Middle East J Dig Dis. April 2023;15(2):72-75

doi 10.34172/mejdd.2023.325 http://mejdd.org

Middle East Journal of Digestive Diseases MEJDD

Review Article

# Mini Review: The Impact of Climate Change on Gastrointestinal Health

**Anahita Sadeghi[1*], Desmond Leddin[2], Reza Malekzadeh[1]**

[1]Digestive Disease Research Institute, Tehran University of Medical Sciences, Tehran, Iran
[2]Professor of Medicine, Dalhousie University, Canada

**Abstract**

Global warming and climate change are important worldwide issues which are a major human health threat. Climate change can affect the gastrointestinal (GI) system in many ways. Increased rainfall events and flooding may be associated with increased GI infections and hepatitis. Climate change could cause changes in gut microbiota, which may impact the pattern of GI diseases. The stress of access to essential needs such as clean water and food, the effects of forced migration, and natural disasters could increase brain-gut axis disorders. The association between air pollution and GI disorders is another challenging issue. There is a lot to do personally and professionally as gastroenterologists regarding climate change.

**Keywords:** Climate change, Health, Gastroenterology

**Cite this article as:** Sadeghi A, Leddin D, Malekzadeh R. Mini review: the impact of climate change on gastrointestinal health. *Middle East J Dig Dis* 2023;15(2):72-75. doi: 10.34172/mejdd.2023.325.

**Received:** January 20, 2023, **Accepted:** March 27, 2023, **ePublished:** April 30, 2023

## Introduction

Climate change is a major human health threat.[1] Our planet is in danger, and climate change is already happening with serious effects on our health.[2] The Intergovernmental Panel on Climate Change (IPCC) has concluded that the world must limit temperature rise to 1.5°C to avoid catastrophic health impacts of climate change. To meet this goal, it is required that greenhouse gas (GHG) emissions be reduced by half by 2030 and achieve net zero $CO_2$ emissions by 2050 but current global efforts are not sufficient to reach this goal.[3-5] The consequences of climate change on our health may be multifaceted, complex, and challenging, however, the evidence for climate change and its impact on gastrointestinal (GI) health is in its infancy.

## Climate Change and Health - Definitions

Climate change influences our health in multiple ways and we have recently seen the consequences of climate change such as extreme rainfalls, and floods and we expect these disasters to continue to adversely affect our health if we do not address them, and accommodate for them.[6-8] A *carbon footprint* is the amount of $CO_2$ we produce through our actions. Studies have shown healthcare sector's carbon footprint accounts for over 4% of global $CO_2$ emissions and as a matter of fact, the proportion of healthcare is significant [9,10] *Greenhouse* effect is the natural warming of the earth that results when gases in the atmosphere trap heat from the sun that would otherwise escape into space. The greenhouse effect is beneficial and leads to the earth being habitable. However, too much atmospheric carbon dioxide and other GHGs released by human activities, and other sources, lead to extra heat being trapped and global warming.[11,12]

## Effects of Climate Change on GI Health

Is there any possible association between climate change and the GI system? When we consider the effects of climate change on health, the cardiovascular and respiratory systems come to mind as the primary victims; however, GI health is vulnerable, and the impact of climate change on the GI system is underappreciated.[13,14] Environmental factors could potentially have an important role in changing the patterns of GI diseases such as inflammatory bowel disease (IBD), functional GI disorders, and GI cancers.[14-16]

## Climate Change and Functional GI Disorders

There is a close link between climate change and mental health. Acute stress as a result of events like wildfires, floods, and storms will be exacerbated by chronic stress due to struggling to obtain food, water, and shelter. There is a strong link between mental health and functional GI disorders-the most prevalent GI disorders in the general population.[14,17-20] Acute dysbiosis could present with mild abdominal pain and diarrhea but more importantly, chronic dysbiosis could lead to an increase in the risk of IBD, celiac disease, and other autoimmune diseases.[21,22] There is a close link between changes in gut microbiota and disease patterns. It is important to know how climate change could impact gut microbiota. We produce a lot of $CO_2$, which leads to changes in the composition of soil and consequently changes the food nutrients, and finally

*Corresponding Author: Anahita Sadeghi, Email: anahita825@gmail.com

alters our gut microbiota as a major culprit in changing the patterns of GI disorders.[23-25]

## Climate Change and Diarrhea

Rising temperatures and flooding can lead to an increase in water-borne diseases such as cholera. This is not just a problem in low-income countries, it can affect all countries.[3,26] Drainage systems can be affected by heavy rains, contaminating drinking water and increasing intestinal infections. Diarrheal diseases are one of the leading causes of death in children. The World Health Organization (WHO) estimates that by 2050, about 33 000 children under the age of 15 could die from diarrheal diseases worldwide due to climate change.[27,28] Water pollution as a result of climate change can expose people to pathogens that cause water-borne and vector-borne infections. In addition, outbreaks of salmonella and campylobacter can be attributed to elevated temperatures. On the other hand, dangerous algae such as cyanobacteria can cause GI problems.[29-32]

## Climate Change and Migration and its Impact

Climate change will increase migration and that consequently will increase the burden on the health care system. Due to cultural differences, GI healthcare providers will require training in the diagnosis and treatment of diseases they have not encountered before. Crowding may also be a significant issue with multiple health effects. On the other hand, migration is associated with several stress factors that can affect mental health.[14,33-35]

## Air Pollution and GI Disorders

Although the association between air pollution and GI disorders is not well understood, some associations are reported between exposure to air pollution and various GI diseases (Figure 1).

**Liver:** Climate change could lead to metabolic liver disease secondary to changes in nutrition and air pollution as well as increase the risk of hepatitis A, E, and other liver infections like schistosomiasis. Moreover, increased exposure to toxins like aflatoxin is another possible consequence of climate change.[14,36,37]

**Irritable bowel syndrome (IBS):** Climate change has implications for mental health that could increase the prevalence of functional GI disorders including IBS. Moreover, the incidence of IBS could be increased by exposure to some micropollutants.

**IBD:** A possible link between pollution and IBD remains controversial. Some studies have not shown a link between IBD and air pollution, whereas there is a study showing an association between some air pollutants and early-onset Crohn's disease and ulcerative colitis.[38-41]

**Cancers:** Several studies have shown an association between air pollution and GI cancer, especially liver, stomach, and colon cancer. However, the evidence for many of these associations is still weak.[42-45]

**Peptic ulcer:** Air pollution may associate with peptic ulcer bleeding and increase the risk of emergency admissions in elderly patients.[46,47]

## Awareness

After distributing the World Gastroenterology Organisation (WGO) survey questionnaire[48] in Google form, among 47 gastroenterologists, about 75% believed climate change was a crisis and most of them believed that climate change mostly or entirely happens due to human activities. Half of them made any changes in their professional life to reduce their carbon footprint and the major issues they reported were lack of time and knowledge, awareness, and leadership on the issue.

## Conclusion

Various conditions that may be impacted by climate change and its effects was outlined in Figure 2. Even though there may be little evidence to support these hypotheses, studies are currently in progress, and additional evidence is anticipated to accumulate soon. Although it may already be late, it is never too late. It is time to change our personal

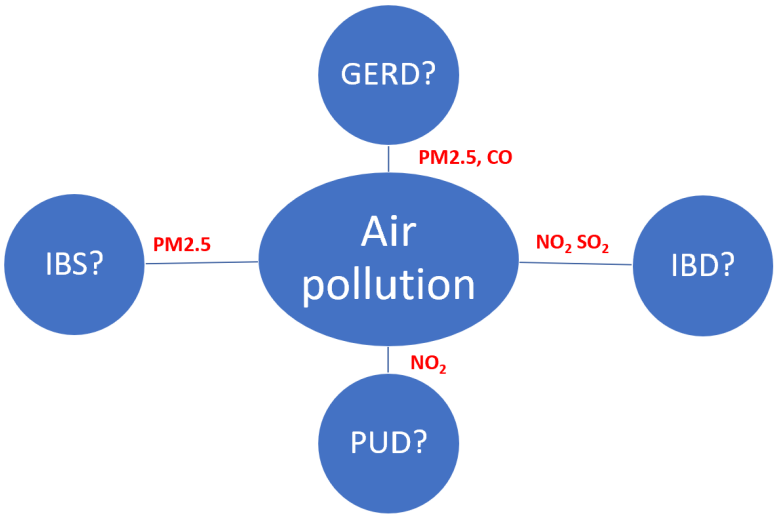


**Figure 1.** Air pollution and GI diseases

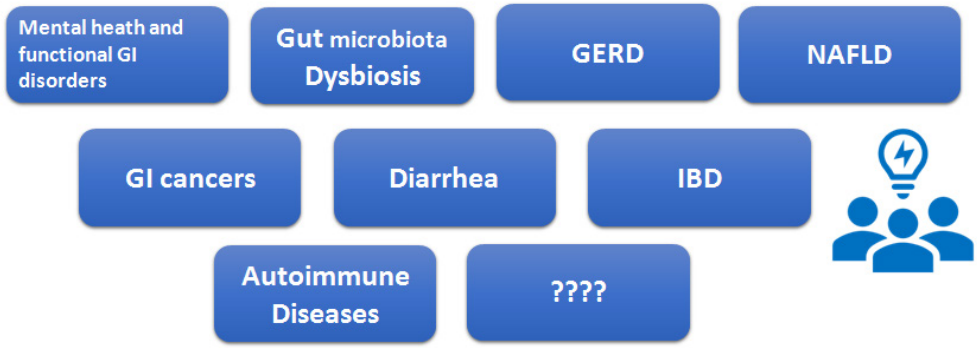


**Figure 2.** Climate change and GI health

and professional activities as role models. We can walk more, we can use public transport more often and mitigate unnecessary travel, reduce red-meat consumption, adjust the indoor temperature to reduce energy consumption, and change our working hours to daylight time if possible. We do these things as a routine not just to show off as a luxurious act. Every one of us is responsible as a teacher and a clinician for increasing the awareness of our students and our patients on how climate change plays a role in their health.[49] Healthcare professionals have a remarkable role and should be encouraged to take any steps toward a greener future.


## Acknowledgments

We acknowledge the great help and support of the Iranian Gastroenterology Association, which has helped distribute the questionnaire amongst its members and all those who have taken the time to fill out the questionnaire.


## Authors' Contribution

All authors reviewed and approved the final version of the manuscript

## Competing Interests

The authors declare no conflict of interest related to this work.

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