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How much disease would climate change cause?

To inform policies, an estimation of the approximate magnitude of the health impacts of climate change is needed. This will indicate which particular impacts are likely to be greatest and in which regions, and how much of the climate-attributable disease burden could be avoided by emissions reduction. It will also guide health-protective strategies.

The global burden of disease attributable to climate change has recently been estimated as part of a comprehensive World Health Organization project.¹ This project sought to quantify disease burdens attributable to 26 environmental, occupational, behavioural and life-style risk factors in 2000, and at selected future times up to 2030.

Disease burdens and summary measures of population health

The disease burden comprises the total amount of disease or premature death within the population. To compare burden-fractions attributable to several different risk factors requires, first, knowledge of the severity/disability and duration of the health deficit, and, second, the use of standard units of health deficit. The widely-used Disability-Adjusted Life Year (DALY²) is the sum of:

- years of life lost due to premature death (YLL)
- years of life lived with disability (YLD).

YLL takes into account the age at death. YLD takes into account disease duration, age at onset, and a disability weight reflecting the severity of disease.

To compare the *attributable* burdens for disparate risk factors we need to know: (i) the baseline burden of disease, absent the particular risk

factor, (ii) the estimated increase in risk of disease/death per unit increase in risk factor exposure (the “relative risk”), and (iii) the current or estimated future population distribution of exposure. The *avoidable* burden is estimated by comparing projected burdens under alternative exposure scenarios.

Disease burdens have been estimated for five geographical regions (Figure 7.1). The attributable disease burden has been estimated for the year 2000. For the years 2010, 2020 and 2030, the climate-related relative risks of each health outcome under each

climate change scenario, relative to the situation if climate change did not occur, were estimated.³ The baseline scenario is 1990 (the last year of the period 1961 to 1990 – the reference period used by the World Meteorological Organization and IPCC).

The future exposure scenarios assume the following projected GHG emission levels:

1. Unmitigated emission trends (approximating the IPCC “IS92a” scenario)
2. Emissions reduction, achieving stabilization at 750 ppm CO₂-equivalent by 2210 (s750)

Figure 7.1 Estimated impacts of climate change in 2000 by region

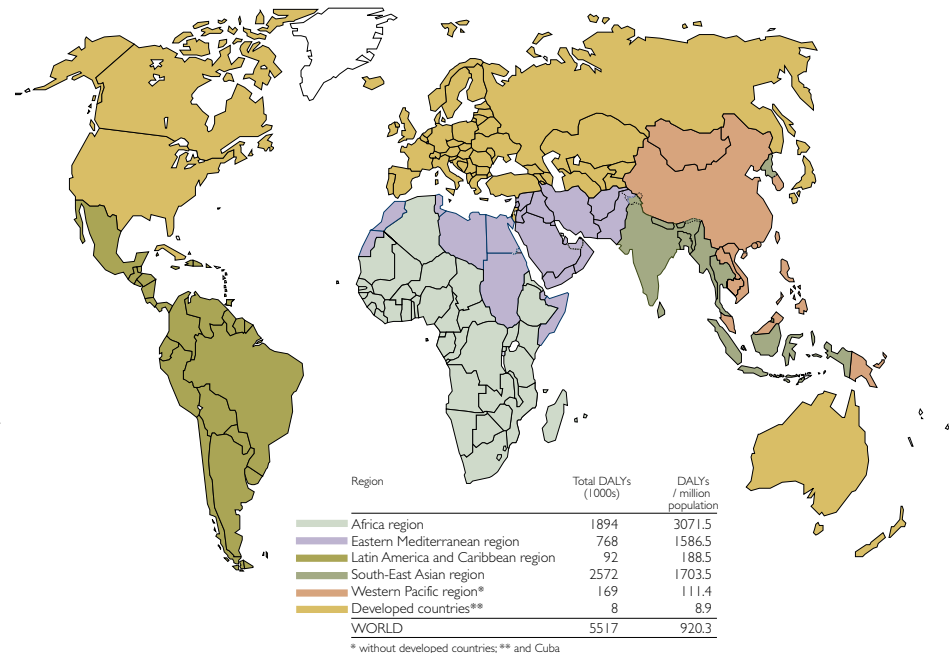


Table 7.1. Health outcomes considered in this analysis

Type of outcome	Outcome	Incidence/Prevalence
Food and water-borne disease	Diarrhoea episodes	Incidence
Vector-borne disease	Malaria cases	Incidence
Natural disasters*	Fatal unintentional injuries	Incidence
Risk of malnutrition	Non-availability of recommended daily calorie intake	Prevalence

*All natural disaster impacts are separately attributed to coastal floods and to inland floods/landslides

3. More rapid emissions reduction, stabilizing at 550 ppm CO₂-equivalent by 2170 (s550).

Health outcomes assessed

Only some of the health outcomes associated with climate change are addressed here (Table 7.1). These were selected on the basis of: (a) sensitivity to climate variation, (b) predicted future importance, and (c) availability/feasibility of quantitative global models.

Additional likely health impacts that are currently not quantifiable include those due to:

- changes in air pollution and aeroallergen levels
- altered transmission of other infectious diseases
- effects on food production via climatic influences on plant pests and diseases
- drought and famine

- population displacement due to natural disasters, crop failure, water shortages
- destruction of health infrastructure in natural disasters
- conflict over natural resources
- direct impacts of heat and cold (morbidity).

All independently-published models linking climate change to quantitative, global, estimates of health impacts (or health-affecting impacts – e.g. food yields) were reviewed. Where global models do not exist, local or regional projections were extrapolated. Models were selected according to their assessed validity. Linear interpolation was used to estimate relative risks for inter-scenario years.

Summary of results

Climate change will affect the pattern of deaths from exposure to high or low temperatures. However, the effect on actual disease burden cannot be quantified, as we do not know to what extent deaths during thermal extremes are in sick/frail persons who would have died soon anyway.

In 2030 the estimated risk of diarrhoea will be up to 10% higher in some regions than if no climate change occurred. Since few studies have characterized this particular exposure-response relationship, these estimates are uncertain.

Estimated effects on malnutrition vary markedly among regions. By 2030, the relative risks for unmitigated emissions, relative to no climate change, vary from a significant increase in the South-East Asia region to a small decrease in the Western Pacific. Overall, although the estimates of changes in risk are somewhat unstable because of regional variation in rainfall, they refer to a major existing disease burden entailing large numbers of people.

The estimated proportional changes in the numbers of people killed or injured in coastal floods are large, although they refer to low absolute burdens. Impacts of inland floods are predicted to increase by a similar proportion, and would generally cause a greater

acute rise in disease burden. While these proportional increases are similar in developed and developing regions, the baseline rates are much higher in developing countries.

Changes in various vector-borne infectious diseases are predicted. This is particularly so for malaria in regions bordering current endemic zones. Smaller changes would occur in currently endemic areas. Most temperate regions would remain unsuitable for transmission, because either they remain climatically unsuitable (e.g., most of Europe) or socioeconomic conditions are likely to remain unsuitable for reinvasion (e.g., southern United States).

Uncertainties relate to how reliable is extrapolation between regions, and to whether potential transmission will become actual transmission.

Application of these models to current disease burdens suggests that, if our understanding of broad relationships between climate and disease is realistic, then climate change may already be affecting human health.

The total current estimated burden is small relative to other major risk factors measured under the same framework. However, in contrast to many other risk factors, climate change and its associated risks are increasing rather than decreasing over time.