



Interplay between Environmental Changes and Human Health

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

This review assesses the effects of climate change on human health, both direct and indirect. Environmental changes are currently impacting and will continue to impact a variety of population groups differently. Unfortunately, this can increase the risk of developmental changes in humans. Climate change poses varying degrees of health risks, depending on people or groups' sensitivity, exposure, and ability to adapt. Populations with lower incomes, certain racial/immigrant groups, children, pregnant women, the elderly, professionals exposed to hazards, persons with disabilities, and those with pre-existing medical issues are particularly vulnerable. Rising environmental changes can increase weed and pest populations, necessitating herbicide and pesticide use, which may in turn lead to developmental changes in humans.

Keywords: Health risk; environment; climate change; human health.

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1. INTRODUCTION

Climate change is a major environmental crisis of the 21st century. It affects human health, development, and behavior, as the COVID-19 pandemic has demonstrated. Even across international boundaries, disease transmission due to climate change is a major cause for concern. Such diseases have an especially detrimental effect on the health of those in developed countries. Environmental factors have led to, and are expected to continue causing, a variety of health risks for different populations. These include cognitive decline due to lead exposure, early onset of puberty through endocrine disruptors, birth defects, and miscarriages. Birth defects are the number one cause of infant mortality, and those affected suffer greater potential risks of long-term illnesses and disabilities. Early life is fundamental to an individual's development. During this critical period of growth, pre-conception, pre-implantation, the fetal period, and early childhood, environmental exposure can lead to genetic mutations, epigenetic alterations, and other types of harm. The consequences of these developmental changes can result in a lifetime of suffering and expensive social costs concerning resources, medical care, and productivity.

2. COMPREHENDING THE SUSCEPTIBILITY OF DIVERSE POPULATIONS

The term 'social determinants of health' describes the social, political, and economic factors that make some individuals or communities more vulnerable to health risks. Certain groups of people are particularly susceptible to the health consequences of environmental change. To 'unlock' this vulnerability, it is essential to have a comprehensive understanding of key concepts. Definitions of key concepts are adapted from the Intergovernmental Panel on Climate Change and the National Research Council [1,2].

3. DETERMINANTS OF VULNERABILITY

Turner et al. [3] define vulnerability to health impacts associated with climate change as the susceptibility to be affected negatively. Vulnerability is composed of three elements: exposure, sensitivity, and adaptive capacity. These elements can determine how different groups of people are affected by climate change-related health impacts. *Exposure:* Exposure occurs when a person is in contact with a

biological, chemical, or physical environmental stressor, which can be impacted by climate change. It can happen in one event or multiple times, in one place or across a larger geographical area. *Sensitivity:* Climate change can negatively or positively affect people and communities due to their sensitivity, exposure, and capacity to cope. Sensitivity refers to how vulnerable people are to the health risks caused by climate change.

Adaptability: Adaptive capacity is the ability to adjust to potential hazards and take advantage of opportunities. Resilience is the capacity to prepare and plan, absorb, and recover from adverse events. Strong adaptive capacity boosts resilience.

4. THE IMPACT OF THE ENVIRONMENT ON DIFFERENT SEGMENTS OF THE POPULATION

Environmental changes are currently impacting and will continue to impact a variety of population groups differently. Vulnerability to health risks associated with climate change depends on the sensitivity of a group or person, their exposure to the risks, and their capacity to adapt. Populations of concern, such as those with lower incomes, certain racial and immigrant communities, local populations, children, pregnant women, the elderly, professionals exposed to particular hazards, persons with disabilities, and those with pre-existing medical issues, are especially vulnerable to environmental changes. Populations of concern are especially vulnerable to climate change, with increased risks to their health and well-being. These groups are the most exposed, sensitive and least resourced to prepare for and respond to health risks. They may face different stressors related to both climate and non-climate factors, such as poverty, isolation, extreme weather, and persistent climate change. Populations at risk in urban or rural areas, floodplains, and coastlines are especially vulnerable [4].

5. ENVIRONMENTAL EFFECTS ON HUMAN HEALTH

Climate change is causing disruptions to communities worldwide. Weather is becoming more extreme and damaging infrastructure, ecosystems and social systems providing essential benefits. This has led to aging infrastructure, impacted ecosystems and increased economic inequality. Populations, who are already vulnerable, such as lower-income

and marginalized communities, have fewer resources to prepare for and cope with climate-related incidents, leading to further health effects. To create a fairer future, adaptation actions should be prioritized for the most vulnerable. In order to lower greenhouse gas emissions and lessen the impacts of climate change, global action is needed now. People, communities, health departments, and healthcare facilities are working to reduce today's health and social vulnerabilities and boost the ability to deal with risks in the years ahead [5].

Climate change is a global phenomenon but it has extreme local consequences, impacting people's physical and mental health in many ways. The below diagram allows us to gain a deeper insight into how climate change affects human health. Balbus et al. [6] explored climate change's potential effects on human health through exposure pathways and the various factors influencing vulnerability, such as social determinants of health and behavior choices. When considering future disease burden, it's important to consider the magnitude of local climate change, individual and population vulnerability, weather exposure, and risk mitigation capacity [7]. To reduce vulnerability and increase resilience to projected risks, individuals, communities, public health departments, healthcare facilities, and organizations are taking action. Heat waves are becoming more frequent and severe, resulting in an increase of heat-related illnesses and deaths. The EPA [8] estimates that by the end of the century, extreme hot and cold temperatures could cause more than 9,000 additional premature deaths annually. This number could be reduced by environmental adaptation, such as using air conditioning more often. Nile neuroinvasive disease is expected to exceed double by 2050 due to rising temperatures and other factors. This would result in yearly hospitalization costs of \$1 billion and preventable deaths under a higher scenario [9].

Insects, including mosquitoes, ticks, and fleas, can transmit West Nile Virus, dengue fever, Lyme disease, and malaria to humans. Modifying their range can reduce the risk of transmission. Pollen exposure is higher due to extended plant growing seasons, severe storms bring more molds, and rising temperature and humidity can worsen allergies and induce asthma. High temperatures in summer increase the risk of illness and death, especially for older adults, pregnant women, and children [10]. Urban heat islands - areas of extra heat created in cities -

also raise ambient temperatures, raising the risk of heat-related illness [11]. Such high temperatures can damage air quality, affecting hearts and worsening cardiovascular disease. Climate change-driven flooding, sea level rise, and water temperature increase can contaminate water sources, leading to food-borne and water-borne illnesses. Additionally, runoff from more frequent and intense rainfall can contaminate recreational and drinking water sources with pathogens and toxic algal blooms [12-17]. Extreme weather events, such as drought, wildfires, heavy rainfall, floods, storms, and storm surge, are expected to have a negative impact on population health [18]. These events cause physical injuries, deaths, illnesses and mental health problems due to property damage, loss of loved ones, displacement and sustained stress. This puts an added strain on hospital and public health systems, and reduces people's access to proper healthcare. Further, people with underlying medical conditions are more vulnerable to the effects of these events and can suffer from adverse mental health issues [19]. Lastly, these climate events can cause disruption to public health, healthcare and related systems, adversely affecting health even after the event has passed [18].

Rising temperatures and extreme weather changes are predicted to have a negative impact on food security by exposing people to dangerous pathogens and toxins such as *Salmonella*, *Campylobacter*, *Vibrio parahaemolyticus* in raw oysters, and mycotoxigenic fungi [20]. Furthermore, these contaminants can lead to food-borne illnesses, resulting in food insecurity and malnutrition. Pregnant women are especially at risk, as malnutrition and under-nutrition during pregnancy can cause low birth weight and developmental problems. Changes in environmental contaminants, like mercury and lead, can cause increased contamination of food sources like seafood, vegetables, and dairy products, leading to developmental issues, such as decreased IQ of the unborn fetus. Bio-toxins in fish and seafood can cause birth defects in children. Increasing environmental changes can lead to more weeds and pests, which necessitate the use of herbicides and pesticides. Unfortunately, this can increase the risk of developmental changes in humans.

The increased use of toxins, such as certain metals, inorganic arsenic, and persistent organic compounds in our environment has been associated with extreme weather events,

including thunder storms and extreme temperatures. Toxins, containing carcinogens, can severely damage the human immune system and lead to dangerous diseases when exposed. Mitigation strategies, such as energy policy changes and technological advancements, could potentially reduce the production, usage, and storage of dangerous chemicals and heavy metals, which have been linked to developmental disorders in humans. Exposure to environmental conditions, whether short-term or long-term, can result in psychological consequences such as stress, distress, anxiety, depression, post-traumatic stress, and even suicidal attempts [19].

6. CONCLUSION

In conclusion, climate change is a significant crisis impacting human health and development. It has led to a variety of health risks, including cognitive decline, early onset of puberty, birth defects, and miscarriages. Vulnerability to these health impacts is determined by exposure, sensitivity, and adaptive capacity. Certain populations, such as those with lower incomes, racial and immigrant communities, children, and the elderly, are particularly vulnerable to environmental changes. Climate change also affects mental health and food security, with extreme weather events and rising temperatures increasing the risk of illness, death, and food-borne illnesses. It is crucial to prioritize adaptation actions for the most vulnerable and take global action to reduce greenhouse gas emissions. Mitigation strategies, such as changes in energy policies, can help minimize the production and usage of dangerous chemicals and heavy metals. Overall, understanding the impacts of climate change on human health is essential for developing effective response strategies and protecting the well-being of communities worldwide.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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