Effects of climate change on digestive health and preventative measures

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We have just lived through the hottest days on Earth since records began, and worse is predicted. Given the stark reality of climate change, its impact on the development of gastrointestinal (GI) and liver disease is increasingly recognised. In this commentary, we aim to raise awareness of the links between climate change and GI and liver disease; some of these links are speculative and research is required to confirm causation. We also briefly introduce potential adaptation and mitigation strategies and what you can begin to do as a health professional.

EFFECTS ON GI AND LIVER PHYSIOLOGY

Climate change is associated with extreme heat events, which can affect mammalian physiological function. Individuals with chronic illness, such as chronic liver disease, are more vulnerable to the physiological effects of excess heat. Reported effects of extreme heat on the human liver include ischaemia, which occurs as a result of peripheral vasodilatation to dissipate heat to the environment.[1] Hepatocyte necrosis can occur due to ischaemia and hypoxia as a result of compensatory splanchnic vasoconstriction, and direct cytotoxicity which can result in acute liver injury and, in extreme cases, acute liver failure. Cytotoxicity as a result of extreme heat is also reported to cause pancreatitis and damage to the intestinal mucosal barrier, increasing permeability which can lead to endotoxinaemia.[1] Climate change affects epithelial barriers of all mucosal surfaces due to thermal toxicity to epithelial cells and changes in the splanchnic circulation resulting in oxidative stress. Diarrhoea, dehydration and dyselectrolytaemia followed by death may ensue.

NON-COMMUNICABLE GI AND LIVER DISEASE

The climate change impact on the GI system is widespread (figure 1).

Concerningly, the developing immune system is vulnerable to the effects of climate change, altering an individual's susceptibility to infection, atopy and autoimmune disease. Climate change may be implicated in the development of immune-mediated GI disease, such as eosinophilic oesophagitis.[2]

There is increasing crop failure due to climate change; chemical and pesticides used for crop development are likely to alter composition of the gut microbiome. Resulting gut dysbiosis may impact the pathophysiology of irritable bowel syndrome, inflammatory bowel disease (IBD) and colorectal cancer, as well as non-GI diseases from obesity to neurodegeneration.[3]

Air pollution and rising levels of particulate matter (PM) are also now implicated in the development of human diseases across many organ systems, and can exert effects through inflammation, insulin resistance and oxidative stress. Air pollution is implicated in the development of steatotic liver disease, chronic liver injury and cirrhosis although the exact mechanisms are still to be identified.[4] Heat waves are associated with an increased risk of a flare in patients with IBD.[5] A potential link has also been identified between increasing ambient temperatures and admissions with biliary tract diseases; the potential mechanisms remain to be elucidated.[6]

Metabolic dysfunction-associated steatotic liver disease (MASLD) is linked to the climate crisis because of increasing agricultural disruption and food insecurity resulting in a reliance on ultraprocessed foods and the subsequent development of malnutrition and/or obesity, and poor air quality resulting in lack of outdoor exercise and active travel encouraging sedentary lifestyles and obesity. Many physicians are concerned that the synergistic epidemic of climate change, obesity and undernutrition is contributing to the MASLD epidemic. Microcystins (a hepatotoxic by-product of blue-green algae which are increasing due to climate change, and which can contaminate drinking water and swimming sites) can lead to progressive MASLD and via its effect on the microbiome increased the risk of inflammatory intestinal pathology and malignancy in experimental models.[7 8]

MENTAL HEALTH AND GI DISEASE

The climate crisis is reported to have negative effects on mental health, which can impact GI health. Food insecurity and the cost of living are implicated. Eco-anxiety and stress have been associated with substance misuse, which may associate with the development of alcohol-related GI disease and viral hepatitis.[9] The burden of disorders of gut–brain interactions may also increase as a result of the climate crisis, in part related to increased outbreaks of gastroenteritis.[10]

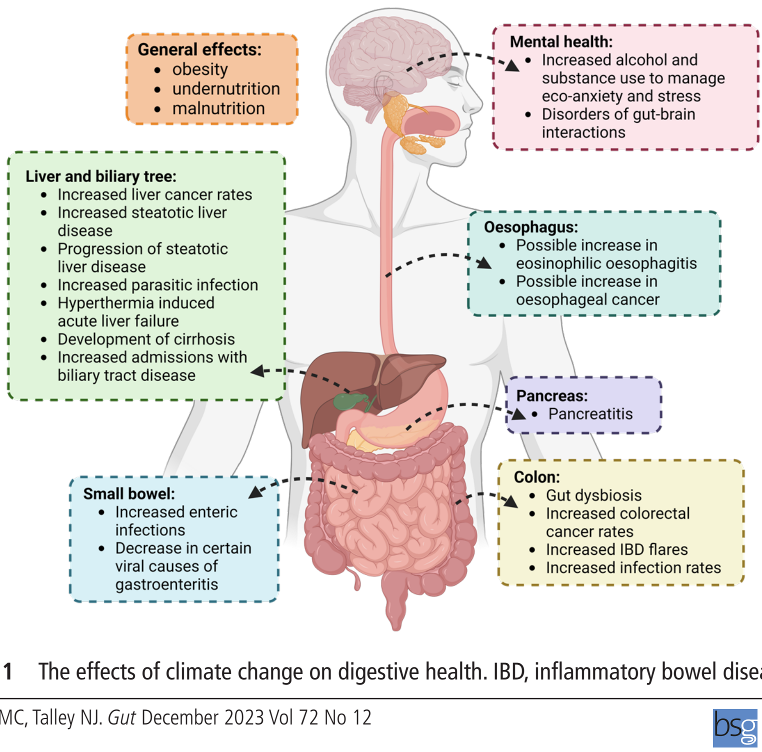

Figure 1 The effects of climate change on digestive health. IBD, inflammatory bowel disease.

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GI INFECTIONS

More than 50% of infectious diseases that humans have encountered have been exacerbated by climate change, and by 2030, a 10% rise in diarrhoeal illness is expected, affecting primarily young children.[11 12]

Climate change related flooding has led to contamination of drinking water and outbreaks of waterborne/enteric infections, such as hepatitis A and E infection. Enteroviruses have been found to be abundant in glaciers, and on glacial melting huge numbers of viral particles (some novel) will be released into the connecting water bodies.[13] Rising sea temperatures also provide a preferable environment for the growth of certain bacteria; bacterial infections of the GI tract including *Vibrio* infections have been reported, even as far north as locations near the Baltic and North Sea.[14] Outbreaks of leptospirosis, campylobacter and cryptosporidiosis have all been reported because of climate change related flooding. On the other hand, rotavirus and norovirus may decrease in a global warming environment because these viruses survive less well at warmer temperatures.[15] A changing pattern of parasitic liver disease has also been reported, with unexpected outbreaks of schistosomiasis in Europe and increased liver fluke (*Fasciola hepatica*) infection documented in the UK.[16 17] This changing pattern of disease is alarming, and its impact is likely to be felt across the world.

GI/LIVER CANCER

Whether climate change impacts on the development of GI and liver cancer is another important question. Increased aflatoxin production by fungi in the setting of warming climes is expected to be associated with increased primary liver cancer rates.[18] Outdoor air pollution and PM (<2.5 μm) are recognised carcinogens which are tightly linked to climate change. A link between PM exposure and the development of oesophageal cancer has been postulated.[19] A recent systematic review provided evidence of an association between PM and colorectal and liver cancer, with strongest evidence for liver cancer.[20] Plastic waste (made from fossil fuels) is also reportedly carcinogenic although the implications of the growing internal microplastic contamination, now affecting most people around the world through contaminated seafood and other sources, on GI disease is unclear.[21] Notably, microplastics have been detected in human liver.[22]

MITIGATING THE IMPACT OF CARING FOR PATIENTS WITH GI AND LIVER DISEASE ON THE ENVIRONMENT

Delivering healthcare to patients with GI and liver disease has a significant carbon footprint. There is an urgent need to better understand the entire GI and liver care carbon footprint, to allow adaptation and mitigation strategies to be put in to place. Industry must be encouraged to provide an assessment of the environmental impact of their products so that lower carbon options can be prioritised where able. Carbon footprint assessments of care pathways (such as detection and staging of steatotic liver disease using blood tests, transient elastography and liver biopsy) must be undertaken. Lean services which minimise waste should become the norm—examples include reusable personal protective equipment in all settings. Data from England showed that in patients with cirrhosis and ascites undergoing paracentesis in the last year of life, those who attended a day case service had almost 17 fewer inpatient bed days compared with those with unplanned care—a dedicated paracentesis service, therefore, appears better for both patient and planet, but these services should have their carbon footprints evaluated.[23]

Another important focus should be on the primary prevention of disease. Ninety per cent of liver disease is potentially preventable in Western populations. Strategies to prevent the development of alcohol-related liver disease and reduce associated hospital admissions would be associated with lower greenhouse gas emissions, for example. Minimum unit pricing for alcohol was introduced in Scotland in 2018. Recently published data have shown that hospital admissions solely attributable to alcohol decreased by 4%, and the effect was driven largely by the reduction in admissions for alcohol-related liver disease.[24] Hence, fewer admissions would result in a lower environmental impact, through a reduction in use of consumables and greenhouse gas production.

EVERY SMALL STEP COUNTS

We face a wicked problem in accelerating climate change that must be solved; the health and survival of future generations likely depends on it. This problem is not just for governments. All of us have the potential to act. As healthcare professionals we are used to being strong advocates in several digestive health domains such as cancer screening; now climate change action needs to become a priority. We can educate and empower ourselves, our trainees and our patients. We can promote strategies that reduce waste and greenhouse gas emissions, from delivering more outreach and telehealth, to working in a green endoscopy environment, to eliminating unnecessary procedures and other low-value care. Lobbying the hospital and clinic you work in to set an aggressive zero emissions target (eg, 2030) and to take positive action will make a difference. We can strongly advocate that our societies stop printing and mailing medical journals to us and stop using plastic covers. We can look at our personal carbon footprint and adjust, for example, by reducing air travel. Finally, we should ask ourselves what will we say when our children and grandchildren in the decades to come ask: What did YOU do about climate change? We hope all of us will be able to say: I acted in the 2020's with haste and courage.

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