COMMENTARY

Projecting universal health risks under climate change to bridge mitigation and health adaptation objectives

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Climate change is one of the biggest threats facing humanity. The global community has stated the objective of limiting the increase in the global average temperature to 1.5°C to prevent potentially catastrophic effects and health threats. A key strategy to reach the mitigation objective is to achieve carbon neutrality, also termed net zero, by cutting down emissions of greenhouse gases to as nearly zero level as possible by the mid-century, mainly through the implementation of clean energy policies or the increase in carbon sinks. To date, more than 130 countries worldwide have proposed carbon-neutral targets, and the identification of an effective, economical, and equitable carbon-neutral pathway is a key challenge in mitigation policies.

It is important to recognize that limiting global warming to 1.5°C may, to some extent, mitigate the effects of climate change on human health; however, this approach would not entirely eliminate the health risks associated with climate change. According to the Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC AR6), a certain amount of additional global warming has already been "baked into" the global climate system for the next few decades, and during 2030–2050, climate change could cause at least 250,000 additional global deaths per year owing to malnutrition, malaria, diarrhea, and heat stress.[1] A further increase in health risks associated with climate change is inevitable, which would profoundly affect the social economy and human health. Thus, adaptation measures, particularly regarding targeted early-warning systems for extreme weather events, disaster preparedness and training, and evacuation planning, are areas that require immediate attention to protect people from climate-change-related hazards and to achieve carbon-neutrality goals. Identifying vulnerable populations (considering key diseases, such as cardiovascular and respiratory system afflictions, age, regional geographic factors, etc.) who are in urgent need of priority protection under climate change is a key challenge to ensure the effectiveness of the implementation of the adaptation measures. However, currently available public health adaptation measures are frequently vague and generalized, rather than being specific, because of the failure to adequately identify populations at high health risks due to climate change. In particular, the identification of populations at high health risks under potential scenarios of carbon reduction pathways based on a long-term climate change perspective has not been achieved; thus, existing health adaptation and mitigation policies persist as individual entities and lack of linkage between them. Therefore, in the context of the global active response to climate change, there is an urgent need to carry out research on global health risk projection under climate change to bridge mitigation and health adaptation objectives, thereby simultaneously supporting the selection of the optimal carbon-neutral pathway and the identification of priority target populations for health adaptation under the same future scenarios.

Almost all existing health risk projection studies based on integrated modeling have focused on the selection of optimal carbon mitigation pathways under climate change, and only a few studies have considered key diseases, age, and regional geographic factors.[2,3] Research that accounts for the potential health benefits of implementing different mitigation pathways may aid in choosing optimal pathways that maximize health benefits, thus introducing a critical societal outcome in the process of selecting a carbon-neutral pathway.

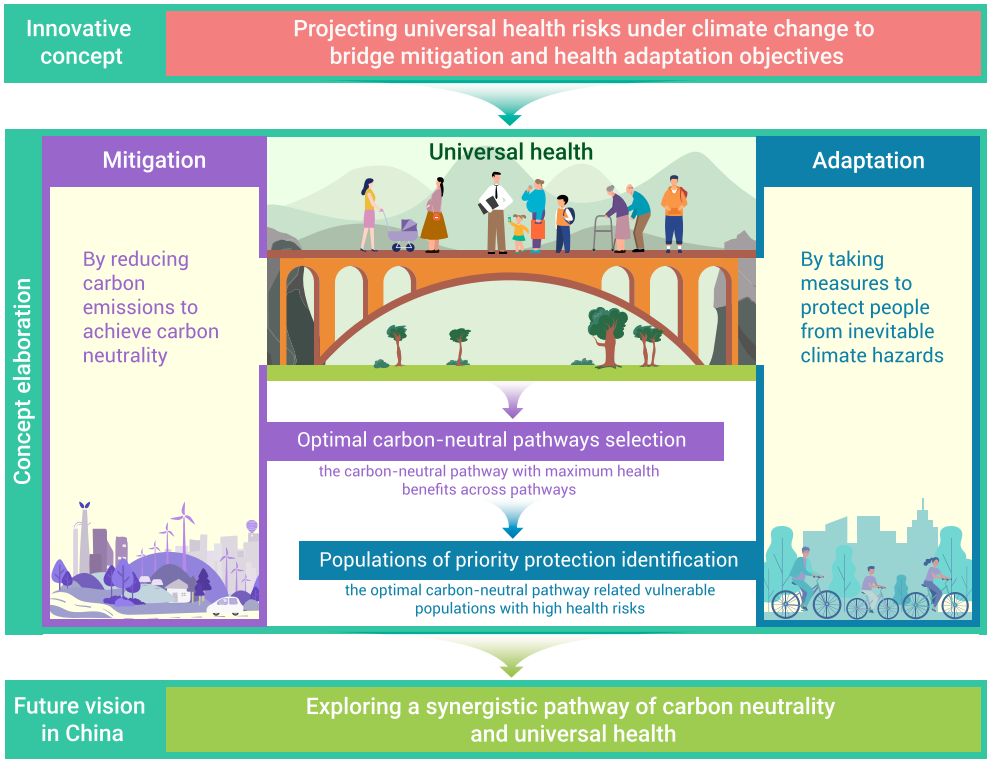

Figure 1. An innovative concept: projecting universal health risks under climate change to bridge mitigation and health adaptation objectives Universal health: human health covering primary health outcomes (such as mortality and morbidity) from the entire population (considering key diseases, such as cardiovascular and respiratory system afflictions, age, regional geographic factors, etc.)

This can provide a more comprehensive account of the economic costs and benefits of alternative pathways.[4] With a view of maximizing the characterization of monetized health benefits across pathways, most current studies have focused on mortality either from all causes or from several specific causes as the primary health outcome, and morbidities have not been considered, and there were no differences in age, geographic region, and key diseases across the population groups considered. This approach leads to a serious underestimation of health benefits, leading to great uncertainty in selecting pathways and insufficient support for implementing mitigation policies. At the same time, with such overly crude results that focus on mortality benefits in the total population, it is difficult to facilitate the identification of vulnerable populations with higher health risks, thus complicating the proposal of adaptation measures that are synergistic with the carbon-neutral pathway.

To better respond to climate change and maximize health benefits, we propose an innovative concept that projects universal health risks under climate change to bridge mitigation and health adaptation objectives (Figure 1). Universal health refers to human health covering primary health outcomes (such as mortality and morbidity) from the entire population (considering key diseases, such as cardiovascular and respiratory system afflictions, age, regional geographic factors, etc.). By comparing universal health risks under various future mitigation pathway scenarios with the current state, the optimal carbon-neutral pathway can be selected using the principle of obtained maximizing universal health benefits. By characterizing trends in the development of health risks for various future periods, geographic regions, and population segments under the optimal carbon-neutral mitigation pathway, vulnerable populations with higher health risks can be identified based on changes in the absolute amounts and relative proportions of health risks in different population groups, which facilitates the formulation of adaptation measures linked to the optimal carbon-neutral pathway under climate change.

To put this concept into practice, it is necessary to improve the integrated modeling method for population health risk assessment and projection under the changing climate scenario. Future research should focus on the following aspects: (1) identifying the relationship between climate-related factors and health outcomes by establishing a basic parameter database of the exposure-response relationships among meteorological factors (including temperature and precipitation), air pollution factors ($PM_{2.5}$, O_3, volatile organic compounds, etc.), extreme weather factors (heatwave, cold wave, flood, and drought, etc.), and health outcomes (mortality and morbidity) in the entire population and by covering the entire life cycle; (2) developing a series of scenarios involving local carbon reduction strategies, by integrating information from multiple sources on energy transition, population growth, economic development, and technological innovation for achieving carbon neutrality; and (3) building a comprehensive assessment and projection system by establishing integrated modeling frameworks that consider the coupling of exposure assessment of ambient environmental conditions, health risk assessment and prediction, and economic assessment. Thus, the dynamic development of health risks and benefits associated with each carbon reduction strategy in the total population and the complete life cycle can be projected in the long term, which supports the practice of this innovative concept.

A functional environmental and health policy foundation is a key prerequisite for the realization of this concept. In 2020, China, which is the largest carbon emitter, officially released an action plan to reduce peak carbon dioxide emissions by 2030 and to achieve carbon neutrality by 2060. To achieve this goal, China should drastically and unprecedently reduce carbon emissions. At the same time, China implemented the Healthy China 2030 plan in 2016 and has been pursuing it since then, with the fundamental objective of building a healthy China to achieve universal health. Under carbon-centered and public-health-centered policies, projecting universal health risks under climate change to bridge mitigation and health adaptation objectives and to explore a synergistic pathway of carbon neutrality and universal health will aid in maximizing health benefits from responding to climate change to promoting the win-win realization of carbon neutrality and healthy China.

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DECLARATION OF INTERESTS

The authors declare no competing interests.