Chapter 7
Climate Change and Health Issues

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Abstract: The current chapter on "Climate Change and Health Issue" provides a comprehensive insight into the complex interactions of climate change and numerous health conditions happening as a result of it. The effects of increasing global temperatures, frequency of extreme weather events, changes in the precipitation patterns and distribution of the ecosystems are sought to bring numerous health impacts for people all over the world. The direct and indirect ways through which climate change impacts the human health are explored in detail which clearly emphasizes on the climate change resulting in the sudden outbreak of prevalence of vector borne diseases, transmission of infectious diseases, polluting the water, air quality and most importantly the effect of climate change in the mental health of individuals. Vulnerable populations are given higher importance since the effect of climate change makes their health conditions even worse than before. Details on the policies for mitigation and adaptation are also indicated on knowing its preference. In order to combat the growing burden on the health infrastructure, it is prioritized to indicate the need for strong public health policies, an effective healthcare system and international collaboration. It is noteworthy that on peeping on the contents is an invaluable resource for academics, researchers and healthcare professionals who want a thorough grasp of the intricate relationship between health and climate change. The information offered is intended to help develop evidence-based plans for reducing health risks, building resilience and advancing world well-being in the face of climate change.

Keywords: Climate change, health impact, vector borne diseases, mental health, adaptation strategies.

1. Introduction

Climate change is the collective term for the long-term changes in Earth's average temperature and weather. Temperature, precipitation and other air quality variations are among the changes that heavily impact the normal

Chandra, A., Chaturvedi, S., Rajasekaran, C., Rao. K. S. (Eds.), Climate Resilience: Challenges and Opportunities in Environmental Management
ISBN: 978-81-975795-5-4, PP 203-224
https://doi.org/10.70497/B978-81-975795-5-4-07

livelihood of humans and other living organisms (Corfee-Morlot and Höhne, 2003). Fossil Fuel combustion, deforestation, industrial processes and waste management are among the main human activities contributing to climate change. Greenhouse gases, which include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases, are becoming more prevalent in the Earth and in the atmosphere as a result of all these human activities. It is imperative to bear in mind that natural phenomena such as variation in the intensity of the sun and volcanic activity can also have an impact on the Earth's climate (Kumar et al., 2021).

The current trend of very rapid and broad global warming is however mainly attributed to human activities (Yang et al., 2021). In general, attempts to combat climate change focuses mainly on lowering greenhouse gas emissions, switching to renewable energy sources and promoting sustainable practices. Climate change may have a number of direct and indirect effects on human health. Health and climate change are associated through a variety of pathways including mental health, the spread of infectious diseases, vector-borne, water-borne diseases and heat related illnesses (Amato et al., 2014).

1.1. Heat-related Illness: Unusual or prolonged exposure to heat and humidity without relief or adequate fluid intake can cause a variety of heat-related illnesses (Bandh et al., 2021).

1.2. Vector-Borne Diseases: All the vector-borne diseases nearly have a climatic dimension which means the pathogens causing the disease, the vectors that carry it and eventually the host associated with the vector-borne diseases is largely responsive to the environment in which they inhabit. Hence changes in the temperature and precipitation in that particular environment vastly impact

the spread of the vector-borne diseases (McMichael, 2003).

1.3. Water-Borne Diseases: Changes in precipitation patterns and harsh weather due to the climate changes in the recent years can have an effect on the quality of the drinking water which can spread diseases including cholera and typhoid and jeopardize the community's access to clean water. The likelihood of developing Salmonella infections rises by 5 to 10% for every degree celsius increase in the world's temperature (Khraishah et al., 2022).

1.4. Mental Health: It is anticipated that climate change would have an impact on mental health in addition to physical health. Stress, trauma, anxiety, depression and other mental health problems can be brought on by climate-related events and environmental changes, especially in populations that are impacted (Bernstein and Rice, 2013). While longer droughts brought on by climate change may result in an increase in farmer suicides, rising ambient temperatures are also expected to cause an increase in violent suicides and aggressive suicide rates. Acculturation stress may result from population migration necessitated by climate change and global warming (Zheng, 2023).

1.5. Spread of Infectious Diseases: Infectious diseases are mainly caused due to pathogens such as viruses, bacteria, fungi and parasites. Changes in climatic conditions can affect the spread of infectious diseases seriously affecting global health. The ability of the disease-causing pathogen to live and propagate will be positively impacted by changes in weather patterns that favour the circumstances needed by the pathogen, especially with regard to average temperature, precipitation and relative humidity (Chen et al., 2007). Certain infectious diseases will also spread more readily in environments that are

conducive to the animals (such as ticks, mosquitoes and rodents) that facilitate pathogen reproduction and transmission. Moreover, extreme weather conditions like heat waves, torrential rains and droughts are happening more frequently and with greater intensity as the climate warms. These dramatic occurrences may make an environment that is more susceptible to the development and spread of illness (Fisk, 2015).

1.6. Migration and conflict: Changes in the climate can cause migration and population relocation which can exacerbate resource-related conflicts and have unintended health effects. It accounts that people displaced by the gradual or abrupt start of climate change consequences could make up a sizable portion of the global population. The effects of the increasing interplay between these three elements such as climate change, migration and conflict will be profound and sometimes illogical (Kim et al., 2017).

2. The impact of climate change on health

Human health is impacted by climate change in both direct and indirect ways. Comprehending these differences is essential to formulate efficacious approaches to alleviate and adjust to the health hazards linked to climate change. The direct impact includes the above discussed heat related illness, water and vector borne diseases (Khraishah et al., 2022) including extreme weather conditions and air quality. Events like hurricanes, floods and wildfires can have a direct influence by causing injuries and fatalities.

Health hazards might be significantly increased when there is disruption to the healthcare infrastructure during extreme weather events. With respect to air quality, elevated temperatures and modified atmospheric conditions have a direct effect on air quality, with elevated pollutant concentrations presenting hazards to respiratory

well-being (Howe et al., 2013). On the other hand, the indirect impacts include food security, mental health, healthcare system strain, spread of infectious diseases and migration and conflict. In the context of food security, extreme weather events, variations in temperature and precipitation can all affect agricultural productivity. Food insecurity and malnutrition can result from crop failures and shortages which can have an impact on general health (Khraishah et al., 2022).

Considering the mental health, climate change-related events, as well as environmental disruptions can lead to psychological discomfort and exacerbate mental health conditions like depression, anxiety and post-traumatic stress disorder (PTSD). Global healthcare systems are under a great deal of strain due to climate change. Extreme weather events, shifting disease patterns and environmental degradation are just a few of the ways that climate change is causing problems for the healthcare system and raising health risks. Moreover, climate change also impose the threat of transmission of infectious diseases at higher rates (Mcmichael and Lindgren, 2011).

2.1. Vector-Borne Diseases

Vector Borne diseases (VBD) are brought on by parasites, bacteria or viruses. In all nations without access to basic hygienic conditions, VBDs continue to be prevalent in the most vulnerable populations. Infectious disorders including malaria, dengue, leishmaniasis or yellow fever, that impact millions of people annually, are common vector-borne diseases. There is a complicated and nuanced relationship between vector-borne illness transmission and climate change. Disease vectors like mosquitoes and ticks are important in the spread of many infectious diseases. Climate change can affect their distribution, abundance and behaviour. Key elements of this relationship includes temperature, precipitation,

extreme weather events, seasonal timing of the transmission of the diseases, human vulnerability and socioeconomic factors (Githeko et al., 2000).

Many vector species can reproduce more quickly in warmer climates. For instances, warmer temperatures may accelerate the reproduction of mosquitoes which would raise the frequency of disease transmission. Addition to that, variations in the precipitation patterns may have an impact on the availability of vector-breeding sites. More breeding sites for mosquitoes may be created due to increased rainfall which might lead to an increase in the spread of infectious diseases like dengue and malaria (Zhang et al., 2008). Optimal seasons for vector activity can be extended by warmer temperatures and changes in the precipitation patterns. This could occasionally result in protracted disease transmission and raising the possibilities of epidemics. Floods brought on by severe weather events can provide a perfect environment for the reproduction of vectors. Mosquito larvae can thrive in stagnant water found in puddles, containers and flooded places. All these events collectively enhance the transmission of vector-borne diseases (Ogden, 2017).

Undoubtedly, the spread of dengue fever and malaria is an excellent example of how climate change can affect the geographic distribution of diseases carried by vectors. Due to temperature constraints, malaria transmission has historically been restricted to particular altitudes. Anopheles mosquitoes that carry Plasmodium parasites which is sought to be the causative agent of malaria spread to higher elevations in response to rising global temperatures. As a result, areas like hilly regions that were previously thought to be malaria-free or at low-risk have evidenced a rise in occurrences of the disease (Caminade et al., 2019). Additionally, increased rainfall and other altered precipitation patterns can lead to an increase in mosquito breeding sites.

Variations in precipitation pattern can impact the dynamics of malaria transmission and raise the overall burden of the disease in areas where the disease is prevalent. Another one example for the vector borne diseases is the dengue fever. Aedes mosquitoes are the primary vectors of dengue disease transmission. The geographic range of Aedes mosquitoes grows with rising temperatures exposing new populations to the risk of dengue illness. This spread has been reported in areas that were previously thought to be dengue-free. Considering the above discussed parameters regarding the vector borne diseases, it is highly clarified that the climate change have a clear impact on human health (Semenza and Suk, 2018).

2.2. Water-Borne Diseases

Climate change impact the prevalence and distribution of water-borne diseases in a number of ways. The distribution, quality and availability of water resources can all be significantly impacted by climate change exerting an impact on the frequency and geographic distribution of water borne diseases (Cissé, 2019). These diseases are caused by microorganisms such as bacteria, viruses or parasites and spread by contaminated water, which pose a serious threat to public's health especially in areas with poor access to hygiene facilities, clean water and sanitation.

Individuals who drink or come in contact with such contaminated water may get the risk of acquiring the diseases that are spread by water-borne pathogens. Water scarcity, waterborne diseases and climate change have a complicated and intertwined interactions (Howe et al., 2013). Changes in precipitation patterns brought on by climate change are causing drought in some areas for a prolonged duration and more intense and irregular rainfall in others. Water scarcity is exacerbated by the above-

mentioned factors that impact availability of drinking water for the people's community.

Communities may turn to unsafe water sources when water becomes scarce which hikes the risk of water-borne diseases. Also, temperature variations and precipitation patterns can influence the growth of bacteria, algae in the water bodies and enhance the proliferation of water-borne pathogens thereby promoting the spread of water-borne disease. Water sanitation and hygiene issues can give rise to a host of water-borne illnesses such as cholera, diarrhoea and gastroenteritis (Pal et al., 2018).

The major water borne diseases includes cholera, typhoid fever, dysentery, giardiasis (transmitted by drinking water contaminated with giardia cyst), cryptosporidiosis (transmitted by ingesting water contaminated with *Cryptosporidium oocysts*), Hepatitis A (transmitted by drinking water contaminated with fecal matter containing the virus) and Schistosomiasis (transmitted through contact with water containing the infected snails that release the infectious larvae which penetrates the skin and causes abdominal pain and diarrhoea and in some case causes enlargement of spleen and liver). These water borne diseases can cause illness, starvation and in the worst situations even lead to fatality (Howe et al., 2013).

3. Imapct of climate change on respiratory health

The composition of the air we breathe can vary as a result of climate change, which can also have a substantial impact on other aspects of the atmosphere. Warmer temperatures linked to climate change results in a rise in the production of ground-level ozone which is the main component of smog and can be harmful to the respiratory health. Variations in temperature and precipitation patterns can have an impact on the distribution and abundance of plants that cause allergies

by altering the amount of pollen present in it. People who have asthma or allergies may find their respiratory symptoms worsened due to such changes in the weather conditions. Vegetation, health and distribution are subject to change due to climate change (Amato et al., 2014). Consequently, this may have an impact on plant promoting emissions of volatile organic compounds (VOCs), which are involved in the formation of ground-level ozone that simultaneously brings adverse effects on the respiratory health.

Higher concentrations of ozone, particulate matter (PM) and other pollutants along with poor air quality can aggravate pre-existing respiratory diseases such as emphysema, chronic bronchitis and asthma. Even healthy individuals on prolonged exposure to air pollution may tend to develop many respiratory issues including a higher chance of respiratory infections and a progressive decline in lung function. High pollution exposure can also cause symptoms like coughing, wheezing, chest tightness, shortness of breath and irritation of the throat, nose and eyes in people. Research studies have indicated a strong correlation between periods of poor air quality and a rise in respiratory-related hospital admissions. Prolonged exposure to air pollution has also been associated with an increased risk of premature mortality especially from heart and lung conditions. Particular populations are more vulnerable to the adverse consequences of poor air quality such as children, the elderly and those with underlying respiratory disorders. There may be more detrimental effects on the health of these communities due to poor air quality resulting from climate change (Khraishah et al., 2022).

4. Impact on mental health

Communities and individuals are affected psychologically by climate change in a variety of ways.

These effects can be more indirect and long-term or they can be directly linked to extreme weather events. Increases in temperature owing to climate change have the potential to exacerbate mental health problems related to heat such as anger, violence and suicide. Trauma may occur to people and communities that are immediately impacted by extreme weather conditions like storms, floods or wildfires. Other mental health issues such as post-traumatic stress disorder (PTSD) might arise from losing homes and livelihoods all of a sudden. In some cases, communities may have to relocate as a result of climate change-related disasters like droughts, extreme weather and sea level rise (Berry et al., 2010). The process of leaving their homes and adjusting to new surroundings can cause environmental migrants to feel stressed, anxious and remain lost. The effects of climate change can disturb the established lifestyles of the communities and lead to the loss of cohesiveness and identity which finally results in distress and a sensation of displacement. Additionally, competition for scarce resources such as water and fertile land can cause societal unrest and conflicts which could elevate stress and anxiety levels. Poor air quality linked to climate change can make mental health issues worse especially for people who already have psychiatric problems (Padhy et al., 2015).

Anxiety levels may rise as a result of the uncertainty surrounding the long-term effects of climate change, particularly the extent of changes and their particular consequences. People could feel overwhelmed by the uncertainty of their environment. Grief can also be triggered by the continuous loss of ecosystems, iconic landscapes and biodiversity as a result of climate change. After an extreme weather disaster, finances can be severely strained, particularly for individuals who are responsible for rebuilding expenditures and do not have sufficient insurance. Stress related to money might make their mental health issues worse. People and communities recuperating from extreme weather disasters may

sometimes experience an extra pressure due to the limited availability of essential resources like food, clean water and necessary medical care (Palinkas and Wong, 2020).

Persistent anxiety and depression may be exacerbated by ongoing pressures related to recovery from extreme weather events and situational adaption. People could struggle with feelings of continual uncertainty and vulnerability. With all these impacts, it is made clear that climate change potentially impact the mental health of the individuals. Hence it becomes very important for communities, policymakers and mental health experts to understand the psychological effects of climate change and collaborate to create resilience, support and adaptation plans. It is imperative to incorporate mental health issues into activities aimed at mitigating and adapting to climate change in order to address the entire well-being of individuals and communities for a better world (Hayes et al., 2018).

5. Vulnerable Populations

Due to a variety of circumstances such as age, pre-existing medical issues, geographic location and socioeconomic level some populations are more vulnerable to the health effects of climate change. Determining these susceptible groups is essential to create targeted treatments and adaption plans. First and most importantly, children developing immunological and respiratory systems may make them more vulnerable to the physiological effects of climate change. Coping to the condition, older persons due to their weakened immune system and long-term medical conditions become more vulnerable to heat-related illnesses and other climate-related health problems. Since, low-income populations frequently have limited access to healthcare, treating health concerns brought on by the climate can be difficult (Benevolenza and DeRigne, 2019).

Many developing nations are more vulnerable because of their limited resources to adapt to and lessen the effects of climate change. Due to climate change, rural communities reliant on agriculture are at risk of reduced water and food security. Heat waves, air pollution and other climate-related factors can aggravate the symptoms of people who already have medical illnesses such as respiratory or cardiovascular ailments. It can be difficult to rely on prescription drugs for long-term illnesses when severe weather prevents people from accessing healthcare. Because of the physiological changes that occur during pregnancy and their higher susceptibility to heat stress, pregnant women may be at greater risk for health problems (Akerlof et al., 2015). Moreover, climate-related factors may have an effect on fetal development and lead to unfavorable birth outcomes.

People who are displaced or migrants may not have easy access to basic amenities including clean water, sanitary conditions and medical treatment. Populations that are displaced as a result of climate-related events may face additional health risks and difficulties. It's crucial to remember that vulnerabilities frequently intersect and that people or communities can be members of several susceptible groups at once. In order to lessen health disparities and promote resilience, measures for climate adaptation and mitigation should take into account the unique needs of these vulnerable communities (White-Newsome et al., 2012).

6. Adaptation and mitigation strategies

Implementing initiatives that increase community and health system resilience is part of adapting to the health implications of climate change. These tactics address the short- and long-term health hazards brought on by climate change. Some of the major adaptation strategies include

- **Early Alerting Mechanisms:** Creation and improvement of early warning systems for severe weather conditions such as heat waves, floods and hurricanes is sought to be excellent strategy to ensure the health condition of the mass public. In addition to that care must be taken to make sure that warnings are effectively communicated to the general population and medical professionals (Grasso and Singh, 2011).
- **Programmes for Vector Control:** Development and improvement of vector control initiatives to stop the spread of diseases that are carried by insects like ticks and mosquitoes lowers the danger of vector-borne diseases and controls vector habitats (Id et al., 2020).
- **Measures for Food and Water Security:** Investment in sanitary facilities and water infrastructure is very much needed to guarantee that everyone has proper access to safe and clean water. Adopting farming techniques that increase climate change resilience while enhancing food security is also essential while planning to overcome the climate change (Babel et al., 2020).
- **Support for Mental Health:** In order to address the psychological effects of extreme weather events, creation of community-based mental health programmes aid in long-term adjustment (Bronkhorst et al., 2015).
- **Monitoring and Surveillance Systems:** To track climate-related health indicators such as respiratory disorders, infectious diseases and heat-related illnesses, establishment of reliable surveillance and monitoring systems is highly needed to utilize the data to guide flexible tactics and proactively address new health hazards (van Bavel et al., 2020).
- **Capacity Building for Healthcare Professionals:** Healthcare practitioners should receive proper and adequate training on the detection and treatment of

illnesses linked to climate change as well as health concerns associated with it (Sorensen et al., 2023).

- **Global Collaboration:** Encouragement of global collaboration and information sharing will pave way to make it easier for the health sector to share their best practices and lessons discovered when adapting to climate change (Peterson and Manton, 2008).
- **Research and Innovation:** Encouraging intensive research helps to understand the developing health risks linked to climate change and also provides opportunities for development of innovative remedies or solutions to combat such health risks (Newman et al., 2020).

Adapting to the health impacts of climate change effectively necessitates a multidisciplinary and comprehensive strategy. Adaptive capacity building and protecting population health and well-being in the face of climate change requires higher and essential cooperation between governments, communities, healthcare providers and international organizations.

7. CASE STUDIES

Climate change is already posing health risks to a number of populations worldwide. To mention a few, communities along the US Gulf Coast, particularly those hit by Hurricane Katrina in 2005 have endured prolonged health issues as a result of trauma, displacement and interrupted access to healthcare (Mills et al., 2007). Another case study is the malarial outbreak in Kenya. Rising temperatures due to climate change have led to a surge in malaria cases in Kenya's previously malaria-free highland regions, underscoring the need for climate-informed public health strategies (Lacey et al., 2023). Thirdly, during the 2019-2020 bushfire season, Australia saw enormous wildfires that severely damaged several ecosystems. Smoke from wildfires caused poor air quality,

which made respiratory disorders like asthma worse. The trauma of the fires also led to mental health issues. There were health risks for both metropolitan areas suffering from smoke pollution and rural communities that were directly impacted by the fires (Li et al., 2021).

Concerning more about India, areas that are vulnerable to flooding, like certain regions of Bihar and Assam deal with the problem of disease epidemics caused by contaminated water, including cholera and diarrheal infections (Khraishah et al., 2022).Due to excessive monsoon rains in 2018, Kerala and many other states in India suffered severe flooding that caused significant damage and forced many people to relocate. In addition to the risk of infectious diseases from crowded relief camps, contaminated water sources also played a role in the development of waterborne illnesses. People who were displaced, especially those living in relief camps had difficulties getting access to healthcare and clean water. India saw an unheard of heat wave in 2015 with highs of over 45^{o}C (113 ^{o}F). In addition to causing a spike in heat-related ailments like dehydration and heatstroke, the intense heat claimed hundreds of lives. Risks were higher for vulnerable groups including those who worked outdoors were elderly or had pre-existing medical issues (Hunt and Menon, 2020).

8. POLICY IMPLICATIONS

Some of the policies implicated for climate change and human heath include-

8.1. Mitigation Policies

8.1.1. Transition to Renewable Energy: Policies that encourage this change can lower greenhouse gas emissions, enhance air quality and lessen the negative

effects of pollution on human health (Aldy and Pizer, 2015).

8.1.2. Green Transportation Initiatives can improve respiratory health by lowering air pollution and promoting physical exercise through the use of electric vehicles, bicycles and public transportation (Jha et al., 2014).

8.2. Adaptation Policies

8.2.1. Early Warning Systems: Preparedness can be improved and the health risks associated with disasters can be decreased by policies that encourage the creation and development of early warning systems for extreme weather conditions (Quansah et al., 2010).

8.2.2. Climatic-resilient Healthcare Facilities and water management systems are examples of resilient infrastructure that can be built to help communities adapt to changing climatic conditions (Ravi et al., 2022).

8.3. Healthcare Policies

8.3.1. Public Health Programmes: To address health issues associated to climate change, governments can put in place public health programmes such as vaccination camps, illness surveillance and awareness campaigns (Blas and Kurup, 2010).

8.3.2. Capacity Building: It is critical to implement policies that improve the ability of medical practitioners to identify, addres, and manage health risks associated to climate change (Sobeck and Agius, 2007).

8.4. Community Engagement

8.4.1. Community-Based Adaptation Programmes: Resilience can be improved by policies that provide local

communities the authority to create and carry out adaptation plans. This include involvement in decision-making processes, resource access and community education (Ayers and Forsyth, 2009).

8.4.2. Social Safety Nets: By guaranteeing access to clean water, healthcare and nourishment, policies that create social safety nets can shield vulnerable populations from the adverse health effects imposed due to climate change (Awal et al., 2013).

9. Future prospectives

In order to address the negative effects of climate change on human health, global collaboration and intensive research are essential. Understanding the intricate connections between health and climate change, creating practical mitigation and adaptation plans, fostering resilience in communities that are already at risk forms the main goals of such initiatives. The effects of climate change are dynamic and could change over time in terms of health. Proactive responses and adaptable tactics could be vigorously made possible by continued research that identifies new health hazards linked to climate change.

Advanced research only makes it possible to create prediction models for the transmission of vector-borne infections, infectious diseases and other health risks that are impacted by climate change. A deeper comprehension of the connections between climate variables and disease dynamics can improve efforts at early detection and prevention. Research is still being conducted to determine which communities are most at risk from the adverse effects of climate change on health. This encompasses underprivileged neighborhoods, vulnerable populations and individuals with pre-existing medical issues. For equitable health outcomes, interventions must be specifically designed to target

particular vulnerabilities. The results of research help educate and raise public understanding of the effects of climate change on health. Communities that possess knowledge are more capable of implementing preventive measures, engaging in adaptation endeavors and championing policies that give priorities to health and climate. To put it briefly, developing a thorough grasp of the complex relationships between climate change and human health is the primary reason for the significance of continued research study and international collaboration. This information is essential for creating resilient and sustainable solutions that shield populations from the shifting health risks brought on by climate change.

10. Conclusion

To sum up, the relationship between climate change and human health is a complex issue that needs to be addressed right away and requires coordinated global efforts. The combination of rising temperatures, extreme weather and changes in the distribution of the ecosystem presents a complicated web of issues that need immediate attention and response. It becomes more and more obvious that collaborative works, innovative research and equitable policies are necessary and inevitable as we traverse this unexplored area. Not only it is critical to reduce the existing and emerging health risks, but it is also critical to build a resilient and sustainable future. This chapter emphasizes the relationship between health and climate change and stresses that the only way we can hope to protect the health of present and future generations against a constantly changing climate is via an international effort and a firm commitment to adaptation and mitigation strategies.

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