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A study of environmental deterioration and incidence of parasitic diseases

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ABSTRACT

The emergence of infectious diseases is linked with environmental deterioration. The food-borne, water-borne and air-borne diseases are directly associated with the sanitary conditions of the locality. In evaluating the chain of infection, the environment plays a key role in reservoir maintenance as well as the route of transmission through food, water and air. Infectious diseases in our country are most common because people are not so aware of the parasitic infections that lead to illness, disability and death. The most prevalent parasitic diseases in India are amoebiasis, Giardiasis, trichomoniasis, dracunculiasis and malaria caused by *Entamoeba histolytica, Giardia intestinalis, Trichomonas vaginalis, Dracunculus medinensis and Plasmodium falciparum* respectively. In the present study, 78.86% of children harboured *Ascaris lumbricoides*, 17.84% *Enterobius vermicularis*, 8.92% *Ancylostoma duodenale* and 2.36% *Dracunculus medinensis* infection. *Entamoeba histolytica* infection dominated *Escherichia coli* and also reported an increased risk of amoebiasis in certain categories of children, pregnant women and patients under immunosuppression. Among protozoan infections, no case of trypanosomiasis and kala-azar was reported whereas, among the helminth infections, the prevalence rate of *Wuchereria bancrofti* (0.77%) and *Loa loa* (1.08%) was less. *Entamoeba histolytica* showed the highest prevalence rate followed by *Giardia intestinalis*. Double infection with protozoans (i.e. *E. histolytica* and *G. intestinalis*) showed a prevalence rate of 4.66% while protozoan and helminth infection (i.e. *E. histolytica* and *A. lumbricoides*) was 3.33%.

Keywords: Hygiene conditions, intestinal worms, parasitic diseases, protozoans.

INTRODUCTION

Intestinal parasitic infections are distributed throughout the world with a high prevalence rate in many regions and particularly among the children of underdeveloped and developing countries. Globally these

affect more than a quarter of the total population (WHO, 1992; World Bank report, 1993).

Although the impact of parasitic infection on public health has beenconsiderably underestimated, its vital role in the growth and development of people in developing countries has been universally accepted.Infections with gastrointestinal parasites are important in our country,where most people are not aware of parasitic infections and thus suffer from various diseases that lead to illness, disability and death.The terrible burden on the world's poorest people, trapping them in a cycle of illness, poverty, unhygienic conditions, poor sanitation, and infected ground and surface water outbreak of enteric infections (Yadav and Upadhyay, 2023). Different epidemiological studies have shown that the protozoan *Giardia intestinalis* causing diarrhoea is common among infants and young children indeveloping countries and children of almost all age groups are infected (Wolfe, 1978). In developing countries alone 4 million children die every year due to diarrhoea. In India alone, it was estimated that around 500 million episodes of diarrhoea were reported after every year with an incidence of 7.9 per child per year (Zaki *et al*., 1986). Various organisms can cause diarrhoea and these include viruses, bacteria and protozoans. It is mainly the protozoa which are an important cause of diarrhoea.

These include *Giardia lamblia, Entamoeba histolytica* and certain newly emerging pathogens like *Cryptosporidium, Cyclospora* and *Isospora*. In addition, recently parasites of the genus *Microsporodium* have also been implicated as a cause of diarrhoea both in immunocompromised and immunosuppressed patients. Studies from around the world have indicated that these parasites are an important cause of diarrhoea in children. *Cryptosporidium parvum* seems to be a fairly common pathogen in India and has been detected in 1-13% of the population studied. *Cyclospora cayetanensis* was initially detected in travellers with diarrhoea in places like Nepal. Subsequent studies from most parts of the world have shown that this was again a case of diarrhoea in both immune-compromised and immune-competent individuals (Haori *et al*., 2001). The transmission was again either water or food-borne. *Isospora* is another coccidian with a similar epidemiological pattern (Godgil *et al*., 1984). Amoebiasis, caused by the hematophagous pathogenic, intestinal protozoan parasite *Entamoeba histolytica* was a major cause of morbidity and mortality, especially in the tropical and subtropical regions of the world (Saha *et al*., 1993). As the parasites reside in the gastrointestinal tract of approximately 10% of the world's population. Due to its high incidence, it is considered the third leading parasitic cause of death. The first step of this infection depends on the adhesion of the pathogen to the intestinal mucus layer, depletion of colonic mucus with disruption of the mucosal barrier and amoebic adherence toand cytolysis of host epithelial and inflammatory cells. Intestinal amoebiasisis the most common form, which may manifest either as an asymptomatic cyst passer or as symptomatic intestinal amoebiasis. Symptomatic intestinal amoebiasis includes a variety of clinical entities such as non-dysenteric colitis and acute amoebic dysentery. The amoebic liver abscess (ALA) is the most common extra-intestinal manifestation of amoebiasis and is primarily responsible for increased morbidity and mortality, if not properly managed.The incidence, of ALA, has been reported to vary between 3-9% of all cases of intestinal amoebiasis. This disease occurs most commonly in the age group of 25 to 45 years. It has been observed that certain categories of individuals like children, pregnant women and immunosuppressed patients are at increased risk of invasive diseases.

Human Trichomoniasis is a sexually transmitted disease (STD) of worldwide importance with medical, social and economic implications (Petrin *et al*., 1998). It is regarded as the most common non-viral STD with more than 170 million cases occurring annually (WHO, 1994). It is a common cause of vaginitis and has recently been found to be strongly associated with several complications in pregnancy and an increase in the transmission of HIV (Petrin *et al*., 1998). Heine and McGreogor (1993) described *T. vaginalis* as a re-emerging pathogen. Kala-azar is known to be an important public health problem in India, particularly in Punjab and adjoining states for decades. It mainly affects the poor people in urban slums or in rural areas under unsanitary conditions that favour sandfly breeding. The ignorance; lack of means and no easy access to health facilities prevent them from seeking early medical help. Kala-azar is caused by anintercellular protozoan parasite in humans,which is transmitted by various species of female sandflies. Zaki *et al*., (1986) observed a strong need for health education programs for endemic areas. Chagas disease

caused by *Trypanosoma* is another parasitic disease. It affects an estimated 2 to 3 million people and claims up to 10,000 lives every year. Dr Carlos Chagas, a Brazilian physician, first described in 1909 the often fatal condition that damages the victim's cardiovascular, nervous and digestive systems. Some 10 million people in Asia are at risk of contracting Chagas disease. Chagas disease is also known as a disease of poverty as it is common among the poorest and most vulnerable populations. The bugs that transmit Chagas disease live in cracks in the walls and roofs of mud and strawhousing, which are common in rural areas and poor urban slums in India.

Globally an estimated 16 million persons suffer from lymphodema in filariasis endemic areas of the world. Clinically, so-called filarial lymphodemais often indistinguishable from lymphodema of other causes, and there is no laboratory marker that proves, at the individual level, that the initial cause of lymphatic vessel dysfunction was the damage associated with adult filarial worms. The earliest onset of lymphodema in the filarial-endemic area is usually observed around the time of puberty, and the prevalence increases with age. In many areas where bancroftian-filariasis is endemic, lymphodema of the leg is more common in women than in men, although this finding is not universal. Malaria occurs mostly in poor, tropical and subtropical areas of the world. Malaria is the more prominent cause of death in these areas where there is the easy availability of mosquito vectors (*Anopheles* species) which assures the high transmission of the predominant parasitic species *Plasmodium falciparum* that causes the most severe form the anaemia.

MATERIALS AND METHODS

The investigation was based on the examination of faecal samples obtained from individuals of different age groups attending medical diagnostic laboratories of three hospitals viz., ESI hospital, Civil Hospital and Guru Nanak Dev Hospital, Amritsar. Thus the data was mainly collected from the above-mentionedlaboratories of Amritsar (Table 1). Amritsar-holy city of Punjab is located at 31.36N-74.87"E. It has an average elevation of 219 m.

The impact of the growing population and growing needs forland, food, shelter and unlimited resources are causing severe ecological imbalance. Population overgrowth led to the breakdown of sanitary conditions and hygienic environments in urban and rural areas and had been chiefly responsible for a high level of endemicity of various infectious diseases in different parts of the country. A clear correlation between high prevalence, low socio-economic status, educational levels and inadequate housing had been observed in India. Industrial development in Amritsar had added to the woes of degradation and pollution which led to several infectious diseases in the city. Moreover, the weather in this region of India is seasonal with four distinct seasons, winter, summer, monsoon and post-monsoon.

Table 1: Number of cases observed in different hospitals

S. No	Name of Parasites	ESI Hospital	Civil Hospital	Guru Nanak Dev Hospital	Total
1	*Giardia*	115	75	80	270
2	*E.histolytica*	45	32	59	136
3	*T.vaginalis*	180	120	100	400
4	*Plasmodium*	45	35	60	140
5	*Trypanosoma*	-	-	-	-
6	*Leishmania sp.*	-	-	-	-
7	*A.lumbricoides*	140	165	115	420
8	*E. vermicularis*	55	35	30	120
9	*W.bancrofti*	2	1	2	5
10	*A.duodenale*	30	25	15	70
11	*D.medinensis*	7	5	10	22
12	*Loa loa*	2	3	2	7
13	*T.solium*	13	8	7	28

The duration of the summer season is from April to October. So there is a great incidence of intestinal parasitic diseases in Amritsar. In the diagnosis of intestinal parasites, a lot of techniques could be employed. But the selection of a particular technique was dependent on its affordability, ease to carry out its effectiveness and the level of professionalism involved. Some of these methods were DNA probes, PCR and direct fluorescent antibody methods which offered high sensitivity, but were expensive to use. Direct stool smear, formal ether and salt floatation techniques in the form of stool microscopy offered many advantages over other diagnostic methods for detecting intestinal parasites. A high choice of direct smear and modified formal ether concentration method in diagnosing intestinal parasites by hospitals and researchers in developing countries was a result of its affordability, simplicity and sensitivity. Due to the low density of the parasites in the faeces, the direct smear method was useful for the observations of motile protozoan trophozoites and the examination of cellular exudates but was not recommended solely for the routine examination of suspected parasitic infections. However, in most laboratories, the diagnosis of some unusual protozoans was not a part of staining with smear and light microscopy but involved the use of special stains, like Geimsa stain, Carbol fuchsin and Weber's Trichrome stain.

For the detection of these protozoans, the stool sample was divided into two parts, the first part being used for routine microscopic examination. This was carried out according to the standard protocol after the preparation of the smear in normal saline and iodine. Then the second half of the sample was used toprepare a smear for use in staining to detect *Coccidia* and *Microsporidium*. To detect Coccidia which includes *C. parvum, C. cayetanensis*, modified Ziehl-Neelson staining was done. The second smear was also fixed in methanol and was used in the trichrome staining procedure to detect *Microsporidium*.

For the detection of *Trichomonas vaginalis*, a microscopic examination of fresh wet preparation of vaginal discharge was done and then staining was done by papanicolaou method. Diagnosis of *E. histolytica* trophozoites in the stool, rectal exudates and necrotic tissue collected from the base of rectal ulcers confirmed the diagnosis of intestinal amoebiasis. Serodiagnostic tests whether detecting specific amoebic antibodies or antigens help in establishing the diagnosis of invasive amoebiasis, especially ALA. Amoebic antigen detection in the faeces, DNA probes and PCR are the other methods of promise to detect pathogenic *E. histolytica* in a stool sample.

After the discovery of the so-called non-pathogenic species *Entamoeba dispar*, which is morphologically indistinguishable from *E. histolytica*. It becomes important to decide whether to treat an asymptomatic individual in whom *E. histolytica* and *E. dispar* had been identified. For the detection of various helminths, methylene blue staining was used. The helminth worms were washed in 70% alcohol and then dehydrated up to 90% alcohol, stained in methylene blue and cleared in lactophenol. The slides were observed under the microscope to identify different species of parasitic helminths.

RESULTS AND DISCUSSION

The data collected from the Medical Diagnostic Laboratories of three hospitals viz., Guru Nanak Dev Hospital, Civil Hospital and ESI hospital, Amritsar revealed that 381 children, 148 males and 103 females were found to be positive for various helminthic diseases. 70.86% of these children harboured *Ascaris lumbricoides,* 17.84% *Enterobius vermicularis*, 8.92% *Ancylostoma duodenale* and 2.36% *Dracunculus* infection (Table 2).

The present study revealed that children of the age group (8-12 years) were the highly infected group. This finding is more or less in close conformity that the highest infestation in the age group (5-15 years) in a study among the rural Kashmiris and also confirms the finding of Virk *et al*., (1994) who recorded age group 6-15 yearsas the infected group, based on a survey done in the Shahajahanpur in Uttar Pradesh. However, the present findings are contradictory to the finding of Mahanta *et al*. (1996), who reported the age group (35-44 years) as the heavily affected group, in the upper part of Assam. The present finding of 8.92% infection with Ancylostomiasis.

The present data also revealed the prevalence of *E. vermicularis* in 17.84% of the children studied. However, Suchitra *et al*. (1991) reported only 5% of her study individuals were infected with pinworm. The present results are similar to that of Acosta and Cazrola (2002) who also reported an increased risk of

E.vermicularis in school children with an overall high prevalence (57.79%) where anal pruritus was the most common clinical finding (53.9%) and other less frequent manifestation vas perianal lesions (34,8%) and vulvo-vaginitis (32.6%). The higher prevalence rate of *E. vermicularis* infection in the present study may be related to autoinfection and perhaps retroinfection, due to the sharing of towels, bed clothing, congested households etc.which are commonly encountered behaviours among the members of the same family. The present study also reported that 49% of the cases were infected with only one helminth, 42.4% with two helminths and (with more than two parasites) were detected in 8.6%. Similarly, Suchitra *et al*., (1991) reported that 10% of her study group harboured multiple infections. Among the helminthic infection the prevalence rate of *Wuchereria bancrofti* (0.77%) and *Loa loa* (1.08%) was less whereas the incidence of *Taenia solium* was high where 32.64% of male harboured taeniasis. In the present study, the low prevalence rate of *Loa loa* was more or less similar to the findings of Haouri *et al*., who reported eye worm infection in 13 patients and subcutaneous migration of adult *Loa loa* in 19 patients, other clinical symptoms including fever and asthenia were reported in 4 patients. The present studies provided information on the prevalence of intestinal parasites viz., *Entamoeba histolytica* and *E. coli* among patients with a complaint of stomach ache and diarrhoea and revealed that 70 children, 36 males and 30 females found to be positive for *E. histolytica* whereas 6 children, 2 male and 1 female found be positive for *E. coli*. (Table 3).

Stool tests revealed that *Entamoeba histolytica* infection dominated over *E. coli.* Amoebic trophozoites with ingested RBC (hemotophagous trophozoites) were considered by pathogens for amoebiasis as suggested by Pariza (2001). The detection and demonstration of hematophagus trophozoites confirmed the intestinal infection caused by pathogenic *E. histolytica*. It was found that children (5-9 years) were at increased risk of amoebiasis (Table 4).

Table 2: Total occurrence rate of various Helminths.

Name of Parasite	Total no. of Children Infection	Percent Prevalence	Male	Female
Ascaris lumbricoides	420	270	70.86%	87	63
Enterobius vermicularis	120	68	17.84%	37	15
Ancylostoma duodenale	70	34	8.92%	19	17
Dracunculus medinensis	22	9	2.36%	5	8

Table 3: Incidence of *E. histolytica* and *E.coli* in faecal specimens over 6 months period in patients and school children.

Parasite detected	Male	Female	Children	Total
E. histolytica	36	30	70	136
E.coli	2	1	6	9

Table 4: Age wise prevalence of Amoebiasis.

	Entameoba histolytica	
Age group	**Total No. of infection**	**Percent Prevalence**
0-4	20	28.57%
5-9	32	45.71%
10-14	18	25.71%

Table 5: Age wise distribution of *Giardia* positive children.

Age group	***Giardia* Positive**	Percent Prevalence
3-4 years	17	11.88%
4-5 years	65	45.45%
5-6 years	47	32.86%
6-7 years	14	9.79%

The enhanced risk in children (45.71%) may be attributed to non- development of acquired immunity in this group. In the present study, the prevalence of *Entamoeba histolytica* was found to be much more than *E. coli* in children. It could be speculated that at this age (5-9 years), Children tend to swallow things in their interest during unhygienic conditions (without washing hands) leading to infection and diseases. A total of 270 patients were found to be positive for *Giardia.* Among the *Giardia* positive samples, cysts were observed in 176, trophozoites in 81 and cysts as well as trophozoites in 13 samples. Age-related prevalence of giardiasis is shown in Table 5.

The male and female ratio showing *Giardia* positive cases was 70: 57 whereas 143 children were found to be positive. The present study confirms the presence of *Trichomonas vaginalis* in women attending the Medical laboratories of Guru Nanak Dev Hospital, Civil Hospital and ESI hospital, Amritsar. The age of 700 women under study ranged between 18 to 45 years and 48 of them were pregnant. In the symptomatic group, vaginal discharge was the most common complaint and vaginitis was the common clinical sign.

T. vaginalis infection was detected in 400 women by one or more techniques used, thus giving an overall prevalence rate of 57.14%. It was found that the infection was maximum (78.75%) in the age group of 18-30 years (Table 6). Thereafter, a decreasing trend with increasing age was observed which agrees with the findings of others (Misra and Das, 1998). This could be due to the relationship between age and the active sexual life as reported earlier (Anderson *et al*., 1991). Infection was found to be more common in illiterate women (66.51%).

Infection was found to be maximum in women with vaginal discharge (68.86%) followed by those with vulvo-vaginal irritation (59.64%), dysuria, (47.05%) and lower abdominal pain (56.09%).The prevalence rate of *T.vaginalis* infections with different symptoms is shown in Table 7. In the present study, the prevalence rate of 57.14% in women confirmed the higher rates reported in other studies (Velayudhan and Kurup, 1963; Fouts and Kraus, 1980; Mall *et al*., 1989 and Sardana *et al*., 1994), but in contrast to a lower rate (3.75%) reported in other studies (Jindal *et al*., 2001).

Table 6: Presence of *Trichomonas vaginalis* infection with respect to socio-demographic characteristics.

Age (years)	No. of women examined	Women positive for *T. vaginalis*	Per cent prevalence
18-30	400	315	78.75%
31-40	200	70	35%
>40	100	15	15%
Educational Standard			
Illiterate	218	145	66.51%
Primary and	134	56	41.79%
Middle School	300	178	59.3%
High School			
College plus technical education	48	21	43.75%
Pregnancy			
Pregnant	48	14	29.16%
Non pregnant	652	386	59.20%

Table 7: Association of *Trichomonas vaginalis* infection with clinical symptoms.

Clinical Symptoms	No. of women examined	Women positive for *T. vaginalis* (%)
Vaginal discharge	485	334 (68.86%)
Vulvovaginal irritation	57	34 (59.64%)
Dysuria	17	8 (47.05%)
Lower abdominal pain	41	15 (56.09%)
asymptomatic	100	3 (3%)

Table 8: Prevalence of protozoan and helminth infections.

Parasitic infection	No of Samples Positive	Percent Prevalence
Entamoeba histolytica		
Boys	36	57.14%
Girls	27	42.85%
Total	63	42%
Giardia intestinalis		
Boys	18	58.06%
Girls	13	41.93%
Total	31	20.66%
Ascaris lumbricoides		
Boys	25	59.52%
Girls	17	40.47%
Total	42	28%
Entamoeba histolytica + Giardia intestinalis		
Boys	4	57.14%
Girls	3	42.85%
Total	7	4.66%
Entamoeba histolytica + Ascaris lumbricoides		
Boys	3	0.6%
Girls	2	0.4%
Total	5	3.33%
Giardia intestinalis + Ascaris lumbricoides		
Boys	0	0.0%
Girls	2	0.1%
Total	2	1.33%

Among other protozoan infections, no case of Trypanosomiasis and Kala-azar was reported in the present study. The prevalence rate of malaria caused by *Plasmodium* is found to be high. 140 cases of malaria were observed in the present study. In the present study, 150 children were found positive for protozoan and helminth infection (Table 8). *Entamoeba histolytica* showed the highest prevalence rate of 42% followed by *Giardia intestinalis*at 20.66%. Among helminth parasites, *Ascaris lumbricoides* was found in 28% of the cases. Double infection with protozoan (i.e. *E. histolytica* and *G. intestinalis*) showed a prevalence rate of 4.66% while protozoan and helminth mixed infection of *E. histolytica and A. lumbricoides* was 3.33% and *G. intestinalis* with *A. lumbricoides* was observed in 1.33% cases. In boys prevalence rate of *E. histolytica* (57.14%) and *G. intestinalis* (58.06%) was slightly higher than that of girls which showed a positivity rate of 42.85% and 41.93%, respectively. Similarly, the boys showed a slightly high prevalence rate for *A. lumbricoides* (59.52%) as compared to girls who showed a positivity rate of 40.47%.

The high prevalence rate of E*ntamoeba histolytica, Giarda intestinalis* and *Ascaris lumbricoides* could be related to general poor conditions, low living standards, poor hygiene, inadequate sanitation and health care which provide favourable conditions for the transmission of these infections. As far as protozoan infections are concerned, the prevalence of *E. histolytica* (14.8%) was highest followed by *G. intestinalis* (20.66%) among the primary school children of Amritsar, Punjab. Similarly, infection rates of 35.1% and 21.1% were recorded for these parasites by Ichhpujani and Arora (1981) in Rohtak town of Haryana. A high incidence of *E. histolytica* (22.1%) was also recorded by Ali *et al*. (1989) in the Nablus area of the West Bank of Palestine. Alzain and Sharma (1999) reported comparatively low transmission rates for *E.*

histolytica (i.e. 9.5% and 10.4%) and for *G. intestinalis* (5% and 6%) among primary school children of Udaipur (India) and Gaza Strip (Palestine), respectively. The infection rate of *Ascaris lumbricoides* in the present study was 28%. However, prevalence rates of 9.6 and 9.0% for *A. lumbricoides* were recorded by Dutta (1973) and Arya (1982) in Delhi. Dutta (1973) also recorded a lower infectivity rate of 6.0% in the urban population of Alwar, Rajasthan. However, much higher infection rates of 37.55% and 28.6% were recorded for the same parasite among the people of the Sindhi colony of Jaipur and rural areas of Upper Assam respectively (Tamboli and Sharma, 1979, Mahanta *et al*., 1996). As far as mixed infections are concerned, in the present study, *E. histolytica* and *G. intestinalis* showed slightly higher infectivity rates among the boys which is contrary to the findings of Alzain and Sharma (1999) who observed higher infection rates for the same parasites in girls. However mixed infection of protozoans and helminths in the present study is slightly higher in boys. Previously Alzain and Sharma (1999) also recorded a high percentage of these infections in the boys in Udaipur. In the light of above findings, it seems that infections of protozoan and helminth parasites are related to the hygienic and sanitary conditions of the area and that they have probably nothing to do with the sex of the individual. The frequent finding of multiple parasitic infections in school children suggests parasite acquisition through the oral route by contaminated fingers and by contaminated food and drink especially when it is handled by either carrier or by children themselves who had not washed their hands properly after defecation. These infections could be minimized simply by giving them proper health education in a classroom which will make them aware of the mode of infection and also help them in protecting themselves from parasitic infections by taking precautionary measures.

CONCLUSION

The changing conditions in the environment have a great impact on the distribution and occurrence of infectious diseases. In the present study, it is found that the socio-economic status of the families had a direct relationship with the prevalence of infectious diseases. Moreover, these diseases are more prevalent among poor people as they are not so much hygienic and their lifestyle plays a role in autoinfection and perhaps retro-infection of pathogenic parasites. Routine diagnosis of protozoans was done by direct smear in normal saline or iodine stain solution whereas, for the diagnosis of helminths, methylene blue staining technique was used. In light of the above findings, it seemed that infections by protozoan and helminth parasites were related to hygienic and sanitary conditions of an area and they had probably nothing to do with the sex of the individual. However, these infections could be minimized simply by giving them proper health education and also motivating them to take precautionary measures against parasitic infections. Epidemiological studies on a large sample size of a wide area can be done in future. Epidemiological surveys targeting the human population suffering from bacterial and viral infections can be an area for future research. The incidence of various diseases, their correlation with the lifestyle of people and the development of possible preventive measures can be targets of future research. Moreover, the awareness and action components can be taken into consideration.

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