INTRODUCTION

Diarrheal disease is a common illness that affects millions of people worldwide and attack rates range from 2 to 12 or more illnesses per person per year (Guerrant et al., 1990). It is common, particularly in developing countries, and continues to be a major cause of morbidity and mortality contributing to dehydration, malnutrition and other risks. It is associated with fecal contamination of the environment, lack of potable water (Adhikari et al., 1986; Guerrant et al., 1990; Rai et al., 2000b; 2001a; Ono et al., 2001), education, and housing in the midst of poverty. Diarrheal diseases mainly affect young children and are attributed to long-term cognitive deficits (Niestroj et al., 2002). Deaths due to diarrheal diseases account for an estimated 12,600 child deaths each day in Asia, Africa, and Latin America (Guerrant et al., 1990).

Diarrhea is produced by a variety of etiological agents. Of them, intestinal parasitic infection alone contributes to a great extent in the cause of diarrhea. Parasites and diarrhea are more frequent in poor populations (Khan et al., 1990) and in immunocompromised individuals (Ferreira and Borges, 2002). Intestinal parasites, particularly the protozoa, are more likely to infect individuals with impaired cellular immunity, such as those with hematological neoplasias, renal and heart transplant recipients, patients receiving high doses of corticosteroids, and patients with AIDS (Ferreira and Borges, 2002). Diarrhea is a common clinical manifestation of HIV infection regardless of
whether or not patients have AIDS (Joshi et al., 2002). Enteric protozoa are also associated with traveler’s diarrhea (Okhuysen, 2001). In the case of helminth parasites, there is little agreement on which worm definitely causes diarrhea (Genta, 1993).

Nepal, situated in the lap of the Himalayas, is a small and impoverished land-locked country located in South Asia. About 70% of health problems and causes of death in Nepal are due to infectious diseases (Rai et al., 2001a). Of these, diarrheal disease alone constitutes one of the major causes of morbidity and mortality (Bista, 2001; Rai et al., 2001a; 2003). Intestinal parasitosis alone is one of the most common public health problems in Nepal (Estevez et al., 1983; Rai and Gurung, 1986; Rai et al., 1995; 1998; 2000a; 2001a,b; 2002; Ishiyama et al., 2001) and is often associated with diarrhea and malnutrition (Sherchand et al., 1996; NMSS, 1998; Rai et al., 1998; 2000a; 2003; Ono et al., 2001). The reported prevalence rates of enteric parasitosis in Nepal vary from considerably low (Rai et al., 2002) to nearly one hundred percent (Estevez et al., 1983; Rai and Gurung, 1986) and have been associated with contamination of soil (Rai et al., 2000b) and water (Adhikari et al., 1986; Ono et al., 2001). Emerging diarrheagenic enteric parasites have also been reported recently (Gianotti, 1990; Hoge et al., 1995; Sherchand and Shrestha, 1996; Ono et al., 2001). In view of a high prevalence of enteric parasitosis and diarrheal diseases in Nepal, this study was conducted to elucidate the association of parasites with diarrhea among the Nepalese. This paper reports on the prevalence of intestinal parasites detected from diarrheal stool samples collected in Kathmandu, Nepal, from 1999 to 2001.

MATERIALS AND METHODS

Study population

The patients who submitted diarrheal stool samples to laboratories in Medical Centers of Kathmandu Valley, namely, Birendra Police Hospital (BPH; Maharajgunj), Kanti Children’s Hospital (KCH; Maharajgunj), Shi-Gan Path Lab (Shi-Gan PL; Putali Sadak and its Boudha branch), and Nepal Medical College Teaching Hospital (NMCTH; Jorpati) for routine and direct microscopic examination were included in this study. Also included, were children from two public schools in a village setting, inside and outside of Kathmandu Valley, who submitted diarrheal stool samples during the school health check program.

Sample collection and preservation

After routine and direct examination, about five to eight milliliters of stool sample was transferred into a screw capped glass bottle (20 ml capacity), thoroughly mixed with an equal volume of 2% dichromate solution, and sealed with vinyl tape. The age and sex of subjects were noted. Samples were then transported to Japan for further analysis. These samples were collected from October 1999 to January 2001.

Detection of parasites

Parasites were detected by a concentration method employing the formal-ether sedimentation technique. Findings of routine and direct microscopic examinations done in Nepal were not considered in this study.

Data analysis

Findings were aggregated against the age and sex of the subjects, and sample collection areas. Statistical analysis was done by the chi-square test.

RESULTS

In the present study, of a total of 396 diarrheal stool samples analyzed for the presence of intestinal parasites, 193 (49%) showed some kind of intestinal parasite (Table 1). Females showed a marginally higher prevalence (52%) compared with males (46%) (p>0.05). Similarly, a marginally higher prevalence was observed in children (15 years and under) (52%) than in adults (45%) (p>0.05). Of the samples collected in different areas, a significantly higher prevalence (91%) was found in public school children living in rural settings inside and outside of Kathmandu Valley compared with those observed in Kathmandu city and suburban areas, namely, BPH, KCH, Shi-Gan PL, and Boudha branch of Shi-Gan PL/NMCTH (Table 2).

Altogether 15 species of parasites (eight pro-
**DISCUSSION**

Both intestinal parasites (Estevez et al., 1983; Rai and Gurung, 1986; Gianotti, 1990; Rai et al., 1995; 1998; 2000a; 2001a, b; 2002; Ishiyama et al., 2001) and diarrheal diseases (Rai et al., 2001a; 2003; Bista, 2001; Ono et al., 2001) are highly prevalent in Nepal. The present study, however, showed a relatively low prevalence of parasitosis (49%) among subjects with diarrhea. This can be due to the high prevalence of helminthiasis.
among the general population compared with protozoan parasitosis (Rai and Gurung, 1986; Rai et al, 1995; 2001b; 2002) and parasitic diarrhea is mainly caused by protozoan parasites (Genta, 1993). However, the parasite load of 63% and 68% reported in children and adults with abdominal discomfort, respectively has been reported earlier (Sherchand et al, 1996).

No significant difference in the prevalence of enteric parasitosis was observed in males and females, which suggested that parasitic diarrheal diseases were independent of sex in Nepal. Ono et al (2001) also reported no significant difference in the prevalence of diarrheal diseases in the two sexes caused by different enteropathogens, bacteria, virus and parasites. Similar findings have also been reported in the general population and school children in Nepal (Rai et al, 1986; 1995; 2001b; 2002; Ishiyama et al, 2001). Similarly, no significant difference was observed in the prevalence of enteric parasites in children and adults. These findings indicated that both children and adults, irrespective of sex, were equally exposed to enteric parasites, particularly diarrheagenic protozoa. This can be attributed to unplanned urbanization, which results in poor sanitary and hygienic conditions, and contamination of drinking water with fecal matter in the Kathmandu Valley (Adhikari et al, 1986; Ono et al, 2001).

In this study, one to three species of potentially diarrheagenic enteric protozoan parasites were recovered in about half of the samples investigated. The present findings reveal that over one-third (42%) of the diarrheal diseases in Nepal are associated with enteric protozoan parasites.

The present study revealed a significantly high prevalence of enteric parasitosis in school children in the northern part of the Kathmandu Valley and outside compared with samples collected in other areas, including children attending Kanti Children’s Hospital. This finding indicated that diarrheagenic parasites were more prevalent in suburban and village settings in the valley.

In this study, eight species of protozoa, most of them being potential and others opportunistic causes of diarrheal diseases, were detected. G. intestinalis topped the list of protozoan parasites and was in agreement with those reported earlier (Rai and Gurung, 1986; Rai et al, 1995; 2002; Ishiyama et al, 2001; Ono et al, 2001) followed by Cyclospora cayetanensis, E. coli and others. Blastocystis hominis reported earlier in people with abdominal complaints (Sherchand et al, 1996) and the general population (Gianotti, 1990; Rai et al, 2001b) was not detected in this study. This can be due to the autolysis of B. hominis cysts during the time lapsed between sample collection and examination.

Among the helminth parasites, T. trichiura was detected most frequently followed by hookworm and A. lumbricoides. This was in contrast to most findings reported earlier from Nepal in which A. lumbricoides topped the list (Rai and Gurung, 1986; Rai et al, 1995; 2000a; 2001b; 2002). However, this was in agreement with the findings of Ishiyama et al (2001). This might be, in part, due to an intake of antihelminthic drugs, usually albendazole that does not clear T. trichiura infection (Hanjeet and Mathias, 1991), at the beginning of diarrhea because most Nepalese believe that abdominal discomfort and/or diarrhea is caused by Ascaris, locally known as Juka. Interestingly, for the first time in Nepal, Clonorchis (or Opisthorchis) eggs were also detected in 1% of the subjects studied (details will be reported elsewhere).

The present study revealed that 42% of the diarrheal diseases in Nepal were associated with enteric protozoan parasites, as long as the samples were carefully examined using concentration techniques. Further, water supply systems need to be corrected and protected from fecal contamination because the water in the Kathmandu Valley has been found to contain various diarrheagenic agents, including protozoan parasites (Adhikari et al, 1986; Ono et al, 2001). Awareness programs are most essential because contaminated food and/or drinks transmit these diarrheagenic parasites. Since parasites and diarrhea are more frequent in poor populations (Khan et al, 1990) and in immunocompromised individuals (Ferreira and Borges, 2002), preventive measures and surveillance systems must be emphasized considering the fact that HIV infection in Nepal is rapidly spreading.
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REFERENCES


