



ANALYSIS OF INFLUENCE OF CLIMATE CHANGE ON AQUATIC DISEASES AND HAZARDS ON HUMAN HEALTH

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ABSTRACT

Progressive climate change holds the potential for increasing human health risks from aquatic diseases infections and intoxications as well as hazards on human health, e. g. through an increase in pathogen concentrations in water bodies. In order to ascertain current and future perspectives on global sustainability, this study set out to explore the effects of climate change on human health from an adaptive perspective and comprehend the policies necessary to prevent or minimize the negative impacts as well as the effects of climate change on aquatic diseases and human health. A search for papers, reviews, and reports using the keywords "aquatic diseases, climate change, human health, drinking water condition, sustainable future" was conducted using the Web of Science database. We restricted the time of publication to examine the effects of climatic factors on aquatic diseases between January 2018 and December 2023 because there were few publications before to 2018. Additionally, published papers from UNICEF and the WHO were examined in order to gather all pertinent data from studies conducted in Pakistan, Bangladesh, and the Philippines. The keywords "aquatic diseases, human health" and "climate change in each country" were used to narrow down the search in Google

Scholar and PubMed. We searched the article titles, key phrases, and abstracts of the online databases. The framework of the SDGs should be adapted to countries to improve legislation, laws, and regulations on climate-related health issues. Efficient collaboration among scientists, researchers, health professionals, and policymakers will assist in addressing the problems associated with the impact of climate change on aquatic diseases in countries.

Keywords: sustainable development goals, climate change, aquatic diseases, hazards, human health

INTRODUCTION

Increased temperatures, higher precipitation, and more frequent extreme weather events are all predicted effects of climate change on society [1]. Extensive climate-change forecasts were created for numerous nations, such as Bangladesh, Pakistan, and the Philippines. The environment and human existence have been profoundly and dramatically impacted by climate change. Extremely high temperatures and cold waves have been blamed for numerous casualties reported globally, particularly in Europe and Asia [1-3]. In addition to the loss of life and property, the negative consequences of climate change on industries like tourism, agriculture, and the service sector cause large economic losses [4, 5]. Changes in the environment brought about by climate change have a major effect on the habitat and day-to-day activities of not only large animals but also small insects (like mites and mosquitoes) and rodents (like mice) [6]. The increasing frequency of floods, heat waves, storms, and forest fires that cause fatalities and injuries are already realizing the human cost of climate change. Long-term health effects from extreme events like trauma, chronic illness, and mental health effects from displacement also exist. Aside from temperature changes, air pollution, and altered local habitats that may result in the introduction of novel disease vectors, climate change also has an impact on health [7-9]. Human health and well-being are seriously threatened by climate change. The growing frequency of extreme weather events including heat waves, droughts, and floods is already realizing human costs. Consequently, given that the majority of infectious diseases are spread to humans by vector-borne pathogens like mosquitoes, mites, and mice, this link between climate change and small living organisms may significantly increase health hazards in many nations [10]. The causative organisms have the potential to modify the timing, severity, and distribution of infectious diseases in response to variations in humidity, precipitation, and temperature [11]. Infectious and vector-borne diseases, aeroallergen exposure, and changes to the natural environment are only a few of the extensive health implications of environmental change that are covered by Fleming et al. [12]. A rising corpus of research, primarily centred on the UK, is also included; it attempts to quantify the dangers and advantages of human interactions with the natural environment, with an emphasis on health, welfare, and the economy. Engaging with the natural environment, such as living in places with more green space and visiting parks and recreation areas, has positive effects on both physical and mental health. The review focuses on studies that demonstrate how diverse environments—such as coastal, rural, and metropolitan areas—have varying effects on mental health and physical capacity [12]. To support cost-benefit calculations for policy makers, health-economic assessments of the co-benefits to health and the economy from climate change mitigation and adaptation policies are crucial. Aquatic or water-related illnesses have a catastrophic effect on people's health all throughout the world, particularly in developing nations. Nichols et al. [13] review the relationship between these infectious disease types and climate variability and change, emphasising that there may be a risk of climate change related to the occurrence of cholera, typhoid, dysentery, leptospirosis, diarrheal illnesses, and toxic algal blooms. The occurrence of many infectious diseases associated to water is expected to be impacted by the indirect effects of climate change, which may lead to population shifts and conflict, even though there are evident direct correlations between weather and the risk of infectious diseases. Aquatic infectious diseases are defined as conditions that primarily affect the digestive system of humans and are mediated by water or foods that are associated with water, such as fruits, vegetables, and fish and shellfish. In addition to raising sea levels and changing precipitation patterns, climate change is also affecting surface water temperature and the ability of bacteria and viruses to reproduce, survive, and sustain themselves in water bodies, all of which have an impact on human health [14, 15]. Typhoid and cholera are two examples of foodborne or waterborne bacterial infections that are

positively correlated with rising temperatures. Every 1°C increase in global temperature raises the risk of contracting Salmonella infections by 5–10% [16]. Even though these problems are most noticeable in developing nations, if climate change continues, economically developed nations may also experience problems with food security. Furthermore, as exposure to extreme climate events increases, so does the number of people who gradually experience mental health issues such as depression, anxiety, tension, pain, sense of deprivation, melancholy, mental impairment, and suicide [17]. A key component of the solution to the climate issue is enhancing the sustainability of the environment by reducing the adverse effects of ongoing climate change. Despite several international and national initiatives, global warming is still occurring, thus it's critical to adjust to the evolving environment. The research that has come before it states that the consequences of climate change on human health include diseases connected to heat and cold brought on by extreme temperatures, heat waves, and cold waves; diseases brought on by changes in ecosystems; diseases related to air quality; and chronic disorders [18]. Naturally, hazards associated with climate change for humans include lost lives, injuries, and deaths from natural catastrophes (such as floods, typhoons, and droughts). Moreover, high temperatures and a lot of rainfall may raise the risk of diarrhoea, one of the most prevalent waterborne infections (WBDs) [19–21]. According to the literature that is currently available, research is moving away from finding correlations between climate conditions and the consequences of aquatic diseases and hazards on human health and instead is just estimating and planning those correlations into the future [22, 23]. It is difficult to determine the exact role that climate change plays in the rising incidence of aquatic diseases due to the simultaneous impact of certain factors on the outcome and the lack of access to healthcare resources [24]. Additionally, knowing exactly how climate change will impact human health and aquatic diseases is one of the most crucial components of attaining sustainable development. In order to ascertain current and future perspectives on global sustainability, this study set out to explore the effects of climate change on human health from an adaptive perspective and comprehend the policies necessary to prevent or minimise the negative impacts as well as the effects of climate change on aquatic diseases and human health. The cooperation and cross-disciplinary relationship between scientific and political management can help address the issues of climate change that are related to water-borne illnesses.

METHODOLOGY

Previously published publications that were taken from the internet databases "Google Scholar," "Web of Science," "Scopus," and "PubMed" were searched for. The Web of Science database was used for the main search, and the Google Scholar and PubMed databases were used for supplementary searches. A search for papers, reviews, and reports using the keywords "aquatic diseases, climate change, human health, drinking water condition, sustainable future" was conducted using the Web of Science database. We restricted the time of publication to examine the effects of climatic factors on aquatic diseases between January 2018 and December 2023 because there were few publications before to 2018. Additionally, published papers from UNICEF and the WHO were examined in order to gather all pertinent data from studies conducted in Pakistan, Bangladesh, and the Philippines. The keywords "aquatic diseases, human health" and "climate change in each country" were used to narrow down the search in Google Scholar and PubMed. We searched the article titles, key phrases, and abstracts of the online databases.

cRESULTS AND DISCUSSION

It has long been acknowledged that aquatic infections pose a serious threat to global public health, especially in developing nations. The three main infectious diseases worldwide in relation to climate change are aquatic, foodborne, and vector-borne [15]. Humans does not wash, bathe, or consume water tainted with germs run the risk of contracting aquatic diseases. Climate change causes pathogens to adapt their environmental habitats and survival strategies, which might result in the spread of diseases [16, 17]. Moreover, worries over aquatic environments continue, even in industrialised countries [18]. Aquatic disease incidence has generally increased with climate change and global warming episodes [15–18]. The impact of climate change on aquatic diseases is inexplicable in certain underdeveloped countries because these countries lack a sufficient and trustworthy health

infrastructure that can keep track of historical and current aquatic disease conditions [19]. Due to a lack of clean drinking water, the problem of aquatic diseases is getting worse [21]. Due to their weakened immune systems and lack of self-control, children are more susceptible to aquatic infections than adults [22]. The fecal-oral channel is a common route for the spread of aquatic diseases. It involves human faeces being eaten through contaminated food or water and is primarily caused by filthy circumstances and inadequate sewage treatment. Furthermore, fecal-oral pathogens are more likely to reach wells, which may serve as the primary supply of water for villagers, when the distance between outside toilets and wells is insufficient (less than 50 m) [23] (Figure 1). One of the biggest risks to human health today is the effects of climate change on the environment, and numerous studies have shown that the prevalence of aquatic diseases will rise [24–27]. Aquatic illnesses brought on by extreme weather will disproportionately impact certain populations and most likely worsen already-existing health disparities. For instance, the most prevalent pathogen connected to severe climate change processes is *Vibrio cholerae* [28]. Furthermore, due to changes in the quality of water sources and an increase in the frequency of natural catastrophes that could contaminate water supplies, climate change may raise the risk of aquatic diseases. Countries and geographical areas might differ greatly in the relationship between climatic conditions and aquatic diseases [23, 25]. In Pakistan, cholera, typhoid and paratyphoid fever, hepatitis A&E, diarrhoea, ulcers, dysentery, jaundice, amoebiasis, and malaria are the most frequent watery illnesses. Every year, between two and five million people die from diarrhoea, and over 2.5 billion people do not have access to adequate sanitation facilities [26]. It has been estimated that diseases transmitted by contaminated water account for over 40% of deaths in Pakistan [27]. A basic human right and a requirement for development and health is access to clean water diseases associated with water that are caused by a lack of clean water access as well as poor hygiene and sanitation. Contaminated and dirty water is unsanitary for all living creatures, but particularly for human health. People in Bangladesh are frequently afflicted by water-borne illnesses such as cholera, dysentery, hepatitis, and diarrhoea. As floods has left a quarter of Bangladesh's population stuck in their houses, authorities are preparing for the development of waterborne illnesses and working quickly to bring potable water to those affected [28]. To reduce the effects of climate change on nations, governments, legislators, and researchers should have a balanced understanding of scientific methods and public policy. The Philippines is one of the nations that the Global Climate Risk Index (GCRI) has ranked in the top 10 (Table 1). Specifically, the most common major climate events in countries are floods, droughts, sea level rise, and tropical events (typhoons and cyclones). On the other hand, the most prevalent aquatic diseases are cholera, typhoid, and diarrhoea. Lack of coping mechanisms, such as flood sanitation and water drainage systems, to manage instantaneous water overflows may contribute to the severity of natural catastrophes and diseases [29, 30]. The Philippines and Bangladesh exhibited a larger percentage than Pakistan, suggesting that these two nations are particularly vulnerable to the negative impacts of climate change on aquatic diseases. Generally speaking, nations with small, isolated islands, like the Philippines, and those lacking robust local administration and infrastructure, like Myanmar, are more vulnerable to climate change than other nations. The main concerns in these nations are emergency mitigation and cleanup, vulnerability to aquatic illnesses, and catastrophe resilience [31]. Summertime use of significant quantities of low-quality water might raise the possibility of eating waterborne bacteria, which can cause cholera and severe diarrhoea [11]. During the monsoon season, severe rainfall events, and floods, children who defecate in public rural open spaces near streams or lakes are at an increased risk of contracting cholera, typhoid, and paratyphoid diseases. *Vibrio cholerae* and other bacteria that spread from faeces to drinking water or food systems are more likely to do so as a result of these climate events [32, 33]. About 80% of infections in impoverished countries are caused by inadequate sanitation and contaminated drinking water [34]. The Sustainable Development Goals (SDGs) that are most pertinent to how climate change affects aquatic diseases are number three (good health and well-being) and number thirteen (climate action). Furthermore, SDGs 3 and 13 share the goal of promoting global health and well-being, and they also call for reducing the prevalence of aquatic diseases and taking rapid action to combat climate change and its effects, particularly on aquatic diseases. Regarding the effects of climate change, SDGs 6 (Clean Water and Sanitation), 11 (Sustainable Cities and Communities), and 17 (Partnerships for the Goals) are equally crucial. Given that climate change

may have a major impact on the sustainability and accessibility of water sanitation, SDG 6, which aims to ensure that everyone has access to cheap and clean drinking water, is crucial. Additionally, one of SDG 11's goals is to create comprehensive, sustainable, durable, and safe communities in cities. It also aims to improve public awareness of clean drinking water and lessen the harm caused by WBDs. SDG 17's goal are to enhance the processes of implementation and promote global cooperation for sustainable growth. This is important since countries need to work together closely in order to achieve the SDGs in the future.

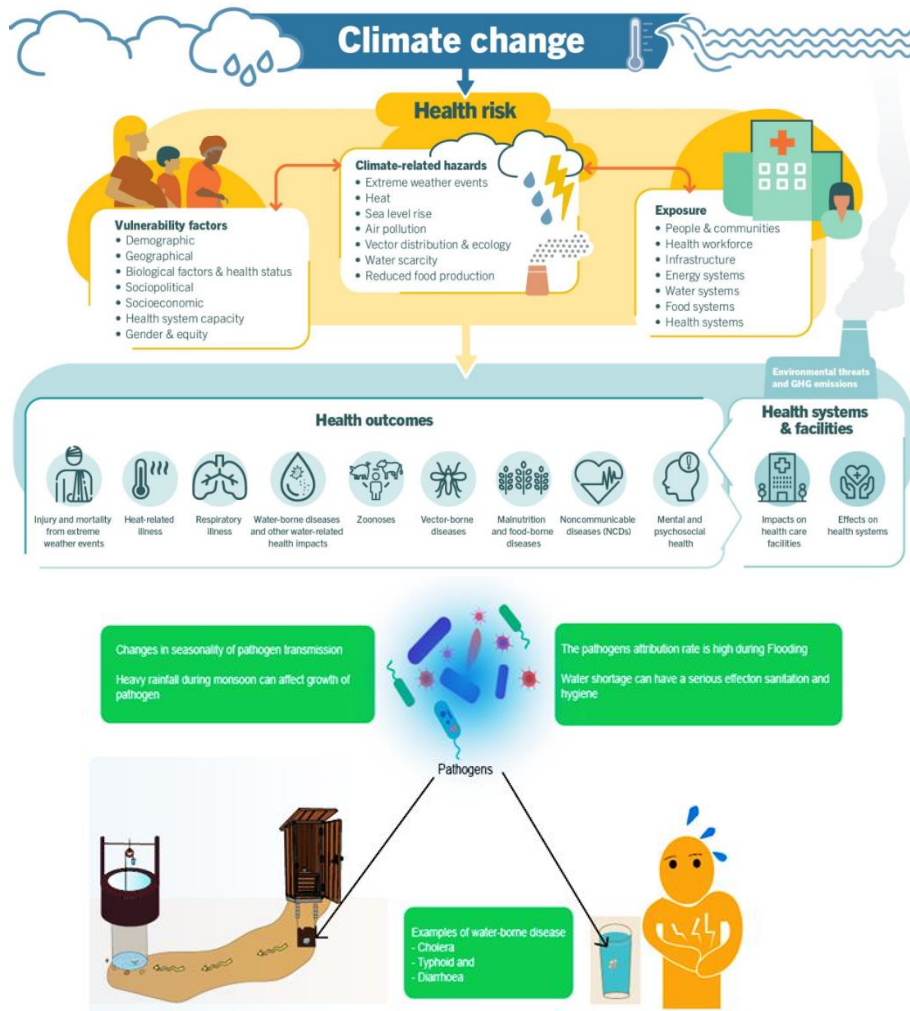


Figure 1: Graphical Explanation of Climate change influence on aquatic diseases and health hazards [35]

Table 1: Typical extreme climate events and common aquatic diseases with the Global Climate Risk Index in Pakistan, Bangladesh, and The Philippines

Country	Extreme Events	Climate	Common aquatic diseases	GCRI	Source of Drinking Water	References
Bangladesh	Floods, sea-level rise, and heat waves		Diarrhea	6	Surface water (rivers) and tap water	[36, 37]
Pakistan	Floods, rainfall-induced landslides, and droughts		Cholera and typhoid	8	Surface water (rivers), tap water, spring water, and groundwater	[38, 39]
The Philippines	Typhoons, ambient temperatures, heat waves, and floods		Cholera, bloody diarrhea, and typhoid	4	Surface water (rivers, lakes, and river basins) and groundwater reservoir	[40]

CONCLUSION:

In conclusion, there is a substantial public health worry regarding the impact of climate change events on aquatic diseases and health dangers on humans, especially in Pakistan, Bangladesh, and the

Philippines. Among aquatic infections, cholera and typhoid are the most prevalent. The first step in evaluating the implications of climate change on human health is to determine how it affects aquatic diseases, not just cholera and typhoid. Therefore, it is important to strategically control and avoid aquatic infections. A good framework for addressing how aquatic diseases are impacted by climate change is provided by the SDGs. Thus, examining the connection between the SDG targets and how climate change affects aquatic diseases could lead to fresh insights and novel approaches to policy. By advancing and accomplishing particular SDGs, we may reduce the occurrence of aquatic illnesses and create a future that is more sustainable and adaptive.

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