

Assessing the Influence of Climate Change on Vector-Borne Diseases and Human Health: A Comprehensive Study

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Abstract

Climate change is one of the most important global environmental challenges of the present century. The IPCC (the intergovernmental panel on climate change) report of 2007 concludes that climate change is projected to increase threat to human health, particularly in lower income countries. It will have implications on food production water supply, air quality, coastal settlements and human health. As two-third of the Indian population depends directly on the climate sensitive sectors like agriculture, fisheries and forests, it is bound to have an adverse impact. The changing climate can affect the basic elements required for maintaining good health: clean air, potable water, adequate food and shelter. Recently, India reported an increase in the incidence of vector – borne diseases, decrease in crop production, more frequent extreme weather events which could be attributed to changing climate. Addressing climate change will need promoting mitigation and adaptation strategies without hampering economic development, good scientific evidence and coordinated action by multiple stakeholders.

Keywords: *climate change, human health, vector -borne diseases.*

I. INTRODUCTION

Human health has always been influenced by climate and weather. Changes in climate and climate variability, particularly changes in weather extreme, affect the environment that provides us with clean air, food, water, shelter and security. Climate change, together with other natural and human, Made health and stressors, threatens human health and well-being in numerous ways. This paper shows that linkages between climate change and human health are complex and multi – layered and predictions of the future health impacts of climate change are still uncertain. Over, India the annual mean temperature has increased in the past hundred years. Climate change is happening and emissions and emissions are bound to increase due to growing economy of India. Therefore, addressing both mitigation and adaptation is important. Even the developed nations are struggling to cope up with the challenges posed by the changing climate; India needs to put more efforts to counter the same. Considering the increase trend of impact of climate change on human health, adoption of mitigation measures like Strengthening health systems and service delivery mechanisms through early monitoring, disease surveillance, vector and disease control, and health insurance to counter the same becomes imperative.

The study of vector-borne diseases (VBDs) as an impact of climate change on human health is a crucial area of research in public health and environmental science. Vector-borne diseases are illnesses caused by pathogens such as viruses, bacteria, or parasites that are transmitted to humans through the bite of infected arthropods, such as mosquitoes, ticks, and sandflies. Climate change can influence the distribution, abundance, and behavior of these vectors, as well as the pathogens they carry, leading to changes in the transmission dynamics of VBDs.

1. Impact of Climate on Vectors: Climate variables such as temperature, precipitation, and humidity can directly influence the survival, reproduction, and feeding behavior of vectors. For example, warmer temperatures can accelerate the development of pathogens within vectors, shorten the pathogen incubation period, and increase vector reproduction rates. Changes in precipitation patterns can create or eliminate breeding habitats for vectors, altering their distribution.

2. Changes in Disease Transmission: Climate change can lead to shifts in the geographical range of vectors and the pathogens they transmit. This can result in the emergence or re-emergence of VBDs in regions where they were previously absent or uncommon. Additionally, altered climatic conditions can extend the transmission season of certain diseases or allow vectors to thrive in areas where they were previously unable to survive.

3. Human Vulnerability: Certain populations may be more vulnerable to the impacts of climate change on VBDs, including those living in low-income countries with limited access to healthcare and resources for vector control. Additionally, individuals in regions experiencing extreme weather events, such as floods or

droughts, may face increased risk of exposure to VBDs due to changes in vector habitat and human displacement.

4. **Adaptation and Mitigation Strategies:** Understanding the complex interactions between climate, vectors, pathogens, and human health is essential for developing effective adaptation and mitigation strategies. These may include vector control measures such as insecticide-treated bed nets, indoor residual spraying, and environmental management to reduce vector breeding sites. Climate-resilient healthcare systems and early warning systems for disease outbreaks are also important components of adaptation strategies.

5. **Interdisciplinary Approach:** Addressing the impacts of climate change on VBDs requires an interdisciplinary approach that integrates knowledge from fields such as epidemiology, ecology, climatology, and public health. Collaborative research efforts involving scientists, policymakers, healthcare professionals, and community stakeholders are essential for developing comprehensive strategies to mitigate the health impacts of climate change.

Studying the impact of climate change on vector-borne diseases is critical for understanding and addressing the complex interactions between environmental change and human health, and for developing effective strategies to protect vulnerable populations from emerging health threats. Malaria, Malnutrition, and diarrhea are major public problems. Any further increase, as projected in weather related disasters and related health effects, may cripple the already inadequate public health infrastructure in the country. The impact of climate change has been considerably enough to threaten human health both directly and indirectly through increasing temperatures, rising sea levels, water and food supply impacts, extreme weather events like floods, droughts, earthquakes, etc., susceptible shelter and population migration.

Direct effect of environmental circumstances may ease the diffusion of vector -borne diseases, water -borne diseases, cardiovascular diseases, respiratory allergies and malnutrition, etc. Indirect effects of climate change such as mental health problems and involuntary migration are also important. Children, the elderly and communities are living in poverty among the most susceptible of the damaging effects due to climate change.

A changing climate Impacts our health and wellbeing. The major public health organizations of the world have said that climate change is a critical public health problem. Climate change makes many existing diseases and conditions worse, but it may also help introduce new pests and pathogens in to new regions or communities. As the planet warms, ocean expands and the sea level rises, floods and droughts becomes more frequent and intense, and heat waves and hurricanes become more severe.

The most vulnerable people-Children, the elderly, the poor, and those with underlying health conditions - are at increased risk for health effects from climate change. Climate change also stresses our health care infrastructure and delivery systems.

Steps can be taken to lessen climate change (mitigation) and reduce its impacts on our health and the health of future generations (adaptations) some of these steps can yield benefits for our health, environment, economy and society at the same time. The federal government has called for efforts to support adaptation and mitigation of climate change to create healthier, more sustainable communities. The goals of the NIEHS climate change and human health program align with these efforts.

II. Review of literature –

- Martens, P. And McMichael, A.J. (2002) climate change is a significant and emerging threat to public health. The effects of climate change on human health are influenced by a variety of pathways and there may be long delays between causes and effects. Various methods have been developed for quantitative estimation of health impacts of future climate change.
- Bhadwal s.(2003) These heat -waves will lead to increased variability in summer monsoon precipitation, with drastic effects on the agricultural sector in India.
- Schulz, A., & Northridge, M.E.(2004) Environmental health promotion interventions should serve to disrupt the complex processes that produce social inequalities , and target issues not commonly considered within the scope of the health sector, such a poverty .
- CIESIN,(2007) WHO, (2004a)vector –borne infections diseases, such as malaria, dengue fever, yellow fever and plague, cause a significant fraction of the global infectious diseases burden; indeed, nearly half of the world’s population is infected with at least one type of vector – borne pathogen.
- Roy, S. Kand Das, Ananda k.(2007)-Trends is heavy rainfall events in India show that it has increased in the western coast and few pockets in North, central Eastern and the North East.
- Srivastav, A.K.(2007) A significant increasing trend has been observed in discomfort indices during the last days of April and a significant increasing trend has been observed in discomfort indices , relative humidity and maximum temperature during may. Similarly, a significant increasing trend has been observed during the second fortnight of may and first fortnight of June.
- Goldstein, R, Goldstein, K., Dwelle, T. (2015) The physical environment is a term often used to describe the natural environment, as well as the build environment.

Overview Of The Health Effects Of Climate Change

Climate change affects health in many ways. This is highlighted by the world health organization (WHO) when it chose to mark 'world health day 2008' with the theme international perspectives on global environmental change : protecting health from climate change. The relationship between climate change and human health is multidimensional. The fourth assessment report of IPCC, 2007 has already identified three areas in which human health has already been affected by climate change. These are:

- (i) Alteration in distribution of some infectious diseases vectors.
- (ii) Seasonal distribution of some allergenic pollen species and
- (iii) Increased heat waves deaths.

WHO has defined a general methodology to qualify the disease burden caused by 26 risk factors at selected time points up to 2030. (Ezzati, M.et al.2002) while climate change affects everyone, it is the world's poor who are on the front line. This section seeks to document some of the devastating impacts that climate change is having on the people of India and highlight the threat to sustainable social and economic development. Major health effects due to changing climate can be broadly classified (Figure 1) as follows:

1. Extreme weather – related health effects.
2. Air pollution – related health effects.
3. Water and food – borne diseases.
4. Effects of food and water shortages.
5. Psycho -social impacts on displaced populations.
6. Health impacts from conflicts over access to vital resources.

Vector – borne Diseases

Vectors are living organisms that can transmit infectious diseases between humans or from animals to humans. Weather affects vector population dynamics and disease transmission, with temperature and humidity considered as key variables. Climatic change are known to increase the availability of water during monsoon, alter the air temperature besides other changes. Hence, there would be increase in the population of the vectors in the altered climate. Clean water is known to promote breeding of vector mosquitoes such as anophelies (Malaria) ,culex vishnui group(JE vector) and aedas (dengue, chikungunya) whereas polluted water bodies promote breeding of culex quiquefasciatus (filariasis vector). Vector -borne diseases are currently prevalent in the tropics and sub -tropics and relatively rare in temperate zones of India.

Policy implications

Precisely at a time when India is confronted with development imperatives, we will also be severely impacted by climate change. (Climate change and India, 2008) with close economic ties to natural resources and climate – sensitive sectors, India may face a major threat, and require serious adaptive capacity to combat climate change.

National action plan on climate change, (2009) Medical officers of health can ensure that mental health is emphasized as part of their overall responsibility to promote health in the community, with the goal of addressing health inequalities. Environmental health officers and public health inspectors, through their focus on environmental health, are in an ideal position to influence public health practice.

Managers, directors, nurses, dieticians, health promoters, dental hygienists, planners, tobacco enforcement officers, Police developers, program evaluators, psychologists and epidemiologists, among other professions, can also play a collaborative role in mental health promotion of children, the elderly and all human when they plan, prioritize and implement environmental health promotion programs and interventions. In order to address some of the predicted changes as well as those are taking place in India in an effective manner, more emphasis is required on the following policies:

- Strengthening health systems and service delivery mechanisms.
- Provision of drinking water and sanitation facility to all.
- Provision of funding for low income communities with poor sheltering and high exposure/risk to heat and cold waves.
- Educating people about climate change and climate -related diseases.

Objective of the study –

- (1) To study the impact of climate change on human health.
- (2) To study the assess Of vector -borne diseases in India.

Hypothesis-

Human health has been affected by climate change. We done the study at some rural level with some common vector born diseases like Dengue fever, Malaria, Chikungunya, diarrhea, Lymphatic filariasis, and encephalitis calculate its frequency in areas.

Table 1: tabulation of most common rural diseases among male female and children

Disease	% Male patient	% female patient	% Child patient
Dengue fever	59	51	78
Malaria	68	71	88
Chikungunya	56	68	31
diarrhea	17	21	57
Lymphatic filariasis	47	33	4
Encephalitis	11	9	36

The provided table illustrates the distribution of patients by gender and age group for different diseases.

Gender Distribution:

- Male Patients: The highest percentage of male patients is observed in cases of malaria (68%), followed by dengue fever (59%) and chikungunya (56%). The lowest percentage of male patients is associated with encephalitis (11%).
- Female Patients: For most diseases, the percentage of female patients is slightly lower than that of male patients. Malaria has the highest percentage of female patients (71%), followed by chikungunya (68%) and dengue fever (51%). Encephalitis has the lowest percentage of female patients (9%).

Age Group Distribution:

- Child Patients: The highest percentage of child patients is observed in cases of malaria (88%), followed by diarrhea (57%) and dengue fever (78%). Chikungunya and encephalitis have the lowest percentages of child patients at 31% and 36%, respectively.

Disease Patterns:

- Malaria: It shows a high percentage of both male and female patients and the highest percentage of child patients among all diseases, indicating a significant impact on children.
- Dengue Fever: Although it has a lower percentage of female patients compared to malaria, it still affects a substantial number of children, making it a concern for pediatric health.
- Chikungunya: While it has a relatively high percentage of female patients, it affects fewer children compared to other diseases, indicating a different age distribution pattern.
- Diarrhea: It has a higher percentage of child patients compared to other diseases, which aligns with the common occurrence of diarrhea in children.
- Lymphatic Filariasis: It has a relatively low percentage of child patients and a higher percentage of male patients, suggesting a different demographic profile compared to other diseases.
- Encephalitis: It has a low percentage of both male and female patients but a relatively higher percentage of child patients compared to some diseases, indicating a significant impact on children's health.

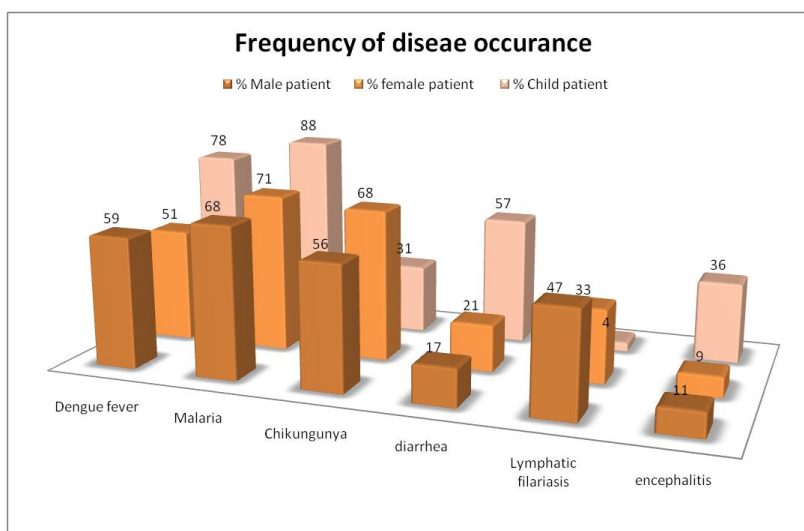


Figure 1: Graphical representation of frequency of disease occur among the respondents

It has been shown by the above study that Dengue fever, Malaria, Chikungunya were prominent vector borne diseases in the studied area while the diarrhea, Lymphatic filariasis placed second after this. The selected area has lesser patients of encephalitis than other area.

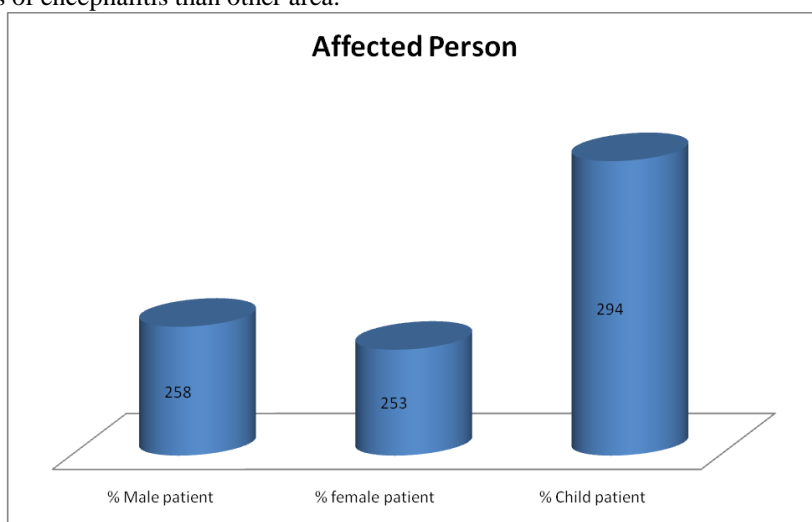


Figure 2: Graphical representation of affected person by selected disease among the respondents

The most affected patients were the childees because of their unhygienicity and bad eating habits. It has been found that the child of the selected study area has very weaker immunity than the other two male and female the second placed were of females due to unhygienic house holds they were mostly come in contact with the vectors while in case of the male the more addiction towards tobacco and nicotine made them more susceptible towards many infections.

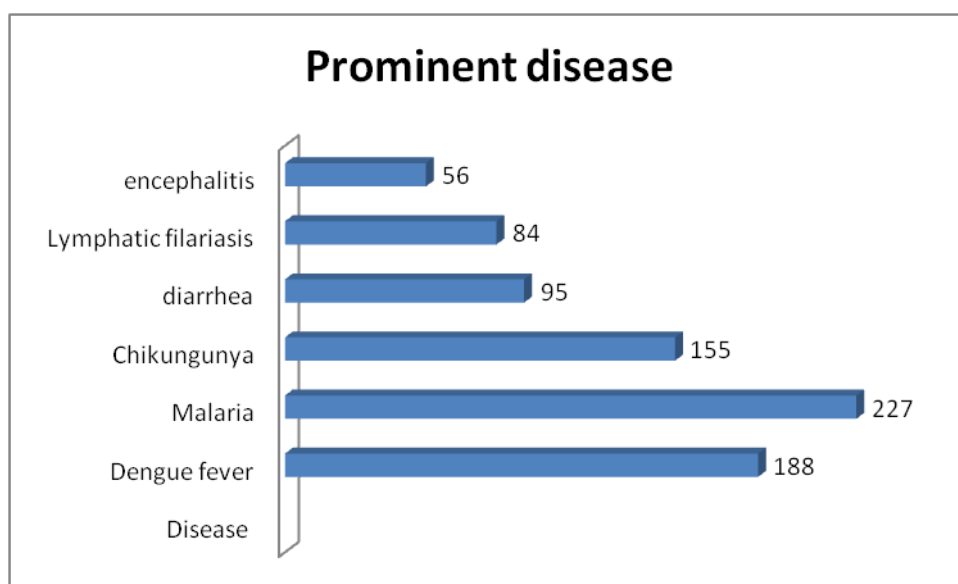


Figure 3: Graphical representation of prominent disease occur among the respondents

The most prominent disease found in the selected area were malaria with 28% frequency of occurring after that Dengue fever and Chikungunya has 28% and 19 % frequency. While diarrhea, Lymphatic filariasis have nearly 199 % of frequency of each while least occurring was encephalitis which has 7% of occurrence. So we can conclude the unhygienic water logging arise the mosquito larva which lead these vectors of leading disease.

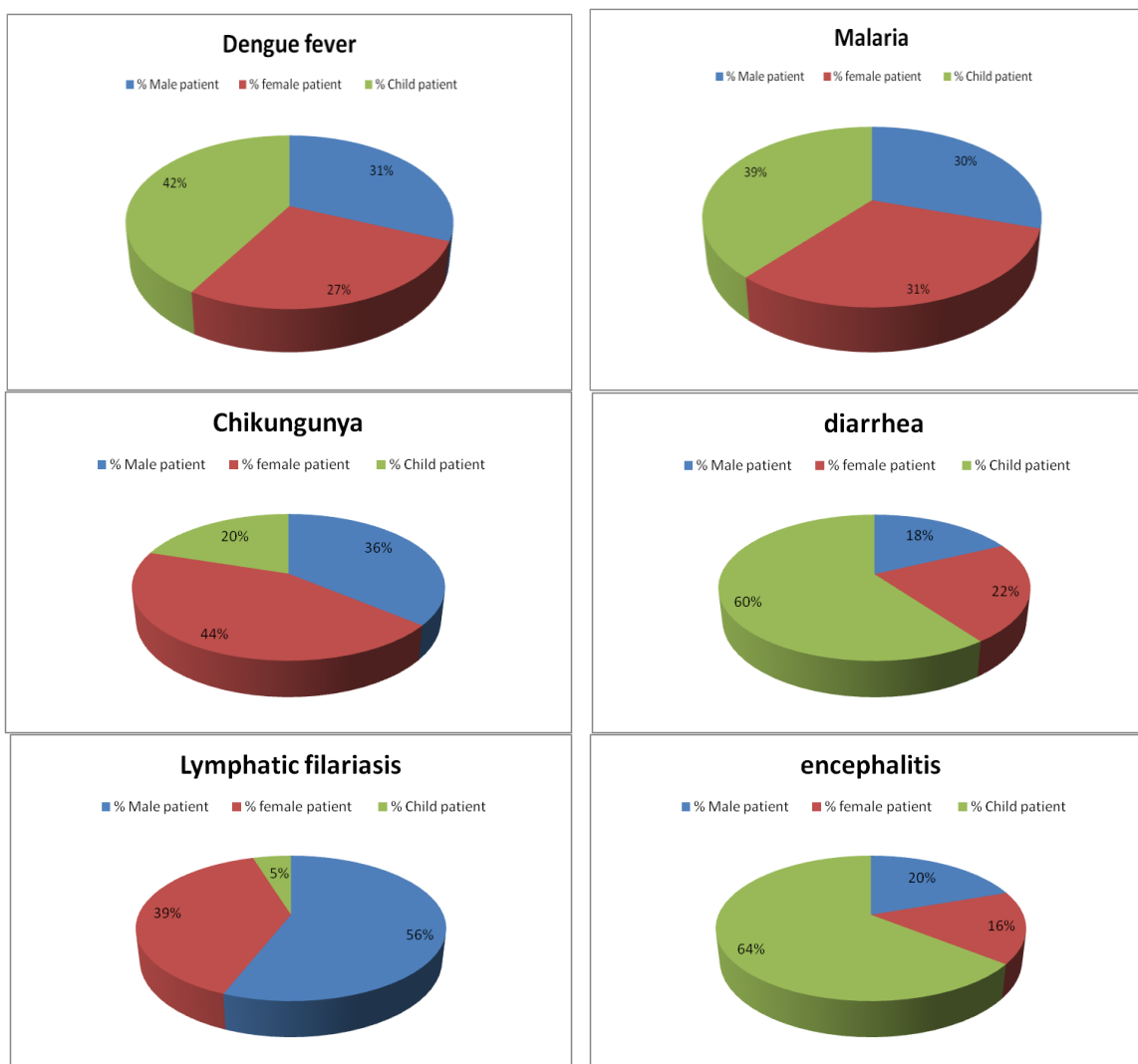


Figure 4: comparative Graphical representation of disease and its occurrence among the respondents

Implications:

- Understanding the gender and age distribution patterns for different diseases is crucial for healthcare planning, resource allocation, and targeted interventions.
- Diseases like malaria and diarrhea have a significant impact on children's health, emphasizing the importance of pediatric healthcare services and preventive measures.
- Tailoring healthcare strategies to target specific demographic groups based on gender and age can help improve disease management and control efforts.

III. Conclusion

Vector -borne diseases are one of the greatest contributors to human mortality and morbidity in tropical settings and beyond. Vector control programmes need to adapt to match the changing epidemiological patterns of new emerging threats. This will require increase Research to Develop a Sustained Approach to ecological and environmental changes in the years ahead.

Innovative, multidisciplinary investigations using environmental epidemiology to elucidate health risks posed by climate change in regions such as India are possible, but will require expanded partnerships among researchers, governments and communities so as to develop a co-benefit strategy that addresses public health while simultaneously ameliorating risks associated with climate change. The analysis of the gender and age distribution of patients across different diseases provides valuable insights into disease patterns and informs healthcare decision-making and intervention strategies.

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