped. The anterior three-fifth is very thin and hair-like and the posterior two fifth is thick and stout, resembling the handle of the whip. The eggs are barrel-shaped with the mucous plug at each pole. Its life cycle is completed in a single host, man. No intermediate host is required. Man acquires the infection by ingesting embryonated eggs with contaminated food and water. The symptoms are nausea, vomiting, diarrhea, appendicitis and prolepses of the rectum. *Trichuris* dysentery, rectal

prolepses, anemia, poor growth constitutes an important public health problem (Stephenson *et al.,* 2000).

Hymenolepsis and Hymenolepiasis

The disease caused by *Hymenolepis nana* is Hymenolepiasis. The species nana meaning small is derived from the small size of the adult worm. It is cosmopolitan and more common in warm climates. The adults are found in the lumen of the ileum with scolex embedded in the mucosa. It is short measures 20-40mm in length with a diameter of 1mm and hence is called a "dwarf tapeworm". It seems like a mucus thread when observed through the naked eye. The scolex is 0.3mm wide, bears 4 suckers and has a retractable rostellum with 20-30 "spanner shaped" hooks. The neck is long and slender. The strobila consists of about 200 proglottids. There are 3 round testes which lie in the posterior part of each proglottid. The eggs are spherical or oval measures 30-45µm in diameter. Some eggs hatch out in the lumen of the small intestine and liberate embryos which directly invade the intestinal villi. Human strains can infect rats through rat fleas (Ichhpujani *et al.,* 2002). The infection is more common in children. The infection is symptomatic in malnourished and immuno-compromised children. Abdominal pain, diarrhea, weight loss and weakness are the major clinical features.

Ascaris and Ascariasis

Ascariasis is caused by *Ascaris lumbricoides*. It is commonly known as round worm is the largest intestinal nematode. It is cosmopolitan in distribution being especially prevalent in tropical countries like India and China (Ichhpujani *et al.,* 2002). It occurs among people living under the poor hygienic condition (Smyth, 1996). Adult worm resides in the small intestine, particularly the jejunum of man. It is cylindrical, tapering gradually at the anterior end and somewhat less so at the posterior end. The head is provided with conspicuous lips. Sexes are separated. Males measures 15-30cm in length and 3-4mm in diameter. Female is longer and stouter than the male and measures 25-40 cm in length and 5mm in diameter. The life cycle of *A. lumbricoides* is passed in only one host, man. Man acquires the infection by ingestion of food, water or raw vegetables contaminated with embryonated eggs. Symptoms like an ulcer, Jaundice, Vitamin A deficiency, abdominal discomfort, fever, coughing, liver abscess are the common symptoms.

ANNEX-2

PHOTOGRAPHS

Photo No. 1

Photo No.2

Photo No. 3

Photo No. 4

Photo No. 5

Photo No. 6

Photo No.1,2 and 3 shows temporary houses built after earthquake and Photo No. 4,5 and 6 shows observation of stool sample under microscope in CDZs Laboratory.

Photo plates of GI parasites

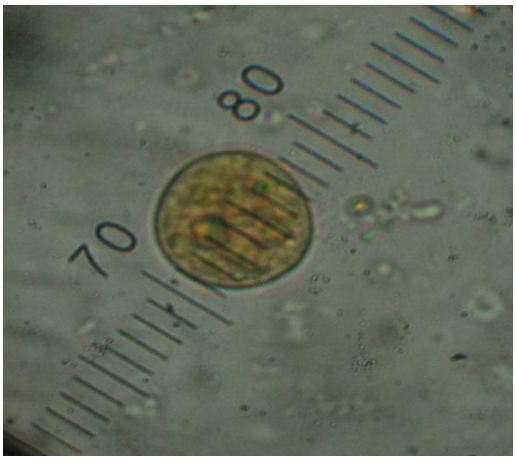

Photo No.7: Cyst of *Entamoeba histolytica* (10X×40X) 20.64µm

Photo No.8: Egg of *Hymenolepis nana* (10X×40X) 43.86µm

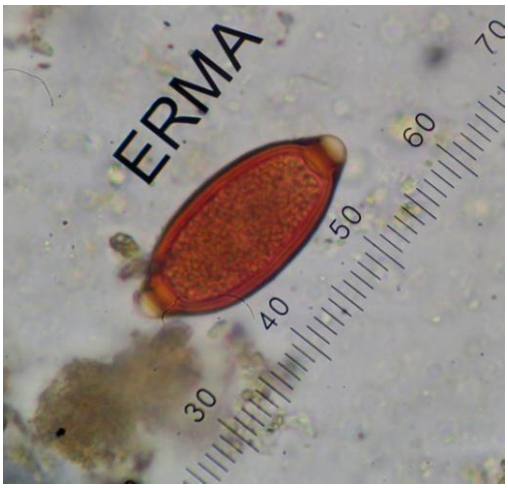

Photo No.9: Egg of *Trichuris trichiura* (10X×40X) 59.34µm

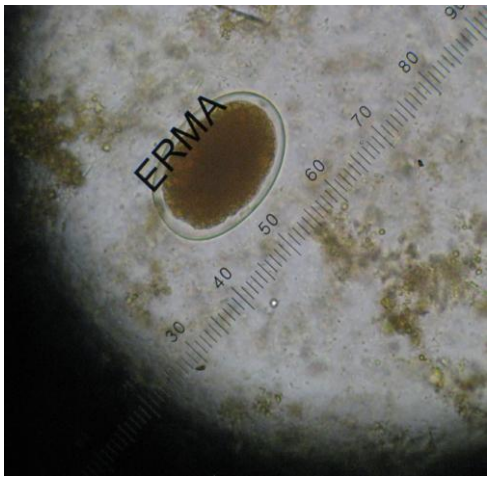

Photo No.10 Egg of *Ancylostoma duodenale* (10X×40X) 63.05µm

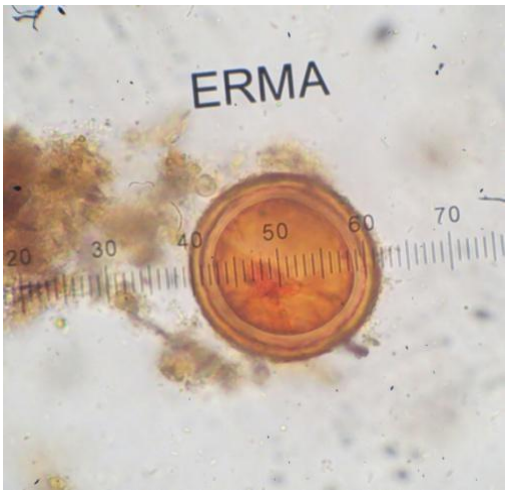

Photo No.11: Egg of *Ascaris lumbricoides* (10X×40X) 60.47µm

Photo No.7,8,9,10 and 11 Gastro-intestinal parasites

ANNEX-3

QUESTIONNAIRES

Date:
Name of Interviewer: Name of Community:

Gender of Respondent: Age of Respondent:

1. What is the type of drinking water you use for your household?

i) Direct tap water ii) Boiling iii) Chlorinated or purified

2. Where do you defecate?

i) Field ii) Near water resources iii) Toilet

3. How do you wash your hand?

i) With soap iii) With soil iii) Water only

4. When do you wash your hand?

i) Before meal ii) After meal iii) After toilet iv) All above

5. Have you taken deworming tablet before earthquake? Yes No

If yes, when? I) don't know ii) Three months before

iii) Six months before IV) Once year before

6. Have you suffered by diarrhea/dysentery worm? Yes No

If yes, when? i) one week before ii) One month before

iii) Six months before IV) Now v) don't know

7. Do you know the causes of worm infection? Yes No

If yes, what are they ……

8. Do you know the symptom of worm infection? Yes No

If yes, what are they? .....

9. Do you know the method of prevention of worm infection? Yes No

10. How long you have been inhabiting in this place?

i) 3 month ii) 5 month iii) 10 month