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Climate change impacts on public health and diseases

Dr. Sadhna Dixit ,Asstt.Professor , Govt. B.P.L.P.G.College , Aarang , (C.G.)

Corresponding author: sadhnadixit28@gmail.com

Abstract

Climate change is one of the most pressing global issues of the time. It is one of the most important challenges in 21stCentury. It is widely recognized that climate change has a significant impact on various aspects of human life, including physical and mental health, water resources & food security. Climate change disrupts ecosystem, affecting human health & economies. Climate change impacts human health & disease, leading to increased respiratory and cardio vascular diseases, injuries and early deaths. It also affects food and water borne illnesses, infectious diseases, & mental health. Flood victims experience physical and psychological effects, including extreme weather events. Extreme weather events & environment shifts now directly influence public health. Climate change is posing on unprecedented threat to humanity. Attributable to human activities & natural climate variability. Climate change refers to the long term changes in weather patterns , & often specifically to the rise in global temperatures. Climate change is directly contributing to humanitarian emergencies from heat waves, wild fires, flood, storms, & hurricans & they are increasing in scale frequency and intensity .Climate change is also having an impact on our health workforce and infrastructure .Climate change has emerged as a significant global challenge with profound implications for human health. Climate change, driven predominantly by anthropogenic green house gas emissions, has emerged as one of the most pressing threats to global public health in the 21st century. Climate change also contributes to displacement and forced migration through impacts like desertification, rising sea levels, erosion, droughts, & extreme weather. Population displacement creates crowded conditions conductive to disease transmission. It also harms mental health through trauma, loss of home & loss of social network & identity. Climate change also indirectly affects well-being by stress. In this way climate change threaten human health. Furthermore the economic impact of climate change extend beyond direct effects & create spillover effects across industries &sectors .The agricultural sector, which is highly dependent on stable weather pattern , suffers from reduced crop yields ,leading to volatile food prices & increased poverty. Similarly, infrastructure damage from storms & floods imposes significant costs on both public & private entities. Health system plays an important role in managing health risks and ensuring the well-being of citizens. Public health organizations take meaningful action that curbs climate risks, saves life immediately, and promotes a more sustainable and socially just future. It is important for health care professionals to play a crucial role in educate the people; individual level adaptations include using personal protective measures to prevent health problems. The innumerable impact of climate change is a global menace to human health. Over all, most systematic review of the health impacts of climate change suggest an association between climate change and the deterioration of health in multiple ways, generally in the direction that climate change is associated with adverse human health outcomes.

Key words : Climate change , Public human health , Vector borne disease , Water borne- disease, Food borne disease, Air borne infectious disease, A global challenge, Extreme weather.

Introduction

Climate change is recognized today as the biggest public health challenge of the 21stcentury. (Costello et al; 2009) (1) .Extreme temperature, especially those leading to heatwaves & cold waves of varying duration, frequency, can impact human health. (Watts et al; 2018) (2) Heat waves caused a dangerous surge in the health. Exposure to heat waves of varying degrees can cause heat exhaustion, heat stress, heat syncope, & heat stroke, heat rashes, dry skin, headaches, nausea, giddiness, excessive sweating, kidney dysfunction, etc. Heatwaves can cause deaths (Azhar et al; 2014) (3). Cold waves also affect health. Heart disease, stroke, and respiratory illnesses have been recorded in extremely cold temperatures. The vector born diseases like Malaria, Dengue , Chikungunya and Japanese encephalitis are all vector borne disease that are projected to increase with changing climatic conditions . It also affects food and water born illnesses, infectious diseases, & physical and mental health. In today's rapidly changing world, the impact of climate change on human healthinclude an increase in respiratory diseases such as asthama & allergies , as well as the spread of infectious diseases transmitted by insects like

mosquitoes & ticks and increasing the risk of infections such as malaria, dengue fever, & chikungunya. It is widely recognized that climate change has a significant impact on various aspects of human life, including physical & mental health, water resources, and food security. (Dawood & Shirazl et al; 2022) (4) The World Organization (WHO) has emphasized that climate change represents the most severe threat to essential human needs that are critical for good health. It compromises access to clean air by increasing levels of air pollutants & respiratory illnesses. (6) Climate change is one of the most pressing global issues of the time. The impacts of climate change on human health & the environment are inter wind & inter-connected. The complex inter-connection between climate change, human health & environmental conditions create a web of consequences that can have far reaching impacts (Bloetscher et al; 2016) (5) .Extreme weather events & environmental shifts now directly influence public health. Climate change is accelerating serious challenges to global health. Safe drinking water sources are endangered due to droughts, flood, & contamination. Food security is jeopardized as changing temperatures & precipitations patterns disrupt agricultural yields , warmer conditions can also facilitate the proliferation of water borne and food borne illnesses (Hatfield et al; 2011) (7).

Overview:

Climate change presents a fundamental threat to human health. It affects the physical environment as well as all aspects of both natural & human system including social & economic conditions & the functioning the health system. As climatic conditions change, more frequent & intensifying weather & climate events are observed, including storms, extreme heat, floods, droughts, & wild fires. These weather and climate hazards affect health both directly & indirectly, increasing the risk of deaths, non-communicable diseases, & spread of infectious diseases and health emergencies. The world health organization (WHO) (2023) identified climate change as the greatest threat to human health, emphasizing its role in various diseases. WHO data indicates 2 billion people lack safe drinking water & 600 million people suffer from food borne illnesses annually. Safe drinking water sources are endangered due to droughts, floods, and contamination. Climate change affects food availability, quality, & diversity. Food security is jeopardized as changing temperatures & precipitation patterns disrupt agricultural yields. Warmer conditions can also facilitate the proliferation of water borne & food borne illnesses (7). Temperature and precipitation changes enhance the spread of vector borne diseases like Malaria, Dengue, Chikungunya, and Japanese encephalitis. Climate change disrupts ecosystems, affecting human health & economies. The adverse impact of climate change on human health have been documented in several studies & these effects are expected to increase with future climate change (Luber & McGeehin, 2008; Bell et al; 2018; Filippelli et al; 2020) (9) (10) (11). Climate change is posing an unprecedented threat to humanity. Attributable to human activities & natural climate variability, climate change refers to the long term changes in weather patterns, & often specifically to the rise in global temperatures. The main direct & measurable effect of climate change are rising temperature, droughts, floods, & changes in precipitation patterns, as well as elevating sea &green house gases (Masson et al; (2021) (12).

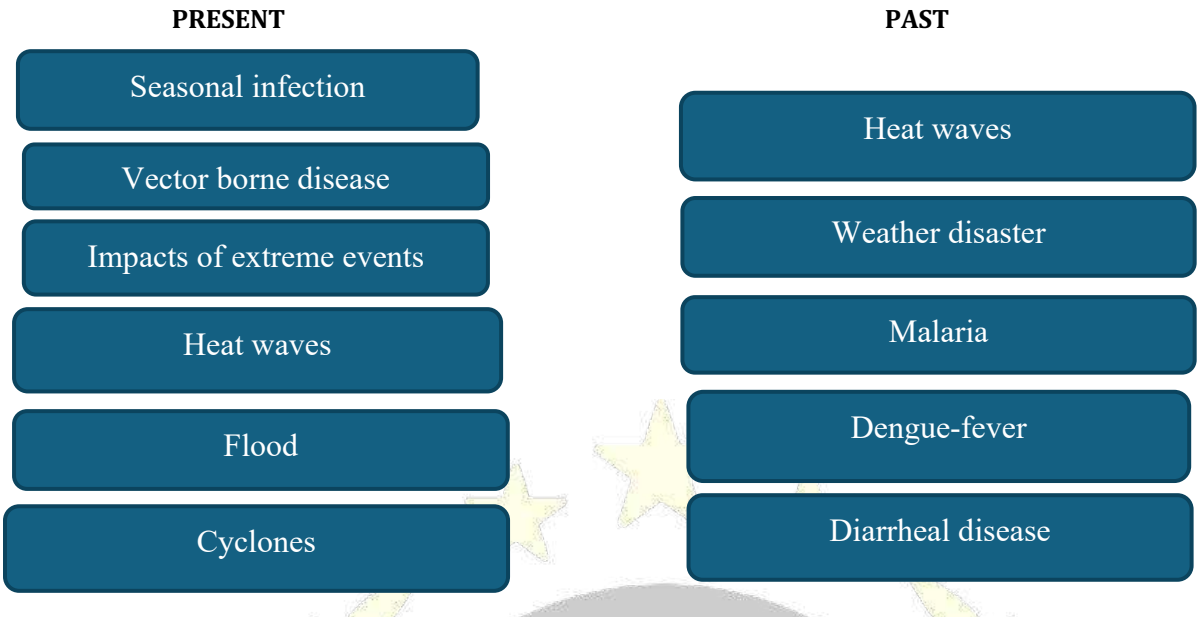
The literature review reveals that climate change is associated with various adverse health outcomes, including extreme weather events, air pollution, water borne disease, food insecurity & vector borne diseases.

Climate related Hazards:

- Cardio-vascular disease
- Ozone layer effects
- Green house emission
- Allergies
- Foetal death
- Mental health

Vector borne disease

Climate change & Health:



FUTURE IMPACTS:

- **CEREAL GRAIN YIELDS**
- **MALARIA**
- **DENGUE FEVER**

Water borne diseases:

Climate change has become a potential threat to human health in the past half century. The risk associated with water borne disease due to change in climatic pattern is increasing all over the world. The degree of water contamination is determined by the persistence & the strength of existing pathogens in water bodies, including natural reservoirs (Dechesne et al; 2006) (13). The main source of contaminated water is water treatment plants, hospitals, & industrial discharge. Water borne disease are caused by contaminated water that is infested with pathogens that cause infection in human .Heavy rain fall can cause sewage over flow &agriculture run off, which can contaminate surface water (Delpa et al; 2011) (14). The most common pathogens include Virus, Bacteria, Protozoa, & Helminthes, which can cause serious infections like diarrhea, cholera, typhoid, fever, & flu like symptoms. The relationship between urban activities & the concentration of pathogen is well-studied and documented (Selvakumar& Borst et al; 2006) (15). Diarrhea disease commonly transmitted via water borne pathway & comprise a substantial proportion of the global burden of diseases (Troeger et al; 2018) (16). Diarrhea diseases are the 2nd leading cause of death in children under five worldwide, & the 2nd greatest source of death & disability in low and middle income countries (LiuL et al; 2012, & Murray et al; 2012) (17) (18). Cholera is well known water borne diarrhoeal disease that has afflicted human kind since ancient times. Cholera is washing related disease, associated directly with climate change. Cholera depends on environmental conditions such as temperature, pH, salinity, &plankton (Christaki et al; (2020) (19). Other water related zoonotic disease are also expected to be impacted by climate change Leptospirosis, the most globally wide spread zoonotic disease, is associated with climatic factors, extreme weather events like flooding. (Chadsuthi. et al; 2021) (20).

Food borne diseases:

Climate change has emerged as a major pressing global issue with far reaching implications for human health, such as the emerging & spread of food borne pathogens. Food borne pathogens are microorganisms that can cause illness in humans, from mild infection to life threatening diseases, through the consumption of contaminated food or water. These pathogens include bacteria, viruses, & parasites & can lead to significant out breaks & health complications (Keerthana et al; 2022) (21). World health organization estimates that 1 in 10 people fall ill every year because of eating contaminated food (WHO 2022). Globally, contaminated food causes 600 million food borne diseases & 420,000 deaths annually (Lee & Yoon 2021)

(22). Common pathogenic bacteria responsible for food borne illnesses include Campylobacter jejuni, Clostridium perfringens, Escherichia coli, Salmonella spp. & Staphylococcus aureus (Bintsis et al; 2017) (23). Other important food borne pathogens are viruses, such as human norovirus, hepatitis A virus (HAV), and food borne parasites. (Koutsoumanis et al; 2018, Pexara & Govaris 2020) (24). The changing climate affects the existence & persistence of all microorganisms and their vectors, leading to increased pathogenic microbial contamination of water & food that, in turn, threatens human health, by laying direct & indirect effects on food security (War et al ; 2022) (25). Climate change has the potential to impact food system, food quality & safety. There is sufficient evidence to suggest that climate change affects not only food yields but also food quality & safety (Vermeulen et al; 2012) (26). The impact of climate change on human health is influenced by various social, environmental, ecological, & economic factors, with the spread, survival, & growth of pathogens playing central role in disease transmission.

Air borne infectious diseases:

Climate change poses a significant threat to public health, with a direct & indirect impact on air borne infectious disease. Wind is a key factor affecting the pathogens of air borne diseases. A positive correlation between dust particle association, attachment & virus survival. (Chen et al 2010, Chung & Sobsey 1993) (27). Wind has dual effects on disease vector & hosts. Wind may affect the malaria cycle both negatively and positively. Strong wind can reduce the biting opportunities for mosquitoes but can extend their flight distance. During a mansoon season, wind is able to change the spatial distribution of mosquitoes (Reid 2000) (28). Wind and dust storms affect the transmission of infectious diseases. Wind can act as a transportation means for pathogen and virus of air borne diseases. Seasonal influenza, an acute respiratory infection that occurs in epidemics, influenced by region-specific climate factors, temperatures, & humidity (25) (106,107).

Vector borne Disease:

The vector borne disease in India like Malaria, Dengue, Chikungunya and Japanise encephalitis are all vector borne disease that are projected to increase with changing climatic conditions in India .

Examples of Vector borne disease:

Vector	**Diseases**
1.Mosquitoes----------	Malaria ,Filariasis , Dengue fever, yellow fever
2.Sand flies----------	Leshmaniasis
3.Tse-Tse fly----------	African Trypanosomiasis
4.Black Flies----------	Onchocerciasis
5.Ixodes ticks----------	Lyme disease &tick borne encephalitis
6.Triatomines----------	Chagas disease
7.Snails----------	Schistosomiasis
(Intermediate host)	

1. Mosquitoes:

Mosquitoes (From the family Culicidae of the order Dipteria). A blood feeder are common flying insects that live in most part of the world. Over 3,700 types of mosquitoes can be found worldwide. Some mosquitoes are vectors. A vector is an animal, insects, or tick that spreads germs to people or animals that can make them sick. Only female mosquitoes bite people & animals to get a blood meal. Mosquito, a blood feeder, disease carrier caused malaria disease. Malaria is a mosquito borne febrile disease. Malaria is a protozoan infection. There are three genera –

1.Culex –About 88 species ***Japanese encephalitis , Lymphatic filariasis.
2.Aedes—About 700 species***Dengue, Zika, Chikungunya, yellow fever
3.Anopheles –About 460 species ***Malaria

Changing climate patterns are expanding the potential malaria zone .Climate change can trigger malaria epidemics through increased rainfall & flooding.Malaria is one of the most important vector borne infectious disease in the world & also climate -sensitive disease.

Mosquitoes and diseases:

1.Parasitic diseases-
Malaria and Filariasis
2.Virual diseases-
Japanese encephalitis , Dengue fever and Yellow fever
3.Annoyance pest:
Local dermatitis
4.Mechanical transmitter:
Some mosquitoes may carry fly eggs to humans inducing myasis.

2. Sand flies:

Sand flies are tiny blood sucking insects (Diptera), known for painful, itchy bites, primarily transmitted by females needing blood for eggs. Found in humid, sandy or tropical areas. They are vector for serious diseases like leishmaniasis and sand fly fever. Leshmamiasis a group of diseases transmitted by infected sandflies, with three main forms:

Cutaneous Leshmaniasis: skin ulcer
Mucocutaneous Leshmaniasis: Nose , mouth sores
Visceral Leshmaniasis : Kala -azar

Climate change specially rising temperature, milder winters, and altered rainfall patterns increased sand fly activity .

Tse-Tse Fly:

Blood sucking insects vector for sleeping sickness. Tse-Tse flies are sensitive to extreme temperatures & distribution is heavily influenced by climate change.

Black flies:

Black flies are persistent and irritating pests which swarm around human and animals like livestock , poultry, wild birds and mammals.Temperature fluctuations mostly warm temperature accelerate their life cycle & affecting both human health and ecological system .

Ixodes ticks:

It is a hard bodied ticks lives in humid environments & causing Lyme disease. Climate change, particularly warmer temperatyure & milder winters, expand their habitats.

Triatomines:

It is also known as vampire bugs. Triatominesare blood sucking insects.Climate change is significantly altering the distribution, abundance, and behaviour of these bugs. Bugs are vector of chagas disease. Chagas disease is caused by the parasite Trypanosoma cruzi.

Snails:

Snail is a shelled gastropod. Snails are natures clean-up crews and recyclers. Snails cause parasitic diseases like angiostrongyliasis, fascioliasis, schistosomiasis etc. Climate change significantly increases snail borne diseases, by elevating water temperatures.

Extreme weather events (heatwaves , floods , stronger storms) increased health problems and threats to biodiversity . Climate change can enhance vector borne diseases.

Methodology:

This study employed mixed methods with literature review, Research articles, Conferences, Magzene, Letters, WHO Report & Epidemiological studies. I conducted a review of published literature. Based on this analysis I searched peer-reviewed research literature , to identify health effects of climate change published from the year (2006) to (2022) & onwords, including [Pub Med, Web of science, Science Direct, Research Gate, Shodh ganga and Google scholar] etc. At this review aims to explore the connection between a problem, its impact effect (climate change) & resulting health issues. After identifying all original research articles, I selected a 10% of random sample with publication information. The analysis of a random sample of original research articles that studied the effects on human health of climate change & published between 2006 to 2022. The main aim is to studying about the climate change create impact on public health & how to tackle climate crisis. My aim is qualitative synthesis based on relevance, eligibility, quality, ensuring they met the criteria of the study.

Result and Discussion:

In my analysis, a total no. of 125 articles was included. As there was a limited representation of studies. The literature indicates that our changing climate is driving a rise in the frequency, duration, & intensity of extreme events. In October 2023, WHO identified climate change as the greatest threate to human health? The result of climate changeinclude heat waves, & hurricane season & increased risks from droughts, wild fires, & flood. The combination of all these components of climate change has directly affected human health. The scope of the problem in India is enormous.

Conclusion:

In conclusion, climate change has profound impacts on human health and the environment (Diseases) These impacts can be both direct, such as increased heat stress & the spread of infectious disease, as well as indirect, including changes in air quality & food security. ‘‘Climate- change is the greatest health challenge of the 21st century, but it is also our greatest opportunity to build a cleaner, healthier world”. [Maria Neira, WHO]. Health care professionals, as responsible member of the community, have a unique opportunity to educate & advocate for measures that mitigate the impacts of climate change. It is important for health care professionals to play a crucial role in educate the people. Public health organizations take meaningful action that curbs climate risks, saves life immediately, & promotes a more sustainable & socially justify future. Individual level adaptations include using personal protective measures to prevent vector borne disease & maintaining adequate hydration in hot weather conditions. In October (2023), WHO identified climate change as the greatest threat to human health, emphasizing its role in various diseases. Early planning can help reduce future adverse health impacts. Flood management needs, building a climatic smart India, secure food and water system, green growth is necessary for environment. Climate change is one of the most important challenge in 21stcentury, effects on human health, ecosystem, & economics.

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