

## Review Article

# Environmental Factors Exacerbating Hepatitis Transmission: A Mini Review

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**Abstract**

Hepatitis is a viral infection primarily affecting the liver, causing inflammation and potentially leading to liver damage or failure. It can be caused by different hepatitis viruses, with symptoms ranging from mild to severe and can be acute or chronic. This study explores the environmental factors exacerbating hepatitis transmission, particularly in regions with poor sanitation and limited access to clean water. The research found a complex relationship between ecological conditions and the spread of hepatitis A virus (HAV) and hepatitis E virus (HEV). Some identified factors include poor water quality and utilisation methods, sanitation, and practices. Other factors exacerbating hepatitis transmission include the healthcare system practices, climate and weather conditions, faecal-oral processes, occupational exposure, crowded and overpopulated areas, migration and travel. Therefore, environmental factors that can exacerbate hepatitis infection are multifaceted, and these factors may pose public health challenges. Therefore, there is a need for a holistic approach, incorporating sanitation improvements, hygiene practices, vaccination programmes, and awareness campaigns to combat hepatitis spread in diverse environmental contexts effectively.

**INTRODUCTION**

Hepatitis is a medical condition characterised by inflammation of the liver, which can manifest as a result of various factors, including viral infections, alcohol consumption, certain medications, autoimmune diseases, or exposure to toxins [1,2]. However, viral infections are the commonest. There are several types of hepatitis viruses, including Hepatitis A virus (HAV), Hepatitis B virus (HBV), Hepatitis C virus (HCV), Hepatitis D virus (HDV), and Hepatitis E virus (HEV).

Hepatitis A is primarily transmitted through the consumption of contaminated food or water, resulting in acute hepatitis with distinct symptoms such as jaundice, fatigue, and abdominal discomfort [3,4]. Hepatitis B can spread mainly through direct contact with infected blood or body fluids, and it can also be transmitted from mother to child during childbirth [5]. It is notorious for causing long-term liver issues like cirrhosis and liver cancer, leading to both acute and chronic forms of hepatitis. Hepatitis C is primarily transmitted through direct contact with infected blood, often due to shared needles or unsafe medical practices [6,7]. It commonly leads to chronic hepatitis, potentially causing liver damage over time. Hepatitis D is unique as it can

only infect individuals already afflicted with Hepatitis B, which could lead to more severe liver disease when co-infected [8]. Hepatitis E is usually transmitted from person to person by consuming contaminated food or water [9,10]. It often leads to acute hepatitis, which can be severe, especially for pregnant women. Different viruses have varying patterns of transmission, severity levels, and clinical manifestations, among others. Hepatitis can give rise to various symptoms, including jaundice (yellowing of the skin and eyes), fatigue, abdominal pain, nausea, and vomiting [11,12]. In severe cases, it can lead to chronic liver disease, cirrhosis, and even liver cancer.

Hepatitis is a significant global public health concern due to its widespread prevalence, potential for severe health consequences, and its far-reaching impact on healthcare systems and communities [13,14]. The severity could be because hepatitis can lead to severe health complications. Several key factors contribute to the detrimental impact of hepatitis on public health (Figure 1). Hepatitis is a global health challenge affecting approximately 325 million individuals with chronic infections, increasing their risk of liver damage and cancer [15,16]. This disease has a profound worldwide impact. Due to its various



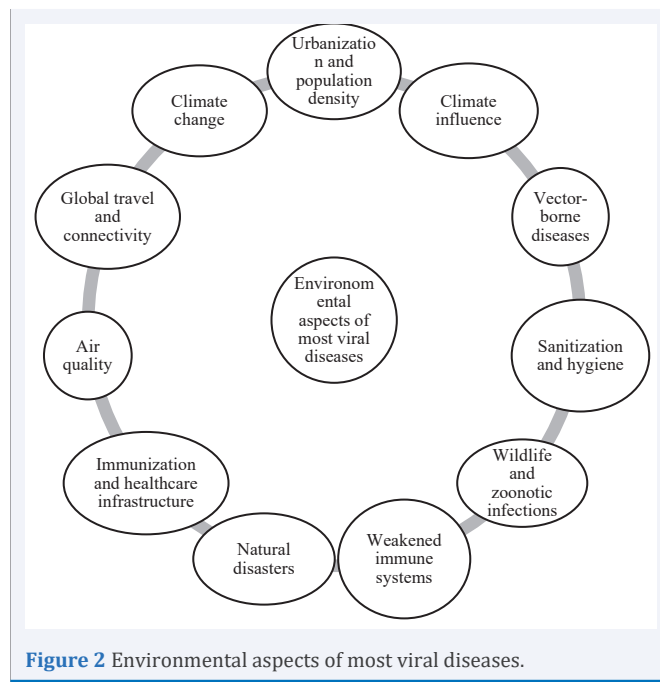
transmission routes, including mother-to-child, contaminated food and drinks, and contact with infected body fluids, achieving effective prevention and control measures can be challenging. Vaccination opportunities exist for hepatitis A and B, and global efforts are underway to enhance access to diagnosis and treatment [17-19].

Hepatitis is a global public health concern that affects millions of people each year. While the primary cause of hepatitis is viral infections, environmental factors play a crucial role in the transmission and prevalence of this disease [20-23]. This mini-review focuses on the environmental factors exacerbating hepatitis transmission.

### Environmental factors and viral diseases

Environmental factors are essential in shaping the spread and impact of infectious diseases [24,25]. These factors influence the survival and transmission of viruses and can contribute to outbreaks [26,27]. Figure 2 summarizes the leading environmental aspects closely linked to most viral disease transmission.

Environmental factors profoundly influence the dynamics of infectious diseases [24]. Climate, including temperature and humidity, affects virus survival and transmission [25]. For instance, the influenza virus thrives in cold, dry conditions, contributing to seasonal outbreaks. Extreme weather events, like heavy rainfall and flooding, can heighten the risk of waterborne diseases [26]. Similarly, temperature, precipitation, and humidity impact disease-carrying vectors like mosquitoes (Basse and Izah, 2017) and ticks, influencing the spread of diseases such as West Nile virus, dengue fever, and Zika. Urbanization and high population density in cities facilitate the rapid transmission of



infectious diseases, particularly in cases like COVID-19, where close human contact plays a critical role [28-30].

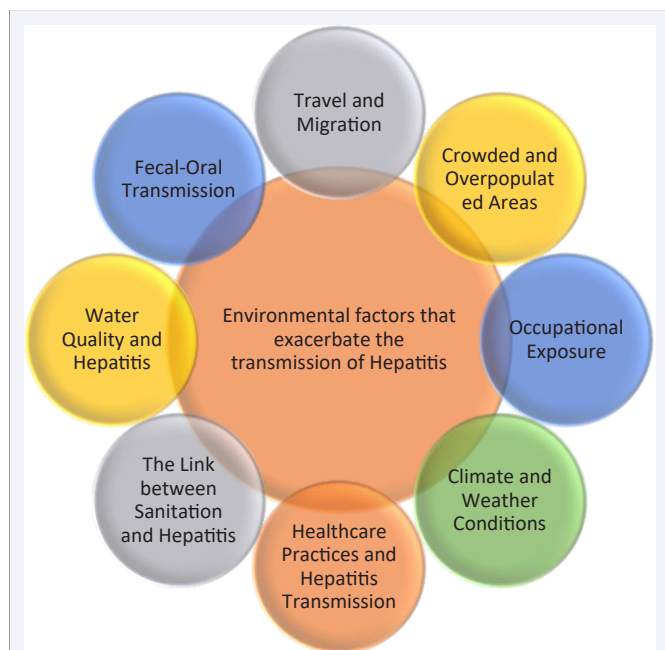
Access to clean water, sanitation facilities, and proper hygiene practices is essential to combat waterborne and fecal-oral transmission of viruses like hepatitis A and rotavirus [31]. Inadequate sanitation can lead to food and water contamination [32-34]. Factors such as deforestation and the wildlife trade contribute to spillover events [35-37]. Air quality and environmental pollutants can worsen the transmission of airborne microbes [38,39], including viruses, impacting respiratory diseases like influenza and COVID-19. Increased international travel and global connectivity may expedite the spread of infectious diseases across borders, posing a substantial public health challenge [40]. Additionally, climate change alters the distribution of disease vectors and the availability of water, affecting diseases and weakening immune systems [41-43]. Natural disasters like earthquakes, floods, and hurricanes disrupt healthcare systems, infrastructure, and sanitation, heightening the risk of outbreaks [44]. Therefore, access to healthcare facilities and immunization programmes is vital in preventing and managing infectious diseases [33].

### Potential Environmental factors that exacerbate the transmission of Hepatitis

Several environmental factors can exacerbate the transmission of hepatitis, particularly in regions with poor sanitation and limited access to clean water. These factors are summarised in Figure 3.

#### Water Quality and Hepatitis

Water quality could significantly impact the risk of contracting hepatitis, particularly in the case of hepatitis A and



**Figure 3** Potential Environmental factors that exacerbate the transmission of Hepatitis.

E, which are primarily transmitted through the consumption of contaminated water sources [9,45,46]. Hepatitis A, which HAV causes, is a highly contagious viral infection primarily transmitted through ingesting infected feces. This transmission mode accounts for most cases [4,47]. Furthermore, inadequately treated or untreated water and contaminated water sources like rivers and lakes can carry the hepatitis A virus. Also, water or food contaminated with faecal matter containing the virus places individuals at risk of infection. Overall, individuals living under poor sanitation and suboptimal water quality are more susceptible to hepatitis A transmission [46,48].

Like hepatitis A, hepatitis E is primarily transmitted through the ingestion of contaminated water [9]. This transmission method is especially prevalent in regions with inadequate sanitation facilities [49,50]. In such areas, human waste can contaminate water sources, leading to the spread of the hepatitis E virus, particularly during flooding or heavy rainfall when water supplies are more likely to become polluted [51,52]. This suggests that communities that are prone to flooding may experience a high prevalence of hepatitis E infection. The association between water quality and hepatitis infection emphasises using clean and safe water sources. Contaminated water, stagnant water or slow-flowing surface water can be a vector for the hepatitis A and E viruses, which could lead to outbreaks and increased disease transmission

### The Link between Sanitation and Hepatitis

The link between sanitation and hepatitis is of utmost importance because the adoption of appropriate sanitation practices is a cornerstone in preventing the spread of hepatitis, particularly in the cases of HAV and HEV, which are predominantly

transmitted via the faecal-oral route [53]. Typically, inadequate sanitation practices can facilitate the spread of the HAV, leading to contamination of both water sources and food. The risk of hepatitis A transmission is heightened in areas where sewage is improperly managed, access to clean and safe water is insufficient, and waste disposal is inadequate [54-57]. This is common in many coastal areas in Southern Nigeria, especially in Bayelsa State.

Hepatitis E, akin to hepatitis A, is chiefly disseminated through the consumption of contaminated water. The transmission route for hepatitis E closely mirrors that of hepatitis A. In regions with inadequate sanitation infrastructure, there is an increased risk of human waste contaminating water sources, providing a fertile environment for the hepatitis E virus [58,59]. This risk is particularly pronounced during flooding or heavy rainfall when water supplies (ground and surface water) are more susceptible to pollution. Sanitation is one of the fundamental bases in breaking the cycle of hepatitis transmission, preventing human waste and the associated viruses from infiltrating water sources and the food supply [60].

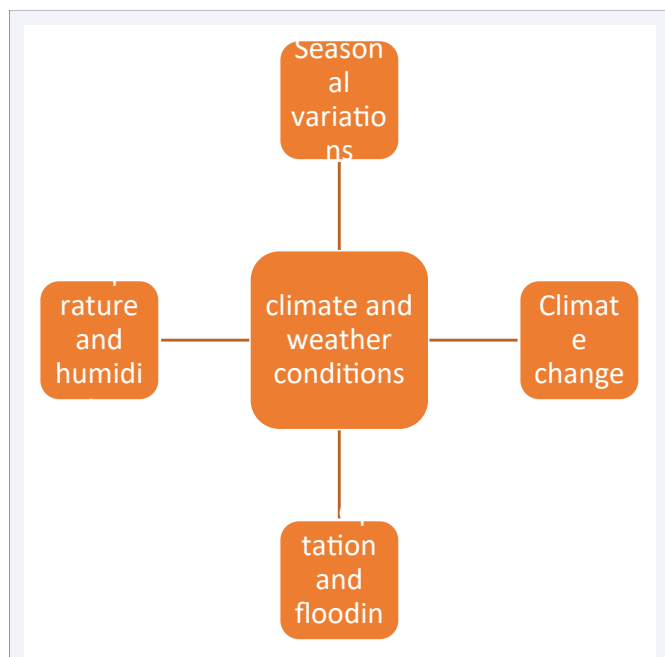
### Healthcare Practices and Hepatitis Transmission

The relationship between healthcare procedures and the transmission of hepatitis is a critical consideration, as healthcare settings can either serve as a secure environment that mitigates the spread of hepatitis or as a potential source of transmission. This connection varies based on the type of hepatitis and the healthcare practices in place. Generally, healthcare facilities, such as hospitals and clinics, can pose a risk for the transmission of hepatitis B and C if stringent infection control measures are not rigorously followed [61]. Furthermore, healthcare workers may be at risk of exposure to patients' blood during medical procedures, as these viruses are present in blood and other bodily fluids [62]. Also, unsafe injection practices, improper sterilisation of medical equipment, and the reuse of needles and syringes can result in the transmission of hepatitis B and C among both patients and healthcare staff [63,64]. In contrast to hepatitis B and C, hepatitis A and E are primarily transmitted through contaminated food and water, often via the faecal-oral route [65,66]. Healthcare practitioners have a less direct role in the transmission of these viruses.

### Climate and Weather Conditions

Climate and weather conditions exert a substantial influence on the transmission and prevalence of hepatitis, notably hepatitis A and E, due to their primary waterborne and faecal-oral transmission routes [10,67]. Several vital effects of climate and weather on hepatitis transmission are summarised in Figure 4.

Temperature and Humidity can significantly impact the survival and transmission of hepatitis A and E viruses [68]. This is because warmer and more humid conditions can expedite the breakdown of viral particles, reducing their persistence. In contrast, colder and drier environments can extend the lifespan of the viruses, increasing the risk of infection when contaminated



**Figure 4** Key effects of climate and weather on hepatitis transmission.

water or food is consumed. Consequently, regions with hot, dry climates may experience more seasonal outbreaks, whereas cold, wet environments are at higher risk of prolonged viral presence and transmission.

Heavy rainfall and flooding events can substantially affect hepatitis transmission [69]. These weather conditions can lead to the contamination of water sources with human faecal matter, which may contain hepatitis A or E viruses [9,70]. Flooding could elevate the likelihood of water supplies becoming polluted, increasing the risk of infection through contamination of food or water [71]. Inadequate sanitation in flood-prone areas also exacerbates this risk, making them more susceptible to hepatitis A and E outbreaks.

Hepatitis A and E outbreaks often exhibit seasonal variations linked to climate and weather patterns [72-74]. Regions with distinct wet and dry seasons may observe variations in the incidence of these viruses. Rainy seasons typically increase runoff and water contamination, leading to higher hepatitis transmission rates. Conversely, dry seasons may reduce transmission due to diminished water source contamination.

Long-term changes in temperature, precipitation patterns, and extreme weather events can significantly impact the distribution and prevalence of hepatitis A and E [75]. Climate change can alter disease vectors' geographic distribution and affect disease season duration and severity. Additionally, climate change may impact the quantity and quality of available water, consequently influencing the prevalence of waterborne diseases like hepatitis A and E [76].

### Faecal-Oral Transmission

Faecal-oral transmission is a significant route of transmission

for various forms of hepatitis, notably hepatitis A and E [77]. This transmission mode entails transferring the virus from the faecal matter of an infected individual to another person's mouth, either directly or indirectly. For instance, hepatitis A can infect people who consume contaminated food or water, as well as those in close personal contact with an infected person [78]. In areas with inadequate sanitation and limited access to clean water, the risk of hepatitis A transmission is higher.

Similar to hepatitis A, hepatitis E is primarily transmitted through the consumption of water or food contaminated with the faecal matter of an infected person [9]. The virus can thrive in areas with poor sanitation, where human waste can easily contaminate water sources. Water supplies are more likely to become contaminated during floods or heavy rainfall, increasing the risk of hepatitis E transmission [79]. For the faecal-oral message, as it concerns hepatitis A and E, there is a connection between inadequate sanitation, contaminated water sources, and the spread of these hepatitis viruses, highlighting the importance of maintaining proper hygiene and sanitation practices [80].

### Occupational Exposure

Occupational exposure is a significant concern regarding hepatitis transmission, particularly for healthcare professionals and individuals in professions that involve potential contact with infected blood or bodily fluids [5]. Generally, the spread of hepatitis B and C in healthcare settings, such as hospitals and clinics, is a cause for concern when stringent infection control measures are not consistently followed [61]. Healthcare workers, including doctors, nurses, and laboratory technicians, frequently encounter blood and other bodily fluids during their daily work, leading to occupational exposure. This direct contact with infectious blood and bodily fluids places healthcare personnel at risk of acquiring hepatitis B and C infections themselves [5]. The transmission of these viruses in healthcare settings often occurs due to unsafe injection practices, inadequate sterilisation of medical equipment, and the reuse of needles and syringes.

### Crowded and Overpopulated Areas

Crowded and overpopulated areas can significantly impact the transmission and prevalence of hepatitis, particularly hepatitis A and E, which are primarily transmitted through contaminated food and water sources [81]. There is a correlation between densely populated regions and hepatitis transmission. For instance, hepatitis A is an infectious disease that is highly transmissible through the fecal-oral route, making it particularly concerning in crowded and overpopulated areas [82]. In such places, close human contact and limited access to clean water and sanitation facilities can facilitate the virus's rapid spread. When humans live in densely populated communities with inadequate sanitation and limited availability of safe drinking water, the risk of contracting hepatitis A increases [83]. Under these conditions, the virus can easily contaminate water supplies and food, leading to outbreaks. Similar to hepatitis A, hepatitis E is primarily transmitted through contaminated food and water, especially in areas with substandard sanitation [84]. Crowded

and overpopulated regions can face a higher risk of hepatitis E transmission due to the limited availability of proper sanitation facilities [9]. In such areas, human waste may contaminate water sources, creating an environment conducive to the proliferation of HEV [85]. Water sources are more likely to become infected during heavy rainfall or flooding periods, which can be more common in densely populated regions.

### Travel and Migration

Migration and travel play significant roles in disseminating hepatitis [86]. The movement of individuals across regions, countries, and continents can significantly impact the prevalence and transmission of hepatitis viruses, including hepatitis A, B, and C [87].

The movement of people, whether through migration or travel, can contribute to the transmission of hepatitis A [88]. Tourists can potentially contract hepatitis A by consuming contaminated food and water in areas with poor sanitation and limited access to clean water. This poses a risk to travellers who may inadvertently carry the virus to new populations when moving from places with lower hygiene standards to regions with better sanitation practices. Such situations can lead to localised outbreaks or the introduction of the virus to previously unaffected areas.

International travel and migration can impact the dynamics of hepatitis B and C transmission [89]. Individuals carrying hepatitis B or C can unintentionally transmit the virus to others through various means, including unprotected sexual contact or sharing needles for drug use [90]. Migrants and travellers engaging in high-risk activities, such as unprotected sexual encounters or drug injection, can contribute to the spread of hepatitis B and C [91,92]. Furthermore, individuals from regions with high virus prevalence who relocate to less prevalent areas may pose a threat, especially if they engage in behaviours that facilitate viral transmission.

Migration and travel can also influence the transmission of hepatitis B and C through bloodborne routes [92,93]. Inadequate infection control measures in healthcare settings and limited access to safe medical procedures in certain areas can facilitate the spread of these viruses. Healthcare workers travelling to provide medical assistance and migrants seeking healthcare in a new country could be at risk if proper infection control measures are not followed [94-97].

### CONCLUSION AND THE WAY FORWARD

Hepatitis is a global health issue influenced by environmental factors, including sanitation, water quality, and healthcare practices. This study focused on the intricate relationship between ecological factors and the transmission of hepatitis, focusing on regions grappling with poor sanitation and limited access to clean water. The study emphasises the importance of addressing these environmental challenges to mitigate the spread

of hepatitis. To this end, several recommendations emerge as pivotal in the fight against hepatitis transmission.

First, there is an urgent need for improved water quality and sanitation practices in at-risk regions. This includes the treatment of wastewater, proper sewage disposal, and promoting personal hygiene and the availability of clean water sources. In areas where sanitation facilities may be lacking or inadequate, public awareness campaigns assume particular significance, emphasising the critical importance of proper hygiene practices, such as regular handwashing and clean water sources, while also elucidating the risks linked with insufficient sanitation.

Secondly, healthcare facilities should rigorously adhere to universal precautions to prevent the transmission of hepatitis B and C. This entails the safe handling of medical sharps, appropriate disposal of medical waste, and the use of personal protective equipment. Additionally, healthcare providers play a pivotal role in advocating for hepatitis A and B immunisation among the general population, especially in areas with a high prevalence of these diseases. Healthcare workers should also be encouraged to receive hepatitis B vaccinations to reduce the risk of occupational exposure.

Thirdly, climate and weather conditions, which impact hepatitis transmission, should be considered in public health planning. Efforts to combat seasonal outbreaks and minimise the impact of extreme weather events should be a priority.

Fourthly, Occupational exposure to hepatitis B and C is a significant concern, emphasising the critical need for robust infection control practices, thorough equipment sterilisation, and widespread vaccination among healthcare workers to minimise the risk of transmission within healthcare settings and protect the health of medical professionals. It is also crucial for individuals in other fields, such as first responders and laboratory technicians, to similarly adhere to infection control measures and receive appropriate vaccinations to reduce the risk of hepatitis transmission in their occupational environments.

Fifthly, there is a link between crowded and overpopulated areas and hepatitis transmission, highlighting the need for improved sanitation infrastructure, greater access to clean water, and public awareness campaigns promoting proper hygiene practices. Efforts to reduce the spread of hepatitis A and E in densely populated regions must address the unique challenges posed by these environments. Vaccination campaigns, when applicable, can also play a vital role in preventing outbreaks of these diseases.

Lastly, the role of migration and travel in the spread of hepatitis highlights the need for travellers to take precautions regarding food and water consumption and high-risk behaviours. Additionally, infection control measures must be strictly followed in healthcare settings to prevent blood borne transmission. In densely populated areas, sanitation improvements, access to clean water, and awareness campaigns should be critical strategies to reduce transmission risks.

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