Prevalence of Gastrointestinal Parasitic Infestation in Hospital Admitted Under Twelve Years Old Children and Their Associated Risk Factors

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Session: 2019-2020

A thesis submitted in the partial fulfillment of the requirements for the degree of MPH (Public Health)

One Health Institute

Chattogram Veterinary and Animal Sciences University

Chattogram-4225

June 2022

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Dr. Tazrina Rahman

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This is to certify that we have examined the above MPH (Public Health) thesis and have found that is complete and satisfactory in all respects, and that all requiredby the thesis examination committee have been made.

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Acknowledgements

All praises to almighty Allah who gave me the opportunity to be enrolled in the **One Health Institute** for achieving Master in Public Health. I would like to express my veneration to honorable supervisor **Dr. Pankaj Chakraborty**, Professor, Department of Medicine and Surgery, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University (CVASU) for his coherent and articulated instructions. It would not be possible to complete such a laborious task without his scholastic guidelines. It was an exquisite experience for me to work under his supervision. I feel much pleasure to convey my gratitude to honorable co-supervisor **Dr. Md. Abdul Alim**, Professor, Department of Pathology and Parasitology, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University (CVASU) for his valuable suggestions and inspiration and for arranging all institutional support regarding laboratory testing. I am grateful to Dr. Md. Anowarul Azim, Associate Professor, Department of Pediatrics, Chattoram Ma-O-Shishu Medical College for his support in relation to data collection. Special thanks to him for his encouragement and cordial co-operation throughout the work. I would like to acknowledge the support and encouragement received during MPH program from other teachers, technical and non-technical staffs of the One Health Institute, CVASU.

I am also grateful to my family members for their allowance and heartiest support.

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List of Abbreviations

Abbreviation	Elaboration
ASEAN	Association of Southeast Asian Nations
CI	Confidence Interval
CMCH	Chattogram Medical College Hospital
CMOSH	Chattogram Ma-O-Shishu Hospital
CVASU	Chattogram Veterinary and Animal Sciences University
DALY	Disability-Adjusted Life Years
ERC	ERC- Ethical Review Committee
g	gram
GIP	Gastrointestinal Parasitic
ICU	Intensive Care Unit
IPP	Intestinal Protozoan Parasites
min	Minute
ml	Millilitre
RPM	Revolution Per Minute
SPSS	Statistical Software for Social Science
WHO	World Health Organization
YLD	Years Of Life Lost Due To Disability
H/O	History of

Abstract

Gastrointesninal (GI) parasitic infestation is an important public health problem in Bangladesh, especially for children and has a great impact on morbidity and mortality. It is caused by intestinal helminths and protozoan parasites. Parasitic diseases are connected to lack of sanitation, lack of access to safe water and improper hygiene. Current study aimed to assess the prevalence of gastrointestinal parasitic infection and associated risk factors among children from 1 month to 12 years. A total of 299 stool sample were collected from CMCH (Chattogram Medical College Hospital) and CMOSH (Chattogram Ma-O-Shishu Hospital) for the study purpose. Data were collected by using a semi-structured quentionnaire and analyzed by STATA 13 analytical software. Staining and quantitative tests were done to detect and count the parasites and qualititave tests were done for identification of parasites. The overall prevalence of gastrointestinal parasitic infection was 7.4%. Among the infestation, nematodes are found the most. The most commonly occurred nematode was *Ascaris lumbricoides* (47.62%, 95% CI: 25.71-70.22) followed by *Ancylostoma duodenale* (28.57%, 95% CI: 11.28-52.17), *Trichuris trichiuria* (23.81%, 95% CI: 8.22-47.17). Among the Cestodes, the commonest was *Taenia* species (66.67%, 95% CI: 9.43-99.16) and *Hymenolepis* species (33.33%, 95% CI: 0.84-90.57). In Protozoa group, the commonest was *Giardia lamblia* (60%, 95% CI: 14.66-94.73), *Balantidium coli* (20%, 95% CI: 0.51-70.64) and *Cyclospora cayetanensis* (20%, 95% CI: 0.51-70.64). GI parasitic infections were more common among the age group 1 to 59 months (90.3%, 95% CI: 86.36-93.41) and the male gender (63.88%, 95% CI: 58.15-69.33) but statistically (P-value <0.05) was similar in both gastrointestinal parasitic infected participants and with no infected group. Lower mother educational status, urban slum, and lower economic status along with poor personal hygiene practice were found higher among the patients with GI parasitic infection. Increased awareness programs regarding good sanitation and proper personal hygiene can help to reduce the prevalence of gastrointrstinal parasitic infection among the children.

Keywords: Parasite, Gastrointestinal Parasitic Infestation, Children

Chapter 1: Introduction

Gastrointestinal parasitic infections carry a high burden of morbidity and mortality. Over 24% of world's population and mostly children are estimated to be infected with intestinal parasites. More than 267 million preschool-age children and 568 million school-age children live in areas where these parasites are intensively transmitted (WHO, 2022). This infections are caused by either intestinal helminths or protozoan. *Giardia lamblia* and *Entamoeba histolytica* are the most common pathogenic intestinal protozoa in temperate and tropical countries, especially among children and the elderly, causing severe diarrhea (Njambi et al., 2020). Along with protoza, *Ascaris lumbricoides* (roundworm), *Ancylostoma duodenale*, *Necator americanus* (hookworm), and *Trichuris trichiura* (whipworm) are commonly found intestinal helminthes (Berhe et al., 2018). These enter in the body by eating contaminated raw vegetables and fruits, soil-eating behavior (Belete, Kassa and Baye ,2021). Infection by *E. histolytica* is considered the third most common cause of death after malaria and schistosomiasis. *G. lamblia* infects 280 million people annually causing diarrhea in two and half million cases every year (Ouattara et al., 2010; Squire and Ryan, 2017). However, the regional distribution and prevalence differences of parasitic infection among children are mainly due to differences in degree of fecal contamination of water and food, climatic, environmental and socio-culture (Chelkeba et al., 2020). In Bangladesh, prevalence of intestinal parasite may vary between 48.5 to 61.20%, which is quite high (Hossain et al., 2019; Fatema et al., 2020). Majority of this prevalence comes from helminthes, of which *A. lumbricoides, T. trichuria* is common. Of protozoa , *E.histolytica, G. lamblia* are the most prevalent. (Afroz et al., 2019; Fatema et al., 2020). More so, type and burden of parasitosis vary with different age group of children and bears a significant association (Hossain et al., 2019). The most affected ones are usually with economically restrained developing country, living in tropical and sub-tropical regions with a limited or no access to safe drinking water, inadequate sanitation, and substandard housing (Harhay, Horton and Olliaro, 2010; Houweling et al., 2016). Chittagong has a population of about 29 million of which 70% reisde in the rural side which makes it a densely populated area (Chittagong division 2022). Children residing in rural Bangladesh are most likely to be affected, where soil-transmitted helminthic infection and water borne infections are

inordinately common in light of the large proportion of the population that walks barefoot, and consumes inappropriately processed water or food. The high prevalence rate of the parasitic infection is usually correlated with poverty, poor environmental and personal hygiene, and insufficient health services (Mukutmoni and Khanum, 2017). Children are particularly vulnerable due to their habits of playing or handling of infested soils, eating with soiled hands, unhygienic toilet practices, drinking and eating of contaminated water and food (Ngowi, 2020). Hence, children residing in Chittagong might have a high prevalence of intestinal parasitic infections.

Intestinal parasite infections lead to malnutrition, mal-absorption, anemia, intestinal obstruction, mental and physical growth retardation, diarrhea, impaired work capacity, and reduced growth rate constituting important health and social problems (Faria et al., 2017; Dudlová et al., 2016). This vicious cycle is most detrimental in early childhood when the child is most dependent on nutritional resources for its physical and mental development (Belete, Kassa and Baye, 2021). Only few studies have been done focused on Dhaka city of Bangladesh (Hossain et al., 2019; Afroz et al., 2019; Fatema, Ahmed and Khaleque, 2020). However, there is a paucity of studies that focused on the preavelnce and risk factors of gastrointestinal parasite infection in children in chittagong.

Estimating prevalence and character in our setting will provide a better understanding of the burden of GI parasitic infestation. This may aid in the development of solutions. As a result, the purpose of this study was to determine the prevalence of gastrointestinal parasite illness patterns in under-12 children and their associated risk factors.

Aim of the study

Gastrointestinal parasitic infection is major public health concern. Climate, poor sanitation, low personal hygiene and overcrowding altogether makes our country an ideal harbor for these infections. Since children are the most vulnerable this particular infection. It is essential to understand prevalence and character of these infections. The results can help prevent further infections and so its affect on physical and mental growth of children. Therefore, this study aimed to find the prevalence of

gastrointestinal parasitic disease pattern in hospital admitted under-12 children and their associated risk factors.

Objectives

1. To estimate the prevalence of gastrointestinal parasitic infection in children under twelve years old admitted at of **"**Chittagong Medical College and Hospital" and "Chottogram Maa-O-Shishu Hospital", Chattogram
2. To analyze the severity of the gastrointestinal parasitic infection in children under twelve years old at the same setting
3. To analyze the risk factors associated with the occurrence of gastrointestinal parasitic infection in children under twelve years old admitted at he same hospitals

Chapter 2: Review of the literature

2.1 Gastrointestinal parasitic disease

Parasitic infections, caused by intestinal helminths and protozoan parasites, are very prevalent. Especially in developing countries. In developed countries, protozoan parasites more commonly cause gastrointestinal infections compared to helminths. Intestinal parasites cause a significant morbidity and mortality in endemic countries (Haque, 2007). Gastrointestinal parasitic infestation is an important public health problem in Bangladesh, especially for children. Poor housing, unhealthy environment, lack of proper sanitation contribute to the prevalence of parasitic infestation in this developing country (Fatema et al., 2020). Discussed below are the common gastrointestinal parasitic disease:

2.2 Helminths

Helminths are invertebrates characterized by elongated, flat or round bodies. develop through egg, larval (juvenile), and adult stages. Below are the classification of common helminthes. Nematodes (roundworms), cestodes (tapeworms), and trematodes (flatworms) are among the most common helminths that inhabit the human gut (Haque, 2007).

2.2.1 Nematodes or roundworms

Under this phylum the common intestinal genus are *Trichuris, Ascaris, Necator* and *Ancylostoma spp*. These are also called Soil-transmitted helminthes:

***Ascaris lumbricoides*:** They are the largest human intestinal nematode or round worms. It can reach up to 35cm in length and 0.5cm in thickness. These are transmitted through ingestion of fecally contaminated food as eggs. Upon reaching the intestine the embrynated eggs become larvae and emerge in the duodenum. It can penetrate intestinal mucose and pass into lungs for further development. They can then pass into trachea and then pharynx to be swallowed by host. This way they reach small intestine and can become adult worms. Symptoms may include nutritional defeciencies and obstruction, intussusception, jaundice depending on the worm burden and tissue reactions (Park et al., 2008).

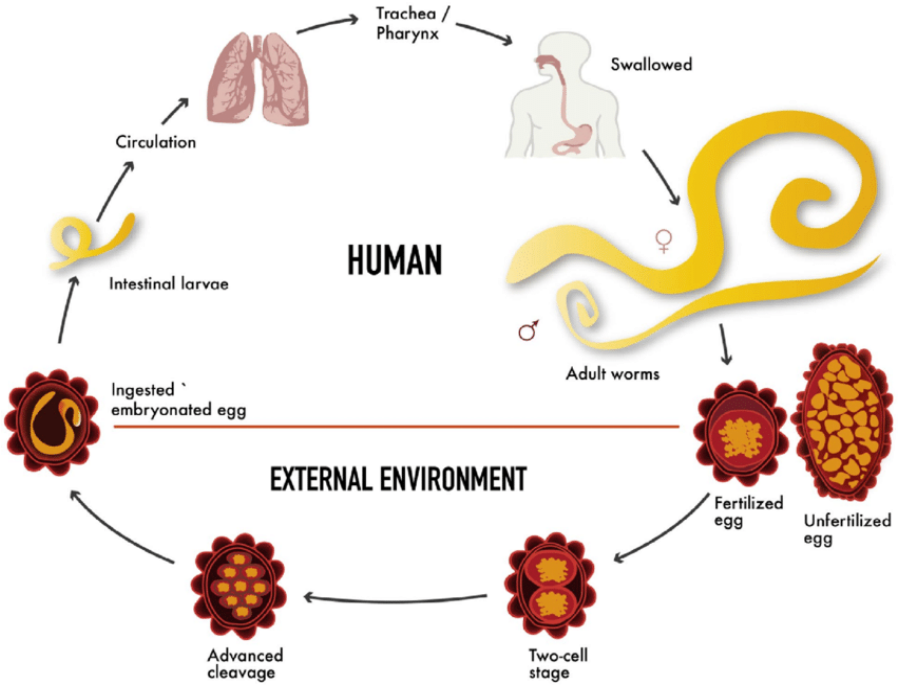


Figure 2.1. Life cycle of Ascaris *zax* inside and outside of the human body(Claus et al., 2018)

***Trichuris trichuria*:** It is another kind of roundworm known as whipworm. It size can vary from 3-5cm, female are larger than male. These can lay 2,000-10,000 eggs per day. They transmit through oro-fecal route. Eggs are deposited in the soil from human feces. In the soil they mature to an infective stage. Upon ingestion of these infective embryonated eggs, they start to hatch in human small intestine and receive their nutrients from intestinal micro flora to grow. Then these move to cecum to penetrate the mucosa and mature to adult worms. Symptoms commonly seen are abdominal pain, painful passage of stools, abdominal discomfort, and mucus discharge. Diarrhea and constipation. Nocturnal passage is also common (Else et al., 2020; Manz et al., 2017; Ranjan et al., 2015).

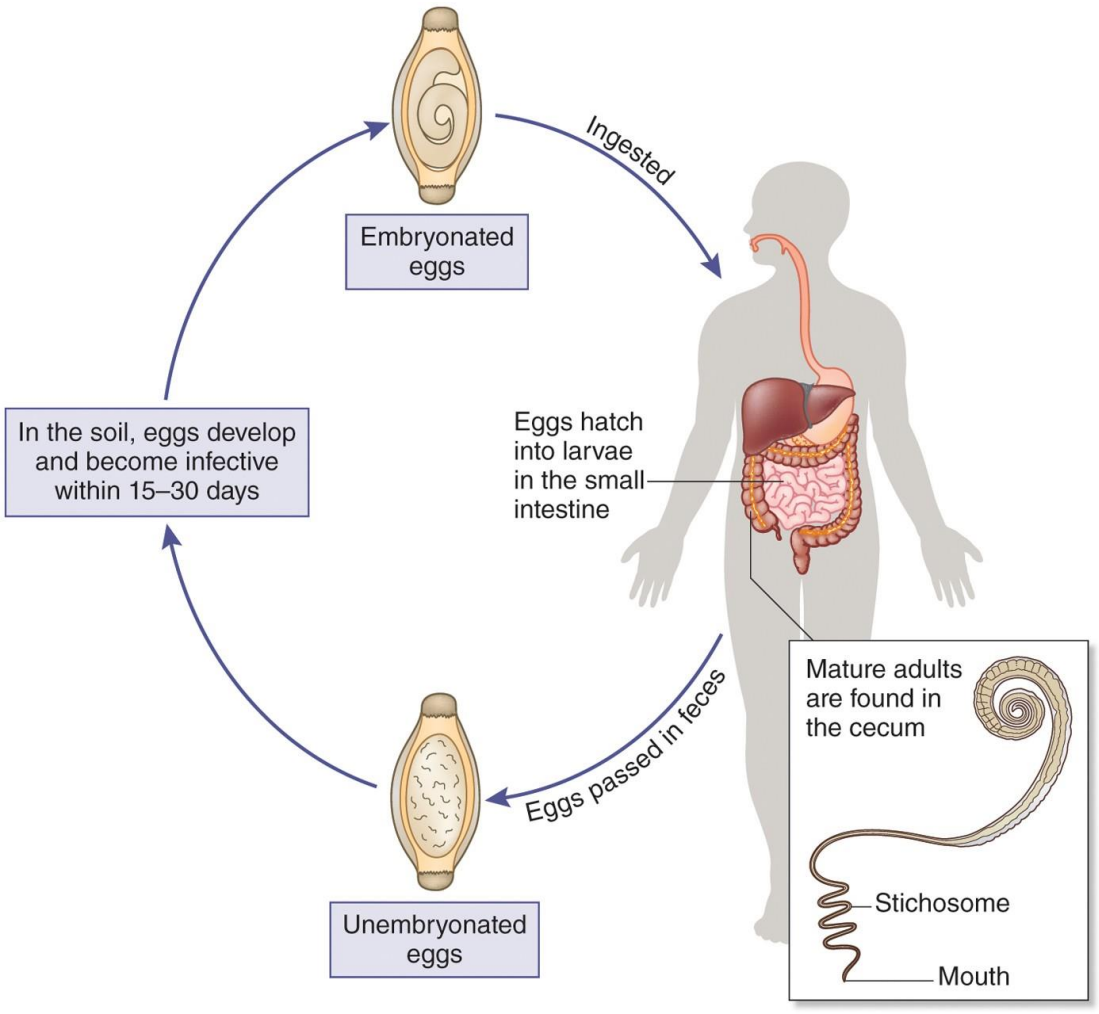


Figure 2.2. Life cycle of *Trichuris trichuria* (Ghedin, 2014)

Ancylostoma dudonale: It is one of most common parasite and a hookworm. It is also transmitted through soil. A.dudonale causes intestinal infections such as GI symptoms, anemia and physical, cognitive impairment. It can also cause pulmonary symptoms. Infections with this hookworms are very commonly prevalent in Asia and other tropical climate, overcrowded populations, poor hygiene and sanitation situations. Their eggs pass from stool of host to soil where they hatch into larvae. Hatch larvae grow in the soil for 5-10 to mature into infective filariform larvae. It can then penetrate the human skin, enter into the lymphatic system and migrate to heart and lungs. In the lungs, the larvae penetrate the pulmonary alveoli, where they ascend from the bronchial tree to the pharynx, can be coughed up, swallowed, and reach the small intestine where they mature into male or female blood-feeding-adults. The mating adult worms can produce thousands of eggs, and the cycle starts over. Furthermore, the filariform larvae can spread via oral ingestion and trans-mammary

route where the larvae directly mature in the small intestine or stay dormant in human skeletal musculature. The dormant larvae have been proven responsible for vertical transmission during breastfeeding and are possibly the cause of transplacental infection. The most serious symptoms of *Ancylostoma* infection develop during the last phase when the adult worms establish themselves in the human intestine. Using their buccal capsule and teeth, the adult worms attach to the mucosa and rupture capillaries and arterioles to feed, and this results in blood and protein loss. Chronic infection in the intestine results in iron deficiency anemia, accompanied by the loss of appetite, abdominal discomfort, and malnutrition due to protein deficiency. This can cause physical and cognitive impairment (Bryant and Hallem, 2018; Gordon et al., 2017).

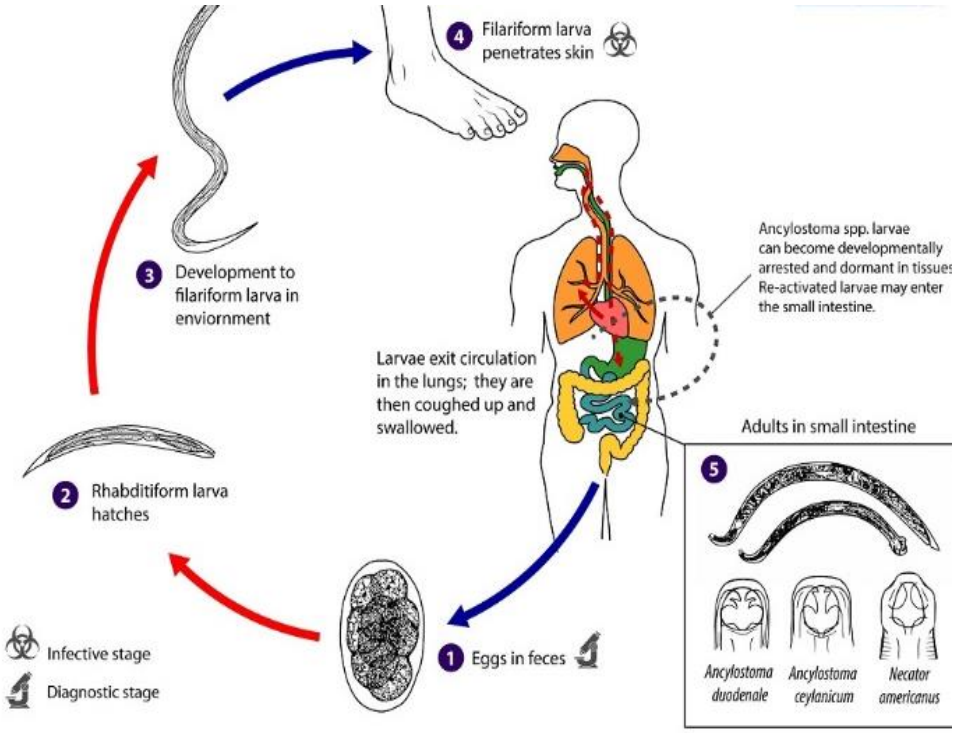


Figure 2.3. Life cycle of *Ancylostoma* (Centers for Disease Control and Prevention, 2019)

2.2.2 Platyhelminthes or flatworms

These are further classied to Trematodes and Cestodes. The common genus under *Cestodes* are *Taenia* spp. And *Echinococcus* spp. Whereas *Schistosoma* spp. falls under trematodes.

Taenia: Taenia saginata, the beef tapeworm, is an important cyclo-zoonotic cestode, with a worldwide distribution. The adult tapeworm develops in the human intestine, producing eggs that are either excreted directly in the faeces or in intact egg-containing proglottids. Cattle, the usual intermediate hosts of the parasite, acquire the infection by the ingestion of eggs, and subsequent migration of the oncosphere via the bloodstream to striated muscles results in the development of a protoscolex containing the cysticercus, the metacestode stage. Both dietary habits (consumption of raw or undercooked cysticerci-infected meat) and sanitary education level of farm workers, as well as appropriate treatment and disposal of sewage can cause the infection. the global burden of disease due to T. saginata is vanishingly low, despite it being a common parasitic infection in some low-income countries. There are, however, occasional case reports of gastrointestinal pain and discomfort or appendicular taeniosis (Torgerson et al., 2019).

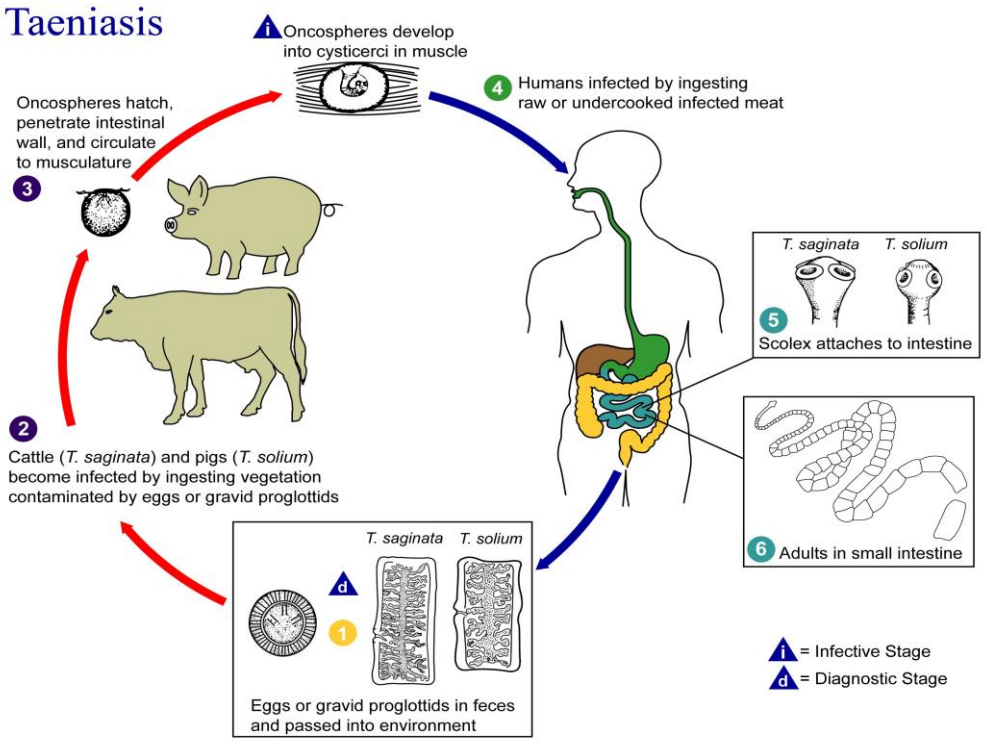


Figure 2.4. Life cycle of *Taenia* (Centers for Disease Control and Prevention, 2019)

Hymenolepis nana: It is also known as the dwarf tapeworm, the most common human tapeworm. Up to 75 million persons are estimated to be carriers, and the prevalence among children is as high as 25% in some areas. Infections are typically asymptomatic. *H. nana* is unique among tapeworms in that it can complete its life cycle in the small intestine, without the need for an intermediate host. Such autoinfection can persist for years and lead to a high parasite burden, particularly in immunocompromised hosts. Infections are generally limited to the gastrointestinal tract, where eggs released in the small bowel by adult tapeworms hatch. The embryos (oncospheres) invade the host intestinal villi, where they are transformed into larvae (cysticercoids) before breaking out and reattaching to the mucosal lining (Muehlenbachs et al., 2015).

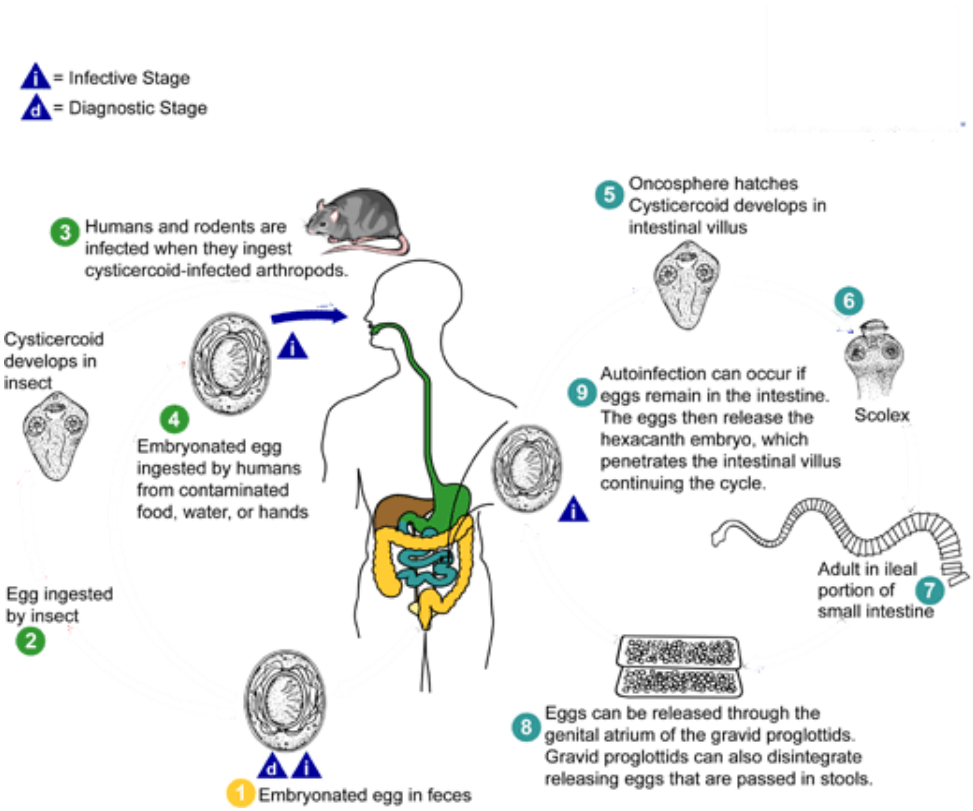


Figure 2.5. Life cycle of *Hymenolepis nana* (Centers for Disease Control and Prevention, 2019)

2.3 Protozoa

Intestinal protozoa are a diverse group of unicellular organism inhabiting the intestinal tract. These cause infections through ingestion of cysts/oocysts contaminating food or drinking water. Infection with intestinal protozoa parasites have worldwide distribution and particularly common in tropics and sub-tropics areas of the world with millions of cases of diarrhea occurring in each year. Several pathogenic protozoan parasites are responsible for the above health issues including *Entamoeba histolytica*, *Giardia lamblia* (also known as *Giardia intestinalis* and *Giardia duodenalis*), *Cryptosporidium* and *Balantidium coli*, which are the most common species associated with significant illnesses (Hossain et al., 2019; Hajissa et al., 2022).

***Entamoeba histolytica*:** Transmit through contaminated water, fecal-oral and contaminated food. It can cause symptoms such as colitis, dysentery, diarrhea, liver abcess, other extraintestinal disease.(Nahar et al., 2011)

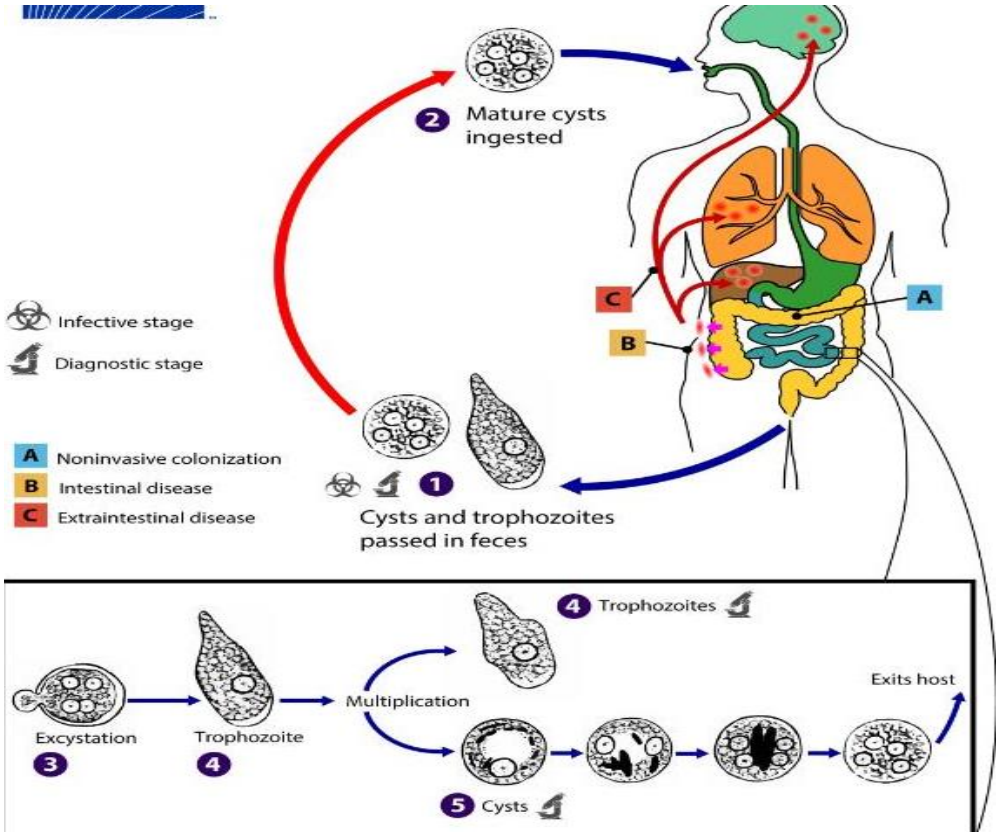


Figure 2.6. Life cycle of *Entamoeba histolytica* (Centers for Disease Control and Prevention, 2019)

***Giardia lamblia*:** Giardiasis is an infection of the small intestine caused by the flagellated protozoan Giardia intestinalis. Worldwide, giardiasis is the most common form of protozoan diarrhea. They transmit through contaminated water, in feco-oral route. Symptoms include nausea, bloating, gas , diarrhea and anorexia (Nahar et al., 2011).

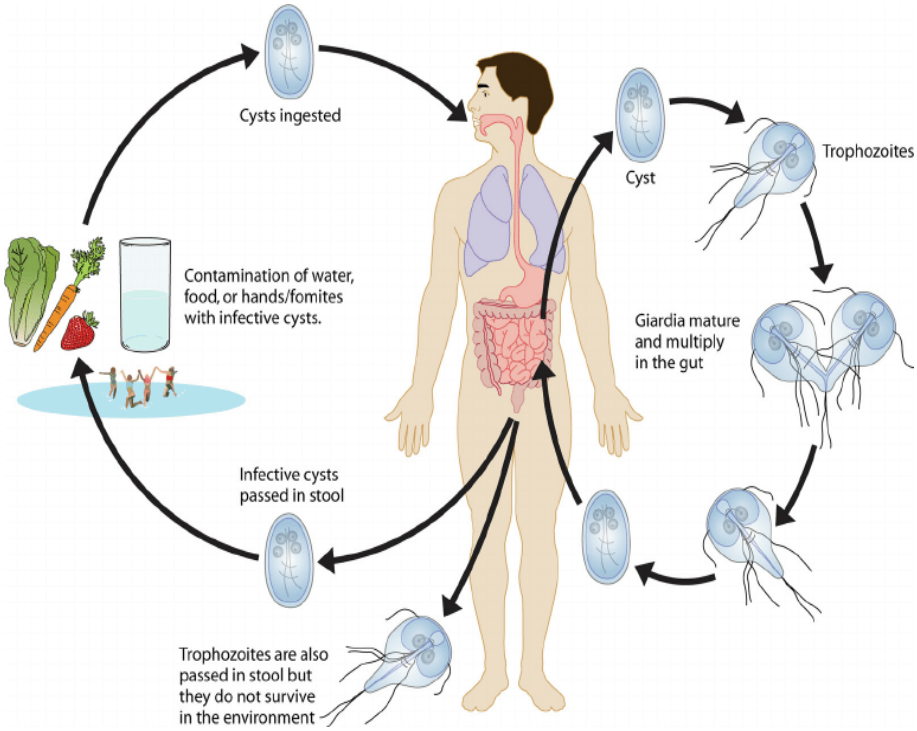


Figure 2.7. Life cycle of *Giardia* spp. (Esch and Petersen, 2013).

Cyclospora cayetanensis: Humans are the only known hosts of this parasite. Its asexual and sexual stages occur in biliary-intestinal epithelium. Male microgamonts have two flagella; female macrogametes contain wall-forming bodies. Oocysts are excreted in feces unsporulated. Sporulation occurs in the environment. Humans are thought to be infected by ingesting food or water contaminated with oocysts (Dubey, Khan and Rosenthal, 2022) .

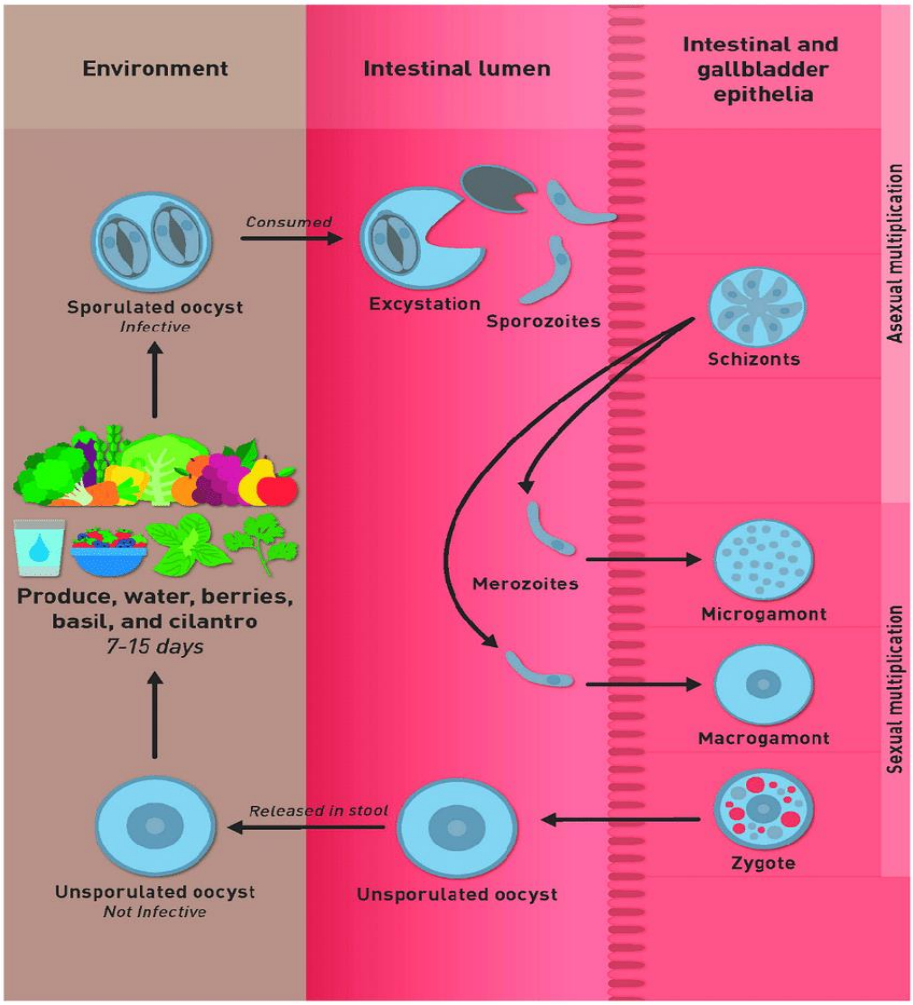


Figure 2.8. Proposed life cycle of *Cyclospora cayetanensis* (Dubey, Khan and Rosenthal, 2022).

Balantadium coli: *Balantidium coli* is a parasitic-opportunistic pathogen that can be found throughout the world. Pigs are its reservoir hosts, and humans become infected through direct or indirect contact with pigs. Balantidiosis is a zoonotic disease and is acquired by humans via the fecal-oral route from the normal host, the pig, where it is asymptomatic. Water is the vehicle for most cases of balantidiosis. Human-to-human transmission may also occur. It resides in human colon and cecum. In rural areas and in some developing countries where pig and human fecal matter contaminates the water supply, there is a greater likelihood that balantidiosis may develop in humans (Schuster and Ramirez-Avila, 2008).

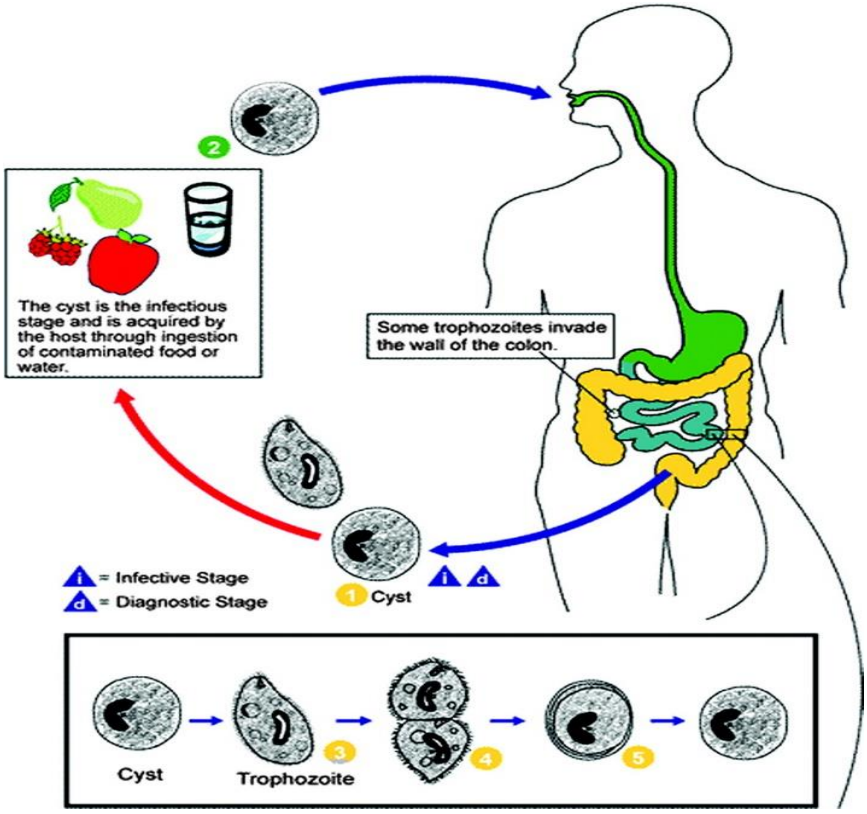


Figure 2.9. Life cycle of *Balantadium coli* (Centers for Disease Control and Prevention, 2015)

2.4 Prevalence of gastrointestinal parasitic disease global, regional and Bangldesh

Infections caused by intestinal protozoan parasites (IPPs) are among the most prevalent human diseases that affect a large section of poor communities particularly in developing countries (Ngowi, 2020).

E. histolytica has an annual incidence rate of five million cases, affects approximately 500 million people worldwide, and results in 50 million annual symptomatic diseases and 100,000 deaths. Making the Infection by *E. histolytica* the third most common cause of death after malaria and schistosomiasis. *Cryptosporidium* spp. and *G. lamblia* are important nonviral causes of diarrhoeal diseases in humans. *G. lamblia/duodenalis* infects 280 million people annually. It results in two and half million cases of diarrhea every year in resource-poor countries alone. In these countries, the prevalence of giardia infection is acquired during early infancy and it reaches up to 30% in children younger than 10 years of age. The global prevalence of

cryptosporidiosis is 1 to 4.5% in developed countries and 3 to 20% in developing countries (Ouattara et al., 2010; Squire and Ryan, 2017).

Globally, it is estimated that 1.45 billion people are infected with soil-transmitted helminths (data as of 2010), resulting in 4.98 years of life lost due to disability (YLDs) and 5.18 million disability-adjusted life years (DALYs) (Suntaravitun and Dokmaikaw, 2018).

The prevalence of soil-transmitted helminth infections is still high among several countries throughout the Association of Southeast Asian Nations (ASEAN) (Dunn et al., 2016).

Small study in Bangladesh found prevalence ranging from 48.5%-61.20% (Hossain et al., 2019; Fatema et al., 2020).

2.5 Risk factors and severity of intestinal parasitic infections

Hand washing practice, lack of personal hygiene, environmental sanitation, safe water supply, poverty, illiteracy, hot and humid climate, young age, female, residing in over crowded area, walking barefoot these are significant risk factors for intestinal parasitic infections (El-Sherbini and Abosdera, 2013; Gelaw et al., 2013; Hailegebriel, 2017)

Table 2.1 Severity of infection (Albonico et al., 2003)

Severity group	**Characteristics**
Light	*A.lumbricoides* when egg count per gram was 1-4999, *T. tichuria* 1-999, and hookworm 1-1999
Moderate	*A.lumbricoides when egg count per gram was 5000-9999, T. trichuria 1000-9999, and hookworm 2000-3999*
Heavy	Both *A.lumbricoides* and *T. trichuria* egg count ≥10,000 and for hookworm ≥4000 was found per gram

2.6 Vulnerability of children to parasitic infection

Despite people of all ages are at risk of being infected by intestinal protozoa, children are the most vulnerable and more likely to present with clinical symptom. Furthermore, school children aged 5–17 years are disproportionately affected and often heavily infected because of their habits of playing or handling infested soil, performing unhygienic toilet practices and eating or drinking with soiled hands (Ngowi 2020).

2.7 Complications of gastrointestinal parasites

They have been recognised as significant causes of gastrointestinal illnesses, malnutrition and substantial mortality. Intestinal parasitic infections causes under nutrition, anemia, intestinal obstruction, and mental and physical growth retardation. Intestinal parasitic infections, mainly Ascariasis, Trichiuriasis, and hookworm, are common clinical disorders in man, with resultant impairments in physical, intellectual, and cognitive development (Gizaw et al., 2018; Park et al., 2008).

2.8 Role of assessing the prevalence of gastrointestinal parasitic disease and their associated risk factor

Parasitic diseases are linked to lack of sanitation, lack of access to safe water and improper hygiene; therefore they occur wherever there is poverty. These diseases deprive the poorest of the poor of health, contributing to economic instability and social marginalization. The poor people of under developed nations experience a cycle where under nutrition and repeated infections lead to excess morbidity that can continue from generation to generation. People of all ages are affected by this cycle of prevalent parasitic infections; however, children are the worst affected (Suntaravitun and Dokmaikaw, 2018; Dunn et al., 2016). Hence, it is essential to estimate the prevalence and understand the character of gastrointestinal parasitic disease in our context , for better handling of this burden.

2.9 Relevant studies showing character and prevalence of gastrointestinal parasitic infection

Jayaram et al. (2021) estimated the prevalence of intestinal parasitic infection under 18 years age group in India. A total of 187 stool samples were analyzed, of

them 13.4% had atleast one parasitic infestation; 6.4% of which were Helminth and 6.9% were intestinal protozoa. Infection were higher in 1-7 years age group compared to 8-18 years age group. Open-air defecation, urban resisdence were significantly associated with these infections. Ascaris *zax* and *Taenia* species were the major organisms and others include *Trichuris trichiura, H. nana, Blastocystis, Trichostrongylus, Entamoeba histolytica, Sarcocystis, Pentatrichomonas* were commonly found. They concluded that one out of eight screened children were positive for intestinal parasitic infection and soil transmitted helminthes were present in half of them and suggested that long term control measures should be implemented to reduce the prevalence of infection (Jayaram et al., 2021).

Fatema et al. (2020) determined the proportion of under five children with parasitic infection. In this descriptive study mothers and their under 5 children from Bangladesh participated. The prevalence of intestinal parasites was found to be 52% in both participants and 48.5% in children. Protozoa was found in 15.8% cases and helminthes in 39.6% children. *Entamoeba histolytica* was found in 8.9% cases, *Giardia lamblia* in 5.9% children. Among the helminthes the commonly found were *Ascaris lumbricoides* and *Trichuris trichiura* or both. Children were 2.478 times more likely to have parasitic infestation if mothers were infected. They concluded that they found majority of the study sample to have parasitic infestation (Fatema et al., 2020).

Gupta et al. *(*2020) determined the prevalence of intestinal parasitosis among school children in Nepal. Samples were collected from school going children up to 15 years. A total of 285 children were enrolled in this study. *Giardia lamblia* was the most prevalent (15.4%) followed by *Entamoeba histolytica* like (7.7%), *E. coli* (7%), *Ascaris lumbricoides* (1.8%), and *Hymenolepis nana* (1.08%), respectively. Children of the age group 11–15 years were highly affected (44.2%) compared to younger age groups. Over 85% of infection was associated with parasitosis that indicated mainly waterborne infection rather than soil-borne helminthes. The concluded that poor hygiene and farming occupation is significantly associated with the prevalence of parasitic infestations (Gupta et al., 2020).

Afroz and others (2019) determined the prevalence of helminthic infestations and its affect among the rural children in Bangladesh. A total of 593 students between 5-13 years were enrolled from 5 schools. In this cross-sectional study 593 students aged 5-

13 years enrolled. Out of this, 204 agreed to for fecal samples. Of them, 39.2% children were infested with at least one speices of helminth. *A. lumbricoides, Trichuris trichiura* and mixed infection was 23%, 12.8% and 3.4% respectively. Female were more commonly infected than male. They concluded that the higher prevalence of helminthic infestation implies that further emphasis should be given on the deworming program as well as regular health education campaigns in schools of rural areas (Afroz et al., 2019).

Hossain and others carried out a study on occurrence of intestinal parasite in school going children of slum area of Dhaka. A total of 183 stool samples were investigated from children of 5-16 years. Samples were found positive for intestinal parasites in 61.20% cases. Eight species were identified which are *Ascaris lumbricoides* (24.59%), *Trichuris trichiura* (12.02%), *Giardia lamblia* (6.01%), *Ancylostoma duodenale* (5.46%), *Entamoeba histolytica* (3.83%), *Diphyllobothrium latum* (3.28%), *Paragonimus westermani* (3.83%), and *Enterobius vermicularis* (2.19%). Male were more commonly infected and highest prevalence was seen in 8-10 and 14-16 years of children, respectively. The highest prevalence *of A. lumbricoides* (38.60%), *T. trichiura* (14.04%), *E. histolytica* (7.02%) and *A. duodenale* (8.77%) were observed in 8 - 10 years age group; *G. lamblia* (7.41%), *P. westermani* (5.56%) and *E. vermicularis* (3.70%) in 11 - 13 years age group and *D. latum* (6.90%) was found highest in 14 - 16 years age group. They concluded that different age groups have significant association with parasitic infestation *(Hossain* et al., 2019).

Parasitic infection especially intestinal protozoa and helminthes impose a large threat on children's health. Its prevalence and characters should be explored more in depth to better tackle the problem.

Chapter 3: Materials and Methods

3.1 Description of the study area

Chittagong division is in Bangladesh's east-south area. It is situated on the banks of the Karnaphuli river, between the Chittagong hill regions and the Bay of Bengal. It covers 33,904 square kilometres and is Bangladesh's largest division. The population is 2,914,45,000 people. There are around 7000 public primary schools and 3000 private primary schools. Literacy rate is 52.09% in Chittagong division in 2022(Bangladesh National Portal,2022sss). Chittagong has a tropical climate. Chittagong receives abundant rainfall throughout the year, with only a brief dry season. Chittagong has an average temperature of 25.3 °C and a humidity level of 70-85% (Climate Chittagong ,2022). "Chittagong Medical College and Hospital" and "Chottogram Maa o Shishu Hospital" were the two study centres.This study area was selected due to high probability of parasitic infections as the over-crowding, high humidity, tropical climates rules in favour of it.

Fig-3.1 Chittagong Medical College Hospital

Fig-3.2 Chattogram Ma-O-Shishu Hospital

3.2 Study period

The data collection for this study over a period of one year of June, 2021 to May, 2022.

3.3. Selection of study population

Children under the age of 12 years were selected for this study as subjects.

3.3.1 Selection of age group

To understand the pattern and types of the gastro-intesitinal parasite infection in different age group, subjects were divided in two groups. Pre-school children age group (1-59 months) and school going children (5-11 years) (Chelkeba et al., 2020).

3.3.2 Sampling

Study population were randomly selected from the indoor of **"**Chittagong Medical College and Hospital" and "Chattogram Maa o Shishu Hospital". Those admitted with complaints of gasto-intestinal symtpoms. A total of 299 patients were enrolled in the study of which 270 were from pre-school children and 29 from school going children.

After taking informed written consent from their guardian, those willing to participate in this study were interviewed with a pre-validated semi-structured questionnaire.

3.4 Sample collection and preservation

Stool (approximately 5 gram) was collected as a sample for this study from the patients, where an individual children was considered a sampling unit. Stool samples were collected in sterile plastic containter and immediately preserved with 10% buffered formalin. Then transferred to the clinical pathology laboratory of Chattogram Veterinary and Animal Sciences University (CVASU). Then samples were stored in refrigerator between 4 degree centigrade temperatures. Labeling of the samples were strictly followed to prevent misinterpretation.

3.5 Sample size

Sample size was calculated by using Cochran's formula considering 5% level of significance, 10% precision level (marginal error), sample size is calculated by using Guiltford Frucher's formula (Habib, Johargy and Mahmood, 2014). The formula is:

$$\left(n = \frac{z^2 \times pq}{d^2} \right)$$

Where,

n = estimated sample size

z = 1.96 (in 95% Confidence Interval)

p = prevalence of gastrointestinal parasite infection in children 48.5% (Fatema et al., 2020) = .485

q =1-p= 1- 0.485= 0.515

d = admissible error (marginal error) considered as 10 % (0.1)

Therefore, the estimated sample size is

$$\frac{(1.96)^2 \text{ X } 0.485\text{X } 0.515}{(0.1)^2} = 95.9$$

So, calculated sample size is 95.9.

In this study, total 299 sample size was considered for this study.

3.6 Examination of stool Sample

All the fecal sample examination was carried out at the Parasitology laboratory, Chittagong Veterinary and Animal Sciences University (CVASU). Samples went through initial gross examination of color, consistency, prescence of blood or mucus and gross parasite or portion of it. Qualitiave tests of three kinds, namely direct smear, floatation and sedimentation tests and quantitavtive test following Mcmaster technique was done to examine the fecal samples. At least, two smears were prepared from each sample for each test to identify the morphological characteristics of eggs, cyst, Oocysts etc. Each individual samples were first homogenized and the filtered by straining for the fecal suspension. Direct smear was performed by putting a drop of fecal suspension and adding idioine stain on a glass slide. Sugar salt solution and MgSo4 solution were used as floatation fluid. Test tube

floatation was achieved by adding 50 ml of floatation fluid to 5 gram of feces sample. After straining it was put into a testube where a cover slip was placed after a meniscus formed. After letting the cover slitp to stand for 20 minutes it was transferred to a slide and observed. With centrifugal technique, mixing 5 gram of feces with enough water and then straining the suspension done. Then taking 15 ml of fecal suspension, it was centrifuged at 1500 rpm for 5 minutes.after discarded the supernatant it was re-suspended using applicator stick follwoing addition of 0.5 ich of concenctrated floatation fluid and then observed. For sedimentation, 3 gram of feces was mixed in 40ml of tap water and filtered to make a suspension. Then it was stand still for 20-30 minutes and centrifuged for 5 minutes at 1500 rpm in centrifugal sedimentation technique. After discarding the supernatant it was re-suspended with 5ml of water for 5 minutes.Then a small amount of put on a slide for omicroscopic observation (Sastry and Bhat, 2018) .

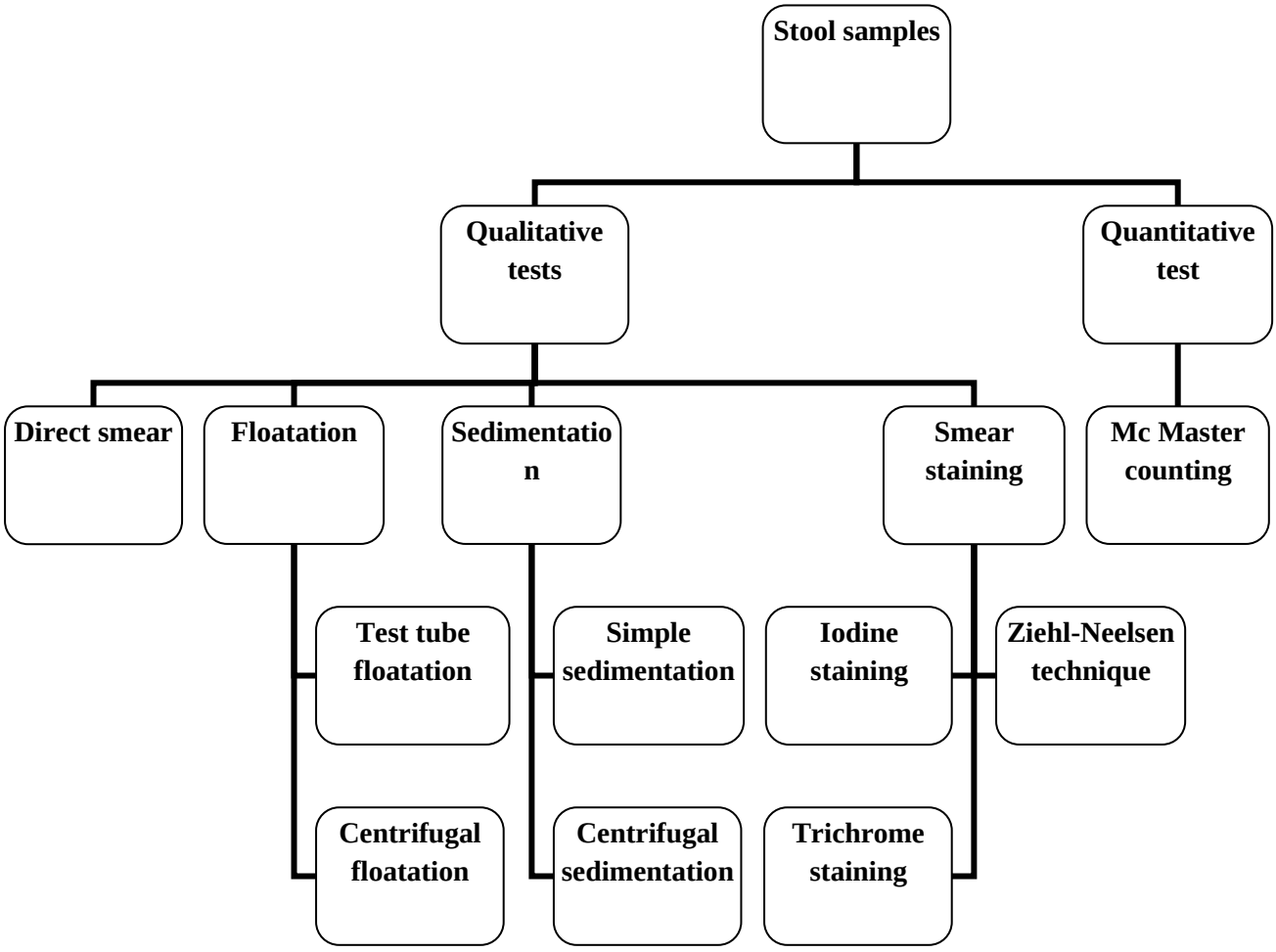
Staining was performed using iodine solution, Ziehl-neelsen and Trichome staining. For the Ziehl-Neelsen staining prepared smear were stained with strong carbolfuchsin for 15-20 minutes. Then it was rinsed thoroughly with tap water. Decolorization by 1% ethyl alcohol was doen for 15-20 seconds and rinsed thoroughly again. Then the slides were counter stained with 0.4% malacgite green for 30-60 seconds. After rinsing thoroughly and letting to air dry. Slides were examined with X40 and X100 objectives. Trichrome staining It was done by first drying the smear for 30 minutes. Then 70% ethanol-iodine was added and kept for 10 minutes followed by 70% ethanol alcohol and wait for 3 minutes. Then slide was immersed in Trichrome stain for 10 minutes. Afterwards, it was de-stained by 90% ethyl alcohol for 1-3 seconds to get the excess stain out. For dehydration, slide was rinsed in 100% ethanol for several times and then immersed in 100% ethanol for 3 minutes two times. Stained smear was then placed in xylene for 10 minutes and for two times. Finally then the slide was mounted placing a coverslip on the smear and dried overnight. Slide was then observed under microscope in oil immersion. (Sastry and Bhat, 2018) .

Quantitative tests were done for counting eggs of nematodes only. With 3grams of feces samples mixed with 45ml of water , a suspension was created and then filtered through a strainer. It was centrifuged by taking 15ml of suspension in the centrifuge

tube. Rate of centrifuge was 1500 rpm for 3 min. Discarding the supernatant , floatation fluid was added up to 15 ml and mixed. Then the McMaster counting chamber was filled with this mixture and left for 3-5 mintues and counted on microscope. Since, 1gram of stool is present in 15 ml of solution and volume of 1 chamber was 0.15ml, the eggs per gram was counted by multiplying 100 with total eggs counted. This formula was also used in case of counting Larva per gram and oocyst per gram as well as described (Bondarenko et al., 2009).

Species of parasite was not explored in this study.Egg,cyst and oocyst were identified upto genus level.

3.7 Experimental design (At a glance)



3.8 Statistical analysis

Data from questionnaire and laboratory testing results were entered, collated, coded and stored in Microsoft Excel 2010 software.After sorting, data were input into STATA 13 analytical software for statistical analysis. Proportions of the patient's demographic and hygiene practice data were presented with a 95% confidence level (CI) at 5% acceptable error level.

Prevalence of gastrointestinal parasite infection was calculated using positive samples divided by the total number of samples tested and the results were expressed as a percentage with 95% CI. Chi-square test was performed to find out the univaraite association of parasitic infestation with different demographic and hygiene practice factors. A p-value of <0.05 was considered as statistical significant.

Severity of infection was divided into three groups; light, moderate and heavy. For A. *zax* when egg count per gram was 1-4999 it was considered light, For T. tichuria 1-999 and for hookworm 1-1999. Moderate was considered for A. *zax* when egg count per gram was 5000-9999, for T. trichuria 1000-9999 and for hookworm 2000-3999. Heavy infection was considered when both A. *zax* and T. trichuria egg count ≥10,000 and for hookworm ≥4000 was found per gram (Albonico et al., 2003).

3.9 Ethical Considerations

Before recruitment, parents of the participants were informed about the purpose, length, and anonymity of the study. The participants were also informed that their data would be used for research purposes, but without disclosing the identity of the participants. The study was conducted following the Declaration of Helsinki.

Chapter 4: Results

This study was conducted in Chattogram Medical College Hospital (CMCH) and Chattogram Ma-O-Shishu Hospital (CMOSH). A total of 299 stool sample of the patients aged between 1 months to 11 years those who were admitted in the hospital during the study period were collected for this study.

4.1 Socio-demographic status of the patients associated with GI parasitic infection

Majority (90.3%) of the children were aged between 1 months to 59 months with mean age of the patients was 22.1±24 months. Most of them were male (63.9%) and school not going (90.6%). Among all, 41.8% of the mother was illiterate and 58.5% were living in urban slum. Majority (67.9%) had economic status lower class. Among all, 70.9% were admitted in CMCH and 29.1% were in CMOSH. Among all, 56.5% had H/O anti protozoal drug and 41.2% had H/O anti helminthic drug and 32.5% were living in proximity of animal.

Table 4.1: Distribution of the patients by sociodemographic profile

	Frequency (n)	Percentage (%)	95% CI
Age group			
1 months to 59 months	270	90.3	86.36 – 93.41
5 years to 11 years	29	9.7	6.59 – 13.63
Mean±SD in months (Range)	22.1±24 (1 to 132)		
Gender			
Male	191	63.88	58.15 – 69.33
Female	108	36.12	30.67 – 41.85
Educational status			
Not school going	271	90.64	86.75 – 93.69
Play	2	0.67	0.08 – 2.4
Primary	26	8.7	5.76 – 12.48
Mother educational status			
Illiterate	96	32.11	26.85 – 37.72
Primary education	125	41.81	36.15 – 47.62
Secondary education	60	20.07	15.68 – 25.06
Higher secondary education	4	1.34	0.36 – 3.39
Graduation	14	4.68	2.58 – 7.73
Area of Residence			
Urban apartment	67	22.41	17.81 – 27.56
Rural	56	18.73	14.47 – 23.62
Urban slum	175	58.53	52.71 – 64.17
Refugee camp	1	0.33	0.01 – 1.85
Economic status			
Lower	203	67.89	62.28 – 72.15
Middle	96	32.11	25.85 – 37.72
Admitted Hospital			
CMCH	212	70.9	65.4 – 75.99
CMOSH	87	29.1	24.01 – 34.6
H/O anti protozoal drug	169	56.52	50.59 – 62.22
H/O anti Helminthic drug	147	49.16	43.36 – 54.98
Living in Proximity of animal	97	32.44	27.17 – 38.07

4.2 Clinical Features of the patients during admission associated with GI parasitic infection

All the patients had loose motion followed by Vomiting (85.3%), Fever (79.6%), Abdominal pain (66.2%), foul smelling stool (56.5%), Itching in perianal area (31.8%), Nausea (26.4%), Anorexia (23.7%), Altered bowel movement (23.1%), Flatulence (21.4%), Dehydration (15.7%), weakness (5.7%), Cough (4%), bloody stool (4%) and urinary retention (3.3%).

Table-4.2: Clinical features of the patients during admission

Sign and symptoms	Frequency (n)	Percentage (%)	95% CI
Vomiting	255	85.28	80.75 – 89.1
Fever	238	79.6	74.58 – 84.02
Abdominal pain	198	66.22	60.55 – 71.56
Odor of stool foul smelling	169	56.52	47.35 – 58.94
Itching in perianal area	95	31.77	26.53 – 37.38
Nausea	79	26.42	21.21 – 31.8
Anorexia	71	23.74	19.04 – 28.98
Altered bowel movement	69	23.08	18.42 – 28.27
Flatulence	64	21.4	16.89 – 26.49
Dehydration	47	15.72	11.78 – 20.35
Weakness	17	5.69	3.35 – 8.95
Cough	12	4.01	2.09 – 6.91
Bloody stool	12	4.01	2.09 – 6.91
Urinary retention	10	3.34	1.62 – 6.06

4.3 Personal hygiene of the participants associated with GI parasitic infection

Personal hygiene of the study participants is given below.

Table-4.3: Personal hygiene of the study participants

Personal Hygiene	Frequency (n)	Percentage (%)	95% CI
Have a place for hand washing	207	69.23	63.66 – 74.42
Source of your drinking water			
Tap water	197	65.89	60.21 – 71.25
Tube well	84	28.09	23.07 – 33.56
Purifier	9	3.01	1.38 – 5.64
Other	9	3.01	1.38 – 5.64
Place of store water			
Drum	30	10.03	6.87 – 14.01
Bottle	22	7.36	4.67 – 10.93
Pitcher	58	19.4	15.07 – 24.34
water tank	189	63.21	57.47 – 68.69
Source of water used for utensil wash			
Tube well	57	19.06	14.77 – 23.98
Tap	209	69.9	64.35 – 75.04
Pitcher	10	3.34	1.61 – 6.06
Pond	11	3.68	1.85 – 6.49
Bottle	9	3.01	1.38 – 5.64
Water tank	3	1	0.21 – 2.9
Took any undercooked or raw meat	15	5.02	2.83 – 8.14
Wash hands before baby feeding	240	80.27	75.3 – 84.63
Wash hands after using washroom	292	97.66	95.24 – 99.05
Sanitation status	296	99	97.09 – 99.79
Use of sandal in house	142	47.49	41.71 – 53.32
Regular nail cutting	140	46.82	41.06 – 52.65

4.4 Overall prevalence of GI Parasitic infection

Among all the patients, gastrointestinal parasitic infection was found in 7.4% (n=22) cases among them 77.3% had single infection and 22.7% had mixed infection (Table 4.4). Nematode was found in 95.5%, Cestode was found in 13.6% and Protozoa was found in 22.7% patients. Most commonly found Nematodes were *Ascaris lumbricoides* (47.6%) followed by *Ancylostoma duodenale* (28.6%) and *Trichuris trichiuria* (23.8%). Cestodes were *Taenia species* (66.7%), and *Hymenolepis species* (33.3%). Protozoas were *Giardia lamblia* (60%), *Balantidium coli* (20%) and *Cyclospora cayetanensis* (20%).

Table-4.4: Prevalence of different type of gastrointestinal Parasitic infection among the patients

Identified parasites (22)	Frequency (n)	Percentage (%)	95% CI
Single Infection	17	77.27	54.63 – 92.18
Mixed Infection	5	22.73	7.82 – 45.37
Nematode	21	95.45	77.16 – 99.88
Ascaris lumbricoides	10	47.62	25.71 – 70.22
Ancylostoma duodenale	6	28.57	11.28 – 52.17
Trichuris trichiuria	5	23.81	8.22 – 47.17
Cestode	3	13.64	2.91 – 34.91
Taenia species	2	66.67	9.43 – 99.16
Hymenolepis species	1	33.33	0.84 – 90.57
Protozoa	5	22.73	7.82 – 45.37
Giardia lamblia	3	60	14.66 – 94.73
Balantidium coli	1	20	0.51 – 71.64
Cyclospora cayetanensis	1	20	0.51 – 71.64

4.5 Age and gender specific prevalence

Gastrointestinal parasitic (GIP) infection was more common among the age group 1 month to 59 months and male gender but statistically no difference found between both groups.

Table-4.5: Age and gender specific prevalence of Gastrointestinal parasitic infection among of the patients

	Gastrointestinal parasitic infection (N=22)	**95% CI**	**No Gastrointestinal parasitic infection (N=277)**	**95% CI**	**P value***
	n (%)		n (%)		
Age group					
1 month to 59 months	20 (90.91)	70.84 – 98.88	250 (90.25)	86.13 – 93.48	0.920
5 years to 11 years	2 (9.09)	1.12 – 29.16	27 (9.75)	6.52 – 13.86	
Gender					
Male	15 (68.18)	45.13 – 86.13	176 (63.54)	57.57 – 69.21	0.663
Female	7 (31.82)	13.86 – 54.87	101 (36.46)	30.78 – 42.43	

4.6 Demographic information associated with GI parasitic infection

Lower mother educational status, urban slum, lower economic status was more common among the patients with GIP infection. Among all, 72.7% of the patients with GIP infection were admitted in CMCH, 72.7% had H/O anti protozoa, 54.5% had H/O anti helminthic and 13.6% were Living in Proximity of animal

Table-4.6: Personal information related to Gastrointestinal parasitic infection among the patients

	Gastrointestinal parasitic infection (n=22)	**95% CI**	**No Gastrointestinal parasitic infection (n=277)**	**95% CI**	**P value**
	n (%)		**n (%)**		
Educational status					
No education	20 (90.9)	70.84 – 98.88	251 (90.61)	86.55 – 93.78	0.922
Play	0	0 – 15.44	2 (0.72)	0.09 – 2.58	
Primary	2 (9.09)	1.12 – 29.16	24 (8.67)	5.63 – 12.62	
Mother educational status					
Illiterate	8 (36.36)	17.2 – 59.34	88 (31.77)	26.33 – 37.61	
Primary	8 (36.36)	17.2 – 59.34	117 (42.24)	36.35 – 48.29	
Secondary	4 (18.18)	5.19 – 40.28	56 (20.22)	15.65 – 25.44	0.704
Higher Secondary education	1 (4.54)	0.11 – 22.84	3 (1.08)	0.22 – 3.13	
Graduation	1 (4.54)	0.11 – 22.84	13 (4.69)	2.52 – 7.89	

Area of Residence					
Urban apartment	2 (9.09)	1.12 – 29.16	65 (23.47)	18.6 – 28.91	0.149
Rural	2 (9.09)	1.12 – 29.16	54 (19.49)	15 – 24.66	
Urban slum	18 (81.82)	59.71 – 94.81	157 (56.68)	50.62 – 62.6	
Refugee camp	0	0 – 15.44	1 (0.36)	0.01 – 1.99	
Economic status					
Lower	14 (63.64)	40.66 – 82.8	189 (68.23)	62.39 – 73.67	0.657
Middle	8 (36.36)	17.2 – 59.34	88 (31.77)	26.33 – 37.61	
Admitted Hospital					
CMCH	16 (72.73)	49.78 – 89.27	196 (70.76)	65.02 – 76.05	0845
CMOSH	6 (27.27)	10.73 – 50.22	81 (29.24)	23.95 – 34.98	
H/O anti protozoa	16 (72.73)	49.78 – 89.27	153 (55.23)	49.17 – 61.19	0.111
H/O anti Helminthic	12 (54.55)	32.21 – 75.61	135 (48.74)	42.71 – 54.79	0.6
Living in Proximity of animal	3 (13.64)	2.91 – 34.91	94 (33.94)	28.38 – 39.84	0.05

4.7 Clinical features

No significant difference found between clinical features of the patients with GIP infection and without GIP infection.

Table-4.7: Clinical features related to GI parasitic infection among the patients

Clinical features	Gastrointestinal parasitic infection (n=22)	95% CI	No Gastrointestinal parasitic infection (n=277)	95% CI	P-value
	n (%)		n (%)		
Vomiting	17 (77.27)	54.63 – 92.18	238 (85.92)	81.26 – 89.79	0.27
Fever	15 (68.18)	45.13 – 86.14	223 (80.51)	75.34 – 85	0.167
Abdominal pain	15 (68.18)	45.13 – 86.14	183 (66.06)	60.16 – 71.62	0.84
Itching in perianal area	1 (4.54)	0.11 – 22.84	94 (33.94)	28.38 – 39.84	0.004
Nausea	6 (27.27)	10.73 – 50.22	73 (26.35)	21.26 – 31.96	0.925
Anorexia	4 (18.18)	5.19 – 40.28	67 (24.19)	19.26 – 29.67	0.524
Altered bowel movement	6 (27.27)	10.73 – 50.22	63 (22.74)	17.94 – 28.14	0.627
Flatulence	2 (9.09)	1.12 – 29.16	61 (22.02)	17.28 – 27.37	0.143
Dehydration	4 (18.18)	5.19 – 40.28	43 (15.52)	11.47 – 20.33	0.742
Weakness	1 (4.54)	0.11 – 22.84	16 (5.78)	3.34 – 9.21	0.810
Cough	1 (4.54)	0.11 – 22.84	11 (3.97)	2 – 6.99	0.895
Urinary retention	1 (4.54)	0.11 – 22.84	9 (3.25)	1.5 – 6.08	0.745
Odor of stool foul smelling	9 (40.91)	20.71 – 63.64	160 (57.76)	51.71 – 63.65	0.125
Bloody stool	2 (9.09)	1.12 – 29.16	10 (3.61)	1.74 – 6.54	0.207

4.8 Personal hygiene

No significant difference found between personal hygiene of the patients with GIP infection and without GIP infection.

Table-4.8: Personal hygiene related to GI parasitic infection among the patients

Personal hygiene	Gastrointestinal parasitic infection (n=22)	95% CI	No Gastrointestinal parasitic infection (n=277)	95% CI	P value
Have a place for hand washing	13 (59.09)	36.35 – 79.29	194 (70.04)	64.27 – 75.37	0.284
Source of your drinking water					
Tap water	15 (68.18)	45.13 – 86.14	182 (65.7)	59.79 – 71.28	0.819
Tube well	6 (27.27)	10.73 – 50.22	78 (28.16)	22.94 – 33.85	
Purifier	0	0 – 15.44	9 (3.25)	1.5 – 6.08	
Other	1 (4.54)	0.11 – 22.84	8 (2.89)	1.25 – 5.61	
Place of store water					
Drum	3 (13.64)	2.91 – 34.91	27 (9.75)	6.52 – 13.86	0.283
Bottle	3 (13.64)	2.91 – 34.91	19 (6.8)	4.18 – 10.5	
Pitcher	1 (4.55)	0.11 – 22.84	57 (20.58)	15.97 – 25.82	
water tank	15 (68.18)	45.13 – 86.14	174 (62.82)	56.83 – 68.52	

Source of water used for utensil wash					
Tube well	4 (18.18)	5.19 – 40.28	53 (19.13)	14.67 – 24.27	
Tap	15 (68.18)	45.13 – 86.14	194 (70.04)	64.27 – 75.37	
Pitcher	1 (4.55)	0.11 – 22.84	9 (3.25)	1.5 – 6.08	
pond	0	0 – 15.44	11 (3.97)	2 – 6.99	0.528
Bottle	2 (9.09)	1.12 – 29.16	7 (2.53)	1.02 – 5.14	
Water tank	0	0 – 15.44	3 (1.08)	0.22 – 3.13	
Took any undercooked or raw meat	3 (13.64)	2.91 – 34.91	12 (4.33)	2.26 – 7.45	0.054
Wash hands before baby feeding	19 (86.36)	65.09 – 97.09	221 (79.78)	74.56 – 84.35	0.455
Wash hands after using washroom	21 (95.45)	77.16 – 99.88	271 (97.83)	95.35 – 99.2	0.477
Sanitation status	22 (100)	0 – 84.56	274 (98.9)	96.87 – 99.78	0.624
Use of sandal in house	12 (54.55)	32.21 – 75.61	130 (46.93)	40.93 – 52.99	0.491
Regular nail cutting	10 (45.45)	24.39 – 67.79	130 (46.93)	40.93 – 52.99	0.894

4.9 Degree of infection of the nematodes found among the patients

Among the patients infected by *Ascaris zax*, in heavy infection average eggs per gram were 12800, in moderate infection average eggs per gram were 7300, in light infection average eggs per gram were 2890. Among the patients infected by *Ancylostoma duodenale*, in heavy infection average eggs per gram were 5200, in moderate infection average eggs per gram were 2790, in light infection average eggs per gram were 40. Among the patients infected by *Trichuris trichiuria*, in heavy infection average eggs per gram were 10200, in moderate infection average eggs per gram were 7600, in light infection average eggs per gram were 380.

Table-4.9: Degree of infection of the nematodes found among the patients (n=21)

Gastrointestinal parasitic	Frequency (n)	Percentage (%)
Ascaris lumbricoides		
Heavy		
11200	1	4.7
14400	1	4.7
Avg. 12800		
Moderate		
6700	1	4.7
7900	1	4.7
Avg. 7300		
Light		
3800	1	4.7
4400	1	4.7
2300	1	4.7
1240	1	4.7
3100	1	4.7
2500	1	4.7
Avg. 2890		

Ancylostoma duodenale		
Heavy		
5300	1	4.7
6100	1	4.7
4200	1	4.7
Avg. 5200		
Moderate		
2200	1	4.7
3380	1	4.7
Avg. 2790		
Light		
40	1	4.7
Avg. 40		
Trichuris trichiuria		
Heavy		
10200	1	4.7
Avg. 10200		
Moderate		
7600	1	4.7
Avg. 7600		
Light		
200	1	4.7
530	1	4.7
410	1	4.7
Avg. 380		

4.10 Degree of infection of the nematodes found among the patients

Among 21 GIP infected patients, Degree of infection was heavy in 7 cases, 5 had moderate and 10 had light degree of infection.

Table-4.10: Degree of infection of the nematodes found among the patients

Gastrointestinal parasitic	Degree of Infection						P value*
	Heavy (n=6)		Moderate (n=5)		Light (n=10)		
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	
Ascaris lumbricoides	2 (33.33)	4.32 – 77.72	2 (40)	5.27 – 85.34	6 (60)	26.24 – 87.84	
Ancylostoma duodenale	3 (50)	11.81 – 88.19	2 (40)	5.27 – 85.34	1 (10)	0.25 – 44.5	0.499
Trichuris trichiuria	1 (16.67)	0.42 – 64.12	1 (20)	0.51 – 71.64	3 (30)	6.67 – 65.24	

4.11 Overall GI parasitic infection in hospital admitted patients

GIP was found higher in CHCH. *Ascaris lumbricoides, Ancylostoma duodenale, Trichuris trichiuria, Giardia lamblia, Taenia species, Hymenolepis species* and *Balantidium coli* were found higher in CMCH and *Cyclospora cayetanensis* were found higher in CMOSH.

Table-4.11: Gastrointestinalparasitic infection among the hospital admitted patients

Parasites	**CMCH n** (%)	**95% CI**	**CMOSH** n (%)	**95% CI**	**P value**
***Ascaris lumbricoides* (10)**	8 (80)	44.39 – 97.48	2 (20)	2.52 – 55.61	0.484
***Ancylostoma duodenale* (6)**	4 (66.67)	22.28 – 95.67	2 (33.3)	4.33 – 77.72	0.696
***Trichuris trichiuria* (5)**	3 (60)	14.66 – 94.73	2 (40)	5.27 – 85.34	0.467
***Giardia lamblia* (3)**	2 (66.67)	9.43 – 99.16	1 (33.33)	0.84 – 90.57	0.8
***Taenia species* (2)**	1 (50)	1.26 – 98.74	1 (50)	1.26 – 98.74	0.449
***Hymenolepis species* (1)**	1 (100)	2.5 - 100	0	0 – 97.5	0.531
***Balantidium coli* (1)**	1 (100)	2.5 - 100	0	0 – 97.5	0.531
***Cyclospora cayetanensis* (1)**	0	0 – 97.5	1 (100)	2.5 - 100	0.531

4.12 Age-specific prevalence of GI parasitic infection

All the patients with GIP infection 22 were in the 1 month to 59 months years age group and only 2 patients were in 5 years to 11 years aged group. *Ascaris lumbricoides, Ancylostoma duodenale, Trichuris trichiuria, Giardia lamblia, Taenia species, Hymenolepis species, Balantidium coli* and *Cyclospora cayetanensis* were found higher in 1 months to 59 months aged group whereas, only 1 case of *Ascaris lumbricoides,*1 case of *Taenia species* and 1 case of *Trichuris trichiuria* were found in 5 years to 10 years aged group.

Table-4.12: Age-specific prevalence of GI parasitic infection among the patients

Parasites	**1 month to 59 months** n (%)	**95% CI**	**5 years to 11 years** n (%)	**95% CI**	**P value**
***Ascaris lumbricoides* (10)**	9 (90)	55.5 – 99.75	1 (10)	0.25 – 44.5	0.892
***Ancylostoma duodenale* (6)**	6 (100)	54..07 - 100	0 (0)	0 – 45.93	0.364
***Trichuris trichiuria* (5)**	4 (80)	28.36 – 99.49	1 (20)	0.51 – 71.64	0.334
***Giardia lamblia* (3)**	3 (100)	29.24 - 100	0 (0)	0 – 70.76	0.556
***Taenia species* (2)**	1 (50)	1.26 – 98.74	1 (50)	1.26 – 98.74	0.035
***Hymenolepis species* (1)**	1 (5)	2.5 - 100	0 (0)	0 – 97.5	0.746
***Balantidium coli* (1)**	1 (5)	2.5 - 100	0 (0)	0 – 97.5	0.746
***Cyclospora cayetanensis* (1)**	1 (5)	2.5 - 100	0 (0)	0 – 97.5	0.746

4.13 Gender specific prevalence of Parasitic infection

GIP was found higher among the male patients. *Ancylostoma duodenale, Trichuris trichiuria, Taenia species, Hymenolepis species,* and *Cyclospora cayetanensis* were found higher in male group and *Ascaris lumbricoides, Giardia lamblia,* and *Balantidium coli* were found higher in female group.

Table-4.13: Gender-specific prevalence of Gastrointestinal parasitic infection among the patients

Parasites	**Female (n=7)**	**95% CI**	**Male (n=15)**	**95% CI**	**P value**
	n (%)		n (%)		
***Ascaris lumbricoides* (10)**	4 (57.14)	18.41 – 90.1	6 (40)	16.34 – 67.71	0.452
***Ancylostoma duodenale* (6)**	1 (14.29)	0.36 – 57.87	5 (33.33)	11.82 – 61.62	0.350
***Trichuris trichiuria* (5)**	1 (14.29)	0.36 – 57.87	4 (26.67)	7.79 – 55.1	0.519
***Giardia lamblia* (3)**	2 (28.57)	3.67 – 70.96	1 (6.67)	0.17 – 31.95	0.163
***Taenia species* (2)**	0 (0)	0 – 40.96	2 (13.33)	1.66 – 40.46	0.311
***Hymenolepis species* (1)**	0 (0)	0 – 40.96	1 (6.67)	0.17 – 31.95	0.484
***Balantidium coli* (1)**	1 (14.29)	0.36 – 57.87	0 (0)	0 – 21.8	0.134
***Cyclospora cayetanensis* (1)**	0 (0)	0 – 40.96	1 (6.67)	0.17 – 31.95	0.484

4.14 Living area specific prevalence of parasitic infection

Parasites were found higher among the patients living in urban slum.

Table-4.14: Living area-specific prevalence of Gastrointestinal parasitic infection among the patients

Parasites	**Urban Apartment** n (%)	**95% CI**	**Rural** n (%)	**95% CI**	**Urban slum** n (%)	**95% CI**	**P value**
***Ascaris lumbricoides* (10)**	0 (0)	0 – 84.19	1 (50)	1.26 – 98.74	9 (50)	26.02 – 73.98	0.400
***Ancylostoma duodenale* (6)**	1 (50)	1.26 – 98.74	1 (50)	1.26 – 98.74	4 (22.22)	6.41 – 47.64	0.529
***Trichuris trichiuria* (5)**	0 (0)	0 – 84.19	0 (0)	0 – 84.19	5 (27.78)	47.82 - 100	0.487
***Giardia lamblia* (3)**	0 (0)	0 – 84.19	0 (0)	0 – 84.19	3 (16.67)	29.24 - 100	0.68
***Taenia species* (2)**	0 (0)	0 – 84.19	0 (0)	0 – 84.19	2 (11.1)	15.81 - 100	0.783
***Hymenolepis species* (1)**	0 (0)	0 – 84.19	0 (0)	0 – 84.19	1 (5.56)	0.14 – 27.29	0.89
***Balantidium coli* (1)**	1 (50)	1.26 – 98.74	0 (0)	0 – 84.19	0 (0)	0 – 18.53	0.005
***Cyclospora cayetanensis* (1)**	0 (0)	0 – 84.19	0 (0)	0 – 84.19	1 (5.56)	0.14 – 27.29	0.89

Chapter 5: Discussion

The epidemic of intestinal parasites is an important public health problem in Bangladesh, especially for children. Poor housing conditions, unhealthy environments, lack of adequate sanitation, and other related conditions are known factors that contribute to the spread of parasites (Fatema et al., 2020). A diarrheal disease which is one of the consequences of intestinal parasitic infection is still a crucial public health problem globally and hence the World Health Organization (WHO, 2002). The current study aimed to assess the prevalence of gastrointestinal parasitic infection and associated factors of parasitic infections among children. A total of 299 children aged between 1 month to 11 years who were admitted to the hospital were enrolled in the study.

Among all the patients, Gastrointestinal parasitic infection was found in 7.4%. The most commonly found parasite was *Ascaris lumbricoides* followed by *Ancylostoma duodenale, Trichuris trichiuria, Giardia lamblia, Taenia species, Hymenolepis species, Balantidium coli* and *Cyclospora cayetanensis.* In a previous study by Nipa et al. among 219 study samples *Giardia* was found positive in 5 (2.3%) samples. Moreover, other parasites like helminthic eggs were found in some samples. Ova of *Ascaris lumbricoides* 3 (1.4%), *Trichuris trichiura* 1 (0.5%) and mixed infection 2 (0.9%) were detected (Nipa et al., 2022). Another study conducted in Bangladesh, found an overall prevalence of intestinal parasites in the study was 9.2% where the protozoan identified were *Entamoeba coli* 4 (1.6%), *Entamoeba histolytica* 2 (0.7%), *Giardia lamblia* 1 (0.3%) and *Taenia Saginata* 1(0.3%) and the helminthes identified were *Ascaris lumbricoides* 1(0.3%), *Hookworms* 11(3.6%), *Trichuris trichuria* 2 (0.7%) and *strongyloides stercoralis* 5 (1.6%) (Hadiza and Maikaje, 2019). Nematian et al. found overall prevalence of intestinal parasitic infection among children was 18.4%, of which 11.5% was *Giardia lamblia*, 3.8% *Enterobius vermicularis*, 3.1% *Blastocystis hominis*, 1.7% *Entamoeba coli*, 0.3% *Hymenolepis nana*, 0.1% *Entamoeba histolytica*, and less than 0.1% *Ascaris lumbricoides* and *Taenia saginata* (Nematian et al., 2004). In the study by Mukul et al., conducted among mothers and their under-five children in Vashantek slum, Dhaka Cantonment where the prevalence of intestinal parasites was found to be 52% (48.5% in children

and 55.4% in mothers) (Fatema et al., 2020). Study by Hossain et al. a total of 183 stool samples were collected from children of age between 5 and 16 years where 61.20% of samples were found positive for intestinal parasites among them 8 species of parasites were identified, where *Entamoeba histolytica* (3.83%), *Giardia lamblia* (6.01%), *Diphyllobothrium latum* (3.28%), *Paragonimus westermani* (3.83%), *Ascaris lumbricoides* (24.59%), *Trichuris trichiura* (12.02%), *Ancylostoma duodenale* (5.46%) and *Enterobius vermicularis* (2.19%) was recorded (Hossain et al., 2019). Some dissimilarity was found in the previous studies which may be due to the different sample sizes and age group distribution in each study. The geographic area may also be a factor in this difference.

In this study, the majority (90.3%) of the children were aged between 1 month to 59 months with the mean age of the patients being 22.1±24 months. Among all, 63.9% of the patients were male. Gastrointestinal parasitic (GIP) infection was more common among the age group 1 month to 59 months and the male gender but no statistically significant difference found between both groups. Hadiza et al., also revealed that the infection rates were highest among the under 5 years aged group and the prevalence rate of intestinal parasites was comparable between males and females, with no significant association between the prevalence rate of infection and gender of the child (Hadiza and Maikaje, 2019). Hossain et al., also revealed that the prevalence of parasitic infection was higher among males (Hossain et al., 2019). Other studies also revealed that intestinal parasitic infections were more frequent in children and slightly higher in males (Sayyari et al., 2005; Nipa et al., 2022). But previous some studies found females had a higher prevalence of parasitic infection than the male with no statistically significant association (Ashtiani et al., 2011; Nematian et al., 2004).

Lower mother educational status, urban slum, and lower economic status were more common among the patients with GIP infection. Personal hygiene of the patients was low among the patients with parasitic infection but statistically, no difference was found between both infected and non-infected patients. High educational status, good socioeconomic condition, and good residence probably help to maintain better sanitation and hygiene practices. A previous study also revealed that urban residents were significantly associated with these infections (Jayaram et al., 2021). Hossain et al., also revealed that lower economic conditions and educational status increased the

prevalence of parasitic infection (Hossain et al., 2019). Hadiza et al., revealed that factors such as low income, poor environmental sanitation, and personal hygiene, lack of potable drinking water and inadequate healthcare, and poor educational awareness, encourage the high prevalence rates of these infections at any given time/place (Hadiza and Maikaje, 2019). In places where there is increased public sensitization and awareness programs coupled with good sanitation and proper personal hygiene, very low incident rates of gastrointestinal infections with parasites are usually recorded (Esiet and Edet, 2017).

Due to covid situation admitted patients was low in the hospital. People were more concern about hygiene practice due to fear of COVID-19. As the current study was held during the pandemic situation a low prevalence of gastrointestinal infections with parasites was found. Education, economic condition, and personal hygiene can decrease the rate of parasitic infection. Health education on intestinal parasite disease and personal hygiene, and mother-to-child transmission of intestinal parasites should be given to mothers.

Chapter 6: Conclusion

According to the study, Gastrointestinal parasitic infection was observed 7.4% among the children. Aged between 1 months to 59 months and male baby had a higher chance of getting infected. Parasites found in stool examination depends on study sample, age distribution and geographical area. Most common parasite found in the study was *Ascaris lumbricoides* followed by *Ancylostoma duodenale*, *Trichuris trichiuria*, *Giardia lamblia*, *Taenia specie* etc. Lower economic status, educational level as well as personal Hygiene practice also increase the prevalence of gastrointestinal parasitic infection. Proper education regarding factors responsible for parasitic infection along with personal hygiene practice is mandatory to reduce the prevalence of gastrointestinal parasitic infection.

Chapter 7: Limitations

1. Due to pandemic situation admission of patients in the hospital during study period was low.

2. Only indoor patients were included in the study but outdoor basis treatment related center was not included in the study.

3. Molecular test was not performed due to financial insufficiency.

Chapter 8: Recommendations

1. Further study is recommended with large sample size along with increased number of center.

2. Both indoor and outdoor basis treatment center should be included in the study to get more accurate scenario.

3. Molecular test should be done to get a better information regarding type of parasitic infection and drug efficacy.

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Annexure-1

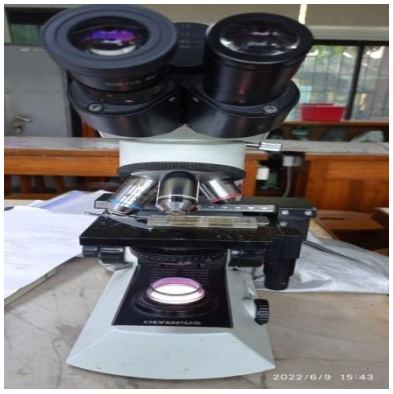

Fig A- McMaster slide

Fig B- McMaster slide Chamber counting under microscope

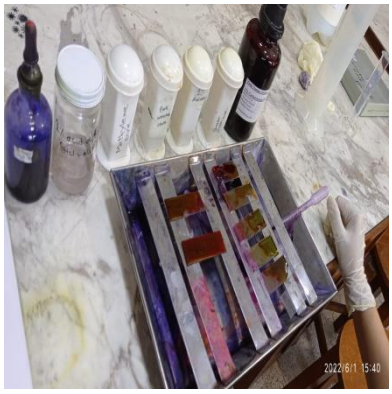

Fig C- Ziehl-Neelsen staining

Fig D- Preparing Z-N staining slide

Annexure-2

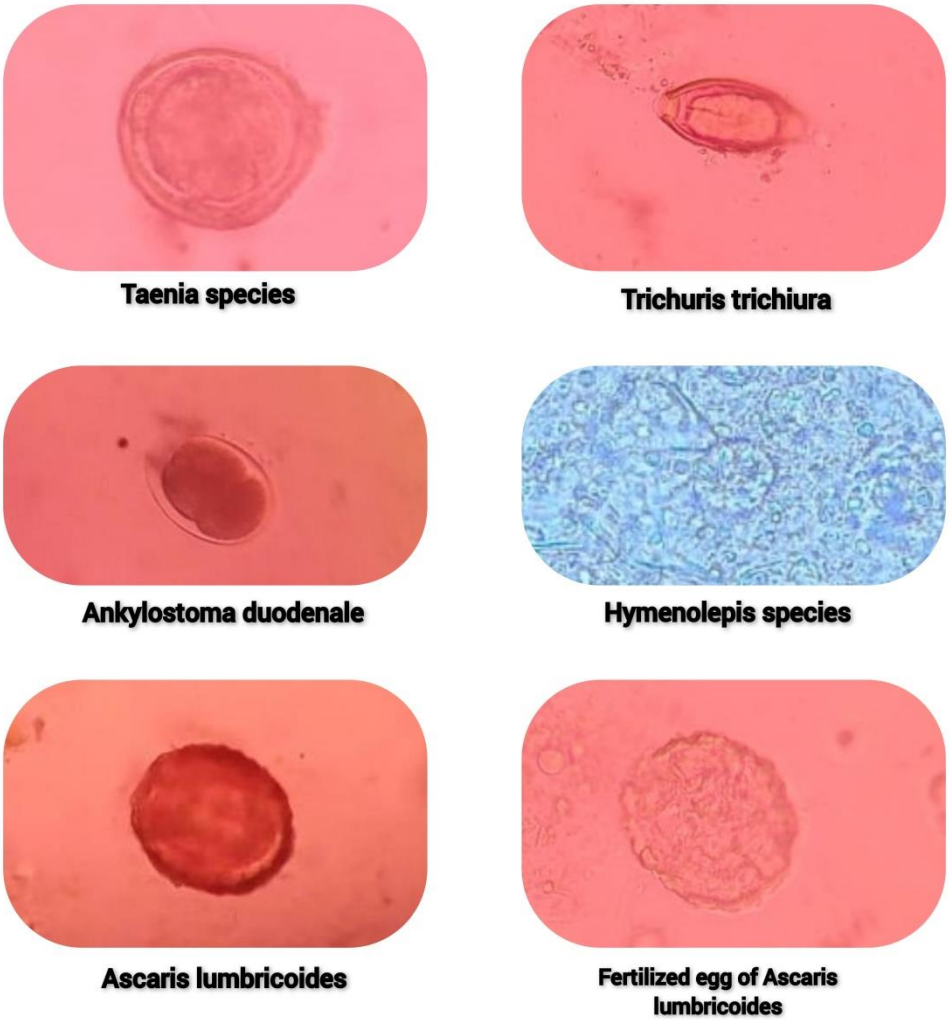

Fig E– Microscopic pictures of eggs of some helminths

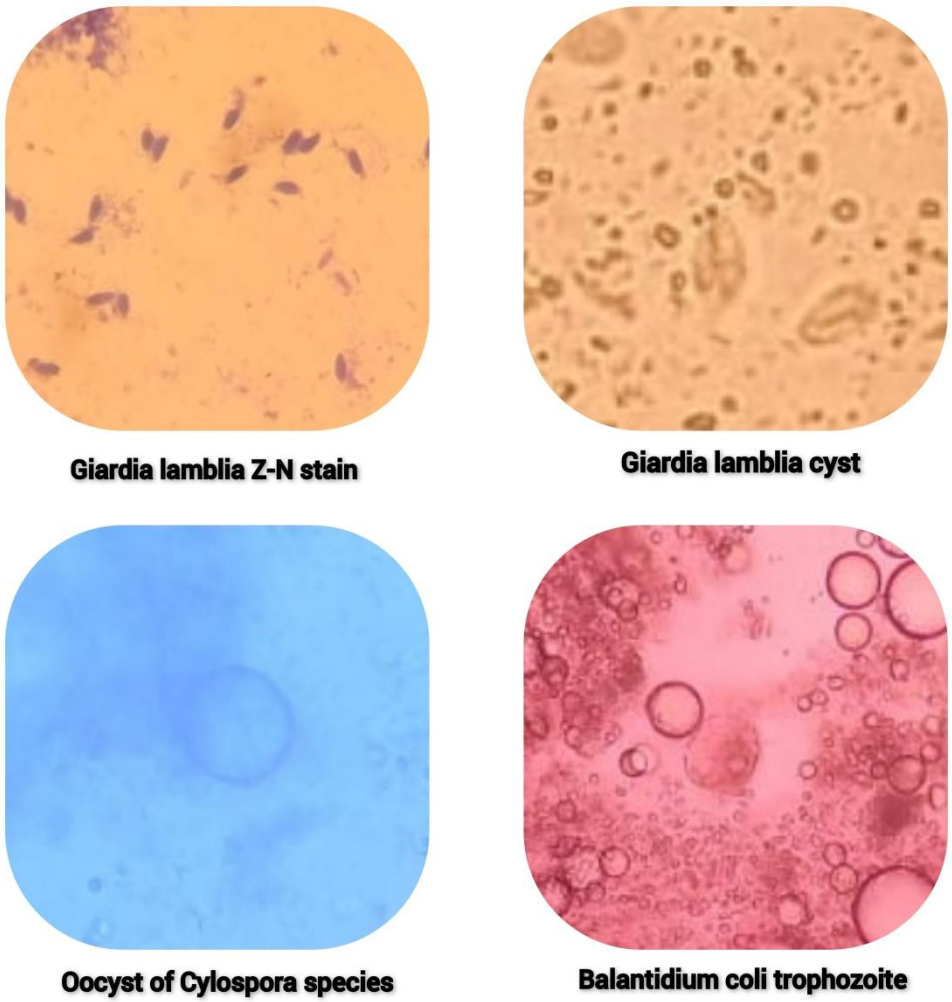

Fig F– Microscopic pictures of cyst, oocyst, trophozoite of some protozoa

Annexure-3

Questionnaire

Title - Characterization and Prevalence of Gastro-Intestinal Parasitic Disease Pattern in Hospital Admitted Under-12 Children

Particulars of the patient

Identification no- 2202089			Date- 26/02/22	
Name	Fariha Tasnim			
Father's name	Abu Taher			
Mother's name	Rina Akter			
Age	18 months			
Sex	1. Male	2. Female	3.	4.
Address	Kapasgola, Panchlaish			
Economic status	1. Lower	2. Middle	3. Upper	4.
Residing Area of the patient	1. Urban slum	2. Urban apartment	3. Rural	4.
Education level of patient	1. Illiterate	2. Primary	3. Secondary	4. Higher secondary
	5. Graduate	6. Didn't	7.	8.
Education level of mother	1. Illiterate	2. Primary	3. Secondary	4. Higher secondary
	5. Graduate	6.	7.	8.

Clinical and epidemiological status

Chief complain	1. Loose motion	2. Fever	3. Vomiting	4.
Cause of hospital admission	1. Loose motion	2. Fever	3. Vomiting	4. Deydration
Sign and symptom	1. Fever	2. Nausea	3. Vomiting	4. Abdominal pain
	5. Anorexia	6. Flatulence	7. Chills	8.
Antibiotic history	1. Yes	2. No	3.	4.
Anti-helminthic history	1. Yes	2. No	3.	4.
Living in proximity of animal	1. Yes	2. No	3.	4.
Anti protozoal history	1. Yes	2. No	3.	4.
What are the characteristics of stool during diarrhoea?	1. Loose	2. Rice	3. Mucoid	4. Watery
	5. Bloody	6. Formed	7.	8.
What is the odour of	1. Foul	2. Normal	3.	4.

stool?	smelling			
Is there blood in stool	1. Yes	2. No	3. Don't know	4.
Is there any event of diarrhoea alternating with constipation?	1. Yes	2. No	3. Don't know	4.
Is there any relieving factors?	1. Yes	2. No	1.	2.
Did any other members of your family have diarrhea recently?	1. Yes	2. No	1.	2.
Any itching in perianal region	1. Yes	2. No	1.	2.

Personal Hygiene

Does your place have a place for hand washing?	1. Yes	2. No	3.	4.
What is the source of your drinking water?	1. Tap water	2. Tube well	3. Pond	4. Purifier
	5. River water	6. Other	7.	8.
Where do you store water?	1. Water tank	2. Drum	3. Pitcher	4.
What is the source of water used for utensil wash	1. Tap water	2. Tube well	3. Pond	4. Purifier
	5. River water	6. Other	7.	8.
Did you take any undercooked or raw meat	1. Yes	2. No	3.	4.
Do you wash your hands before baby feeding	1. Yes	2. No	3.	4.
Do you wash your hands after using washroom	1. Yes	2. No	3.	4.
Sanitation status	1. Yes	2. No	3.	4.
Use of sandal in house	1. Yes	2. No	3.	4.
Regular nail cutting	1. Yes	2. No	3.	4.

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Signature of interviewee

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Signature of interviewer