



Carbon pollution increases health inequities: lessons in resilience from the most vulnerable

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ABSTRACT

Climate change is a social justice as well as an environmental issue. The magnitude and pattern of changes in weather and climate variables are creating differential exposures, vulnerabilities, and health risks that increase stress on health systems while exacerbating existing and creating new health inequities. Examples from national and local health adaptation projects highlight that developing partnerships across sectors and levels are critical for building climate-resilient health systems and communities. Strengthening current and implementing new health interventions, such as using environmental information to develop early warning systems, can be effective in protecting the most vulnerable. However, not all projected risks of climate change can be avoided by climate policies and programs, so health system strengthening is also critical. Applying a health inequity lens can reduce current vulnerabilities while building resilience to longer-term climate change. Taking inequities into account is critical if societies are to effectively prepare for and manage the challenges ahead.

Keywords

Climate change; global warming; environmental risks; health vulnerability; disaster vulnerability; environmental exposure; United Nations Environment Programme.

Health inequities arise from a range of environmental and socioeconomic factors, not from inevitable forces independent of human control. That is, there are significant and preventable differences in health

outcomes among those groups with limited power and resources to avoid them (1). These inequities are rooted in social relationships and processes that suggest opportunities to respond at different scales (2). Climate change is affecting human and natural systems in ways that exacerbate existing and will likely create new health inequities (3).

In the 1970s, national and international organizations began to seriously consider the possible consequences of increased atmospheric concentrations of greenhouse gases, particularly carbon dioxide, due to human activity. Subsequent negotiations to reduce greenhouse gas emissions were informed by earlier experiences with less

complex environmental problems, such as pesticides and sulfur compounds, that are typically more short-lived than carbon dioxide, and that were relatively easily and successfully controlled (4). These negotiations eventually led to the 1992 adoption of the United Nations Framework Convention on Climate Change (UNFCCC), whose stated *ultimate objective* was the “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (5).

In the 20+ years since, the possible consequences of climate change for human and natural systems have become better

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understood, leading to a risk-based framework for managing the challenges ahead. As detailed in the assessments conducted by the Intergovernmental Panel on Climate Change and in national assessments, changing temperatures and precipitation patterns associated with climate change are already causing adverse impacts on human health and well-being, with risks projected to markedly increase during this century (3, 6–8). The magnitude and pattern of possible health risks associated with climate change depend not only on global average temperatures, but also on the status of the human and natural systems being affected, their degree of underlying vulnerability, and their capacity to prepare for, respond to, cope with, and recover from exposure (9). That is, climate interacts with other environmental and socioeconomic drivers to increase (or decrease) risk, affecting risk through multiple pathways that vary across spatial and temporal scales. Three entry points for preparing for and responding to the challenge of climate change and its health and health equity impacts are:

1. Differential *exposures* to the hazards created by a changing climate (e.g., extreme weather and climate events; reductions in air quality; ecosystem changes that could facilitate water-, food-, and vector-borne diseases changing their incidence, geographic range, and/or seasonality; and lower nutritional quality and quantity of food);
2. Differential *vulnerabilities/capabilities* in avoiding or protecting against harms from exposure (e.g., a wide range of individual and local to national factors from individual susceptibility, socioeconomic status, and housing conditions to the capacity of health systems, local to regional emergency response systems, and governance); and
3. Differential *consequences* related to geographic location, unequal access to resources, and other factors (e.g., higher deaths among marginalized groups with limited access to health services) (10).

The objectives of this paper were to outline why climate change is a social justice issue; summarize and illustrate how reducing exposures and vulnerability to climate change can address health inequities; discuss examples of reducing vulnerabilities to climate change while addressing inequities; and highlight that some inequities cannot be eliminated.

CLIMATE CHANGE AS A SOCIAL JUSTICE ISSUE

Climate change is intimately intertwined with equity, social justice, and sustainable development, especially evident at the macro level by the striking mismatch between countries that historically and currently emit the most greenhouse gases and those that are particularly vulnerable to the consequences of climate change. Understanding this leads to a complex and nuanced perspective of social justice.

Negotiations under the UNFCCC aim to reduce atmospheric concentrations of greenhouse gas emissions to prevent dangerous anthropogenic interference with the climate system by reducing atmospheric concentrations of greenhouse gas emissions. The criteria for determining what was considered to be *dangerous* were: allowing time for ecosystems to adapt naturally; ensuring food production is not threatened; and enabling economic development in a sustainable matter (5). These criteria are challenging to operationalize because they are not easily quantified. Furthermore, the UNFCCC does not specify whether these criteria should be considered on the global, regional, or national scales. And, while these criteria are important, other possible risks of climate change could have large-scale consequences; for example, the availability of sufficient quantities of safe water in some areas; the impact of changing patterns of extreme weather and climate events; changes in the geographic range and incidence of climate-sensitive health outcomes; sea level rise; and acidification of the oceans.

Climate change will result in some countries experiencing much greater increases in temperatures and larger shifts in precipitation patterns (11). The UNFCCC recognizes certain regions are more vulnerable to climate change, including least developed countries, small island states, and areas with fragile ecosystems. Just 20 countries are responsible for approximately 80% of annual greenhouse gas emissions; with China, the European Union, India, the Russian Federation, and the United States being the largest emitters in 2013 (12). However, these are not necessarily the countries that are and will experience the largest shifts in weather patterns. The Arctic and parts of Africa, Asia, and Latin America are warming faster than most land areas,

and may be more vulnerable to the associated consequences.

At any particular concentration of atmospheric carbon dioxide, some regions and sectors will experience significant risks that they perceive to be unacceptable, while others will experience little to no impacts (13). In general, wealthier countries that historically emitted more greenhouse gases are less vulnerable because they will have the capabilities—financial resources, governance, and other factors—to implement proactive adaptation. Thus, addressing climate change is a matter of social justice.

REDUCING VULNERABILITY TO CLIMATE CHANGE

Vulnerability in the context of climate change is defined as the propensity or predisposition to be adversely affected (9). Vulnerability is the summation of all risk and protective factors that determine whether an individual or subpopulation is more likely to experience adverse health outcomes (14). Factors determining vulnerability and resilience in a particular location typically do not align in one direction; each community and nation has a mix of factors that increase or decrease each. Reducing vulnerability and increasing resilience are complementary strategies that enhance the capability of a community to prepare for and cope with climate variability and change.

There is a wide range of factors that determine vulnerability, from the geographic, environmental, and demographic situation of a country or region to its educational, social, cultural, political, socioeconomic, institutional, and governmental circumstances. In the health sector, additional factors determining vulnerability include the health status of the population, and the quality, responsiveness, and availability of public health facilities and other infrastructure (e.g., capacity to prepare for and manage the consequences of changing weather patterns, laboratories) (3). Because factors that increase vulnerability often act on the local scale, social participation is an important factor in building resilience.

There is an abundance of literature on the particular factors that increase health vulnerability to changing weather patterns. Individuals with higher levels of susceptibility and reduced ability to prepare for/cope with climate-related

exposures include pregnant women, those with chronic medical conditions, members of an under-represented or disadvantaged group, or those with impaired mobility and/or cognitive constraints (14). Geographic factors also are important, with those living in environmentally degraded areas and/or unplanned settlements often experiencing higher vulnerability because mechanisms for social protection are limited. Social and environmental factors often interact, leading to increased exposures, vulnerability, and adverse consequences in communities consisting largely of racial and ethnic minorities and people of low socioeconomic status (15).

Among the most effective policies and measures to reduce vulnerability and enhance capability in the near term are those that improve basic public health infrastructure, such as providing safe water and improved sanitation, ensuring access to essential health care, increasing the effectiveness of disaster risk management, increasing social capital, and alleviating poverty (3, 16). Addressing health inequities is central to these activities. An example of how occupational health policies can influence health inequities comes from Mexico, where 65%–70% of the population lives in poverty (17). In this country, the wealthiest 10% of the population has 37 times the income of the poorest 10%. Annual work-related incidents in the formal sector, approximately 35% of the working population, average approximately 600 000 accidents, 6 000 illnesses, and more than 1 100 deaths (18). The informal sector is much larger and comprises formal-sector workers without benefits or health coverage and all informal-sector workers including those in small enterprises and family workshops; no information about work-related incidents in this sector is available. There is no government program that offers social protection for informal workers by, for example, minimizing workplace exposures and ensuring access to healthy working conditions and health services. Furthermore, informal outdoor workers have higher exposures to weather and related factors. In Mexico City, there are at least 60 000 individuals who work outdoors for long hours, with increased exposure to air pollutants (19) and heatwaves, which can increase cardiovascular events and heat stroke.

REDUCING HEALTH VULNERABILITY TO ADDRESS INEQUITIES

Enhancing resilience, in part by reducing vulnerabilities, means increasing the capacity of nations, communities, and systems to cope with changing weather patterns by responding to or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity to adapt, learn, and transform (9). WHO defines a climate resilient health system as one that is “capable to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stress, so as to bring sustained improvements in population health, despite an unstable climate” (16).

The number of vulnerable communities and areas that have used ingenuity, resources, and capacity to increase resilience and reduce inequities is growing. Identifying, supporting, and learning from these examples can help make more efficient use of scarce resources for managing climate change. One example for learning about building the resilience of health systems is the first 5 years of implementation (2008–2013) of multinational health adaptation projects in Albania, Barbados, Bhutan, China, Fiji, Jordan, Kazakhstan, Kenya, Kyrgyzstan, Philippines, Russian Federation, Tajikistan, and Uzbekistan (20).

Seven countries were included in the WHO/United Nations Development Programme (UNDP) Global Environment Facility (GEF)-funded project, “Piloting climate change adaptation to protect human health” (20). The project was designed to build capacity and provide lessons, globally and nationally, in the design, implementation, monitoring, and evaluation of health adaptation policies and measures. Its overall objective was to increase the adaptive capacity of national health system institutions, including field practitioners, to prepare for the health risks of climate variability and change.

Most of these countries developed early warning systems to reduce health inequities by taking into account the needs of the most vulnerable, including addressing educational needs, designing messaging to be readily understood, strengthening surveillance programs to detect disease outbreaks, and ensuring

equal opportunity and resources for preparedness. Although there has not been sufficient time since the completion of these projects to measure the extent to which resilience was increased, there are early indications of increased awareness and capacity, and specific interventions to address the health risks of climate change, suggesting improvements over the baselines.

Country examples

Because it appears that the geographic ranges of malaria and dengue fever are changing, at least partially in response to warmer temperatures, the Ministry of Health of the Royal Government of Bhutan developed collaborations with the national Hydro-Meteorological Service to initiate an early warning system for environmental conditions associated with infectious disease outbreaks (20). At the beginning of the 3-year project, village health workers were aware of changing weather patterns, even if unaware of anthropogenic climate change. Training of district health managers, basic health units, and village health workers resulted in very high awareness of changing weather and disease patterns; of how climate change can exacerbate or ameliorate current health burdens; and of what interventions can reduce additional health burdens. A national integrated database will be developed to include climate-related data that will facilitate an understanding of the magnitude and pattern of climate-sensitive health outcomes. This understanding will be used to reduce health inequities by focusing on the needs of the most vulnerable.

Given the increase in the frequency, intensity, and duration of some extreme events, and the significant (and preventable) associated health impacts, China, Kazakhstan, Tajikistan, and the former Yugoslav Republic of Macedonia designed and implemented heatwave early warning and response systems. The aim was to guide the issuance of warnings, particularly for the most vulnerable, and outline response plans to facilitate timely coordination of resources and strategies in response to heatwaves. In China, the system was developed with community collaboration to ensure effective messaging and appropriate responses when a warning is issued.

In Indonesia, a special climate change task force initiated countrywide efforts on adaptation and mitigation with intersectoral actions among ministries, facilitating interactions and coordination at the national and local levels. An example is the training kit for “Participatory Adaptation Climate Change Transformation for Dengue Fever and Malaria” (PACCT for Dengue Fever and Malaria). This kit is being used to raise awareness and to support the work of communities in developing their own action plans for managing the risks, taking into account the needs of the most vulnerable.

Ecuadorian researchers, in collaboration with colleagues from Canada, are using a systems approach to investigate the sustainability and resilience of how food is produced and the wider set of pathways that can affect health equity. The project, “Food systems and health equity in an era of globalization: Think, eat and grow green globally” has observed that “sovereignty” is of much greater interest in the Spanish literature than in the English (21). Action research projects underway in partnership with local communities include examining the feasibility and benefits of linking local agro-ecological producers with institutional purchasing opportunities (e.g., schools, public programs); and exploring ways that greater sovereignty can be asserted by indigenous communities in settings where growing/gathering of food retains especially strong cultural meaning.

In the Caribbean, several countries are promoting a smart initiative to develop resilient, climate-adapted, and more sustainable health care facilities through the application of interventions aimed at reducing vulnerabilities (personal communication, David Latchman, Ministry of Health, Wellness, and the Environment, St. Vincent and the Grenadines). The initiative promotes public health strategies to address climate change and reduce fossil fuel use. These activities would realize cost savings on health care and utility bills, reduce greenhouse gas

emissions, improve air quality, enhance physical access to hospitals, improve access to safe water, and improve safety conditions.

SOME INEQUITIES CANNOT BE ELIMINATED

Not all risks can be adapted to; for example, melting permafrost, increased storm surges, and other climate-change associated risks are threatening the existence of villages in Alaska. In Newtok, Alaska, coastal erosion associated with permafrost melt resulted in inundation of the dumpsite in use in 1996, with the possibility of releasing its contaminants into the environment (22). Given the current and projected amount of permafrost melt, with the associated loss of infrastructure, the village needs to be moved. Moving a village is challenging; doing so requires approval of multiple federal and state agencies over and above the expressed interest of the affected population. It is especially challenging for small villages that do not have the required expertise to comprehensively manage the application processes, including resolving contradictions in requirements between agencies, while assessing equitable options. Moreover, the loss of social and cultural institutions can have psychosocial repercussions that reduce the community’s capacity to manage changing conditions.

Similar challenges are being observed in a range of contexts. For example, in small island nations, infrastructure such as roads, schools, and health care facilities is increasingly at risk due to rising sea levels and increases in the magnitude of storm surges. In countries experiencing frequent extreme heatwaves, the health impacts of thermal extremes affect worker productivity, as well as mortality and morbidity.

DISCUSSION

Climate change, interacting with the wider environmental and social

determinants of health, is increasing stress on health systems, while exacerbating existing and creating new health inequalities. As such, climate change is a humanitarian and social justice issue as much as an environmental issue. Using a health inequity lens can increase the effectiveness of interventions to address the wide range of social and environmental factors underlying vulnerability to climate change.

Because no health policy or program was developed taking climate change into account, there is much work to be done. There also are many opportunities to use efforts to prepare for and manage the health risks of climate change to reduce health inequities. Examples from national and local health adaptation projects highlight that partnering with communities is important for building resilience because factors increasing vulnerability often act at local scales. Using environmental information to develop early warning systems can be effective in protecting particularly vulnerable individuals and communities from climate-sensitive health outcomes. Because not all projected risks of climate change can be avoided, health system strengthening is also critical for managing the risks.

Climate resilience needs to be proactively built into health system strengthening and should focus on the needs of the most vulnerable. This means explicitly incorporating climate and sustainable development when improving surveillance systems, developing actions plans, ensuring sufficient human and financial resources, training and capacity building, and monitoring and evaluating progress. Taking inequities into account is critical if societies are to effectively anticipate, prepare for, and manage the challenges ahead.

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RESUMEN

La contaminación por carbono empeora las inequidades sanitarias: enseñanzas de los más vulnerables sobre la capacidad de recuperación

El cambio climático es un asunto no solo ambiental, sino también de justicia social. La magnitud y naturaleza de los cambios observados en las variables de tiempo meteorológico y clima están llevando a exposiciones, vulnerabilidades y riesgos de salud diferenciales que incrementan la sobrecarga de los sistemas de salud y exacerbando las inequidades sanitarias existentes, a la vez que generan nuevas inequidades. Los proyectos nacionales y locales de adaptación al cambio climático para proteger la salud humana ponen de manifiesto que la creación de alianzas entre diferentes sectores y en distintos niveles es fundamental para lograr que haya sistemas de salud y comunidades capaces de recuperarse de los efectos del clima. El fortalecimiento de las intervenciones de salud en curso y la aplicación de nuevas intervenciones, tales como el uso de información de tipo ambiental para crear sistemas de alerta temprana, pueden ser eficaces para proteger a los grupos más vulnerables. Sin embargo, no todos los riesgos previstos en relación con el cambio climático pueden evitarse por medio de políticas y programas climáticos, de manera que el fortalecimiento de los sistemas de salud también es fundamental. La aplicación de una óptica de inequidad sanitaria puede reducir las vulnerabilidades actuales y al mismo tiempo crear capacidad de recuperación frente a los efectos del cambio climático a más largo plazo. Si las sociedades han de prepararse para los retos que se avecinan y hacerles frente de una manera eficaz, es imprescindible que se tengan en cuenta las inequidades.

Palabras clave

Cambio climático; calentamiento global; riesgos ambientales; vulnerabilidad en salud; vulnerabilidad ante desastres; exposición a riesgos ambientales; Programa de las Naciones Unidas para el Medio Ambiente.