Literature Review: Floods Cause Diarrhea and Acute Hemorrhagic Conjunctivitis in China

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ABSTRACT

Background. Floods in China increase the risk of waterborne diseases, particularly diarrhea and Acute Hemorrhagic Conjunctivitis (AHC), due to contaminated water, poor sanitation, and overcrowded shelters. Method. This literature review analyzes studies from 2020–2025 using the PICO method, focusing on flood exposure and disease morbidity in affected regions. Data were collected from PubMed, Google Scholar, Garuda, and Scopus. Discussion. Floods significantly contribute to increased cases of diarrhea and Acute Hemorrhagic Conjunctivitis due to contamination of drinking water and poor sanitation in affected areas. Environmental factors such as high temperatures and humidity further exacerbate disease transmission. Crowded living conditions in evacuation shelters accelerate the spread of infections. The study highlights the importance of sanitation, clean water access, public education, and healthcare preparedness in mitigating flood-related disease outbreaks. Conslusion. Floods in China pose severe public health risks, particularly increasing the incidence of diarrhea and Acute Hemorrhagic Conjunctivitis. Effective prevention strategies, including improved water sanitation, hygiene education, and infrastructure resilience, are essential to reduce disease burdens in flood-prone regions. Strengthening disaster response mechanisms and public health interventions can help minimize future health impacts caused by flooding.

Keyword : Diarrhea, Acute Hemorrhagic Conjunctivitis, Flood, Disaster

Introduction

Floods are one of the most common natural disasters in various parts of the world. This phenomenon can be caused by various factors, such as extreme rainfall, sea level rise, land use changes, and poor drainage systems in urban areas [1]. The impact not only causes great economic losses, but also threatens human safety, destroys infrastructure, and disrupts the balance of ecosystems. Climate change plays a big role in increasing the frequency and intensity of floods in

various countries. Global warming causes an increase in atmospheric temperature, which in turn increases evaporation and accelerates the hydrological cycle, resulting in higher rainfall in a shorter period [2]. In addition, melting ice at the poles also contributes to sea level rise, which increases the risk of coastal flooding in island countries and low-lying areas. Some of the countries most affected by the floods include Bangladesh, India, China, and the United States.

Flooding in China is caused by several key factors that is the monsoon significantly influences precipitation patterns, leading to heavy rainfall, especially in summer. This concentrated rainfall can overwhelm river systems, particularly in coastal southeastern China and the mid-lower reaches of the Yangtze River Basin [3]. Climate change has resulted in increased intense precipitation events, contributing to a rise in flash floods. These flash floods are often triggered by local short-duration heavy rainfall, particularly in small catchments. Rapid urban expansion has increased impervious surfaces, which exacerbates flood risks by reducing natural water absorption and altering river networks [4]. Urban sprawl often encroaches on floodplains, increasing vulnerability to flooding. China's varied terrain, with high mountains in the west and alluvial plains in the east, contributes to river flooding. Major rivers like the Yangtze, Yellow, and Pearl Rivers flow through these flood-prone areas. Insufficient flood control infrastructure and incomplete disaster management legislation in some regions can worsen the impacts of flooding [5].

From 1950 to 2019, China became one of the most vulnerable countries to flood risk due to geographical factors, climate, and rapid urbanization. In order to reduce the risk of flooding, the Chinese government has adopted various mitigation strategies that include structural and non-structural approaches. The construction of large dams, such as Tiga Ngarai Dam, has been one of the main steps in controlling water flow and reducing the risk of flooding in downstream areas. In addition, more systematic urban planning management aims to ensure that urban development does not further increase vulnerability to floods. One of the latest innovations in flood management is the application of the "Sponge City" concept, which is designed to increase the city's capacity to absorb, store, and drain rainwater more naturally. This program includes the development of green infrastructure such as infiltration parks, permeable roads, and urban reservoirs [6].

Material and Methods

This study is a literature review that focuses on the impact of flooding in China that causes diseases, namely diarrhea and acute hemorrhagic conjunctivitis with references obtained from pubmed, google scholar, garuda, and scopus. References are taken from articles or studies published in the last 5 years from 2020-2025. The article is original research from China available in full text form with appropriate data, open access, and not a literature review. This review article uses the PICO method where the method analyzes population, interventions, comparisons, and outcome.

1. P (Population): Residents in China, particularly in flood-prone areas such as Mengshan (Guangxi) and Sichuan Province, across different socio-economic and climatic zones.

2. I (Intervention): Exposure to floods during the research period.
3. C (Comparison): The public health implications of flooding on disease morbidity rates in flood-affected populations with those in non-flood areas.
4. O (Outcome): Increased morbidity of Acute Hemorrhagic Conjunctivitis (AHC) and diarrheal diseases. The impact of floods on these diseases varies, with Acute Hemorrhagic Conjunctivitis cases peaking in children (5–14 years) and females, while diarrheal cases peak within the first five days post-floods. Attributable health burdens include Years Lived with Disability (YLDs) for Acute Hemorrhagic Conjunctivitis and an estimated 0.25% of diarrheal morbidity due to floods over the study period, rising to 0.48% in the flood season.

Results

Table 1. List of Literatur

Author & Year	Title	Research Method	Results
Tianjiao Lan, Yifan Hu, Liangliang Cheng, Lingwei Chen, Xujing Guan, Yili Yang, Yuming Guo, Jay Pan (2022).	Floods and diarrheal morbidity: Evidence on the relationship, effect modifiers, and attributable risk from Sichuan Province, China.	The study used a time-series Poisson regression model combined with meta-analysis and meta-regression to analyze the relationship between floods and diarrheal morbidity across 21 cities in Sichuan Province, China (2017-2019). It also estimated attributable risk within the framework of a distributed lag model.	The study found that floods had a significant cumulative association with diarrheal morbidity at the provincial level, with variations across different regions. The effects were most pronounced in areas with higher air pressure, lower diurnal temperature range, or warmer temperatures. The attributable fraction of diarrheal cases due to floods was 0.25% overall and 0.48% during the flood season. However, the study suggests that the impact of flood-related diarrhea may increase in the future due to changing climate conditions.
Xuena Liu, Shuo Qiu, Zhidong Liu, Dongzhen Chen, Hui Liu, Guoyong Ding (2020).	Effects of Floods on the Incidence of Acute Hemorrhagic Conjunctivitis in Mengshan, China, from 2005 to 2012.	The study employed a generalized additive model (GAM) to analyze the relationship between floods and the incidence of acute hemorrhagic conjunctivitis (AHC) in Mengshan, China (2005-2012). The model controlled for meteorological variables, and years lived with disability (YLDs) were used to measure the disease burden.	The study found a significant association between floods and an increased risk of Acute Hemorrhagic Conjunctivitis morbidity (Rate Ratio = 2.136, 95% CI: 2.109–2.163). The burden of Acute Hemorrhagic Conjunctivitis was higher in females and children aged 5-14 years. The attributable YLD per 1,000 due to floods was 0.0434 (95% CI: 0.0425–0.0442), confirming that floods substantially increase Acute Hemorrhagic Conjunctivitis risks, especially among vulnerable populations.

Discussion

The Relationship Between Floods and Disease

Floods often contaminate drinking water with pathogens from sewage, human waste, and animal feces. Overflowing sewage systems and agricultural runoff introduce bacteria, viruses, and parasites into water supplies, increasing the risk of waterborne diseases including diarrhea [7]. Floodwaters can contaminate drinking water and living environments, increasing exposure to enterovirus type 70 (EV70) and Coxsackievirus A24 variant (CA24v), which are the main causes of Acute Hemorrhagic Conjunctivitis [3]. People affected by floods often live in overcrowded shelters with poor sanitation, creating conditions for rapid virus transmission. Flooding can create conditions that support the growth and spread of pathogens, such as E. coli, which can contaminate drinking water sources [4]. Clean water is often difficult to access after flooding, compromising personal hygiene. Infected people can easily spread the virus through contaminated hands when touching their faces or sharing personal items such as towels and toiletries. Liu, X., Qiu, S., Liu, Z, et.al., 2020 journal, research has found that high temperatures and high humidity contribute to an increased risk of Acute Hemorrhagic Conjunctivitis. Higher temperatures can increase the survival of viruses in the environment, while high humidity creates ideal conditions for the spread of pathogens. After the floods, many residents were forced to live in temporary shelters that were crowded and had poor sanitation. In these conditions, close contact between individuals increased, accelerating the transmission of the virus [6]. Lan T, Hu Y, Cheng L, et.al., 2022 journal in its study conducted in Sichuan, China, showed that the effects of flooding on increasing cases of diarrhea usually began to be seen within two days after the flood and lasted for about five days. The severity and duration of the outbreak depended on the severity of the flood, local sanitation infrastructure, and climate conditions. Limited access to clean water makes it difficult for people to maintain hygiene, such as washing their hands, thus accelerating the spread of diarrheal diseases [7].

Factors That Modify The Effects of Flooding

Areas with high air pressure and warm temperatures are more susceptible to increased cases of post-flood diarrhea. Higher temperatures also accelerate the growth of disease-causing pathogens. Lower temperature ranges are correlated with high humidity, which prolongs the survival of pathogens in the environment, increasing the risk of infection [7]. Water contaminated by flooding becomes a medium for the spread of diarrhea-causing pathogens and Acute Hemorrhagic Conjunctivitis viruses, especially in areas with poor sanitation. Living in crowded evacuation sites with poor sanitation accelerates the spread of diarrhea and Acute Hemorrhagic Conjunctivitis. Children who play in floodwater are more susceptible to infection, while women are at greater risk due to post-flood cleanup activities. Communities with limited access to clean water and health facilities are more susceptible to both diseases. The lack of health facilities hinders the handling of diarrhea and Acute Hemorrhagic Conjunctivitis cases after flooding can also affect a person's health.

Communities who do not understand the health risks of flooding are less likely to implement preventive measures such as washing hands and avoiding contaminated water. The absence of a vaccine for Acute Hemorrhagic Conjunctivitis makes prevention highly dependent on good hygiene and sanitation [6].

Prevention of diarrhea and Acute Hemorrhagic Conjunctivitis in floods

Prevention of diarrheal diseases due to flooding requires a comprehensive approach, including aspects of sanitation, availability of clean water, public education, and readiness of infrastructure and health services. One of the main steps is ensuring access to clean water. After a flood, drinking water sources are often contaminated by waste and pathogens, so efforts need to be made to purify and disinfect water, for example by boiling it before consumption or using water purification tablets. The government and humanitarian organizations must also provide an adequate supply of clean water for affected communities. In addition, repairing sanitation infrastructure is very important. Toilets damaged by flooding must be repaired immediately so that human waste does not pollute the environment. If sanitation infrastructure cannot be repaired immediately, temporary facilities such as emergency toilets must be provided immediately to prevent the spread of pathogens [7]. Prolonged flooding, and flooding preceded by drought, are associated with an increased risk of diarrhea in children under 5 years of age living in low- and middle-income countries [8].

Public education about personal hygiene also plays a major role in prevention. The community needs to be given an understanding of the importance of washing hands with soap, especially before eating and after using the toilet. Food management must also be considered, by ensuring that food is cooked properly and stored in hygienic conditions. On the other hand, the preparedness of the health system must also be improved. Medical personnel and health facilities need to be prepared to handle the spike in diarrhea cases after the flood. Stocks of medicines, especially oral rehydration salts to treat dehydration due to diarrhea, must be sufficient. Governments and health organizations also need to monitor the disease to detect and respond to outbreaks more quickly. In addition to short-term efforts, long-term steps that need to be taken are to increase infrastructure resilience to flooding. Building better drainage systems, protecting water sources, and managing flood-prone areas can help reduce the impact of flooding on public health in the future [7].

Prevention of Acute Hemorrhagic Conjunctivitis (AHC) due to flooding can be done through various steps including environmental cleanliness, personal hygiene, and public education. Maintaining the cleanliness of water and food is very important to avoid virus contamination, such as by ensuring that drinking water comes from a safe source or has been cooked. Environmental cleanliness must also be maintained by disposing of garbage properly and using disinfectants on water used daily [6]. Wearing clean, clear eyeglasses and refraining from touching your eyes with unwashed hands can help prevent the spread of eye-related diseases. It is important to follow local health guidelines and take necessary precautions to reduce the risk of infection [9]. In addition, maintaining hand and face cleanliness by washing hands with soap and avoiding touching the eyes

with dirty hands can prevent infection. Using protective equipment such as masks and gloves when cleaning the environment after a flood can also reduce the risk of exposure to the virus. Public education about the importance of sanitation and cleanliness, as well as the readiness of the health system in handling AHC cases during the flood season, is essential. Immediate health checks if you experience AHC symptoms are highly recommended so that the infection does not spread further. With this combination of efforts, the risk of increasing AHC cases due to flooding can be controlled and its impact on public health can be minimized [6].

Conclusion

The relationship between floods and disease highlights that floods create conditions that support the spread of various illnesses, particularly diarrhea and Acute Hemorrhagic Conjunctivitis (AHC). Contaminated floodwater, carrying waste and pathogens, serves as the main medium for disease transmission, especially in areas with poor sanitation infrastructure and limited access to clean water. Environmental factors such as high temperatures and humidity further increase the risk of infection. Additionally, overcrowded and unsanitary evacuation shelters accelerate the spread of diseases. Prevention efforts should include ensuring access to clean water, improving sanitation infrastructure, educating the public on personal hygiene, and strengthening healthcare system preparedness to handle post-flood disease outbreaks. With a comprehensive approach, the health impacts of floods can be minimized, and communities can be better prepared to prevent disease outbreaks in the future.

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