

The human health chapter of climate change and ozone depletion

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ABSTRACT

Climate change is one of the greatest emerging threats of the 21st century. There is much scientific evidence that climate change is giving birth to direct health events including more frequent weather extremes, increase in epidemics, food and water scarcity. Indirect risks to health are related to changes in temperature and precipitation, leading to droughts and floods, which affect agricultural yields and production. In some regions of the world, these impacts compromise food security and threaten human health through the spread of infectious diseases, malnutrition, and food contamination. The health impacts of climate change constitute a major task for public health planners and policymakers because they require new techniques and approaches to deal with the complexities and uncertainties that are bound with it. The complexities related to the problem are far beyond simple epidemiologic analysis and interpretations of disease causation. There is need to strengthen existing health systems with the ability to assess health vulnerabilities and build capacity to fight health risks due to climate change. This paper explores the health impacts of climate change in humans in general, while emphasizing on the role of local government and policy makers in the control of health related hazards to climate

Keywords: climate change, health impacts, policy makers

RESUME

Le changement climatique est l'une des plus grandes menaces émergentes du 21^e siècle. Il existe des preuves scientifiques démontrant que le changement climatique a des effets directs sur la santé, à l'exemple des variations extrêmes plus fréquentes de la météo, l'augmentation des épidémies, la rareté de l'eau et de la nourriture. Les risques indirects pour la santé sont liés aux changements de température et des précipitations, entraînant des sécheresses et des inondations, qui affectent les rendements et la production agricole. Dans certaines régions du monde, ces impacts compromettent la sécurité alimentaire et menacent la santé humaine à travers la propagation des maladies infectieuses, la malnutrition et la contamination des aliments. Les effets sur la santé du changement climatique constituent une tâche majeure pour les planificateurs et les décideurs de la santé publique, car ils nécessitent de nouvelles techniques et approches pour faire face aux complexités et aux incertitudes qui sont liées avec elle. Les complexités liées à ce problème sont bien au-delà de la simple analyse et de l'interprétation des phénomènes épidémiologiques. Il est nécessaire de renforcer les systèmes de santé existants avec la possibilité d'évaluer les vulnérabilités de santé et de renforcer la capacité de lutter contre les risques sanitaires liés au changement climatique. Cet article explore les effets sur la santé du changement climatique chez les humains en général, tout en insistant sur le rôle du gouvernement et des décideurs locaux dans la lutte contre les risques sanitaires liés au climat.

Mots Clés : Changement climatique, impact sur la santé, Décideurs

Introduction and Background

Socioeconomic changes and the development of efficient health interventions have led to overall improvement in health of populations within the last decades, although there are drastic disparities involving morbidity and premature mortality rates across the planet (WHO, 1995). Costello et al. (2009) quoted that "Climate change is the biggest global health threat of the 21st century." Climate changes lead to the death of at least 150,000 people around the world every year, a figure which is likely to increase as global warming continues to exacerbate existing environmental health threats (McMichael et al, 2004; Patz, Gibbs et al, 2007). The burden of health impairments is rising as a counter effect of deteriorating global environmental conditions caused by human activities (Martens, 1998).

The burning of fossil fuels have led to the release of sufficient quantities of carbon dioxide and other greenhouse gases into the atmosphere which are rapidly depleting the ozone layer, leading to climate extremes (EPA, 2009). Compounded by the rate of industrialization, the concentration of carbon dioxide in the atmosphere has risen above 30% from the pre-industrial times, trapping more heat in the lower atmosphere. This is causing weather extremes and frequent climate embarrassments that are resulting to various health risks, ranging from deaths in extreme high temperature to changes in the epidemiology of communicable diseases. The worst of these effects are projected to occur in developing countries, among vulnerable populations. The poor, the elderly, and children are facing the highest risks from climate change. Poor countries do not have access to resources that can enable them fight major weather events and many poor people already suffer from illnesses that result from conditions related to environmental hygiene and sanitation, lack of access to potable water, urban pollution, and food insecurity which are responsible for the high burden of infectious communicable diseases. Heat related morbidities

and mortalities, skin cancers, ecologically mediated diseases, marine-borne diseases, vector-borne diseases are on the rise because of increasing ultraviolet levels due to ozone depletion (McMichael et al, 2004; EPA, 2009).

Climate change or climate variation has led to the establishment of new wind directions with increase in frequency of typhoons and hurricanes. These winds are responsible for changes in cloud and sea wave directions, floods and heavy rains, and the sea volume has been on a steady rise from the melting arctic ice caps. The WHO estimated 600,000 deaths worldwide in the 1990s resulting from weather-related natural disasters with 95% of them occurring in developing countries (WHO, 1990) Heat stress (hyperthermia) or extreme cold conditions (hypothermia) have led to increased death rates from cardiovascular and respiratory diseases. The heat waves in summer of 2003 were responsible for an estimated 70,000 more deaths in Western Europe than during previous summer seasons (Robine, 2008).

The scientific resolve is that global climate change has brought on aggregate, changes that constitute a more fundamental hazard to human health than any that have occurred before, and present major scientific challenges and complexities that are beyond human understanding (Martens, 1998; Luber, 2008). Environmental and public health experts are expected to assist local government and policy makers with simplified but comprehensive information on the current and anticipated impacts of climate change on health, so as to facilitate the creation of legally binding framework with reference to the Kyoto protocol.

Health impacts of climate change

Indirect health effects of climate change occur due to climate-induced changes on biological and biogeochemical systems whereas direct health effects result from direct effect of climate variables on the human biology (Figures 1 and 2).

Climate Change and Health Research Tasks and Policy Foci

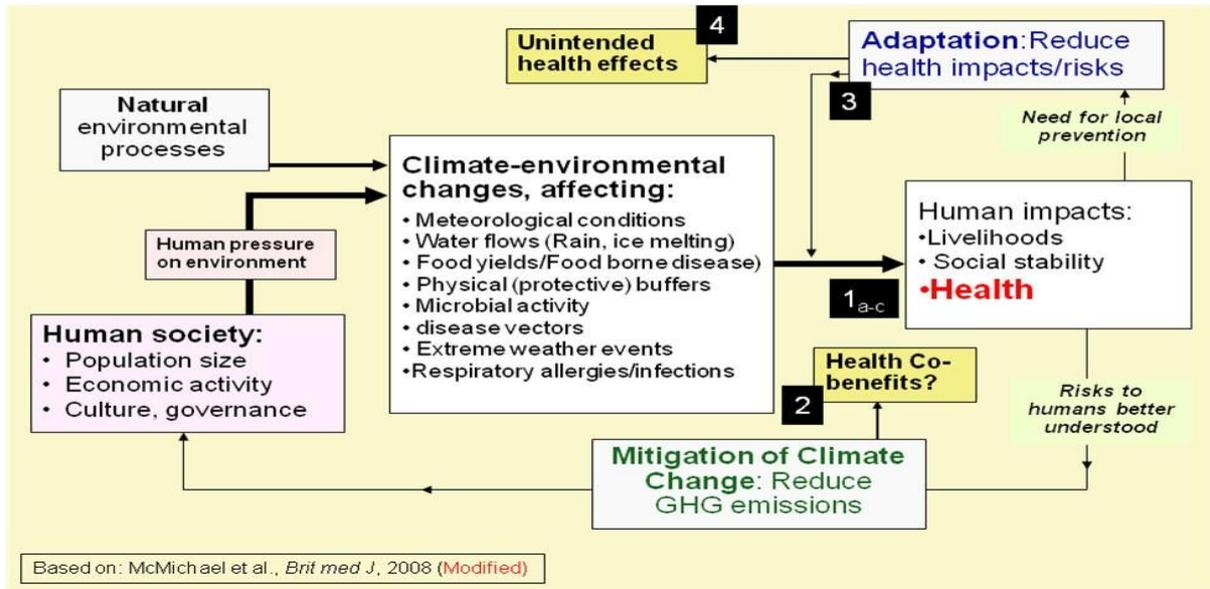
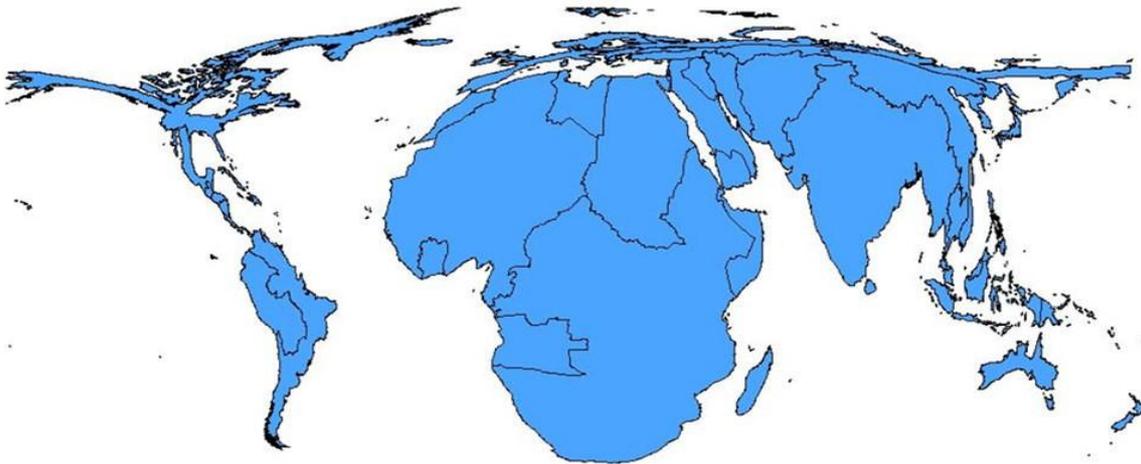


Figure 1: Climate Change and Health: Research Tasks and Policy foci.

Estimated Mortality Impacts of Climate Change: Year 2000

Estimated annual deaths due to climate change: **malnutrition** (~80K), **diarrhoea** (~50K), **malaria** (~20K), **flooding** (~3K)



14 WHO regions scaled according to estimated annual death rates due to the change in climate since c. 1970.

(Patz, Gibbs et al, 2007: based on McMichael, Campbell-Lendrum, Kovats, et al, 2004)

Figure 2: Estimated mortality impacts of climate change: Year 2000

A healthy individual possesses efficient temperature regulatory mechanisms that enable the body to adapt and cope with atmospheric temperature variation, keeping the body temperature close to normal (37°C). Temperature regulatory mechanisms are not efficient in very young and very old individuals making them more susceptible to illnesses that are caused or aggravated by extreme cold or extreme hot climates. Extreme temperatures increase the risk of cardiopulmonary diseases in humans, apart from the direct physical effect of heat and cold. Increase in temperature leads to increase in activity and replication of certain disease causing organisms such as bacteria and viruses. Photosynthetic activities in plants also increase with temperature. In all situations, there are maximum and minimum threshold temperatures that either stall or reverse the trend of activity. Temperature and moisture variations also have direct effect on grain germination and growth, as well as indirect effect on plant diseases predators and the supply of irrigation water. Highly populated poor tropical countries are already experiencing decline in agricultural output. Rosenzweig, (1993) revealed that global warming was causing a drop in cereal crop production which accounts for two-thirds of all foodstuffs consumed by humans (Table 1).

Table 1: Modeled impact of climate change on global cereal grain production
Percent change, 1990-to-2080

	% Change (range)	
World	-0.6	-0.9
Developed countries	+2.7	+9.0
Developing countries	-3.3	-7.2
Southeast Asia	-2.5	-7.8
South Asia	-18.2	-22.1
Sub-Saharan Africa	-3.9	-7.5
Latin America	+5.2	+12.5

During recent years, global warming has favoured cereal production in temperate regions but causing drastic drop in tropical regions. Since a larger proportion of the global population relies on rain-fed agriculture, food production will be vulnerable to the effects of climate variability, seasonal shifts, and change in precipitation patterns. This will have drastic impact on food availability, food accessibility, food utilization, and food systems stability in many parts of the world, especially in the tropics. In Africa crop production and livestock husbandry account for about half of household income and one-third of the income in Africa is generated by agriculture. The poorest members of societies are those who depend mostly on agriculture for jobs and income (FAO, 1999; Patz, 2007). Climate change implications on agriculture will increase the prevalence of malnutrition and under nutrition which is already accounting for 3.5 million deaths annually (WHO, 2009).

Naturally, climatic conditions set geographic and seasonal limits on infectious diseases transmission. Reason why variation in temperature and precipitation influence the behavior and geographic distribution of disease vectors, causing modifications in incidence of vector-borne diseases, as well as shift in the distribution of food borne and water borne infections.

The rising sea level due to global warming is responsible for rampant flooding in coastal areas, causing population displacement. Floods salinate the soil, contaminate fresh water supplies and spread along toilet contents and sewage systems, thus increasing the risk of water borne diseases and establish new breeding grounds for disease vectors such as mosquitoes. They cause drowning, deaths and physical injuries, destroy homes and health services, making roads inaccessible by rescuers and the medical team. More than half of the world's population lives within 60 kilometers radius from shorelines. More frequent and intense storms will also cause similar damages. Other damages include the loss of

electricity supply after a storm that may expose an area to extreme heat from lack of air conditioning and the cumulative effect from more allergies due to increased pollen counts (EPA, 2009). The prevalence and severity of asthma is also affected by aeroallergens, concentrations of which are projected to increase with increasing temperature (IPCC, 2007).

Rising temperatures and variable precipitation will likely decrease the production of staple foods in many poor regions on the planet, and in some African countries by up to 50% by 2020 (CCSP, 2008; IPCC, 2007; EPA, 2009). Since many people in the world rely on rain-fed agriculture, the least amount of warming will increase water stress and reduce crop yield. About 70% of the world's population lives by farming, and 40% of all exports are agricultural products. One-third of Africa's income is made through agriculture. Long-term increase of ultraviolet-B (UV-B) radiation due to ozone depletion is expected to increase the incidence of skin cancer, with light skin individuals being more susceptible. The incidence of eye disease, particularly pterygium and cataract will likely increase. UV-B radiation may impair photosynthesis in-land and in the sea (phytoplankton) accelerating the decline in the world's food production (Martens, 1998).

Policy requirements for climate change
George Luber, epidemiologist and associate director for global climate at the Centers for Disease Control and Prevention stated that "The face of climate change ought to be people.....we ought to kind of internalize it" (Chemnick and ClimateWire, 2013). Since the scientific community is already aware of the vast uncertainties in health impact assessment and the complexity of processes linked to climate change, global alert systems are required to constantly monitor human and environmental changes. Governments and the policy community are certainly myopic, as more value is being attributed to the economic benefits of industrialization,

with little or no attention given to human and environmental damages due to climate change. Poor developing countries with weak health infrastructures are highest hit by climate change, and will be the least able to cope without assistance to prepare and respond. Meanwhile industrialized nations that contributed considerably to climate change have started protecting themselves by developing adaptation interventions.

Government policies that fight the causes of climate change will definitely improve the health communities. Many policies and individual choices can lead to decline in greenhouse gas emissions. Policies that discourage deforestation or discourage creation and functioning of coal plants, encourage the creation of transit and pedestrian friendly cities, promote the use of improved environmental friendly transport systems, and good choices of energy and food, will definitely improve health. It is rather unfortunate that health is hardly a priority on the agenda of international climate negotiations.

Conclusion

Climate change affects health through a cascade of various mechanisms. Direct effects of climate change on health result to diseases and deaths meanwhile indirect effects result from changes in the ecosystem, leading to the proliferation of infectious diseases, and changes in agricultural output. Climate change can also indirectly affect health through social and economic instability brought by natural disasters that lead to population movements.

Recommendations

There is need to enforce advocacy on awareness and human implications of climate change, through the dissemination of simple but comprehensive scientific evidence. Policies are expected to strengthen national health systems on disaster preparedness, while putting in place efficient detection and alert systems. Since the

environment is a major influence to human health, national policies should establish or enforce existing measures that promote environmental safety, including the fight against malaria, diarrhea and malnutrition (Figure 2). All sectors within the political, administrative, and public health machinery should collaborate and start adaptation processes now, which will mitigate the impacts of climate change on human health. This can be achieved through the enforcement of further research on changes in agricultural productivity due to climate change. It will require total revision of environmental policy, the establishment of new partnerships, and intensification of scientific research to confront health challenges due to climate. National and international organizations within the United Nations system should enforce the implementation of work plans and global protocols on climate change and health.

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