Climate change – the biggest health threat of our time

Climate change represents a serious health threat. There is still a possibility of reducing the harm to life and health if the global community agrees on effective measures for bringing about rapid and substantial reductions in CO_2 emissions. Many of the measures involved, like choosing cycling and vegetables rather than driving cars and eating meat, will also promote health. Measures necessary to combat climate change will therefore fulfil environmental as well as health objectives. Greater emphasis should be placed on the health aspect when justifying, designing and implementing national and global policy for combating climate change.

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There is scientific consensus to the effect that human activity is changing the Earth's climate more than can be expected as a result of natural variations (1, 2). Depending on the level of greenhouse gas emissions, the Intergovernmental Panel on Climate Change (IPCC) estimates that in the course of this century the average global temperature will increase by between 1.1°C and 6.4°C compared with the period 1980–1999 (1).

The concentration of CO_2 in the atmosphere is now around 390 parts per million (ppm) and is increasing by about 2 ppm annually. If we are to meet the internationally accepted target of not exceeding a global rise in temperature of 2°C, the concentration of CO_2 in the atmosphere needs to be stabilised at a level around 350–400 ppm (3). However, new analyses indicate that a 2°C rise in temperature will have more serious consequences than previously believed. This figure can therefore no longer be regarded as a threshold between acceptable and dangerous consequences, but rather as a threshold between dangerous and extremely dangerous climate changes (4).

Climate and health

In 2009, the British journal *The Lancet* published a series of articles on health and climate change. A thorough review article describes global warming as the biggest health threat of our time (5).

Health and climate are inextricably bound up with the questions of poverty alleviation and international fairness. A common feature of most prognoses concerning climate change and health can be formulated as a paradox of injustice: climate change will have the greatest impact on poor peoples who have contributed very little to these changes (5). The reasons for this are in part related to geographic location. Climate change is expected to be most extreme in coastal regions that have dense populations and limited economic resources. Even more important is the fact that these regions are more vulnerable to health impacts and are far less capable of adapting their social structure to future climate-related challenges.

«Whereas the effects of emission cuts will mainly be observed in the longer term, the health benefits will quickly be noticeable»

Climate change can undermine the effect of global measures for improved health and development and lead to a reversal of the advances observed in the past decade related to efforts to attain the Millennium Development Goals. Unfortunately, it is no longer possible to prevent some rise in the global temperature above the current level (1). This means that preventive health work also has to focus on the best way of adapting to the changes that are coming, in parallel with work to curb the rise in temperature by reducing greenhouse gas emissions.

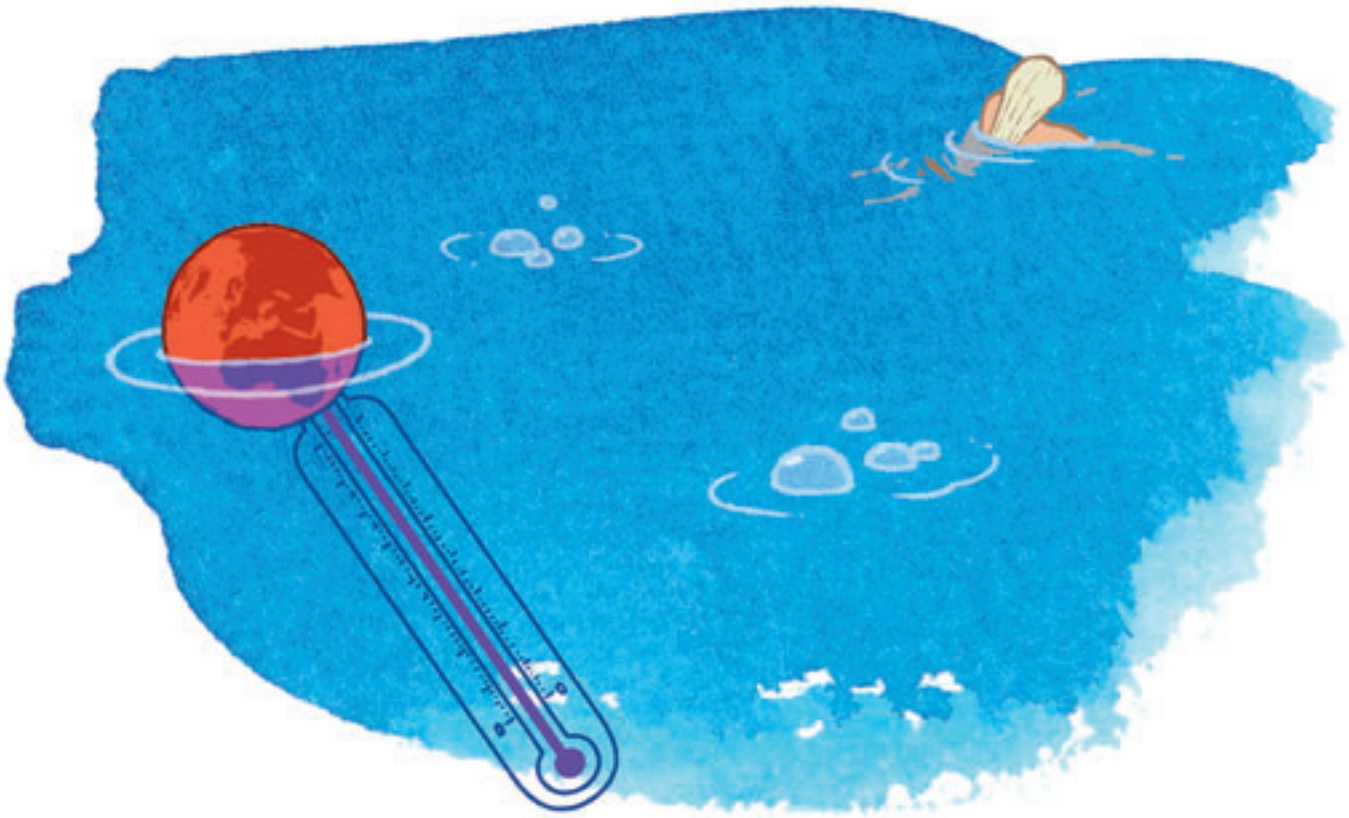
Global warming influences health directly as well as indirectly through an intermeshing set of causes and effects, with many factors contributing to a complex whole. The authors of a review article in *The Lancet* (5) discuss various health impacts in detail. The most important effects are summarised in Box 1 (5–11).

Health benefits of measures to mitigate climate change

Recent research indicates that many important measures to tackle climate change will also benefit the health of the community where the measures are implemented (12). In many cases, savings as a result of these local health benefits can balance out the costs of the measures, while at the same time global health benefits are achieved as a result of the reduction in greenhouse gas emissions.

Increased use of active transport, such as cycling instead of driving, will substantially reduce the prevalence of heart disease and other chronic diseases and at the same time reduce greenhouse gas emissions (13). Reducing meat consumption is regarded as by far the most important and most effective climate-related measure in the context of food and agriculture (14) and will also result in major health benefits (15). For example, it is estimated that a 30 % reduction in the consumption of saturated animal fat will reduce the burden of heart disease by 15 % in the UK and by 16 % in Brazil. A vegetarian diet will reduce the prevalence of heart disease even more, and at the same time leave a substantially smaller carbon footprint (16). A vegetarian diet is also associated with a lower prevalence of obesity, hypertension and diabetes mellitus (17). An improved food policy would make it possible to reduce greenhouse gas emissions from agriculture and at the same time produce enough food for the global population (14).

Changes in electricity and heat produc-



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tion to reduce greenhouse gas emissions will reduce the harmful effects of outdoor air pollution (18). This applies in particular to less use of coal and a transition to means of transport with lower emissions. In low- and middle-income countries, indoor pollution could be substantially reduced if inefficient open fires and ovens were replaced by efficient ovens with low emissions. It is estimated that a programme in India for introducing 150 million low-emission coke ovens over a ten-year period could prevent around two million premature deaths due to heart and lung disease (19).

Thus, many measures to reduce emissions could fulfil both climate and health objectives. However, some measures may also have adverse health effects. An example is biofuel cultivated on arable land that should be used for food production (20). All such measures should therefore be assessed carefully in terms of the overall health effects that are expected, both locally and globally.

Knowledge entails commitment

It is still possible to stabilise climate change and thereby reduce the risk of the most serious health impacts we have described. But it is a matter of urgency to take substantially stronger steps to reduce CO_2 emissions than those so far implemented . The longer we postpone making the necessary cuts in greenhouse gas emissions, the more serious the impacts will be on health, the environment and the economy, and the greater the future costs. The main cause of climate

Box 1

Important relationships between global warming and health (5)

- Change in disease patterns
  Changes in precipitation and temperature will affect vector populations and influence the spread of vector-borne infections and zoonotic diseases, also in northern areas (6, 7). Larger population groups are expected to be exposed to dengue, tick-borne encephalitis, malaria, plague (Yersinia pestis) and schistosomiasis (5–7). Since many other factors also influence the prevalence of these diseases, it is difficult to predict the scale on which the changes can be expected.
- Food security
  Climate models show a high probability of serious drought in the course of the 21st century for most of Africa, in Southern Europe, the Middle East, the USA and South-East Asia (8). The prospect of drought coupled with a global rise in temperature poses a serious threat to agriculture and food security in many areas, particularly in parts of Africa and Asia, where there is already a high risk of starvation.
- Water, housing and sanitary conditions
  Climate change will affect the water supply and sanitary conditions, resulting in a higher risk of diarrhoea and infectious diseases (9). Global urbanisation is taking place in parallel with incipient climate changes. Steadily growing population groups who live in densely populated impoverished urban areas will be particularly vulnerable to these health hazards.
- Extreme weather
  Floods, drought, storms and heat waves are expected to increase in the years ahead, with major health impacts as a direct effect. These events will also entail a long term higher risk of disease as a result of the destruction of homes, infrastructure, and water and food resources. The increase in temperature will result in a higher risk of heatstroke and heat-related distress in connection with physical activity may have major occupational health consequences (10).
- Population growth and migration
  An escalating number of climate refugees may be one of the most dramatic consequences of the climate changes. There is a real danger of some 200 million people having to move away from coastal areas (11). The interplay between population growth, migration and climate change will have a mutually reinforcing effect on problems associated with food supply, living conditions and access to fresh water.

change is the use of fossil fuels in wealthy countries. Therefore, the main responsibility for preventing a further rise in global temperature rests with these countries.

The well known Potsdam Institute for Climate Impact Research has shown that in order to have a realistic chance of avoiding a temperature increase of more than 2°C, more than half of the proven economically recoverable oil, gas and coal reserves must remain unused (21). Highest priority must be given to stopping production from the most highly polluting sources, such as tar sands and coal. A large proportion of fossil fuels from other sources must also remain untouched. Norway, a rich, oil-producing country with large oil reserves, is in a particularly good position to show the world that it is possible to stop production before the reservoirs are empty.

Action must be stepped up considerably to avoid a temperature increase of 3–4°C or more, which would result in climate changes with many serious and unpredictable consequences (22).

The knowledge we possess of the serious consequences of global warming for life and health can pave the way for a new approach in national and global climate policy. Whereas the effects of emission cuts will mainly be observed in the longer term, the health benefits will quickly be noticeable. This may increase motivation to take the necessary steps to reduce emissions.

The Norwegian Medical Association has taken an initiative to draw attention to the harmful health effects ensuing from climate change and has appointed a committee on global warming and health (23, 24). In a position document, the committee points to the need for overarching policy measures. At the same time, it stresses that the individual can make a substantial contribution through an environmentally aware and climate-friendly lifestyle.

It is important that healthcare workers, who know how dangerous climate change is for life and health, should take the lead in putting forward clear demands for stronger and more effective measures to combat climate change (25). Health policy-makers should be involved to a greater extent in the shaping of national and global climate policies. The health benefits of the mitigation efforts as well as the very serious consequences for life and health if action is taken too late, would then emerge more clearly. This may contribute to adequate priority being given to measures to combat climate change in policies at both national and international level.

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Bibliography

1. Meehl GA, Stocker TF, Collins WD et al. Global climate projections. I: Solomon SD, Qin M, Manning Z et al, red. Climate Change 2007: The Physical Science Basis. Cambridge: Cambridge University Press, 2007.
2. Pachauri RK, Reisinger A, red. Climate change 2007: synthesis report. Genève: IPCC, 2007. www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm (29.4. 2011).
3. Baer P, Athanasiou T, Kartha S. A 350 emergency pathway. A greenhouse development rights brief. EcoEquity og Stockholm Environment Institute, 2009. http: //gdrights.org/2009/10/25/a-350-ppm-emergency-pathway-2/ (29.4. 2011).
4. Anderson K, Bows A. Beyond «dangerous» climate change: emission scenarios for a new world. Philos Transact A Math Phys Eng Sci 2011; 369: 20–44.
5. Costello A, Abbas M, Allen A et al. Managing the health effects of climate change. Lancet 2009; 373: 1693–733.
6. Rogers DJ, Randolph SE, Snow RW et al. Satellite imagery in the study and forecast of malaria. Nature 2002; 415: 710–5.
7. Khasnis AA, Nettleman MD. Global warming and infectious disease. Arch Med Res 2005; 36: 689–96.
8. Dai A. Drought under global warming: a review. Hoboken, NJ: John Wiley & Sons, 2010. http://onlinelibrary.wiley.com/doi/10.1002/wcc.81/full (16.5. 2011).
9. World Health Organization. Climate change and human health: risks and responses. Genève: WHO, 2004. www.who.int/globalchange/climate/summary/en/print.html (29.4. 2011).
10. Kjellstrøm T, Holmer I, Lemke B. Workplace heat stress, health and productivity – an increasing challenge for low and middle income countries during climate change. www.globalhealthaction.net/index.php/gha/article/viewArticle/2047/2541 (16.5.2011).
11. Nicholls RJ, Marinova N, Lowe JA et al. Sea-level rise and its possible impacts given a «beyond 4 °C world» in the twenty-first century. Philos Transact A Math Phys Eng Sci 2011; 369: 161–81.
12. The Lancet. The health benefits of tackling climate change. An Executive Summary for The Lancet Series, 2009. www.thelancet.com/series/health-and-climate-change (29.4. 2011).
13. Woodcock J, Edwards P, Tonne C et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. Lancet 2009; 374: 1930–43.
14. Steinfeld H, Gerber P, Wassenaar T, Castel V et al, red. Livestock's long shadow. Environmental issues and options. Roma: Food and Agriculture Organization of the United Nations, 2006. www.fao.org/docrep/010/a0701e/a0701e00.HTM (7.5.2011).
15. Friel S, Dangour AD, Garnett T et al. Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture. Lancet 2009; 374: 2016–25.
16. Fraser GE. Vegetarian diets: what do we know of their effects on common chronic diseases? Am J Clin Nutr 2009; 89: 1607S-12S.
17. Craig WJ. Nutrition concerns and health effects of vegetarian diets. Nutr Clin Pract 2010; 25: 613–20.
18. Markandya A, Armstrong BG, Hales S et al. Public health benefits of strategies to reduce greenhouse-gas emissions: low-carbon electricity generation. Lancet 2009; 374: 2006–15.
19. Wilkinson P, Smith KR, Davies M et al. Public health benefits of strategies to reduce greenhouse-gas emissions: household energy. Lancet 2009; 374: 1917–29.
20. Tilman D, Socolow R, Foley JA et al. Energy. Beneficial biofuels – the food, energy, and environment trilemma. Science 2009; 325: 270–1.
21. Meinshausen M, Meinshausen N, Hare W et al. Greenhouse-gas emission targets for limiting global warming to 2 °C. Nature 2009; 458: 1158–63. www.nature.com/nature/journal/v458/n7242/full/nature08017.html (29.4.2011).
22. Hansen J. Storms of my grandchildren. New York, NY: Bloomsbury, 2009.
23. Braaten KE. Resept for en frisk planet. Tidsskr Nor Legeforen 2010; 130: 189.
24. Den norske legeforening. Ønsker helse i klimadebatten. www.medisinstudent.no/id/165711.0 (7.6.2011).
25. Norsk nettverk for klima og helse. www.klimaoghelse.com (29.4.2011).

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