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Assessing the health risks of global climate change

A health impact assessment is a combination of procedures or methods by which a proposed policy, programme or project may be judged as to the effects it may have on the health of a population. The basic principles underlying such an assessment are democracy, equity, sustainable development and evidence-based advice. Assessments should be an iterative analytical process that engages both analysts and end users to analyse and interpret the interactions of dynamic physical, biological and social systems to communicate useful insights about the significant causes and likely consequences of climate change, of potential responses of affected systems and components thereof. Assessments can combine a variety of methods, including expert judgement, surveys, literature reviews and modelling. Both qualitative and quantitative approaches may be appropriate, depending on the level and type of knowledge. Uncertainties throughout the assessment process should be clearly identified. These uncertainties, along with the outcome of each iteration of a the assessment should be used to prioritize research gaps that need to be filled for future assessments. Adaptation and response strategies should be considered within the context of sustainable development, along with their costs and benefits.

Assessments in the most vulnerable populations may require some baseline research on climate and health relationships use appropriate epidemiological data, particularly in relation to diarrhoeal disease, vector-borne disease and malnutrition. Appropriate climate information at the local level is also a pre-requisite for impact assessment, particularly the assessment of the current impact of climate variability and extremes.

The attributable burden of weather and climate exposure

Ecological studies are used to quantify the relationships between exposure and response for a range of climate-sensitive diseases. Ecological studies are epidemiological studies in which the exposure is defined at the population level rather than the individual level. Group-level relationships are investigated through spatial or temporal variation in exposure and outcome. These studies take advantage of large aggregated databases of health outcomes that are routinely reported, such as deaths or hospital visits. Similar to other epidemiological methods, potential confounders must be identified and, if possible, their effects removed from the analysis. Whatever method is used, it should be unbiased and appropriate to the data available.

Time–series methods have been developed to estimate the proportion of disease in a population that is attributable to the day-to-day or week-to-week variation in exposure to weather parameters. Temperature and daily mortality have been shown to have a strong short-term associatoin, as have temperature and cases of diarrhoea. The advent of geographical information systems and the georeferencing of disease and exposure data have facilitated the investigation of the spatial distribution of many vector-borne diseases and/or their vectors.

Epidemiological research can be used to identify and quantify relationships between exposure and response in the relevant population. This relationship can then be applied using risk assessment methods to estimate the population at risk or the population-attributable fraction. Risk assessment may be undertaken without first undertaking

expensive epidemiological research if an appropriate exposure–response relationship is available. Any calculation of the attributable fraction or the absolute number of attributable cases should clearly state the underlying assumptions. In particular, the following should be addressed:

- justification for applying the exposure–response relationship beyond the bounds of the observed temperature range;
- justification for applying the exposure–response relationship derived from a different population; and
- the baseline disease incidence used to estimate attributable cases.

In traditional environmental epidemiology, only a proportion of the population is exposed to the exposure (a pollutant) of concern. Quantifying this exposure is therefore an important step in the assessment process. In climate change assessment, the whole population is assumed to be exposed to changes in climate, although the degree of change may vary spatially. Groups within a population may differ in sensitivity (exposure–response relationships). For example, mortality among elderly people is much more sensitive to higher temperatures than is mortality in younger adults.

The attributable burden of climate change

Models of the impact of climate on health have been developed for a limited range of health outcomes. The choice of model depends on several factors, such as the purpose of the study and the type of data available. Integrated health risk assessment uses any or all of these methods to forecast the potential impact of global climate change and other major environmental changes (such as population growth or urbanization) and policy responses upon human health. However, quantitative modelling is only one approach for describing future vulnerability to the potential health effects of climate change and other methods are more appropriate for some outcomes.

In 2002, climate change was one of the types of environmental exposure quantified in the World Health Organization's comparative risk assessment of the global burden of disease (see 2002 World Health Report). WHO developed comparative risk assessment to quantify the burden of disease from specific risk factors and to estimate the benefit of realistic interventions that remove or reduce these risk factors. For climate change, the exposure cannot be completely removed, as some amount of climate change is inevitable in the future because of the inertia of the climate and ocean systems. The burden of disease was therefore estimated based on one "business-as-usual" scenario (projected emissions with no policy on climate) and two stabilization scenarios.

Climate scenarios should be of the most appropriate scale, and some consideration of changes in extremes should be addressed. National Population projections are available from a variety of national and international sources. National population projections are available from government agencies in most countries. These are likely to include age-specific and other relevant demographic information. However, projections may not be available for time periods beyond 2020. Scenarios can be also developed regarding possible changes in the adaptive capacity of the community of interest. In general, several variables can be identified that determine adaptive capacity and as well as the plausible states of these variables in the future. One method is to consider two or three states for the future:

- reduced capacity as a result of deterioration in one or more of the determinants of adaptive capacity;

- similar capacity with little or no change in the determinants; and
- increased capacity as a result of an enhancement in one or more of the determinants.

In this session, we will discuss the various advantages and disadvantages of methods used to quantify the potential health impacts of climate change.

Recommended reading

- Kovats RS, Ebi K, Menne B (2003) *Methods of assessing human health vulnerability and public health adaptation to climate change.* WHO, Health Canada, UNEP, WMO, Copenhagen. (Health and Global Environmental Change Series, No. 1).
- Chapters on Air pollution and Vector-borne diseases in Dept of Health, 2002, Health Effects of Climate Change in the UK, London, Department of Health. http://www.doh.gov.uk/hef/airpol/climatechange/
- McMichael,AJ, R E Woodruff, P Whetton, K Hennessy, N Nicholls, S Hales, A Woodward, T Kjellstrom, 2003, Human Health and Climate Change in Oceania: Risk Assessment 2002, Canberra, Commonwealth of Australia, Department of Health and Ageing.

Biography

Sari Kovats is a Lecturer in the Department of Public Health and Policy in the London School of Hygiene and Tropical Medicine (LSHTM). She has worked for many years on the health impact assessment of climate change and climate variability. Currently, she is a partner in the EU-funded CCASSH project (coordinated by WHO Rome office) on developing adaptation strategies to reduce the health the impacts of climate change in Europe.