Original Research

Measuring the burden of disease due to climate change and developing a forecast model in South Korea

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ABSTRACT

Objectives: Climate change influences human health in various ways, and quantitative assessments of the effect of climate change on health at national level are becoming essential for environmental health management.

Study design: This study quantified the burden of disease attributable to climate change in Korea using disability-adjusted life years (DALY), and projected how this would change over time.

Methods: Diseases related to climate change in Korea were selected, and meteorological data for each risk factor of climate change were collected. Mortality was calculated, and a database of incidence and prevalence was established. After measuring the burden of each disease, the total burden of disease related to climate change was assessed by multiplying population-attributable fractions. Finally, an estimation model for the burden of disease was built based on Korean climate data.

Results: The total burden of disease related to climate change in Korea was 6.85 DALY/1000 population in 2008. Cerebrovascular diseases induced by heat waves accounted for 72.1% of the total burden of disease (hypertensive disease 1.82 DALY/1000 population, ischaemic heart disease 1.56 DALY/1000 population, cerebrovascular disease 1.56 DALY/1000 population). According to the estimation model, the total burden of disease will be 11.48 DALY/1000 population in 2100, which is twice the total burden of disease in 2008.

Conclusions: This study quantified the burden of disease caused by climate change in Korea, and provides valuable information for determining the priorities of environmental health policy in East Asian countries with similar climates.

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Introduction

Over the last century, the average global temperature has increased by 0.60–0.74 °C.[1] The third report of the Intergovernmental Panel on Climate Change (IPCC) predicted that average global temperatures would continue to rise by an additional 1.4–5.8 °C over the next century. The fourth report of the IPCC, which had higher minimum (0.4 °C) and maximum (0.6 °C) temperatures than the third report, predicted a rise of 1.8–6.4 °C. Global warming has accelerated, which has resulted in severe heat waves in recent years.[1,2] In Korea, the average temperatures of the six major cities have increased by 1.5 °C since 1900, which exceeds the increase in average global temperature over the same period.[1]

The World Health Organization (WHO) has developed a unit to quantify the environmental burden of disease, and has emphasized the importance of adaptive policy making in response to climate change.[3] Previous studies concerning the impact of climate change on human health have mainly focused on Africa, where there are underdeveloped social infrastructures and weak social capital, or major cities in the USA and Europe, which currently represent the leaders in adaptive policies to combat climate change.[4–7]

In Korea, there is increasing interest regarding the influence of climate change on human health, such as increased temperature, heat waves, extreme cold, droughts, floods and typhoons.[3] Korea is a small territory with a complex terrain and four seasons. Its climate is affected by numerous meteorological factors. National assessments of the impact of each climate factor on human health are very important for establishing environmental health policies. This study quantitatively measured the national burden of disease attributable to climate factors, and estimated the environmental burden of disease that will be caused by climate change in 2100.

Methods

The following four steps were employed to estimate the burden of disease caused by climate change. First, meteorological data were collected, and diseases related to climate change were identified. Second, mortality was calculated using computerized data obtained from the National Statistical Office of Korea regarding cause of death. In addition, a database of disease incidence and prevalence was established using claim data from the National Health Insurance Corporation of Korea for 2005–2008, and the exposure distribution rate of climate change was calculated. Third, after measuring the burden of each disease using the aforementioned estimated variables, the total burden of disease related to climate change was calculated as the sum of the products of population-attributable fractions (PAF) and the burden of each disease. Finally, a Korean burden of disease forecast model was built based on the available climate change data.

Construction of meteorological data

The mean daily temperature in Korea was calculated using a meteorological database from the Korea Meteorological Administration, which collects data eight times per day from 77 regional meteorological offices and observatories. This study used the lowest, highest and mean daily temperatures obtained from all 77 locations in 2008. Ozone concentration data were taken from the 2008 Annual Report of Ambient Air Quality in Korea, and the number of natural disasters was
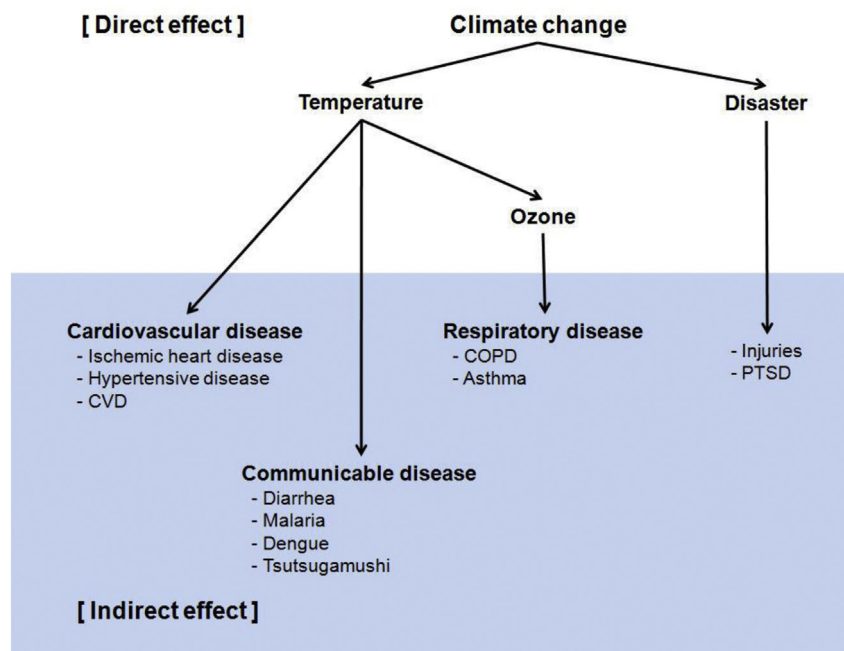

Fig. 1 – Direct and indirect effects of climate change on human health. COPD, chronic obstructive pulmonary disease; PTSD, post-traumatic stress disorder; CVD, cerebrovascular disease.