International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Insights into the Shifting Dynamics of Climate Change and Human Health in N.E. India: a Rapid Review

Bishakha Bora[1], Nabanita Paul[2], Lima Hazarika[3]

[1,2]Master of Science Student, Dept. of Zoology, Assam Don Bosco University
[3]Assistant Professor, Dept. of Zoology, Assam Don Bosco University

Abstract
Climate change is the greatest existential challenge to planetary and human health and is dictated by a shift in the Earth's weather and air conditions owing to anthropogenic activity. The interactions between climate change and health outcomes are diverse and complex and include several exposure pathways that might promote the development of non-communicable diseases such as cardiovascular disease, diabetes, etc. The World Health Organization estimates that the warming and precipitation trends due to anthropogenic climate change of the past 30 years already claim over 150,000 lives annually. Climate change and human health are interconnected through a direct and indirect pathway. The increase in high temperatures due to climate change has a tremendous impact on human hydration levels and can cause heat stress in diabetics with cardiovascular complications leading to strokes. It is difficult to disregard the harmful impact of heat waves on the geriatric population all over the world, due to varied physiological conditions related to socioeconomic level. Exposure to high temperature prompts significant stress and strain on the thermoregulatory responses to heat stress in CVD. Studies reported that environmental effects from climate change have negative impacts on metabolic control, glucometer availability, insulin pumps, and medication gradually threatening the health, well-being, economy, and environment of the world. Reviewing the interconnections between the expanding climatic variability in climate change and human health it seems the growing risk factors are enormous and have tremendously fueled global health disparities.

Keywords: Global temperature, Metabolic disease, Heart disease, Stress, Heat-waves, Homeostasis, N.E. Region.

1. Introduction:

The impact of climate change on human health is significant and has become a major concern for public health and public health sciences. Climate change refers to long-term shifts in weather patterns and global temperatures caused by increased greenhouse gas emissions, primarily from human activities. These changes have far-reaching consequences for human health and well-being (UN, 2023). Assessing the link between climate change and human health involves examining the various pathways through which climate change impacts human well-being and understanding the potential health outcomes. The key aspects considered in assessing this link are direct impacts on human health through extreme weather events such as hurricanes, floods, and heatwaves; climatic influence on the distribution, prevalence, and

transmission of infectious diseases; change of air quality by altering atmospheric conditions and increasing the concentration of air pollutants leading to respiratory conditions, cardiovascular diseases which increases hospitalizations and mortality cases.

Climate change has emerged as a significant global issue facing humanity. Despite the scientific consensus, it is unfortunate to see that some people become concerned about this growing issue while others remain unconvinced (Luo & Zhao, 2019). A recent report in 2021 stated from 3.1 billion population of 65 years old to 626 million children of 1 year were exposed to heat wave, faced unpredictable social disadvantages due to record-breaking temperatures of over 40°C in the Pacific Northwest areas of the USA and Canada, which unfolded with the COVID-19 pandemic, causing global health crisis. Climate-sensitive infectious diseases such as transmission of non-cholerae Vibrio bacteria, malaria transmission, transmission of arboviruses such as dengue, chikungunya, and Zika raised between 7% and 13% which is far higher than it was in the 1950s. Climate change such as increase in temperatures, frequent extreme weather events and increased wildfire exposure affecting gradually the food and water security in many parts of the world, leading to substantial economic consequences in different ways across countries of all UN-defined human development index (Romanello et al., 2021). Air pollution has been identified as a significant environmental risk factor for CVD. Numerous scientific studies have demonstrated a strong association between exposure to air pollution and an increased risk of various cardiovascular conditions, including heart attacks, strokes, and other cardiovascular-related illnesses (Aitken et al., 2022). Long-term exposure to air pollution has also been associated with the development of atherosclerosis (hardening of the arteries), high blood pressure, hypertension, diabetes mellitus, dyslipidemia and changes in heart rate variability (Jacobsen et al., 2022). Addressing the health impacts of climate change requires a multidisciplinary approach that combines public health sciences, environmental science, policy development, and community engagement. The impact of the climate change with reference to cardiovascular disease (CVD) and Diabetes is discussed here.

1.1. Impact of Climate Change on North Eastern States, India:

Geographically, the north eastern states of India are located on 26ºNorth and 91º East. The eight states viz, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim face a high susceptibility to environmental challenges, including floods, deforestation, earthquakes, landslides, and riverbank erosions. Pollution concerns are on the rise due to various factors, such as coal mining operations, crude oil exploration, and the presence of industries involved in paper, fertilizers, cement, and automobiles (Secretariat & Division, 2022). The India Meteorological Department (IMD) reports from 1981–2021 showed that Assam experienced a monsoon with a 22% rainfall deficit and a 21% to 30% deficit in the six other northeastern states. In Meghalaya, potential surge of up to 14 days in heavy precipitation (R20mm) events were recorded due to significant increase of 4 °C in maximum temperatures and 5.5 °C in minimum temperatures (Paul & Maity, 2023). Changes in the decline of number of rainy days, elevation in simple daily intensity index of 2.4 mm/day compared to the current baseline of 14.4 mm/day has anticipated significant implications for water resources, agriculture, health, and infrastructure in the region. A 2018 report stated that in Arunachal Pradesh, about 200 mountain springs almost dried up with decreased flow of water due to decrease in rainfall (Secretariat & Division, 2022). The soil of the river Brahmaputra has become coarser and acidic decreasing the soil fertility and water absorption. Assam experiencing a degradation in the land area due to floods, and imbalance in the rainfall pattern. The change in precipitation and temperature has both direct and indirect effects on human health.

1.2 Impact of climate change on metabolic disorder like Diabetes:

Climate change is a long-term rise in the planet's average surface temperature and the dramatic changes in global, regional, and local weather patterns that follow that rise, all of which are brought on by a sharp rise in greenhouse gas concentrations. The effects of climate change on people, animals, and our civilization as a whole could be significant. The greatest threat to human health is climate change, and medical professionals are already taking action to mitigate its negative effects on health around the world. It greatly affects human health and disease in a variety of ways. Increased rates of Diabetes mellitus, cardiovascular disease (CVD), and other linked disorders are among the health implications of these disruptions. Diabetes and climate change are interconnected. Extreme weather events and rising temperatures may increase morbidity and mortality in patients living with diabetes, especially in those with cardiovascular complications. Failure to mitigate climate change and the diabetes epidemic threatens the lives of many people (Zilbermint *et al.*, 2010). Factors such as air pollution, noise pollution, temperature etc. If exposed for an extended period of time, the Particulate Matter (PM), a mixture of dirt and smoke, which makes up the components of air pollution, can cause diabetes (**Figure 1**). High temperature widens blood vessels, which improves the absorption of insulin and lowers blood pressure. Low blood sugar is often made worse by cold temperatures also. Noise pollution causes more stress, which causes more stress hormones, which might cause issues with metabolism and insulin resistance after prolonged exposure.

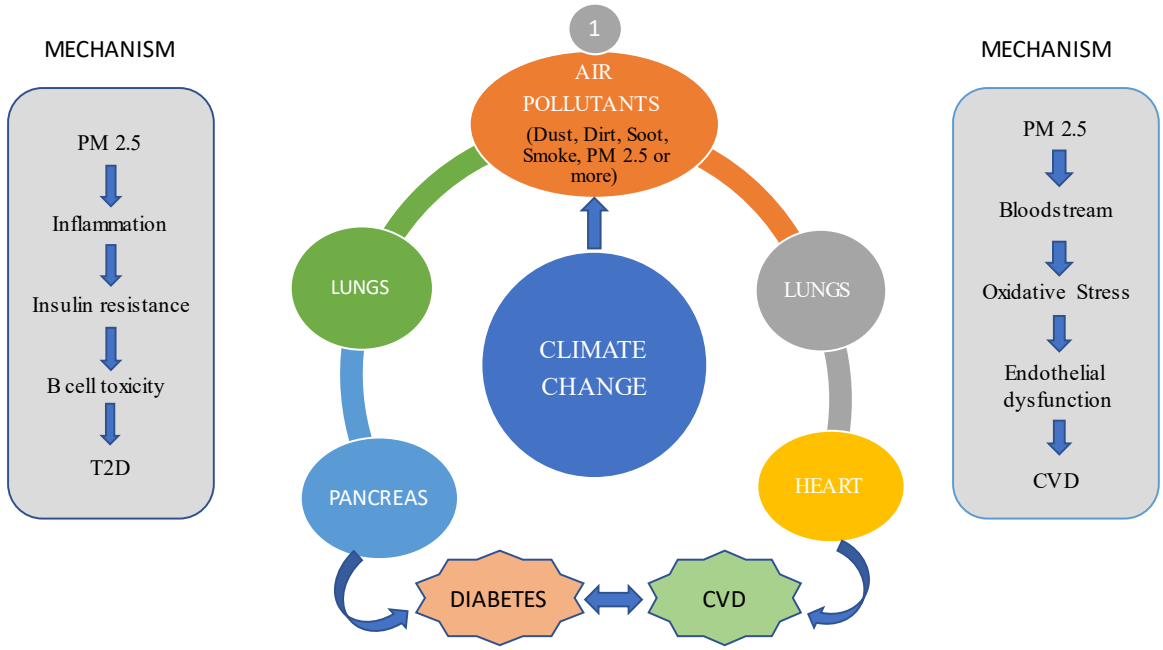

Figure 1: Link between Air pollution due to climate change and human health conditions.

1.3 Impact of climate change on Cardio Vascular Disease (CVD):

Increases in mortality with cardiovascular diseases in extreme heat and cold weather had been studied in many regions. These results suggested that people died rapidly from climate-change related cardiovascular diseases before they were sent to hospital. These findings reminded us that climatic stress can be considered as a new potential risk factor of sudden cardiovascular events in human health, and there was an urgent need for large-scale, prospective, community-based and international study of sudden

cardiovascular events to explore deeply the risk factors to schedule preventive strategies (Cheng & Su, 2010).

Studies have shown that there are many factors that increases Cardiovascular risk in human health such as air pollution, noise pollution, rising temperature etc. When a person breathes in poor quality air, the air pollutants travel deep into the bloodstream through the lungs, and to the heart which increases the risk of developing heart and circulatory diseases by making the blood vessels narrower and harder. At the pathophysiological level, particularly traffic noise at night causes oxidative stress and inflammatory processes in the brain, which in turn impact negatively on the vascular system and result in endothelial dysfunction and hypertension. Similarly, high temperatures and high humidity causes more blood flow to the skin which results in faster heart beat i.e., twice the blood circulation per minute on a normal day which may result in dysfunction of the heart.

Discussion:

Several studies have estimated that air pollution, heat waves, unhealthy diets and many other factors has an adverse effect on CVD as well as Diabetes along with many other health related diseases. Literature also suggests the intersections between extreme temperatures and human health conditions need to be thoroughly characterized with focus on applications of geographic information science (GIS) in health science research (Hazarika, 2023). Observational studies provide some evidence for a possible relationship between DM, CVD and climate change. Diabetes and CVD could be interconnected with climate change both directly and indirectly. It is known that people living with diabetes are more prone to dehydration and cardiovascular events during extreme heat.

Researchers have claimed that one novel possible risk factor for cardiovascular events and even mortality is climatic stress. The cardiovascular mortality is shown to be influenced by variations in the ambient temperature through elevated blood pressure, blood viscosity, and heart rate. Air pollution and noise pollution can increase the chance of vascular dysfunction, inflammation and hypertension, thereby increasing the risk of CVD (Figure 1). Studies have also shown that deaths from coronary heart disease increases significantly during winter season. This cold stress can enhance the upper respiratory tract infection which can impact the Cardiovascular system. A specific collection of pathophysiological mechanisms focused on stress hormone signaling, oxidative stress, and inflammation are triggered by exposure to almost all environmental risk factors which leads to high risk of cardiovascular disease. Therefore, studies have suggested that collective social action is highly required to address those environmental stresses.

According to some authors, there are many possible environmental obstacles that reduce T2DM burden through individual level interventions. They also reported that greater level of walkability and green space are linked to a lower risk of developing T2DM. In contradiction to the above statement, some other researchers suggested that walking in a polluted environment can diminish the health benefits of a diabetic person. Current studies also shown that temperature variations can raise a person's risk of developing diabetes and have negative impacts on those who have diagnosed with diabetes.

The evidence for the harmful effects of ambient air pollutant exposure on T2D and that diabetic patients may be more susceptible to air pollution exposure has been reinforced by a recent publication. In contradict to it, some studies reported that the onset of T2D may be influenced more by transportation noise than by air pollution. The diabetes epidemic will require a mitigation strategy, as would climate change, and rigorous, exact execution of the strategy. To conclude, the repercussions of global climatic change include

not only loss in economy agriculture, production, energy and infrastructure but also significant loss of life and cause serious concerns human health. The review briefly summarized the growing association between different climatic crisis such as air pollution and human health conditions, which needs multidisciplinary adaptation strategies that can incorporate epidemiology, climatology, indoor/building environments, energy usage, and human thermoregulatory models.

Conclusion:

To assess the link between climate change and human health, researchers employ various methods such as epidemiological studies, modeling techniques, and risk assessments. These approaches involve collecting data on health outcomes, analyzing climate and environmental data, and investigating the relationships and interactions between climate variables, human behavior, and health outcomes. Researchers also consider vulnerability and adaptation factors, including socioeconomic conditions, demographic characteristics, and access to healthcare, to understand differential impacts on different populations. Understanding the link between climate change and human health is crucial for informing policy decisions, designing effective adaptation and mitigation strategies, and promoting public health interventions to minimize the adverse health effects of climate change.

Exploring the intricate relationship between climate change and human health in Northeast India through this rapid review offers a crucial opportunity to raise awareness about the urgent need for action towards a sustainable environment. By shedding light on the shifting dynamics of this region's climate and its profound impact on human well-being, this study serves as a wake-up call to individuals, communities, and policymakers alike.

Conflict of interest: The authors declare no conflict of interests.

References:

1. Abrignani, M. G., Lombardo, A., Braschi, A., Renda, N., & Abrignani, V. (2022). Climatic influences on cardiovascular diseases. *World journal of cardiology*, *14*(3), 152.
2. Al-Shihabi, F., Moore, A., & Chowdhury, T. A. (2023). Diabetes and climate change. Diabetic medicine a journal of the British Diabetic Association, 40(3), e14971.
3. Aitken, W. W., Brown, S. C., & Comellas, A. P. (2022). Climate Change and Cardiovascular Health. *Journal of the American Heart Association*, *11*(24), 10–12. doi.org/10.1161/jaha.122.027847
4. Baaghideh, M., & Mayvaneh, F. (2017). Climate change and simulation of cardiovascular disease mortality: A case study of Mashhad, Iran. *Iranian Journal of Public Health*, *46*(3), 396.
5. Cheng, X., & Su, H. (2010). Effects of climatic temperature stress on cardiovascular diseases. *European Journal of Internal Medicine*, *21*(3), 164-167.
6. Colagiuri, Director, R. (2013). Diabetes and climate change: Different drums–same orchestra. *Journal of public health policy*, *34*(1), 165-169.
7. Cuschieri, S., & Calleja Agius, J. (2021). The interaction between diabetes and climate change - A review on the dual global phenomena. Early human development, 155, 105220.
8. Dain, K., & Hadley, L. (2012). Diabetes and climate change—Two interconnected global challenges. *Diabetes Research and Clinical Practice*, *97*(2), 337-339.

9. Dendup, T., Feng, X., Clingan, S., & Astell-Burt, T. (2018). Environmental Risk Factors for Developing Type 2 Diabetes Mellitus: A Systematic Review. *International Journal of Environmental Research and Public Health*, *15*(1), 78.
10. Eze, I. C., Foraster, M., Schaffner, E., Vienneau, D., Héritier, H., Rudzik, F., ... & Probst-Hensch, N. (2017). Long-term exposure to transportation noise and air pollution in relation to incident diabetes in the SAPALDIA study. *International journal of epidemiology*, *46*(4), 1115-1125.
11. Giorgini, P., Di Giosia, P., Petrarca, M., Lattanzio, F., Stamerra, C. A., & Ferri, C. (2017). Climate changes and human health: a review of the effect of environmental stressors on cardiovascular diseases across epidemiology and biological mechanisms. *Current pharmaceutical design*, *23*(22), 3247-3261.
12. Gostimirovic, M., Novakovic, R., Rajkovic, J., Djokic, V., Terzic, D., Putnik, S., & Gojkovic-Bukarica, L. (2020). The influence of climate change on human cardiovascular function. *Archives of environmental & occupational health*, *75*(7), 406-414.
13. Hazarika, L. (2023). Rising Temperatures, Rising Risks: A Review of the Impact of Climate Change on Human Cardiac Health. *Journal of Environment Pollution and Human Health, Vol. 11, 2023, Pages 33-36*, *11*(2), 33–36. doi.org/10.12691/JEPHH-11-2-2
14. Jacobsen, A. P., Khiew, Y. C., Duffy, E., O'Connell, J., Brown, E., Auwaerter, P. G., Blumenthal, R. S., Schwartz, B. S., & McEvoy, J. W. (2022). Climate change and the prevention of cardiovascular disease. *American Journal of Preventive Cardiology*, *12*(September), 100391. doi.org/10.1016/j.ajpc.2022.100391
15. Luo, Y., & Zhao, J. (2019). Motivated attention in climate change perception and action. *Frontiers in Psychology*, *10*(JULY). doi.org/10.3389/fpsyg.2019.01541
16. Khraishah, H., Alahmad, B., Ostergard Jr, R. L., AlAshqar, A., Albaghdadi, M., Vellanki, N., ... & Rajagopalan, S. (2022). Climate change and cardiovascular disease: implications for global health. *Nature Reviews Cardiology*, 1-15.
17. McCutcheon, K., Vachiat, A., & Manga, P. (2022). Climate Change and Cardiovascular Disease in Africa. *Wits Journal of Clinical Medicine*, *4*(3), 135-140.
18. Münzel, T., Hahad, O., Sørensen, M., Lelieveld, J., Duerr, G. D., Nieuwenhuijsen, M., & Daiber, A. (2022). Environmental risk factors and cardiovascular diseases: a comprehensive expert review. *Cardiovascular research*, *118*(14), 2880-2902.
19. Myers, S. S., Smith, M. R., Guth, S., Golden, C. D., Vaitla, B., Mueller, N. D., ... & Huybers, P. (2017). Climate change and global food systems: potential impacts on food security and undernutrition. *Annual review of public health*, *38*, 259-277.
20. Paul, A. R., & Maity, R. (2023). Future projection of climate extremes across contiguous northeast India and Bangladesh. *Scientific Reports*, *13*(1), 1–16. doi.org/10.1038/s41598-023-42360-2
21. Rajagopalan, S., Al-Kindi, S. G., & Brook, R. D. (2018). Air Pollution and Cardiovascular Disease: JACC State-of-the-Art Review. Journal of the American College of Cardiology, 72(17), 2054–2070.
22. Romanello, M., McGushin, A., Di Napoli, C., Drummond, P., Hughes, N., et al., (2021). The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. *The Lancet*, *398*(10311), 1619–1662. doi.org/10.1016/S0140-6736(21)01787-6
23. Schultz, R., & Tait, P. (2014). Climate change and diabetes: averting two linked catastrophes. *Med J Aust*, *200*(2), 87.

24. Shubair, M. M., Haider, M., & Bassa, M. (2013). Climate change and type 2 diabetes. *Journal of Endocrinology*, *1*(1), 23.
25. Sørensen, M., Poulsen, A. H., Hvidtfeldt, U. A., Frohn, L. M., Ketzel, M., Christensen, J. H., Brandt, J., Geels, C., & Raaschou-Nielsen, O. (2022). Exposure to source-specific air pollution and risk for type 2 diabetes: a nationwide study covering Denmark. International journal of epidemiology, 51(4), 1219–1229.
26. Secretariat, L. S., & Division, I. (2022). Impact of Climate Change on North Eastern States. *Parliament Library*, *LARRDIS NO. AJNIFM/64/2022*.parliamentlibraryindia.nic.in/lcwing/impact_climate2023.pdf
27. UN, U. N. (2023). What Is Climate Change? | United Nations. In *United Nations Climate ACtion Report*. Doi. www.un.org/en/climatechange/science/causes-effects-climate-change
28. Vallianou, N. G., Geladari, E. V., Kounatidis, D., Geladari, C. V., Stratigou, T., Dourakis, S. P., Andreadis, E. A., & Dalamaga, M. (2021). Diabetes mellitus in the era of climate change. Diabetes & metabolism, 47(4), 101205.
29. Yudhani, R. D., Sholikhah, E. N., Nugrahaningsih, D. A. A., & Primaningtyas, W. (2022, April). The bidirectional interaction between climate change and type 2 diabetes burden. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1016, No. 1, p. 012054). IOP Publishing.
30. Zilbermint M. (2020). Diabetes and climate change. Journal of community hospital internal medicine perspectives, 10(5), 409–412.