Bangladesh J. Zool. **38**(1): 31-39, 2010

PREVALENCE OF HELMINTHS IN A LAKE OF DHAKA CITY, BANGLADESH

H. Parvin, M.H. Uddin, H. Khanum[1], M.S. Islam*, M.A. Matin, M.S. Rahman, H.P. Endtz, A. Cravioto and M.S. Islam

International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), Mohakhali, Dhaka-1212, Bangladesh

Abstract: A total of 24 water samples were collected from March 2005 to February 2006 from a permanent station of Gulshan lake. The eggs and larva of four types of helminth parasites were identified; two were helminth eggs of *Ascaris lumbricoides and Trichuris trichiura* and two were helminth larva (rhabditiform larvae) of *Strongyloides stercoralis* and hookworm. The eggs and larvae of *A. lumbricoides* was found in all samples and it was numerically dominant over the eggs and larvae of other parasites. Its intensity was the highest (33.50) in winter and lowest (12.75) in rainy season. In case of *T. trichiura*, the prevalence was 25% with highest egg count in January. The prevalence and intensity of *T. trichiura* were the highest in winter and lowest in rainy season. The prevalence of the helminth larva was the highest in summer (37.5% for both) and lowest in rainy season (12.5% for both). Faecal coliform count (7.38 and 7.2 $\log_{10}$ cfu/L) also showed similar trends. All the physico-chemical parameters of water showed highest value in the summer. Among them conductivity and pH were the lowest in rainy, and salinity, DO, TDS were the lowest in the winter season. A positive correlation between *S. stercoralis* and hookworm larvae indicates that both of them were abundant at the same time in the water samples. *Ascaris lumbricoides* and *T. trichiura* eggs were also significantly correlated. The abundance of nematode larvae was inversely correlated with TDS. The present study suggests that the occurrence of different helminth eggs and larvae in the lake water are beyond the acceptable limit recommended by WHO.

mvi-ms‡¶c: ¸jkvb Lv‡ji ¯vqx Avevm †_‡K gvP, 2005 †_‡K †de"qvix, 2006 Gi g‡a¨ †gvU 24wU cwbi bgbv msMn Kiv nq| M‡elYvKv‡j 4 ai‡bi Kwg RvZxq ciRxexi wWg Ges jvfv wPwýZ nq| Zb¥‡a¨ 2 ai‡bi Kwgi wWg (*A. lumbricoides* and *T. trichiura*) Ges 2 ai‡bi Kwgi jvfv| M‡elYvKv‡j mKj cKvi bgbvi g‡a¨ *Ascaris lumbricoides* cvIqv hvq Ges Ab¨b¨ wWg Ges jvfvi g‡a¨ Bnvi cKU wQj ‡ekx| Bnvi cKU kxZKv‡j ‡ekx wQj (33.5%) Ges elvKv‡j Kg wQj (12.75%)| *T. trichiura* Gi †¶‡Î m‡ev"P wWg cvIqv hvq Rvbqwi gv‡m (25%)| M‡o *T. trichiura* Gi kZKiv c‡Kvc Ges msL¨v kxZKv‡j †ekx cvIqv hvq Ges elvKv‡j Kg cvIqv hvq| Kwgi (*S. stercoralis* and hookworm) jvfvi c‡Kvc †ekx cvIqv hvq Mx®§Kv‡j (37.5%) Ges mewbg cvIqv hvq elvKv‡j (12.5%)| GKB nv‡i g‡j Kwcdg cvIqv hvq (7.38 Ges 7.2 $\log_{10}$ cfu/l))| cwbi †fŠZ-ivmvqwbK ag (Conductivity, Salinity, TDS, DO, pH) m‡ev"P c`wkZ nq Mx®§Kv‡j| Zb¥‡a¨ Conductivity Ges pH Kg wQj elvKv‡j Ges Salinity, TDS, DO Kg wQj kxZKv‡j| *S. stercoralis* Ges hookworm jvfvi g‡a¨ abvZK Avš:m¤úKh³ wQj hv wb‡`k K‡i †h, DfqB GKB mg‡q cwb‡Z †ekx cvIqv hvq| *Ascaris lumbricoides* Ges *T. trichiura* I GKB ai‡bi m¤úKh³| †bgv‡Uv‡Wi jvfvi Dcw¯wZ TDS Gi mv‡_ wecixZ m¤úKh³| eZgvb M‡elYv †_‡K GUvB †ewi‡q Av‡m †h, cwb‡Z †h wewfb ai‡bi Kwgi wWg Ges jvfv cvIqv hvq Zv cnbmxgvi ewn‡i| G †_‡K GUvI †ewi‡q Av‡m †h cwb hv wek¯v¯¨ ms¯v KZK mcwikKZ Waste water treatment plant wbqgvbhvqx, hw` Mnv¯jx Kv‡R e¨eüZ nq ZeI Zv gvbe ¯v‡¯¨i Rb¨ ûgwK¯i|c|

Key words: Prevalence, helminth, lake, surface water

*Corresponding author. Email: sislam@icddrb.org [1]Department of Zoology, University of Dhaka, Dhaka-1000, Bangladesh

INTRODUCTION

Helminth infections impose a great burden on poor population in the developing world (WHO 2006). It is a major public health problem in the developing and the underdeveloped countries including Bangladesh (Rahman *et al.* 2001). *Ascaris* and *Trichuris* infections are estimated to range between 1450 and 604-800 million, thereby representing a disease burden of 1.8 and 1.6 million DALYs, respectively (Bethony *et al.* 2006, WHO 2002). Due to the pathogenic effect of helminth infections causing blood loss, *Ascaris* and *Trichuris* reach their maximum infectious intensity among children between age 5 and 15 years (Bundy *et al.* 2004). Crompton (2000) and Crompton *et al.* (1989) observed 335, 220 and 159 million morbidity for *A. lumbricoides, T. trichiura* and hookworm, respectively. They found highest mortality (65 thousands/year) due to the infection of hookworm followed by *A. lumbricoides* (60 thousands/year) and *T. trichiura* (10 thousands/year).

The environmental route of transmission is important for many protozoan and helminth parasites, with water, soil and food being particularly significant. Both the potential for producing large numbers of transmitable stages and their environmental robustness (with the ability to survive in moist microclimates for prolonged periods of time) pose persistent threats to public and veterinary health. Increased demands made on natural resources increase the likelihood of encountering environments and produce contaminated with parasites (Smith 1999).

The Gulshan lake is mainly contaminated by sewage due to discharged faecal matters and other pollutants. The unhygienic latrines which discharge the faecal matters directly into the water bodies play a major role in this faecal contamination. Due to these unhygienic and unplanned latrines and careless practices of the slum people of Gulshan area around the lake pollutes it’s water. These factors are related with the microbial contamination and act as a basic cause for the wide prevalence of intestinal protozoan and helminths infection.

The common nematode found in Bangladesh are *Ascaris lumbricoides*, *Trichuris trichiura, Ancylostoma duodenale* (Hookworm), *Strongyloides stercoralis* etc. These parasites may cause mild or severe diseases, generally producing symptoms like abdominal pain and vomiting (Saha and Chowdhury 1961). Strongyloidiasis caused by *S. stercoralis*, like most filth borne diseases, is most prevalent under the condition of low sanitation standards. Peoples typically become infected with strongyloidiasis by contacting the juvenile in contaminated soil and water (Schmidt and Roberts 1989). An estimated one billion persons in low-income group of developing countries do not have access to improved drinking water (Rangel *et al.* 2003).

Surface water system of Bangladesh consists of four major rivers, three large lakes and more than 1000 beels and haors (Rahman *et al.* 2002). WHO (2002) estimated that up to 80% of all sickness and diseases in the developing world is caused by inadequate sanitation and polluted water. At least two billion people in the world suffer from helminthiasis and, of those, approximately 300 million sufferers are associated with severe morbidity (Kaminsky *et al.* 2004).

OBJECTIVES

The present study was conducted (1) to isolate and identify the helminth parasites from the surface water of Gulshan Lake and to determine the monthly and seasonal prevalence of different species of helminths; (2) to determine the biological and chemical parameters of the surface water system and its co-relation with the parasites.

Though Gulshan lake is an important issue for Dhaka city no study was done on the parasitological contamination of this water body. The present study is a pioneer approach in this regard.

MATERIAL AND METHODS

A total of 24 water samples was taken from March 2005 to February 2006 from the Gulshan lake, Dhaka, Bangladesh. The samples were collected in a sterile plastic bottle of one liter capacity and transported direct to the Environmental Microbiology Laboratory, ICDDR,B in an insulated cool box containing ice packs (Johnny Plastic Ice, Pelton Shepend, Stockton, CA, USA). Collected water samples were processed within six hours of collection. Samples were collected at every 15-day interval. Every time three litres of surface water were collected. Samplings were always made from a permanent station previously set up in the site. For the determination of biological parameter water samples collected separately and all processes were carried out aseptically. The collection and record keeping procedures were maintained as per APHA technique (APHA 1998).

All the samples were tested for total coliform (TC) and faecal coliform (FC) following the procedure described APHA (1998) and Islam *et al.* (2001). In short, water samples were diluted serially then dropped on MFC (membrane faecal coliforms) agar plate and incubated at 37±0.5°C and 44±0.5°C for TC and FC, respectively for 18-24 hours. Then the characteristic blue colonies were counted as TC and FC and expressed as colony-forming units (CFU) per ml.

The water samples were analyzed for physico-chemical parameters immediately according to APHA (1998). The total dissolved solids (TDS), conductivity, salinity, dissolved oxygen (DO) and pH were measured using potable meters (HACH conductivity meter Cat No. 51800-18, Session™5, USA, HACH potable dissolved oxygen meter, Cat No. 51850-18, Session™6, USA and Orion potable pH meter, Cat No. 210 A, Orion Research, USA). The physico-chemical parameters were measured immediately at 25°C in the laboratory following the procedure described earlier Tandon (1985) and Islam *et al.* (1995).

The modified Bailenger method (Bailinger 1979) was followed for the detection of pathogenic helminths in the water. One liter surface water was allowed for 1-2 hour(s) for sedimentation. Then 90% supernatant was removed using siphon. The sediment was transferred to a centrifuge tube and centrifuged at 1000g for 15 minutes. The pellet was suspended in an equal volume of acetoacetic buffer (pH: 4.5) and double volume of ether followed by centrifugation at 1000g for 15 minutes. The sample was separated into three distinct phases and the pellet was resuspended with five times of zinc sulphate solution (specific gravity 1.18-1.20). An aliquot was transferred to a graded slide and left to stand on a flat surface for five minutes before examination, which allows all the eggs to float to the surface. Finally the slide was observed with a binocular light microscope (Olympus, Japan) under 10x magnification.

The eggs or larva of the parasites present in the collected samples were observed under the microscope and identified following the key described earlier by Chatterjee (1980) and analyzed according to Margolis *et al* (1982). The microphotographs of worms were taken using Olympus PM-6 compact photomicrograph equipment and also with a digital camera. All the data were analyzed with the help of SPSS 10.1 statistical software.

RESULTS AND DISCUSSION

In the present study, four types of nematode parasites were found out of which, two were the nematode eggs of *Ascaris lumbricoides* and *Trichuris trichiura* and two were nematode larvae (rhabditiform larva of *Strogyloides stercoralis* and hookworm). All the samples collected were positive for *A. lumbricoides* whereas *T. trichiura*, *S. stercoralis* larva and hookworm larva detected only in 25% samples. A total of 576 *A. lumbricoides* eggs was enumerated from 24 samples (mean intensity 23.96 ± 14.63). Sixty two *T. trichiura* eggs were found with 10.33 ± 2.87 mean intensity. In total 117 larvae of *S. stercoralis* and 124 larvae of hookworm were identified from six positive samples. The mean intensities were 19.5 ± 1.64 and 20.67 ± 2.5 for *S. stercoralis* and hookworm larva, respectively (Table 1).

Table 1. Percentage and mean intensity of helminth egg and larva present in the water of Gulshan lake, Dhaka in the years 2005-06.

Parasite eggs and larvae	No of sample observed	No. of positive samples	%	No. of egg / larva	Mean Intensity
A. lumbricoides egg	24	24	100	576	23.96 ± 14.63
T. trichiura egg	24	6	25	62	10.33 ± 2.87
S. stercoralis larva	24	6	25	117	19.5 ± 1.64
Hookworm larva	24	6	25	124	20.67 ± 2.5

During the summer season (March-June), a total eight water samples were taken and examined. All the samples were positive for *A. lumbricoides* eggs. Intensity of eggs was 25.62 ± 10.17 (Table 2). The same numbers of samples were examined in the rainy season (July-October) and 102 eggs were found with a mean of 12.75 ± 5.9 (Table 2). During the winter season (November-February) highest mean value (33.5 ± 17.72) (Table 2) observed for *A. lumbricoides* eggs. No *T. trichiura* eggs were found during the rainy season.

In case of *T. trichiura,* the mean intensity of eggs were 7.5±2.12 during the summer and 11.75 ± 2.1 during the winter season (Table 2). Both *S. stercoralis* and hookworm larvae showed highest number (21.00 ± 0.0 and 22.66 ± 0.0, respectively) during the summer season. The same mean intensity observed both in rainy and winter seasons (18.00 ± 0.0) in case of *S. stercoralis* whereas, the hookworm showed the lowest mean intensity in the winter season (Table 2).

The highest count of total coliform (7.56 $\log_{10}$ cfu/l) observed in April, October and February, and the lowest in January. The highest count of faecal coliform was 7.38 $\log_{10}$ cfu/l in October and lowest count (7.2 $\log_{10}$ cfu/l) recorded in July. Table 3 shows the correlation within helminth counts, bacteriological counts and also the physico-chemical parameters of the water.

The highest conductivity was (1445 ± 82 uS/cm) recorded in March and lowest (385 ± 0.0 uS/l) in August. While considering the seasonality, conductivity was the highest (851.25 ± 469.7 uS/L) during the summer and lowest during the rainy season (566 ± 179 uS/L). The salinity was highest (0.44 ± 0.24 ppt) during the summer season and lowest (0.25 ± 0.16 ppt) during the winter. The highest salinity (0.75 ppt) was recorded in March and lowest (0.15 ppt) in January, February and August. Both TDS and DO of the water was the highest in summer (418.5 ± 235.6 and 1.35 ± 0.73 mg/l, respectively) and lowest in winter (347.25 ± 114.16 and 0.89 ± 0.23 mg/l, respectively). pH showed difference with the above parameters. It was the highest in winter (6.91 ± 0.36) and lowest in rainy season (6.4 ± 0.88).

Table 2. Seasonal occurrence and intensity of four types of parasites in the Gulshan lake.

Parasites	Summer (March-June)				Rainy (July- October)				Winter (November-February)			
	n	Positive %	No of para-sites	Mean Intensity	n	Positive %	No. of para-sites	Mean Intensity	n	Positive %	No. of para-sites	Mean Intensity
A. lumbricoides	8	100	205	25.62 ± 10.2	8	100	102	12.75±5.9	8	100	268	33.5 ± 17.7
T. trichiura	8	25	15	7.5 ± 2.12	8	00	00	0±0	8	50	47	11.75 ± 2.1
S. stercoralis	8	37.5	63	21 ± 0	8	12.5	18	18±0	8	25	36	18 ± 0
Hookworm larva	8	37.5	68	22.66 ± 0	8	12.5	20	20±0	8	25	36	18 ± 0

A strong correlation (0.998, P < 0.01) was found between *Strongyloides stercoralis* and Hookworm larva which indicates that both of them were abundant at the same time in the water sample. *A. lumbricoides* and *T. trichiura* eggs were also significantly correlated (0.633, P < 0.05) with each other. The abundance of nematode larva was inversely correlated with TDS. Total coliform (TC) showed a significant correlation with faecal coliform (FC). No significant relationship was found between microbial parameters and chemical parameters. But some interrelationship was found within chemical parameters such as between conductivity-salinity, salinity-TDS, TDS-DO etc.

Table 3. Correlation matrix for the relationship among the parasites and the parameters of collected water samples from Gulshan Lake.

	Con	Sal	TDS	DO	pH	TC	FC	*A.l*	*T.t*	SL	HL
Con	1.000										
Sal	0.413*	1.000									
TDS	0.399	0.862**	1.000								
DO	0.273	0.388	0.412*	1.000							
pH	0.236	0.275	0.142	0.137	1.000						
TC	0.200	0.261	0.441*	0.272	-0.264	1.000					
FC	0.302	0.494*	0.483*	0.113	-0.080	0.753	1.000				
A.l	0.093	0.094	0.260	0.220	0.352	0.062	-0.009	1.000			
T.t	-0.086	0.131	0.266	-0.060	0.328	0.107	0.074	0.633*	1.000		
SL	-0.158	-0.340	-0.543	-0.041	-0.299	-0.121	-0.025	-0.192	-0.225	1.000	
HL	-0.157	-0.338	-0.540**	-0.290	-0.290	-0.128	-0.019	-0.188	-0.219	0.0998**	1.000

* and ** representing significance at 5% and 1% level of probability, respectively (Pearson Correlation, 2-tailed). Con= Conductivity, Sal= Salinity, TDS= Total Dissolved Solid, DO= Dissolved Oxygen, TC= Total coliform, FC= Faecal coliform, SL= Strongyloides larva and HL= Hookworm larva.

Helminth parasites are abundant in the tropical and subtropical countries like Bangladesh but the abundance of such helminths in the surface water have never been determined. The present study is pioneer in this country. The prevalence of intestinal helminthes in different population has been determined in different times but not in surface water.

CONCLUSION

In different parts of the world helminth parasites are detected in the wastewater to observe the efficacy of Wastewater Treatment Plant (WTP) where less than one helminth egg count per liter is recommended. In our country lake water rather than wastewater, helminths egg count is beyond the acceptable limit according to the WHO recommendation (WHO 1989).

According to WHO (1990) and other environmental and agricultural agencies this water cannot be used for irrigation or other agricultural purposes. But in the present situation people around the lake using this water for washing vegetable, utensils and different household purposes. This practice may have a greater health impact on the population of that region.

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(Manuscript received on September 6, 2009; revised on April 24, 2010)