

## Climate change, water resources, and child health

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### Introduction

Climate change is occurring and has tremendous consequences for human health. In medical metaphor, the lab reports and vital signs from the earth suggest that our climate is in critical condition. Admitting our planet to the intensive care unit and beginning appropriate treatment will require significant political action at the global scale. In 2009, representatives from governments and organisations around the world gathered in Copenhagen, Denmark for the fifteenth United Nations Climate Change Conference. The goal was laudable: to establish a multilateral agreement to address climate change. However, the results were largely anaemic with countries failing to commit to a binding agreement.

Uncontrolled greenhouse gas emissions will have serious implications on children's health in this century. Leadership from paediatricians and the health care community are critical for initiating and sustaining the kind of global action required for addressing "the biggest global health threat of the 21<sup>st</sup> century."<sup>1</sup>

### Effects of Climate Change

It is widely acknowledged that human production of greenhouse gases has contributed to both an increase in global temperatures and to the global burden of disease and premature death.<sup>2</sup> As Table 1 indicates, climate change caused roughly 5.5 million Disability-Adjusted Life Years (DALYs) in 2000.<sup>3</sup> Continued unmitigated emissions are expected to further threaten human health. Campbell-Lendrum et al (2003) predict that by 2030 unmitigated emissions will result in up to 16% additional malnutrition, 5% greater incidence of diarrhoea and 17% more malaria in Africa (Table 2).<sup>4</sup> In public health terms, these are enormous increases. Similar though less marked increases are predicted for the South East Asian, Eastern Mediterranean and Western Pacific regions.<sup>4</sup>

Recognizing that the effects of climate change on child health are manifold (Figure 1),<sup>6,7,8,9</sup> this article focuses on the substantial impacts occurring through changes in water resources. The rise in temperature, precipitation, droughts, floods, glacier melt, and sea levels resulting from human-induced climate change is affecting the quantity, quality, and flow of water resources worldwide and impacting child health through dangerous effects on water supply and sanitation, food production, and human migration.

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### *Water Supply and Sanitation*

Access to clean water and sanitation are critical to children's health. Malnutrition causes roughly 35 of all deaths of children under the age of five. More than half of these malnutrition deaths are linked to unsafe water, inadequate sanitation, and insufficient hygiene.<sup>10</sup> Diarrhoea, caused to a large extent by contaminated water, remains the second-leading cause of death in young children, causing over 1.4 million preventable child deaths per year.<sup>10</sup>

Climate change is degrading access to clean water and sanitation, with serious implications for child health.<sup>2</sup> According to Bates et al. (2008), the combination of population increases, economic growth, demand for more water-intensive food crops, and the regional effects of climate change will result in as much as half of the world's population living in water-scarce river basins by 2050.<sup>11</sup> Such shortages will be caused, in part, by extended droughts that diminish both the quantity and quality of available water supplies and contribute to deaths, malnutrition, and infectious and respiratory diseases.<sup>2</sup>

In mountainous regions, river systems will also be affected by earlier thawing of snowpack and accelerated glacial melting, resulting in an earlier and increased spring runoff, flooding, and dry-season shortages in the short term. In the medium to long term, severe water shortages are likely in glacier-dependent river basins.<sup>12,13</sup> Current predictions suggest that many of the Andes' tropical glaciers will disappear within 20 years, threatening the water supply for over 77 million people living in the region.<sup>12</sup> In the Himalayas, earlier thawing of the snowpack, accelerated glacial melting, and changes in the characteristics of the precipitation patterns will also impact the quantity and quality of water relied on by billions of people.<sup>14</sup>

In other regions, increases in precipitation, storms, and floods associated with climate change are worsening child health by injury, infectious disease, and toxic contamination (Table 3).<sup>2</sup> Rising temperatures and extreme rainfall are linked to diarrheal diseases in Africa and Asia.<sup>15,16</sup>

Throughout the world, inequities in the distribution and use of water resources have, at times, been a source of tension and dispute. The increase in water scarcity caused, in part, by climate change has the potential to exacerbate existing tensions or spark new disputes related to the allocation and management water resources at the local, national and international level.<sup>17</sup>

### *Food Production*

Currently, the growth of one-third of all children under five in developing nations (178 million children) is stunted by malnutrition.<sup>18</sup> For many of these children, access to food will be further threatened as global temperatures continue to rise and key river basins become more susceptible to floods and droughts. "Today for the first time in history," explained Josette Sheeran, Executive Director of the UN World Food Programme, "over a billion people on earth will go to bed hungry and one of the key factors is an increasingly severe and erratic climate."<sup>19</sup> Nelson et al (2009) anticipate that by 2050 climate change will increase global rates of child malnutrition by 20%.<sup>20</sup>

Declining food production and rising food prices will exacerbate the global rates of malnutrition and stunting and worsen children's health.<sup>21</sup> In Kenya and Ethiopia, where droughts are common and are expected to become more frequent as temperatures rise, children under six are 36% and 50% respectively more likely to experience malnutrition if they are born during a drought.<sup>22</sup> In Ethiopia, this has resulted in 2 million additional malnourished children in 2005. In Niger, children under three are 72% more likely to experience stunting if born during a drought.<sup>22</sup> Stunting and malnutrition are associated with high rates of illness, death, and impaired cognitive development.<sup>21</sup>

### *Migration*

Changes in the quantity and quality, of drinking water as a result of human-induced climate change will also contribute to large increases in human migration.<sup>23</sup> By 2050 it is expected that roughly 200 million “climate refugees” will be forced from their homelands by events including: increases in the frequency and severity of droughts and natural disasters, sea-level rise, environmental destruction, and diminished access to safe water and food.<sup>18</sup>

The burden of migration due to climate change will fall primarily on the world's most poor and vulnerable populations with particularly severe consequences for children.<sup>24</sup> Children are the most susceptible population to vector- and airborne diseases, and are the most impacted by malnutrition.<sup>6</sup> Exposure to such conditions increases when a population migrates and basic health services become less accessible.<sup>6</sup>

### **Global Commitments**

Preventing serious deterioration of global child health will require dramatic reductions in greenhouse gas emissions and increases in carbon biosequestration. Scientific agencies and experts have concluded that carbon emissions must be reduced to limit global temperature rise to no more than 2 degrees Celsius above pre-industrial levels.<sup>23</sup> Based on this evidence, in 2007 the Intergovernmental Panel on Climate Change (IPCC) called on industrialized nations to reduce carbon emissions by 25%–40% below 1990 levels by 2020 and by 80% by 2050.<sup>25</sup> Recent reports suggest that these recommendations may be too conservative and that even greater action is needed to avoid a dramatic rise in temperature.<sup>26,27</sup>

Despite high expectations, the Copenhagen Conference failed to produce a binding global treaty. Instead, countries issued the Copenhagen Accord, a statement acknowledging the importance of capping temperature rise at 2 degrees Celsius above pre-industrial levels and encouraging countries to submit their commitments by January 31, 2010. The UK remains dedicated to reducing greenhouse gas emissions by at least 34% below 1990 levels by 2020 while the EU has pledged 20% reductions from 1990 levels by the same year.<sup>28</sup> However, as UK's Energy and Climate Secretary Ed Miliband noted, “there is much further to go, including ensuring we achieve a legally binding outcome for everyone.”<sup>28</sup>

### **Time to Lead**

A significant transformation of our energy economy will be required to avoid extraordinary public-health problems for the children of today and tomorrow. Paediatricians and health care professionals have a critical leadership role to play in motivating and sustaining efforts for policy change and program implementation at the local, national, and international level.

Many paediatric and medical membership organisations in the UK and abroad have already recognized the importance of addressing climate change and have advocated important steps in advocacy, education, research, and personal behaviour.<sup>1,29,30,31,32,33</sup> The Royal College of Paediatrics and Child Health (RCPCH) has made commitments to reduce its carbon dioxide output by 10% every year beginning in 2007. The College also facilitated a joint meeting with the *BMJ* and Faculty of Public Health on addressing climate change within the UK National Health System.<sup>34</sup>

There is a growing body of literature recommending many opportunities for health care professionals and medical organisations to take action on climate change.<sup>35,36,37,38,39,40</sup> While recognizing the importance of physicians' action at multiple levels and in multiple ways, we must not lose sight of the need for political action at the local, national, and international level.<sup>41</sup> Combating climate change will

require more than just turning off the lights. Well-organized medical and public health advocacy is urgently needed.

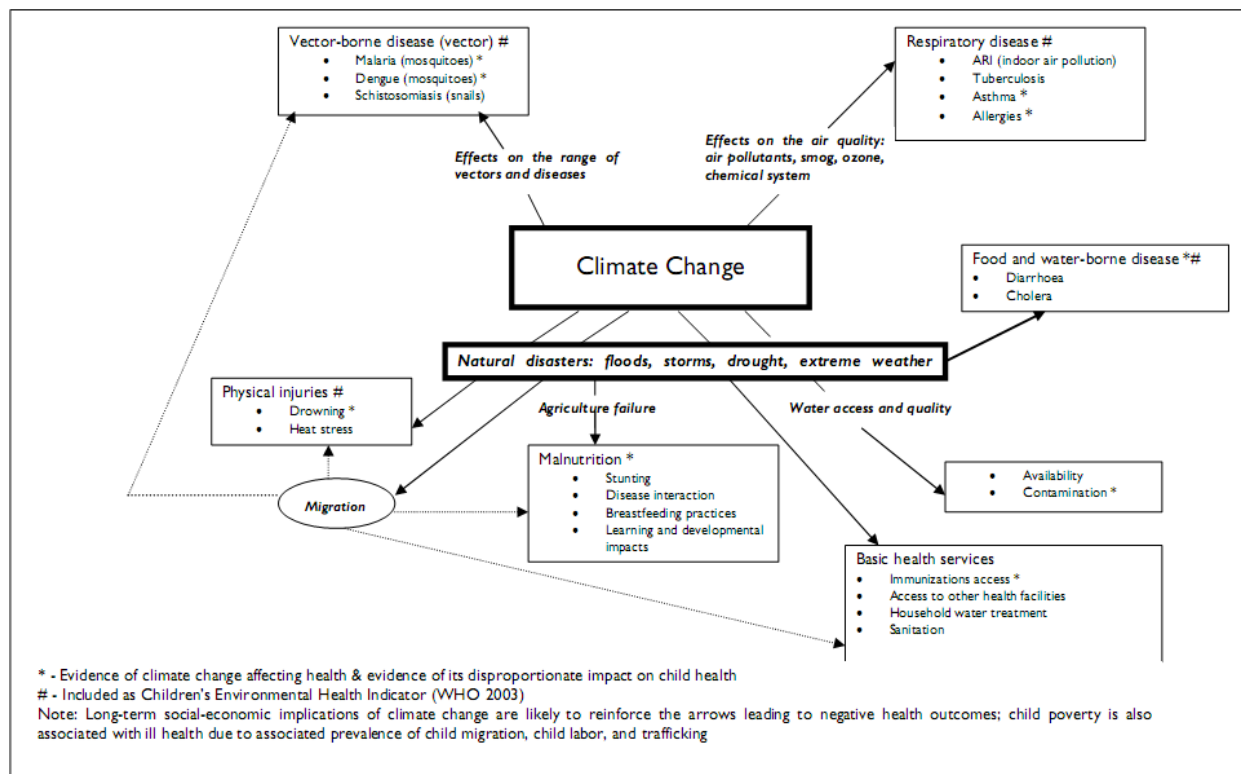
Paediatricians and physicians can play an important role by putting pressure on professional organisations and societies such as the RCPCH and the European Academy of Paediatrics to adopt climate change as a key advocacy focus area and to dedicate substantial resources for lobbying and political action at the national and international level. Health professionals can join the UK Climate Health Council and the recently launched International Climate Health Council as easy avenues for getting involved political action at multiple scales. In *Health Practitioner’s Guide to Climate Change: Diagnosis and Cure*, Gill and Stott (2009) provide a comprehensive outline of ways in which physicians can act both individually and collectively.<sup>41</sup>

Protection of human health is a core function of societies and governments. Health care professionals have many opportunities to be the vanguard of the global energy transformation and the burgeoning movement to solve climate change. The time to lead is now.

**Competing interests:** None.

**Figures and Tables**

**Figure 1. Pathways of the impact of climate change on child health<sup>6</sup>**



Source: Akachi Y, Goodman D, Parker D. Global climate change and child health: a review of pathways impacts and measures to improve the evidence base. Florence: UNICEF Innocenti Research Center. Available from [http://www.unicef.at/fileadmin/medien/pdf/Climatechange\\_Childhealth.pdf](http://www.unicef.at/fileadmin/medien/pdf/Climatechange_Childhealth.pdf) (accessed 14 December 2009).

**Table 1. Estimates for the impact of climate change in 2000 (in thousands of DALYs)<sup>3</sup>**

Region	Diarrhoea	Malnutrition	Floods	Malaria	Total	Total DALYs/ million population
African	414	616	4	860	1894	3071.5
Eastern Mediterranean	291	313	52	112	768	1586.5
Latin American and Caribbean	17	0	72	3	92	188.5
South-East Asian	640	1918	14	0	2572	1703.5
Western Pacific <sup>1</sup>	89	0	37	43	169	111.4
Developed Countries <sup>2</sup>	0	0	8	0	8	8.9
World	1460	2847	192	1018	5517	920.3

<sup>1</sup>without developed countries.

<sup>2</sup>and Cuba.

Source: McMichael A, et al. Global Climate Change, In: Ezzati M. et al (Eds.), *Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors*, Geneva: WHO, 2004. Available from <http://www.who.int/publications/cra/chapters/volume2/1543-1650.pdf> (accessed 14 December 2009)

**Table 2. Range of estimates of relative risks attributable to climate change in 2030, under alternative exposure scenarios<sup>4</sup>**

Region	Climate Scenario	Diarrhoea	Malnutrition	Inland Floods	Coastal floods	Malaria
African	Unmitigated <sup>c</sup> emissions	(0.99-1.16)	(1.00-1.05)	(1.00-2.27)	(1.20-1.79)	(1.00-1.17)
	Rapid emissions <sup>d</sup> reduction	(0.99-1.11)	(1.00-1.00)	(1.00-3.16)	(1.13-1.55)	(1.00-1.09)
Eastern Mediterranean	Unmitigated emissions	(0.98-1.16)	(1.00-1.12)	(1.00-6.83)	(2.16-5.61)	(1.00-1.43)
	Rapid emissions reduction	(0.98-1.11)	(1.00-1.06)	(1.00-3.16)	(1.80-1.55)	(1.00-1.09)
Latin American and Caribbean	Unmitigated emissions	(0.92-1.08)	(1.00-1.00)	(1.00-4.24)	(1.80-4.20)	(1.00-1.28)
	Rapid emissions reduction	(0.95-1.05)	(1.00-1.10)	(1.00-3.74)	(1.57-3.28)	(1.00-1.15)
South-East Asian	Unmitigated emissions	(0.99-1.17)	(1.00-1.27)	(1.00-1.75)	(1.06-1.21)	(1.00-1.02)
	Rapid emissions reduction	(0.99-1.12)	(1.00-1.22)	(1.00-2.49)	(1.04-1.15)	(1.00-1.01)
Western Pacific <sup>a</sup>	Unmitigated emissions	(0.92-1.09)	(1.00-1.00)	(1.00-3.13)	(1.03-1.10)	(1.00-1.83)
	Rapid emissions reduction	(0.95-1.06)	(1.00-1.02)	(1.00-2.50)	(1.02-1.07)	(1.00-1.43)
Developed Countries <sup>b</sup>	Unmitigated emissions	(0.94-1.06)	(1.00-1.00)	(1.00-8.79)	(1.32-2.27)	(1.00-1.27)
	Rapid emissions reduction	(0.93-1.08)	(1.00-1.00)	(1.00-7.73)	(1.45-2.81)	(1.00-1.52)

<sup>a</sup>without developed countries.

<sup>b</sup>and Cuba.

<sup>c</sup>scenario approximately following the IPCC "IS92a" predictions<sup>5</sup>

<sup>d</sup>scenario of rapid emissions reduction resulting in stabilization at 550ppm CO<sub>2</sub> equivalent by 2170.

Source: Campbell-Lendrum D, Corvalan C, Pruss-Ustun A. How much disease could climate change cause? In McMichael, A.J. et al (Eds) *Climate change and human health : risks and responses*, Geneva: WHO, 2003. Available from <http://www.who.int/globalchange/publications/climatechangechap7.pdf> (accessed 14 December 2009)

**Table 3. Impacts of climate change due to changes in extreme precipitation-related weather<sup>11</sup>**

Phenomenon and Direction of Trend	Likelihood of future trends	Major projected impacts by sector			
		Agriculture, Forestry and Ecosystems	Water resources	Human health	Industry, settlements and society

Heavy precipitation events: frequency increases over most areas	Very likely	Damage to crops; soil erosion; inability to cultivate land due to waterlogging soils	Adverse effects on quality of surface and ground water; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries and infectious, respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property
Area affected by drought increases	Likely	Land degradation; lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of food and water shortage, malnutrition and water- and food-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	Likely	Damage to crops; windthrow (uprooting) of Trees; damage to coral reefs	Power outages causing disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases and post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers; potential for population migrations; loss of property

Source: **Bates BC**, Kundzewicz ZW, Wu S, Palutikof JP (Eds). Climate change and water. Technical paper of the Intergovernmental Panel on Climate change. Geneva: IPCC Secretariat, 2008. Available from [http://www.ipcc.ch/publications\\_and\\_data/publications\\_and\\_data\\_technical\\_papers\\_climate\\_change\\_and\\_water.htm](http://www.ipcc.ch/publications_and_data/publications_and_data_technical_papers_climate_change_and_water.htm) (accessed 14 December 2009).

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