



The toll of climate change on human health

Supriya Shrivastava

Assistant Professor, Department of Biotechnology, Ranchi Women's College, Ranchi, Jharkhand, India

Abstract

Excess fossil-fuel consumption over the last one-and-half centuries has caused global carbon emissions to reach alarming levels resulting in global warming, climate change and air pollution. As a result not only planetary health has been ruined; climate change has become the single biggest threat to human health globally. The unfortunate part is- it is affecting marginalized population the most- the people who have contributed the least to climate change. The solution lies in transforming the world to low-carbon economy. A strong resolve on the part of governments and a greater awareness on the part of people is needed to achieve this goal.

Keywords: climate change, greenhouse gases, air pollution, human health

Introduction

In 2021, the World Health Organization declared climate change to be “the single biggest health threat facing humanity”^[1]. Fossil-fuel combustion is the root cause of global greenhouse gas emissions and particulate air pollution^[2]. Climate change has affected both infectious and noncommunicable disease through extreme temperature, increased air pollution, expanded habitats for disease vectors like mosquitoes and ticks, worsened food scarcity and undernutrition, and longer and more intense pollen seasons^[3]. Greenhouse-gas emissions make climate system unstable increasing the frequency, intensity, and duration of some extreme weather and climate events like heat waves, floods, and droughts. These have devastating adverse effects on human health. Climate change has caused sea levels to rise, exposing populations to coastal flooding.

Climate change

Climate change is occurring as a result of an imbalance between incoming and outgoing radiation in the atmosphere. As solar radiation enters the earth's atmosphere, some of it is absorbed by the land and oceans. It is reemitted as infrared radiation, which is then absorbed by greenhouse gases. This is greenhouse effect and it helps keep earth's atmosphere warm enough to sustain life on our planet. Without the greenhouse effect the earth would be about 35°C colder^[4]. The primary greenhouse gases are carbon dioxide, methane and nitrous oxide.

Anthropogenic fuel combustion for transportation, electricity generation, and industrial processes has led to increased emission of greenhouse gases. Deforestation and ocean saturation have reduced the capacity of terrestrial and marine environments to absorb extra carbon dioxide (the main greenhouse gas) from the atmosphere. As a result, the heat-retaining capacity of the lower atmosphere has increased causing global warming. This has led to climate change. The hydrologic cycle has altered because warmer air retains more moisture than cooler air. Altered precipitation patterns have led to excessive rain falls in some parts of the world and prolonged drought in other parts. Severe weather events like heat waves, excessive rainfalls and flash floods, droughts and windstorms have increased in frequency, intensity and duration. Climate change threatens human health and wellbeing through effects on weather, ecosystems and human systems. These effects increase exposure to extreme events, change the environmental suitability for infectious disease transmission, alter population movements and undermine people's livelihoods and mental health. The poorest countries are suffering the greatest consequences of climate change even though their contribution to greenhouse gas emissions has been the least^[5].

Carbon dioxide is the primary greenhouse gas. Atmospheric carbon dioxide concentrations are now 50% higher than in preindustrial era^[6]. Carbon dioxide remains in atmosphere for centuries, with about 20% persisting for more than thousand years. Other, short-lived climate pollutants, such as methane and black carbon, also contribute to warming. Oxidation of methane produces ozone, which is another important greenhouse gas. The world is now 1.2°C warmer than the preindustrial period (1850-1900) and the global temperature is increasing at the rate of 0.2°C per decade^[3, 5].

Climate change has both direct and indirect adverse health effects. Exposure to extreme heat poses acute health hazard and increases death from cardiovascular and respiratory conditions and is associated with more suicides. Individuals older than 65 years, populations in the urban environments, people with chronic diseases and disabilities and outdoor workers are the most vulnerable. Heat-related mortality for people older than 65 years reached a record high of almost 345,000 deaths in 2019- 80.6% higher than the 2000-5 average. India and Brazil had the highest absolute increase in heat-related mortality.⁵ In addition to direct impacts on health, high ambient

temperatures can also affect people's ability to work. Globally 295 billion hours of potential work were lost in 2020 due to heat exposure ^[5]. Pakistan, India and Bangladesh suffered the greatest losses, which was 2.5-3 times the world average. Agricultural workers accounted for 80% of the total potential work losses in these countries. This would cause significant decline in yield of major crops. A climate change-associated net increase of 529,000 adult deaths worldwide is projected to result from expected reductions in food availability (particularly fruits and vegetables) by 2050, as compared with a reference scenario without climate change ^[7].

Hotter and drier conditions caused by climate change increase the risk of wildfires and the extent of the damage caused by them. India is one of the three topmost countries where largest increase in wildfire has been observed ^[5]. Climate change is increasing the frequency, intensity and duration of drought events. These changes pose threat to water security, sanitation, and food productivity. Rising carbon dioxide concentrations have adverse effects on the nutritional quality of major cereal crops, such as rice and wheat, including lowering levels of protein, a range of micronutrients, and B vitamins ^[8]. Climate and other environmental changes also reduce the yield of vegetables, fruits and legumes overall, which has compromised the prevention strategies for noncommunicable diseases (NCD) like type 2 diabetes, obesity and coronary artery disease ^[9].

A warming and unstable climate is playing an ever-increasing role in driving the global emergence, resurgence and redistribution of vector-borne, food-borne and water-borne diseases. Insect vectors tend to be more active at higher temperatures. Climate change along with global mobility & urbanization is a major driver of dengue virus infections, which have doubled every decade since 1990. By 2080, about 6 billion people will be at risk of contracting dengue fever as a consequence of climate change, compared with 3.5 billion people if the climate remained unchanged ^[10]. Global warming has helped mosquitoes responsible for malaria to spread to higher altitudes- places once free of the disease. The length of transmission season of malaria has also increased substantially. Lindsey and Martens have used models and scenarios to estimate that 260-320 million more people will be affected by malaria by 2080 as a consequence of new transmission zones ^[11]. Epidemics caused by Zika and Chikungunya viruses have become commonplace in several parts of the world. The World Health Organization (WHO) estimated that approximately 250,000 deaths annually between 2030 and 2050 could be due to climate change-related increases in heat exposure in elderly people, as well as increases in diarrheal disease, malaria, dengue, coastal flooding, and childhood stunting ^[12].

Modern climate change is the direct consequence of fossil fuel consumption in the European industrial revolution, but the impact of this in different populations is varied and depends on their social, economic and physical conditions ^[13]. Low-income and remote populations are more vulnerable to physical hazards, undernutrition, diarrheal and other infectious diseases, and the health consequences of displacement. Unfortunately, many of the most serious health consequences of climate change are being experienced by these people, increasing global health inequalities ^[14]. In fact, climate change is acting as amplifier of existing risks to health that the poor and disadvantaged people are already facing.

In addition to these direct health effects, climate change also has indirect substantial consequences on health. The World Bank estimates climate change could force more than 100 million people into extreme poverty by 2030 ^[15]. Economic collapse will devastate global health and development and has the potential to undermine the gains made in public health and development during the past half-century. Mass environmental displacement and migration will disrupt the lives of hundreds of millions of people. Economic progress in resource-poor countries has caused rapid and unplanned urbanization which has created several public health problems of its own and climate change would further exacerbate these problems. There is also danger of conflict erupting from resource scarcity and competition, or from migration and clashes between host and migrant groups.

Air pollution

Fossil fuel combustion in high-income and middle-income countries and biomass burning in low-income countries- is the root cause of air pollution. Combustion of fossil fuel accounts for 85% of the fine particulate air pollution and almost all airborne emissions of sulfur oxides and nitrogen oxides. Air pollution consists of particulate matter and gaseous components in a pollutant mixture. Particulate matters are of various sizes. PM₁₀ is inhalable particulate matter and originates from windblown soil dust, road dust, and sea salt. Anthropogenic fuel combustion produces PM_{0.1} and PM_{2.5}. Their other source is landscape fire smoke. PM_{2.5} particles are particularly dangerous as after inhalation, they easily pass from the lungs to bloodstream and gradually but permanently damage the heart and lungs. Climate change increases chemical reaction rates in atmosphere. As a result, PM_{0.1}, PM_{2.5} and ozone are also produced from precursors like nitrogen oxide, sulfur oxide and volatile organic compounds. Nitrogen dioxide and sulfur dioxide are emitted from combustion of anthropogenic fuel. Natural production of nitrogen dioxide is taking place from soil and lightning, while for sulfur dioxide decomposing organic matter and volcanic eruptions are the natural sources.

Air pollution is the world's largest environmental threat to health and is responsible for an estimated 8.7 million deaths each year ^[16]. WHO has set evidence-based guidelines for levels of these pollutants in the ambient air, above which concentrations are associated with significant risks to human health. WHO estimates that 97% of urban residents in low-income and middle-income countries (LMICs) are exposed to air that does not meet WHO air quality guidelines ^[17]. In the absence of major intervention, the air pollution death toll is projected to double by 2050 ^[18].

All vital organs, including the kidneys, lungs, heart and brain, may be affected by air pollution and climate change. Air pollutants produced by combustion are major drivers of NCD mortality. These pollutants are

responsible for 22% of deaths from cardiovascular disease, 26% of death from ischemic heart disease, 25% of stroke deaths, 53% of deaths from chronic obstructive pulmonary disease, and 40% of lung cancer deaths. They cause widespread cognitive dysfunction and neurobehavioral impairment ^[19]. Cohen and colleagues reported that China and India, with the largest populations and commensurately high levels of pollution, had the largest estimated numbers of deaths attributable to air pollution: 1.1 million and 1.09 million, respectively in 2015 ^[20]. For high-income countries behavioral and metabolic risk factors are the main causes of NCD mortality, for upper-middle-income countries pollution and behavioral risk factors are of equal importance, while for heavily polluted, rapidly developing LMIC like India, pollution is the predominant risk factor for death from NCDs ^[21].

Conclusion

Human activity is driving climate change on our planet. Air pollution and climate change has resulted in increasing scarcity of food and fresh water, extreme weather events, rise in the sea level, loss of biodiversity, loss of habitable land, mass human migration, and conflict and violence. The health consequences of these changes are enormous and the total number of deaths attributable to climate change is not even known. The sixth assessment report (AR6) from the United Nations Intergovernmental Panel on Climate Change published earlier this year warned that greenhouse gas emissions must start to decline by 43% from the current levels by 2030 if we were to limit warming to 1.5°C, the preferred climate goal of the Paris Agreement ^[22]. Technological advances made in renewable energy sources like solar and wind energy has made it possible to achieve these goals. The lack of political will and absence of strong public opinion on the issue of climate change has resulted in a painfully slow adaptation of low-carbon economy in most parts of the world. Climate change is a complex issue and is hard to grasp for general public as Eric Chivian says” Our brains are wired to see what is happening right in front of us right now. We are not very good at seeing things that are not obvious, that happen incrementally, or that occur over large area or in other parts of the world” ^[23].

References

1. World Health Organization. COP26 special report on climate change and health: the health argument for climate change. Geneva: World Health Organization, 2021.
2. Solomon CG, Salas RN, Malina D, *et al.* Fossil-fuel pollution and climate change. *N Engl J Med*,2022;386:2328-2329.
3. Keswani A, Aksetrod H, Anenberg S. Health and clinical impacts of air pollution and linkages with climate change. *NEJM Evidence*, Published on June 15, 2022. DOI: 10.1056/EVIDra2200068.
4. Lancet and University College London Institute for Global Health Commission. Managing the health effects of climate change. *Lancet*,2009;373:1693-733.
5. Romanello M, Mcgushin A, Di Napoli C, *et al.* The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. *Lancet*,2021;398:1619-63.
6. Met Office. Mauna Loa carbon dioxide forecast for 2021., 2021. <http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/long-range/forecasts/co2-forecast-for-2021> (accessed April 7, 2021).
7. Springmann M, Mason-D’Croz D, Robinson S, *et al.* Global and regional health effects of future food production under climate change: a modelling study. *Lancet*,2016;387:1937-46.
8. Myers SS, Zanolotti A, Kloog I, *et al.* Increasing CO₂ threatens human nutrition. *Nature*,2014;510:130-142.
9. Scheelbeek PFD, Bird FA, Thomisto HL, *et al.* Effect of environmental changes on vegetable and legume yields and nutrition quality. *Proc Natl Acad Sci USA*,2018;115:6804-9.
10. Hales S, de Wet N, Maindonald J, *et al.* Potential effects of population and climate change on global distribution of dengue fever: an empirical model. *Lancet*,2002;360:830-34.
11. Lindsay SW, Martens WJM. Malaria in the African highlands: past, present and future. *Bull World Health Organ*,1998;76:33-45.
12. Quantitative risk assessment of the effect of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014 (<http://www.who.int/iris/handle/10665/134014>).
13. Stephenson J, Crane SF, Levy C, *et al.* Population, development, and climate change: links and effects on human health. *Lancet*,2013;382:1665-73.
14. Commission on Social Determinants of Health. Closing the gap in a generation: health equity through action on the social determinants of health. Final report of the Commission on Social Determinants of Health. Geneva. World Health Organization, 2008.
15. Hallegatte S, Bangalore M, Bonzanigo L, *et al.* Shock waves: managing the impact of climate change on poverty. Washington, DC: World Bank, 2015.
16. Vohra K, Vodonos A, Schwartz J, *et al.* Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: results from GEOA-Chem. *Environ Res*,2021;195:110754.
17. WHO Global Ambient Air Quality Database (update 2018). <http://www.who.int/airpollution/data/cities/en/> (accessed Sept 12, 2018). Le
18. Lelieveld J, Evans JS, Woodward A, *et al.* The contribution of outdoor air pollution sources to premature mortality on a global scale. *Nature*,2015;525:367-71.

19. GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systemic analysis for the Global Burden of Disease Study 2015. *Lancet*,2016;388:1459-544.
20. Cohen AJ, Brauer M, Burnett R, *et al.* Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. *Lancet*,2017;389:1907-1918.
21. Fuller R, Rahona E, Fisher S, *et al.* Pollution and non-communicable disease: time to end the neglect. *The Lancet Planetary Health*,2018;2(3):e96-e98.
22. Atwoli L, Baqui AH, Benfield T, *et al.* Call for emergency action to limit global temperature increases, restore biodiversity, and protect health. *N Engl J Med*,2021;385:1134-7.
23. Godlee F. Climate change is a health emergency. *BMJ*,2014;348:g2546.