Predominance of Gastrointestinal Protozoan Parasites in Children: A Brief Review

Iram Abdullah*, Hidayatullah Tak, Fayaz Ahmad, Nazima Gul, Shafaquat Nabi and Tanveer A Sofi
Department of Zoology, University of Kashmir, Srinagar, Jammu and Kashmir, India

Abstract

Intestinal parasitic infections are among the major diseases of concern to public health throughout the world [1]. About 25% of world’s population suffers from one or more kinds of intestinal parasitic infections (helminthes/protozoa). Children because of their complex nutritional requirements and less developed immune systems are observed to be the principal sufferers of these parasitic infections [2]. Moreover, they have an extremely delicate physiology which can result in severe upsetting of their biochemical and physiological processes associated with these infections. Intestinal protozoan parasites can affect children in a variety of ways; they cause mal-absorption, reduced growth, increased risk for protein energy malnutrition, reduced psychomotor development and anemia. This report addresses Cryptosporidium, Giardia, and Entamoeba as the main parasitic protozoa of concern among children worldwide.

Keywords: Immune systems; Protozoan parasites; Cryptosporidium; Giardia; Entamoeba

Introduction

Intestinal parasitic infections caused by intestinal helminths and protozoa are among the most common human infections endemic throughout the world especially in tropical and subtropical countries including India. About 3.5 billion persons are infected with intestinal parasites and nearly 450 million suffer from clinical morbidity [3]. The protozoan parasites are the more common cause of gastrointestinal disorders compared to helminthes especially in developing countries. A number of intestinal protozoan parasites are reported in different parts of the world like Giardia lamblia, Dientamoeba fragilis, Entamoeba histolytica, Blastocystis hominis, Isospora belli, Cyclospora cayetanensis and Microsporidia. Among them Entamoeba, Giardia and Cryptosporidium are the major protozoan parasites of global public health concern. Protozoan parasites being single celled can rapidly multiply inside the body leading to the development of the serious infection. Most of the protozoan infections tend to be asymptomatic. However, the common symptoms associated with it include abdominal discomfort, vomiting and dysentery [4]. When burden of infection is pronounced, it may cause several complications like diarrhea, malaise, bloating, fatigue, epigastric discomfort, malnutrition, mal-absorption, intestinal ulceration, gastroenteritis, weight loss, abscesses, mental retardation and even death. Protozoan infections can also lead to structural and functional abnormalities of small intestines in humans and can be misdiagnosed as appendicitis or other inflammatory diseases of gastrointestinal tract. Children are the primary victims of gastrointestinal protozoan parasites. So the disease control interventions need to be focused towards the pediatric group.

*Corresponding author: Iram Abdullah, Department of Zoology, University of Kashmir, Hazratbal, Srinagar-190 006, Jammu and Kashmir, India, Tel: +919419456456; E-mail: miriram07@gmail.com

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Table 1: Prevalence of Giardia worldwide.

| Country   | Area of study                  | Prevalence (%) reported | Reference |
|-----------|--------------------------------|-------------------------|-----------|
| Bangladesh| ICDDRB Hospital, Dhaka         | 0.37                    | [13]      |
| Egypt     | Damanhur city                  | 14.8                    | [14]      |
| Ethiopia  | North Gondar                   | 41.9                    | [15]      |
| Ghana     | Kumasi                         | 0.2                     | [16]      |
| Iraq      | Abu-Malah and Harer, Basrah    | 45.16 and 18.7          | [17]      |
| Iraq      | Kadhmiyah hospital, Baghdad    | 1.77                    | [18]      |
| Iraq      | Erbil/Kurdistan                | 13.13                   | [19]      |
| Iran      | Abyek, Gazvin                  | 3.0                     | [20]      |
| India     | Auranagabad                    | 55                      | [21]      |
| India     | Barabanki, UP                  | 19.13                   | [22]      |
|           | Buea, Cameroon                  | 21.4                    | [23]      |
| India     | Chandigarh                     | 7.96                    | [24]      |
| India     | Gujarat                        | 5                       | [25]      |
| Kenya     | Thika District                 | 6.9                     | [26]      |
| Libya     | Sebha Province                 | 3.19                    | [27]      |
| Malaysia  | Inanam sabah                   | 35.48                   | [28]      |
| Mexico    | Coacalco-de Berriozabal        | 18                      | [29]      |
| Nepal     | Dadelhura                      | 7.47                    | [30]      |
| Nepal     | Dharan                         | 6.8                     | [31]      |
| Nigeria   | Delta and Edo States           | 0.51 and 3.1            | [32]      |
| Oman      | Dhafrica                       | 10.5                    | [33]      |
| Philippines| Metro Manila                   | 11.6                    | [35]      |
| Pakistan  | Muzaffarabad                   | 11.8                    | [22]      |
| Pakistan  | Quetta                         | 32                      | [36]      |
| Rwanda    | Kigali                         | 3.6                     | [37]      |
| Thailand  | Thai                           | 1.56                    | [38]      |
| Tajikistan| Western                        | 26.4                    | [39]      |

Table 2: Prevalence of Entamoeba worldwide.

| Country   | Area of study                  | Prevalence (%) reported | Reference |
|-----------|--------------------------------|-------------------------|-----------|
| Bangladesh| ICDDRB Hospital, Dhaka         | 1.11                    | [13]      |
| Cameroon  | Buea                           | 24.4                    | [23]      |
| Egypt     | Damanhur city                  | 16.8                    | [14]      |
| Ethiopia  | NorthGondar                    | 27.3                    | [15]      |
| Ghana     | Kumasi                         | 8.5                     | [16]      |
| Iraq      | Sulaimani district             | 4.05                    | [41]      |
| Iraq      | Abu-Malah, and Harer, Basrah   | 23.87 and 30.93         | [17]      |
| Iraq      | Kadhmiyah hospital, Baghdad    | 9.80                    | [18]      |
| Iraq      | Erbil/Kurdistan                | 30                      | [42]      |
| India     | Barabanki, UP                  | 28                      | [22]      |
| India     | Bhopal                         | 25.4                    | [43]      |
| Japan     | Hanoi, Vietnam                 | 2                       | [44]      |
| Kenya     | Thika                         | 14.6                    | [26]      |
| Lesotho   | Qacha's Nek                    | 24                      | [45]      |
| Mexico    | Coacalco-de Berriozabal        | 10                      | [29]      |
| Malaysia  | Inanam sabah                   | 83.87                   | [28]      |
| Nigeria   | Nigeria                        | 8                       | [46]      |
| Nepal     | Dehran,                        | 6.1                     | [31]      |
| Philippines| Metro Manila                   | 2.9                     | [34]      |
| Pakistan  | Quetta                         | 29                      | [35]      |
| Pakistan  | Muzaffarabad                   | 5.9                     | [22]      |
| Rwanda    | Kigali                         | 54.5                    | [37]      |
| Tajikistan| Western                        | 25.9                    | [39]      |
| Thailand  | Thai                           | 0.03                    | [38]      |
| Uganda    | Kampala                         | 2.5                     | [47]      |
Cryptosporidium parvum

It is a small coccidian protozoan parasite belonging to Phylum Apicomplexa that infects the microvillous region of epithelial cells of the digestive tract in humans. Cryptosporidium causes moderate to severe diarrhea in the immunocompetent individuals due to malabsorption and increased secretion. In the immunocompromised individuals, the condition can be prolonged and dangerous. Cryptosporidium infection of the intestinal epithelium is associated with villous atrophy, hyperplasia of intestinal crypt cells, and inflammation of the lamina propria. Cryptosporidiosis can sometimes lead to extra-intestinal complications like respiratory cryptosporidiosis, cholecystitis, hepatitis and pancreatitis [48].

Global burden

Global statistics on prevalence of Cryptosporidium parvum shows that it infects 2-50% of population worldwide [3]. In Asia and Africa, the infection rate ranges from 5-10% (Table 3).

Intestinal Protozoan Infections in Kashmir Valley

In Kashmir valley the studies conducted so far demonstrate the presence of protozoan parasites Giardia intestinalis, and Cryptosporidium parvum among children. Besides this a number of helmint parasites have also been reported especially Ascaris lumbricoides, Trichuris trichiura, Enterobius vermicularis Taenia saginata Hymenolepis and Ancylostoma [64,65] (Table 4).

New Approach for Parasite Detection

Diagnosis of intestinal protozoa is made usually by microscopy after staining fecal smears with iodine or any other stain. This technique is being widely used for diagnosis of intestinal protozoa [10,70-74]. However nowadays molecular diagnostic tests are increasingly being used for both clinical as well as research purposes. They involve identification of specific antigen or DNA of parasite in stool or serum samples through Enzyme linked immunoassay (ELISA) [22-24] or direct fluorescent antibody assay [25-27]. These molecular methods besides having high sensitivity for parasite detection help in differentiation of various species of parasite with the help of PCR.

| Country     | Area of study          | Prevalence (%) reported | Reference |
|-------------|------------------------|-------------------------|-----------|
| Bangladesh  | ICDDR, Hospital, Dhaka | 4.44                    | [13]      |
| Ethiopia    | Girar Jaros and Dera   | 7.3                     | [49]      |
| Ethiopia    | Pawl, northwestern Ethiopia | 8.1                | [50]      |
| Egypt       | Cairo                  | 15.3                    | [51]      |
| Ghana       | Kumasi                 | 8.5                     | [16]      |
| Ivory coast | Yamounoukoure          | 36.93                   | [52]      |
| Iran        | Isfahan                | 4.6                     | [53]      |
| Iraq        | Baghdad                | 2.3                     | [54]      |
| India       | Delhi                  | 27.4                    | [55]      |
| India       | Uttar Pradesh          | 33.33                   | [56]      |
| Jamaica     | Kingston               | 4.3                     | [57]      |
| Kenya       | Kenya                  | 4                       | [58]      |
| Mexico      | Coacalco-de Berriozabal | 4                    | [29]      |
| Netherlands | Netherlands            | 21.8                    | [59]      |
| Nigeria     | Zaria                  | 4.5                     | [60]      |
| Palestine   | Gaza                   | 16.3                    | [61]      |
| Philippines | Philippines            | 1.9                     | [62]      |
| Saudi Arabia | Makkah               | 4.07                    | [63]      |
| Uganda      | Kampala                | 1.5                     | [47]      |

Table 3: Prevalence of Cryptosporidium worldwide.

Control and Prevention

In view of high prevalence of protozoan infection and the morbidity they cause, the measures aimed at their control and prevention need to be strengthened. Steps should be taken to reduce the infection rate to the levels at which they cease to be of public health significance. The prevention and control of protozoan diseases can be primarily achieved through improvement in personal as well as environmental hygiene [75]. The most effective control can be achieved by involving the community to participate in its own disease control. For this purpose, mass awareness programmes should be conducted to make the people aware about the various infectious agents and their modes of transmission, encourage hygienic practices, recommend use of safe drinking water, avoid defecation in open areas, and prioritize primary health care. Moreover, standard techniques should be used by clinical microbiologists for screening the stool samples to increase the chances of detection of parasites and chemotherapy option should be used for treatment of individuals diagnosed with protozoan infections.

Conclusion

Gastrointestinal disorders caused by various protozoan parasites impose a great burden on human populations in the developing world, particularly among children. The need of the hour is that we should have enough epidemiological information on the prevalence of gastrointestinal protozoan infections and their associated risk factors in different localities which are a prerequisite to develop quality control measures.

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