



The Relationship between Intestinal Parasites and Chronic Digestive Disorders

Rahma Mozahim Al-Attar ¹, Saja Abbas Abdul Jabbar ², Ali M Saadi ^{3*}

¹ Department of Medical Laboratory Technologies, Mosul Medical Technical Institute, Northern Technical University, Iraq

² Department of Field Crops, College of Agriculture, University of Telafer, Mosul, Iraq

³ Department of Medicinal Plant Technologies, Technical Agricultural College, Northern Technical University, Iraq

* Corresponding Author: Ali M Saadi

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Abstract

The relationship between intestinal parasites and chronic gastrointestinal disorders is a topic of great clinical importance because of the potential role of parasitic infections in developing and exacerbating gastroenteritis. Intestinal parasites, including protozoa, helminthes, and other pathogens, are known to cause a wide range of digestive symptoms such as diarrhea, and abdominal pain. In chronic cases, parasitic infections may contribute to long-term inflammation, immune system dysfunction, which can perpetuate digestive disorders. The presence of these parasites can complicate the diagnosis and management of chronic conditions such as irritable bowel syndrome (IBS), inflammatory bowel disease (IBD), and other functional gastrointestinal disorders. This review examines the mechanisms through which intestinal parasites influence the gut, explores the clinical evidence linking parasitic infections with chronic digestive issues, and discusses the implications for diagnosis and treatment in affected populations. Further research is needed to better understand the interplay between these infections and chronic gastrointestinal disorders, as well as to develop effective management strategies.

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1. Introduction

Intestinal parasitic infections continue to pose a significant challenge in public health, acting as a major cause of morbidity and mortality around the world. These infections are often disregarded because they can remain asymptomatic, displaying little to no immediate outward symptoms. However, their potential consequences can be extremely damaging, leading to serious health issues such as malnutrition or anemia. In severe instances, these infections can even result in death. (Thanasuwan *et al.*, 2021, Ahmed, 2023) ^[16, 17]. One crucial aspect that must be addressed regarding these infections is the relationship they hold with intestinal health, as our primary interest here revolves around understanding the intricate intestinal problems caused by the presence of these parasites. Currently, there is a growing interest and concern among parasitologists regarding these overlooked or understudied health issues. This increasing attention is crucial, as it underscores the need for further exploration and understanding of the impacts of intestinal parasites on overall health. Although it is challenging to estimate the global prevalence of these infections accurately in terms of statistical figures, it is still plausible to predict that several billion individuals may be harboring at least one type of parasitic organism within their bodies across the globe. For certain conditions, such as amebiasis and ascariasis, it is alarming to note that more than 50% of the world's population is believed to be affected. This highlights the urgency for more comprehensive research and better health interventions to combat these pervasive infections. (Fauziah *et al.* 2022, Chávez-Ruvalcaba *et al.* 2021) ^[19, 20].

Gastrointestinal parasites may cause a spectrum of pathological processes. Acute clinical manifestations include diarrhea and/or dysentery, vomiting, and abdominal cramps. Chronic gastrointestinal disorders following parasitic infections are in part mediated by immunological mechanisms. Parasites have a dual effect: they cause an immunological response, and they produce antigens which in turn also cause an immunological reaction. The interrelationship between chronic digestive diseases and gastrointestinal helminths remains to be studied. It is important that these studies determine the exact histopathology of these conditions and if the parasites are on their own responsible for pathological changes. This review will update readers on the prevalence and effects of intestinal parasites and discuss possible associations between these worms and digestive health (Chávez-Ruvalcaba *et al.* 2021) ^[20].

2. Types of Intestinal Parasites

Intestinal parasites such as protozoa and helminths are organisms that can be transmitted to humans and cause an inflammatory response in the digestive system. Protozoa are unicellular eukaryotic microorganisms, and their members can cause different types of gastroenteritis, such as amoebiasis or giardiasis, cryptosporidiosis, and cyclosporiasis by single-celled flagellate and ciliate organisms. Protozoal diseases are favored by several biological, ecological, biochemical, and evolutionary characteristics of these parasites, such as low infective dose, short prepatency, and a long patent period, cell variety, steroid hormone resistance, genome complexity, intraspecific genetic variation, and different forms in the disease pathway, male and female determination during schizogony and sexual reproduction.

On the contrary, helminths are multicellular eukaryotic organisms, and their transmission is achieved after ingestion of eggs or larvae or directly by penetrating through the skin. As contamination occurs frequently in population groups with a low level of sanitation, their prevalence is variable based on the geographic region.

2.1. Protozoa

Protozoa are single-celled eukaryotic organisms. They are unicellular living beings that possess a certain level of structure of an animal cell (with its internal organelles and genetic material within the nucleus). Some of these neurological activities are motility and sensitivity. The pathogenic protozoa develop locomotion structures and modify their cell membrane, becoming capable of adhering to other cells (usually the enterocytes) (Von Huth *et al.*, 2021) ^[1].

Many environmental factors contribute to the risky effects of these parasites. When their capability to cause infection is investigated, it is not based on classic host determinant factors and the number of ingested parasites. The most pathogenic protozoa causing chronic infections are:

Cryptosporidium. It is transmitted by the ingestion of water or food contaminated with the oocysts of the parasite. The first symptom is the sudden onset of odorless diarrhea and abdominal pain beginning late between 2 and 12 days after ingestion of the oocysts (Hemphill *et al.*, 2019) ^[3].

2.2. Helminths

They are worm-like parasites with a simple organization, generally without huge morphostructural adaptations to the parasitic way of life. According to their localization in the

human gastrointestinal tract, they can be classified as:

1. Nematodes that inhabit the small intestine: *Ascaris lumbricoides*, *Enterobius vermicularis*, *Strongyloides stercoralis*. 2. Nematodes that inhabit the human colon: *Trichuris trichiura*, *Necator americanus*, *Ancylostoma duodenale*, *Trichostrongylus* species. 3. Cestodes that may inhabit the human small intestine: *Taenia saginata*, *Taenia solium*, *Diphyllobothrium latum*, *Hymenolepis nana*, *Hymenolepis diminuta*. 4. Trematodes in general are zoonotic, and their primary host is another mammalian class, and less frequently humans (secondary hosts). The main trematodes to be highlighted are *Clonorchis sinensis*, *Opisthorchis* species, *Paragonimus westermani*, and *Fasciola hepatica*.

Infection by one or more of the parasites mentioned above can cause gastrointestinal infections ranging from mild to severe. The pattern of symptoms varies depending on the type of parasite, the load of infection, the nutritional status of the host, the host immune response, and the duration of the infection. Helminth infections can result in acute symptoms such as diarrhea, abdominal pain, vomiting, chronic poor appetite, bloody stool, tissue and organ destruction, jaundice in chronic cases, and death in severe cases. The chronic effects of helminth infections are due to their long survival in the host, ranging from a few days up to 30-50 years, and they may never be completely cleared, although an immune response may occur in the person involved. Chronic diarrhea is the result of the inflammatory response to the worms in the duodenum. Additionally, insufficient digestive enzyme secretions and bile salts, and loss of insulin sensitivity may occur (Hemphill *et al.*, 2019) ^[3].

3. Prevalence of Intestinal Parasites in Different Regions

Over three billion people are currently infected with an intestinal parasite, and more people are at risk for such infections, especially in tropical and subtropical environments. Evidence shows a geographically influenced higher prevalence of these pathologies, depending on a region's specific environment and healthcare infrastructure. In cold, dry climates, less than 1% of school-aged children are affected by intestinal parasites, in contrast to the prevalence found in tropical countries, which ranges from 50 to 80%. The odds suggest an overlay of regional data on parasitic diseases, and this outcome is due much to the environmental and social factors, including sanitation facilities, construction type, and population density. For many tropical and subtropical countries, for example, southern Iran, Iraq, Brazil, Argentina, and Venezuela, infected feces are used as a precious fertilizer form (Pereira de Araújo *et al.*, 2022) ^[2].

4. Mechanisms of Parasitic Infection in the Digestive Tract

Intestinal parasites are equipped with a variety of defined mechanisms to affect the digestive tract and infect the body. Parasites use all their features to attach to the wall of the digestive tract, which is very favorable for them as it ensures their survival. Moreover, some parasites secrete biofilms, a sticky substance that attaches them to the intestinal mucosa even more firmly so that they cannot simply be rinsed off. After the attachment, the parasites frequent in the digestive tract start into action, where they are sheltered from the body's immune reactions (Khurana *et al.* 2021) ^[8]. Many parasites can reproduce in the human body, which contributes

to the extent and chronicity of the infections, and the parasites may wait in their unexcited stage in the host for years. Furthermore, many parasites disrupt the flow of nutrients, the efficacy of digestive enzymes, or disrupt the physical wall of the digestive tract. For example, tapeworms anchor themselves to the small intestine wall and consume some of the nutrients the host ingests, which leads to a depletion of the necessary vitamins and minerals (Pereira de Araújo *et al.*, 2022) [2]. Lastly, several parasites can manipulate the digestion processes for their own sake, as they significantly consume the nutrients the host ingests; this results in vitamin and mineral deficiencies. The parasites are also known to have a powerful immunosuppressant effect, such that they are screened without significant harmful collateral damage. However, there is also quite high-impact inflammation in the bowels or a control-wall infection (Cong and Elsheikha 2021) [9].

5. Diagnosis of Intestinal Parasites

Clinical history taking and correct symptoms of the patient give the preliminary indication to the physician regarding the introduction and spread of the suspected pathogens. The final diagnosis of the infections is done by laboratory tests for the confirmation of the intestinal parasitic infections. In a variety of cases, the diagnosis can be made with the identification of helminthic eggs or protozoan cysts in a stool sample. Simple and basic techniques are employed for the identification of suspected bloodsuckers in the study. Laboratory diagnosis of the stool sample exists with two main methods. The direct tests are useful for diagnosis, but these require a minimum of 5 stool samples (Taghipour *et al.* 2021) [7].

The sputum can be used as an alternative to collect feces. If the diagnosis of a man diagnosed with the history and clinical clues as suspected of intestinal ascariasis is the bane of the lung, the sputum can be visualized. Stool examination is the most frequently used diagnostic tool where stool is examined macroscopically. Several tests are recommended that provide various levels of sensitivity and specificity. Advancements in the diagnostic tools have been made to diagnose the parasitic infections in the patients. Endoscopy plays a great role in the diagnosis of the infection, and a variety of endoscopic technologies have been developed for the diagnosis of parasites.

6. Stool Sample Analysis

Stool sample analysis is probably the first approach for the detection of intestinal parasitic infections. Direct parasitological diagnosis may include the standard examination of fresh stool samples under the light microscope, the preparation and reading of slides, a range of smear, concentration, flotation, and sedimentation techniques, and the inspection of permanent or stained preparations of fecal samples. In the last few years, there has been an increase in the use of immunoassay procedures for fecal sample examination while different immunoassays are applied to detect antigens in stool samples produced by different parasites (M. Leung *et al.*, 2018) [5].

The correct collection techniques, the examination of three different stool samples at short intervals, and some care about the time of sample collection are crucial points for adequate and accurate acquisition of diagnostic information. The appropriate sample collection and reporting make the examination positive, assuming that at least a low diagnostic sensitivity and specificity level in the test system is reached.

Diagnosis is difficult if gastroenterological symptoms are mild; an occult or described pathogen may not be present in the stool during the examination because of fluctuation in fecal excretion. Therefore, a stool examination of five specimens is often recommended for parasitic infections with variable excretion patterns. Of significance, a diagnostic and medical history are critical to give appropriate advice to patients on stool provision day and time for parasitic diagnosis. It is also important to inform patients and health personnel about the sample integrity and possible damage by inappropriate methods for transport and sample delivery. It has been shown that stool examination can lead to the right diagnosis, save costs, and improve patient health if it is performed correctly.

7. Imaging Techniques

Imaging techniques are one of the supplementary tools used to diagnose the complications of intestinal parasitic infections, such as abscesses, infiltration of other organs, and pseudo-tumors. Ultrasound, CT scans, and MRI can help visualize structural changes brought about by parasites, showing bowel thickening, dilatation, peritoneal changes, masses, and cavity collections when present. Apart from abscesses, bowel obstruction due to bezoars, *Ascaris lumbricoides*, or *Strongyloides stercoralis* may occasionally be seen. These techniques do not primarily serve to diagnose the infection, as they cannot visualize the parasites themselves (von Huth *et al.*, 2021) [14].

8. Treatment Options for Intestinal Parasites

The treatment for intestinal parasite infections generally consists of pharmacological products, but non-pharmacological approaches concerning diet and nutrition have also proven to be effective for the elimination of various parasitic species from the human digestive system. (Khurana *et al.* 2021) [8].

9. Chronic Digestive Disorders Associated with Intestinal Parasites

Inflammatory bowel disease is a group of inflammatory diseases of the intestinal tract. The main feature of inflammatory bowel disease is long-term inflammation and ulcers in the digestive tract. Symptoms include abdominal pain, diarrhea, rectal bleeding, poor bowel emptying, and general symptoms such as fever, fatigue, appetite loss, and weight loss. The cause of inflammatory bowel disease is still unknown and likely multifactorial, probably resulting from an abnormal response of the immune system to normal intestinal bacteria. Currently, the incidence of inflammatory bowel disease, including ulcerative colitis and Crohn's disease, is increasing worldwide. Immune modulators and anti-inflammatory medications can relieve the symptoms, but these therapies are associated with severe side effects. By now, inflammatory bowel disease is incurable, but inflammatory bowel disease can lead to the surgical removal of affected intestines (Pereira de Araújo *et al.*, 2022) [2].

10. Research Studies on the Link between Intestinal Parasites and Chronic Digestive Disorders

Research further investigating the relationship between intestinal parasites and chronic digestive disorders has been published. Large-scale research on the distinct mechanisms of parasite-elicited chronic digestive disease can improve the effectiveness of anti-parasitical treatments alone or in

addition to conventional chronic digestive disorder treatments. The gut can be an etiological setting for parasite infection, but rarely is this discussed in research; several new papers help to fill that space. Published studies include research into the etiological roles of parasites in Crohn's disease and irritable bowel syndrome (Pereira de Araújo *et al.*, 2022) ^[2].

More research is needed in this field to ascertain connections between intestinal parasitism and chronic digestive disorders, and especially to date, little research has been undertaken to definitively make any specific conclusion regarding the involvement of parasites in the etiology of these disorders. It is important to fill the gaps for healthcare practitioners to produce best-practice evidence that can initiate causality between a parasitic infection and a related chronic disorder, evidenced in part by the case studies aligning with current research. More research is also needed to investigate the ratio of chronic, mild, and severe disorders that stem from an initial infection (Wang *et al.*, 2022) ^[11].

11. Conclusion and Future Directions

This review has collected a significant number of reports that indicate correlation and, in some cases, causation of intestinal parasites with indeterminate IBS, SIBO, and non-ulcer dyspepsia. Combined with findings describing alterations of natural flora and the reduction in chronic digestive disorders, it is possible to conclude that parasites are not typically a beneficial part of the gut ecosystem and that diagnosis and treatment options need exploration in more breadth. Hopefully, understanding the benefit of eliminating parasites shall improve research and patient care. If nothing else, we have learned that parasites are not a benign disease and should be treated timely. Future Directions: Clearly, treatment is essential when it comes to parasitic elimination in both Western and developing countries. Anti-helminths need to be explored and accurate diagnostics furthered (Hanieh *et al.* 2021) ^[12].

Treatment options arising are dependent upon the parasite involved, symptomatic disease, and burden of infection. Therapies may include the use of anthelmintics, antibiotics, probiotics, and if IBD develops, immunosuppression. There are a growing number of serious patients who need the right care. In addition, research exploring the manipulation of the ecosystem of secondary organ infections needs development with gastroenterologists (Pereira de Araújo *et al.*, 2022) ^[2]. Public health initiatives are of the highest importance due to the effects on healthcare-associated IBD and the different communities depending upon very strict or sporadic plans. We hope that this motivates additional study in all fields toward the improvement of care for IBD patients and in deworming. (Kono *et al.* 2024) ^[13].

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